Texas Instruments

Unit Diagnostics Handbook

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DS10PD

DS10 Disk Test

1.1 INTRODUCTION

The DS10 Disk Test (DS10PD) verifies the correct operation of the 10-megabyte disk drive and its associated TILINE(TM) controller. The test also isolates faults to specific areas of the hardware under test.

1.2 TEST REQUIREMENTS

The following equipment is required for the operation of DS10PD:

* A Model 990 Computer with a minimum of 48K bytes of memory (where K equals 1024)
* A 10-Megabyte Disk Kit (part number 937500)
* An interactive terminal
* A device to load the test module

1.3 TEST CHARACTERISTICS

DS10PD has certain characteristics that you should know before operating the test:

* DS10PD operates under the control of DOCS. Information about DOCS operation can be found in Volume 1 of this handbook.

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* DS10PD consists of six parts, and is structured so that you can run either the complete test or any of its parts. These parts are as follows:

Part	Title	Execution Time
1	Quick Controller Test	10 sec.
2	Quick Controller and Disk Test	1 min.
3	Disk Addressing Test	8 min.
4	Memory Addressing Test	from 30 sec. to 5 min., depending on memory in chassis
5	Disk Media Test	6 min.
6	Interactive Write-Protect Test	1 min.

* In addition to the verbs supplied by DOCS, DS10PD uses the following test verbs:

Verb	Function
IT	Initialize test
EA	Execute all six parts
E1 - E6	Execute individual test parts 1 - 6
L1 - L5	Loop on individual test parts 1 - 5
LA	Loop on parts 1 - 5
C2 - C5	Loop on individual part 2 - 5 and change drives
CA	Loop on parts 2 - 5 and change drives
ET	Execute an individual subtest
LT	Loop on an individual subtest
IC	Issue command to controller
IM	Issue multiple commands to controller
LO	Loop on multiple commands to controller
DC	Display returned status
DT	Display trace table
CD	Compare two blocks of data
SR	Store registers command
FD	Format disk command
RD	Read only of write-protected disk
RS	Hardware I/O reset command
AL	Disk alignment

2.1 TEST EXECUTION

The DS10PD test module must be loaded and initialized by DOCS before execution can begin.

2.2 LOADING

The loading procedure is discussed in Section 3 of Volume 1.

2.3 INITIALIZATION

When DOCS loads the DS10PD test module, it outputs the name and version of the test:

```
DS10PD 990 MEGA-BYTE DISK TEST VERSION XX  MM/YY
```

Then DOCS executes the initialize test (IT) verb by asking you the following questions:

```
DISK TILINE ADDRESS D=F800 -

DISK INTERRUPT LEVEL D= 0D -

DO YOU WISH TO RUN WITH INTERRUPTS?  DEF= 0 -

UNIT TO TEST D = 1 -

OTHER AVAILABLE  UNITS (0-3 TERMINATE  WITH  FF) FF -

MAX ERROR COUNT EQUAL - FFFF -

INSURE THAT ALL DISC PACKS WHICH ARE NOT SCRATCH PACKS

ARE WRITE PROTECTED BEFORE PROCEEDING
```

When you have answered the initialization questions, DOCS outputs the following question:

```
EXECUTE EA VERB? -
```

If you respond with a 1 (yes), the DS10PD test executes one time. If the test executes without errors, you may assume that the drive and controller are operating properly and that no further testing is necessary. However, if any error messages are output, it is recommended that you run other test verbs to determine the cause of the error. The following messages are output when the EA verb executes without errors.

```
PART 1  QUICK TILINE DISK CONTROLLER TEST
        SUBTESTS# 1-3 - TIME<10 SEC.
PART 01 DONE
PART 2  CONTROLLER AND DISK TEST - SUBTESTS# 4-13 - TIME<1 MIN.
PART 02 DONE
PART 3  DISK ADDRESSING TEST - SUBTESTS# 14-16 - TIME<8 MIN.
PART 03 DONE
PART 4  MEMORY ADDRESSING TEST - SUBTESTS# 17-18 - TIME=1-5 MIN.
PART 04 DONE
```

```
PART 04 DONE
PART 5  MEDIA INTEGRITY TEST - SUBTEST# 19 - TIME<6 MIN.
PART 05 DONE
PART 6  INTERACTIVE, WRITE PROTECT TEST - SUBTEST# 1A -TIME<1 MIN
WAS PART 5 RUN LAST? (0=NO, YES=1) -1
HAS SYSTEM AND DISK POWER BEEN CYCLED? (0=NO, YES=1) -1
WRITE PROTECT THE DISK DRIVE CURRENTLY UNDER TEST.
HIT RETURN WHEN READY -
UNPROTECT THE DISK DRIVE CURRENTLY UNDER TEST,
PUT IT IN READ/WRITE MODE.
HIT RETURN WHEN READY -
PART  06  DONE
ERROR COUNTS
DATA = 0000  TIMING = 0000  STATUS = 0000

VERB ? -
```

If you answer the EXECUTE EA VERB? question with a 0 (no), DOCS outputs the question VERB?. You may then execute any of the DS10PD test verbs.

2.4 TEST VERBS

When DOCS asks the question VERB?, you may enter any of the DS10PD test verbs, which are discussed in the following paragraphs.

2.4.1 E1 - E6 Verbs

The verbs E1 through E6 execute individual test parts 1 through 6, respectively. When one of these verbs completes, DOCS outputs the question VERB?.

2.4.2 L1 - L5 Verbs

The verbs L1 through L5 cause the continuous execution of individual test parts 1 through 5, respectively. Each time a pass is made through a test, the error count and loop count are output. To halt execution of a looping verb, press the @ key.

2.4.3 LA Verb

The LA verb causes the continuous execution of test parts 1 through 5 on the disk drive you selected during test initialization. To halt execution of the LA verb, press the @ key.

2.4.4 C2 - C5 Verbs

The verbs C2 through C5 execute individual test parts 2 through 5, respectively, on each disk unit that you specified during test initialization. As it executes, the selected verb outputs the number of the unit under test. If you do not specify any other available units during initialization, the verb loops on the sole unit under test. At the end of each execution, the verb outputs the loop count. To halt execution, press the @ key.

2.4.5 CA Verb

The CA verb causes the continuous execution of parts 1 through 5 on each disk unit that you specified during test initialization. When the verb has executed these test parts on the first disk unit, it switches to the next available unit and outputs the number of that unit. The verb outputs the loop count at the end of each execution. To halt execution of the CA verb, press the @ key.

NOTE

When the CA and C2 through C5 verbs are halted in mid-execution, the unit under test at that time replaces the unit under test specified during test initialization. To verify or reassign the unit under test, reexecute the IT verb.

2.4.6 ET Verb

The ET verb executes a specified subtest of a test part. When you enter the ET verb, the test asks for the number of the subtest you want to execute. The individual subtests are discussed under the appropriate test part in paragraph 2.5.

2.4.7 LT Verb

The LT verb causes the continuous execution of a specified subtest, outputting the loop count at the end of each pass through the subtest. To halt execution of the LT verb, press the @ key.

2.4.8 IC Verb

The IC verb issues a user-written command to the disk controller from a memory address. The command must be eight words long.

Specify the address of the command and if you want the status of the controller and disk drive checked. The messages output with this verb are as follows:

```
STARTING ADDRESS OF COMMAND =

DO YOU WANT TO CHECK STATUS? (0=NO, 1=YES)
```

2.4.9 IM Verb

The IM verb issues multiple user-written commands to the disk controller from a memory address. Each command must be eight words long, and all must occupy consecutive memory locations. You must specify the starting address of the first command, how many commands are to be issued, and if you want the status of the controller and disk drive checked. The messages output with this verb are as follows:

```
STARTING ADDRESS OF COMMAND =

HOW MANY COMMANDS?

DO YOU WANT TO CHECK STATUS? (0=NO, 1=YES)
```

2.4.10 LO Verb

The LO verb loops on multiple user-written commands that are issued to the controller from memory locations. Each command must be eight words long and all must occupy consecutive locations in memory. Looping continues until you press the @ key. The messages output with this verb are as follows:

```
STARTING ADDRESS OF COMMAND =

HOW MANY COMMANDS?

DO YOU WANT TO CHECK STATUS? (0=NO, 1=YES)
```

2.4.11 DC Verb

The DC verb displays the status returned from the last command issued to the disk controller. The status is output to the interactive terminal as follows:

```
CONTROLLER STATUS

DISK STAT COMM SA S/R RA CYL A BYTE C MEMADD SEL CONT STAT

XXXX    XX  XX XX  XX XXXX   XXXX  XXXXXX XX    XXXX
```

This output is explained in the following table:

DISK STAT - disk status. Any of the following bits can be combined in the status returned:

- 8XXX - off line
- 4XXX - not ready
- 2XXX - write protect
- 1XXX - unsafe
- X4XX - seek incomplete

COMM - command number

- X0 - store registers
- X1 - write format
- X2 - read data
- X3 - write data
- X4 - read unformatted
- X5 - write unformatted
- X6 - seek
- X7 - restore

SA - head number. Recording surface number 0 or 1.

S/R - sectors per record: 0 to >14

RA - number of the record addressed: 0 to >14

CYCL A - cylinder address: 0 to >197

BYTE C - byte count for data transfers

MEM AD - TILINE memory address for data transfers

(continued)

SEL - Number of unit under test

08 - unit 0
04 - unit 1
02 - unit 2
01 - unit 3

CONT STAT - controller status
(Refer to Appendix A for an illustration of the controller status bits.)

2.4.12 DT Verb

The DT verb dislays the returned status from the last 10 commands issued to the disk controller. The status is formatted like the output from the DC verb, with the newest returned status at the bottom of the table.

2.4.13 CD Verb

The CD verb compares two blocks of data in memory, word by word, beginning with the two addresses you enter. If any miscomparisons are detected, the verb outputs the data and its locations. The messages output with this verb are as follows:

STARTING ADDRESS OF FIRST BLOCK OF DATA?

STARTING ADDRESS OF SECOND BLOCK OF DATA?

HOW MANY WORDS TO COMPARE?

2.4.14 SR Verb

The SR verb issues a store registers command to the disk controller and then outputs the disk descriptor words and the controller self-test returned status:

TOTAL WORD COUNT=XXXX

SEC/TRACK=XX OVERHEAD/RECORD=XX

TRACKS/CYL=XX CYL/DRIVE=XX

SELF-TEST STATUS=XXXX

2.4.15 FD Verb

The FD verb formats the entire disk with one sector per record and the maximum allowable word count. The data written is the cylinder number of the track. The status check flag is set so that any disk errors are output. The front panel lights are incremented to display the number of the cylinder being formatted. When you execute this verb, the following question is asked, because the FD verb erases the contents of the disk:

DO YOU REALLY WANT TO FORMAT THE WHOLE DISK?

2.4.16 RD Verb

The RD verb verifies the integrity of a system disk or other user medium and also tests the read/write compatibility between drives. The verb reads each track address and then determines if error bits have been set in the controller status.

2.4.17 RS Verb

The RS verb generates an I/O reset to the computer system. It also resets the trace table to zeros.

2.4.18 AL Verb

The AL verb adjusts the alignment of the disk drive. It issues one or two unformatted reads to the cylinder and head locations on the disk, and loops on these reads until you press the @ key. This verb has no error-checking capabilities. The messages output with the AL verb are as follows:

NUMBER OF DIFFERENT READS? 1 OR 2?

SEEK TO CYLINDER NUMBER?

SURFACE NUMBER?
(IF 2 READS SELECTED)

SEEK TO CYLINDER NUMBER?

SURFACE NUMBER?

CHECK STATUS?

2.5 TEST DESCRIPTIONS

The DS10PD test consists of the following six parts, which include 24 subtests:

Part	Title	Subtests
1	Quick Controller Test	1-3
2	Disk and Controller Test	4-13
3	Disk Addressing Test	14-16
4	Memory Addressing Test	17-18
5	Media Test	19
6	Interactive Test	1A

2.5.1 Part 1 - Quick Controller Test

Part 1 is a quick test of the controller. It is unnecessary that a disk unit be present for this part. If part 1 fails, there is problem with the controller and the remainder of the test will not run correctly. Part 1 consists of subtests 1, 2, and 3.

2.5.1.1 Subtest 1. All bits in slave logic that can be written to and read from are tested by writing and reading them under a mask. The 16 patterns are 0, 1111, 2222, ...,FFFF. If miscompares occur during the read portion of the test, an error message is output.

2.5.1.2 Subtest 2. All unit select lines in word 6 of the controller slave registers are set to 0, which deselects the unit. The disk status is then checked. The returned status should be C000, with the offline and not ready bits set. Then a reset command is executed and the controller status is checked. The returned status should be A100, with the idle, error and abnormal completion bits set. If the expected status from either operation is not returned, an error message is output.

2.5.1.3 Subtest 3. A store registers command is issued to the controller and then the status is checked. The descriptor parameters read from the controller are then checked against a parameter table for the disk. If the descriptor words read do not compare with the table, an error message is output. Then word 2 of the slave logic registers, which holds the returned self-test status, is checked for errors. An error message is output if the expected status is not returned.

2.5.2 Part 2 - Quick Controller and Disk Test

Part 2 contains several subtests that check for special conditions in the controller status and disk status registers. The general procedure for these subtests is to issue commands that force the error bits in the status registers to set and then verify that the

correct bits have been set. The status bits checked in part 2 are as follows:

Status Bit	Definition	Subtest
TIH	Transfer inhibit	8
IE	Header ID error	9
SE	Search error	A
DE	Data error	B
CT	Command time-out	C
SI	Seek incomplete	D
UE	Unit error	D
IDLE	Idle bit	F
TT	TILINE time-out	10
RE	Rate error	11

Part 2 consists of subtests 4 through 13.

2.5.2.1 Subtest 4. This test issues seek commands to cylinders 0, 10, 20, 30, and 40 and checks the controller status, register 7, to determine if the idle and complete bits have been set. After each seek command is issued and the correct status has been returned, the attention interrupt mask for the unit under test is set. With the controller idle, this should cause an interrupt. Checks are made to insure that an interrupt has occurred and then a restore command is issued.

2.5.2.2 Subtest 5. This subtest verifies that unformatted writes and reads can be performed. An unformatted write is issued to the disk, after which an unformatted read with interrupts enabled is issued. Both the write and the read specify 16 words. The data written is compared to the data read. If any miscompares are detected, an error message is output. Ten writes and reads are issued using the following pattern: 0, >1111, >2222, >4444, >8888, >5555, >AAAA, >3333, >CCCC, >6666, >9999, >7777, >EEEE, >BBBB, >DDDD, >FFFF.

2.5.2.3 Subtest 6. This subtest verifies that the write format command can be performed. A write format command is issued to different tracks on the disk. After each write, a read unformatted command is issued and the format read is checked against the correct format. If any miscompares occur, an error message is generated. Ten writes and reads are issued during this subtest.

2.5.2.4 Subtest 7. This subtest verifies that write and read data commands can be performed. This is done by formatting a cylinder, issuing a write data command specifying 16 words, issuing a read data command with 16 words specified and then comparing the data written with that read. If any miscompares occur, an error message is output. This sequence is performed 32 times and is issued to different cylinders.

Subtest 7 also verifies the auto retry code on the controller. One track is formatted at one sector per record with the maximum word count. A write data command is issued to that track specifying one full track of data for the word count. This write data command is timed to allow only one retry of the command (the controller standard) on each sector. If the command is not finished within the allowed time, an error message is output. This procedure is performed 10 times.

2.5.2.5 Subtest 8. Subtest 8 tests for the correct operation of the transfer inhibit bit. Track 0 on the disk is formatted one sector per record, a word count of four, and the data equaling 0000. An area in memory is then initialized with the data >AAAA. A read command is issued to the disk with the transfer inhibit bit set specifying the previously initialized memory area. The memory area is then checked to ensure that it still contains >AAAA. If it does not, an error message is output.

2.5.2.6 Subtest 9. Subtest 9 verifies that an ID header error can be generated and detected by the controller. A write format command is issued to a track on the disk. A read unformatted command is issued to obtain the header parameters. The test then changes each of the three words of the header and the CRC, one at a time, and replaces the good header information on the disk with the modified header values using an unformatted write command. The test then issues a write data command using the good header information to cause an ID error. After the write data command completes, the returned controller status is checked to determine if an ID error has been reported. If not, an error message is output.

2.5.2.7 Subtest A. Subtest A verifies that a search error can be generated and detected by the controller. A write format command is issued to a track, specifying two sectors per record. A read data command is then issued starting at sector 1 where there is no header information. The controller is then checked to verify that a search error has been detected by the controller. A write formatted command is issued to the same track as before, starting with sector 0, which will write over the header information of sector 0. A read data command is issued to sector 0 of the track. The controller is checked to verify that a search error has been detected. If not, an error message is output.

2.5.2.8 Subtest B. Subtest B verifies that a data error can be generated and detected by the controller. A write format command is issued to a track on the disk specifying a word count of 80. Then an unformatted read is issued to the same track to get the header information. The returned word count, in word 3 of the header information, is changed to a value of two. The new word count is used along with the other header values to generate a new CRC character value. These are then written to the disk using an unformatted write. The test then issues a read data command specifying a word count of two. A CRC error should result and the data error bit should be set.

2.5.2.9 Subtest C. Subtest C verifies that a command time-out can be caused and that the controller can detect its occurrence. A read data command specifying a sector address equal to the maximum address plus six is issued. The controller is then checked to ensure that the command time-out bit is set. If it is not, an error message is output.

2.5.2.10 Subtest D. Subtest D verifies that a seek incomplete error can be generated and that the seek incomplete bit sets upon its occurrence. This is verified by the following procedure:

1. The last track on the disk is formatted with the maximum sectors per record and a word count of 100 words.

2. A write to the last track with a word count of 101 words is performed. The the controller and disk status is checked. The controller status should be A801 and the disk status should be 04XX, where XX represents a nonsignificant bit.

3. After the write, a restore is issued to clear the disk.

2.5.2.11 Subtest E. Subtest E verifies that no data is be transferred during a write operation with a word count of zero. It also verifies that the destination record of the write is set to all zeros. This is done by issuing the following commands:

1. A write format command is issued to track 0 specifying one sector per record and a word count of two.

2. A write data command is issued with a word count of zero and data initialized to >1234.

3. A read data command is issued with a word count of two. The data read back is checked to ensure that it has all been set to zero.

2.5.2.12 Subtest F. Subtest F checks for the correct operation of the idle bit. A state of 0 defines the controller as busy; a

state of 1 defines an idle controller. The check is made by issuing a write data command using the TILINE address in the memory address portion of the write command word. Since the controller should be busy while the write is being performed, the most significant bit of the controller status should be set to 0. The commands issued are as follows:

1. Issue a write format to track 0 with a word count of 12.

2. Issue a write data with a word count of eight and the TILINE address equal to the address of the controller.

3. Issue a read data with a word count of eight. Check the most significant bit of the controller status word. It should be 0. If not, an error message is output.

2.5.2.13 Subtest 10. Subtest 10 verifies that a TILINE time-out can occur and be detected by the controller. A store registers command with an illegal memory address specification is issued. As soon as the idle bit sets to 1, controller idle, the controller status is checked to confirm that the TILINE time-out bit is set. If it is not set, an error message is output.

2.5.2.14 Subtest 11. Subtest 11 verifies that a rate error can occur and can be detected by the controller. After issuing a write format command to a track, a read data command is issued. The timing is altered during the read by moving data from a nonexistent memory location >800 times. The controller status is checked to determine if the rate error bit is set. If it is not, an error message is output. The expected controller status is >A008 when running the test without interrupts. If the test is running with interrupts, expected controller status will be >B008. This test is only valid on DS10 controller boards of revision R or later. Boards issued prior to this release cannot generate predictable rate errors.

2.5.2.15 Subtest 12. Subtest 12 verifies that the disk drive can correctly switch heads from the maximum cylinder of head 0 to cylinder 0 of head 1. A write format command is issued, specifying one sector per record and a maximum word count. Then a write data command is issued with a word count of 4096 (enough words to cause the controller to switch heads). The controller status is inspected after the write data command is completed for a status of >C800. If this status is not returned, an error message is output.

2.5.2.16 Subtest 13. Subtest 13 verifies that the controller can read successfully when it is forced to switch heads and cylinders. The commands issued are as follows:

1. Issue a write format command to cylinder >FF, head 0, last sector with a word count of 10.

2. Issue a write format command to cylinder >100, head 1, beginning with sector 0 with a word count of 10.

3. Issue a write data command to cylinder >FF, head 0, sector equaling the last with a word count of 20. Use various data.

4. Issue a read data command to cylinder >FF, head 0, sector equaling the last with a word count of 20.

5. Compare the data written with the data read. If any miscompares are detected, issue an error message.

2.5.3 Part 3 -- Disk Addressing Test

Part 3 of the DS10PD test checks the ability of the controller and disk to address every record on a track and every track on the disk. Part 3 is comprised of subtests 14 through 16.

2.5.3.1 Subtest 14. Subtest 14 verifies that the controller can address all of the sectors on one track correctly by performing the following procedure:

1. Issues a write format command to track 0 with one sector per record and a word count of eight.

2. Issues a write data command specifying eight words of data to each sector on the track. The write is done to the last sector first; then the sector address is decremented to 0 so that if a write modifies the next sector, the following write does not cover up the error. The data word used is the sectors/record and sector address. Then a read data command is issued and the data read is checked against what has been written. The read starts at the first sector on track 0.

3. The controller is checked for improper sector selection in the disk drive or an incorrect cartridge.. This is done by issuing a write unformatted command to sector 15, the maximum sector number plus one. The controller status register is examined to determine if the CT error bit has been set. If it is not, an error message is output.

2.5.3.2 Subtest 15. Subtest 15 verifies that the controller can address every track on the disk by performing the following procedure:

1. Formats the entire disk with one sectors per record and a word count of eight.

2. Issues a write data command specifying eight words to the first record on each track. The data is equal to the cylinder address.

3. Issues a read data command and compares the data read to the data written. In reading the data back, the test starts at the middle cylinder, then increments by one, decrements by two, increments by three, etc., until all cylinders are read.

4. Performs 2000 random read data commands on the disk. The controller is checked to determine if each command has completed successfully. If not, an error message is output.

2.5.3.3 Subtest 16. Subtest 16 verifies that the controller can perform writes and reads with variable sectors per record and autoincrements. The subtest performs the following procedure:

1. Issues a write format command to the first 80 tracks of the disk with X sectors per record (where X ranges from 1 to the maximum) and the word count of one word per record. The data used is the sectors per record value.

2. Issues a read data command with the word count equal to >50 words and then checks the data read. If any miscompares are detected, an error message is output.

3. Increments the sectors/record count and reexecutes the test until the sectors/record count equals the maximum.

2.5.4 Part 4 -- Memory Addressing Test

Part 4 of the DS10PD test checks the ability of the controller to address all of TILINE memory. A minimum of 8K bytes of memory beyond the end of the test program must be available to execute the subtests in part 4: subtests 17 and 18.

2.5.4.1 Subtest 17. Subtest 17 tests the ability of the controller to read and write to unmapped memory, which is every memory location from the end of the test to the end of memory or the end of the first 32K-byte block of memory, whichever comes first. All of this memory is used as the read/write buffer for

the tests. The test first verifies that a minimum of 8K bytes of memory is available for the buffer. If insufficient memory exists, the subtest is skipped.

If sufficient memory is available, the address is written as data into each buffer location. The entire buffer is written to disk and the buffer is cleared. The data is then read back from the disk into the buffer and each buffer location is checked to verify that it has its own address written in it as data. If any miscompares occur, an error message is output.

2.5.4.2 Subtest 18. Subtest 18 verifies the ability of the controller to read and write to memory locations in mapped memory. If there is no mapped memory, the subtest is skipped. The test first verifies that a minimum of 8K bytes of memory are available for the test buffer. If insufficient memory is available, the subtest is skipped. If sufficient memory is available, the first >80 bytes of each 8K-byte block of mapped memory is written to and read from. Every two words of data in each >80 byte block contain the processor address and the mapped bias used by the processor to address the mapped buffer. The block is then written to disk and the buffer is cleared. The data is read back from disk to its mapped buffer area and each data pair is checked to verify that it contains its correct address and bias. All mapped memory is checked in this way. If any part of a 8K-byte segment fails to initialize, that segment is skipped.

2.5.5 Part 5 -- Media Integrity Test

Part 5 uses the CRC character to verify the recording reliability of the disk using four different data patterns. Part 5 consists of subtest 19.

2.5.5.1 Subtest 19. Subtest 19 uses the CRC character to verify data written to the entire disk by performing the following procedure:

1. Issues a write format command to the entire disk with the maximum sectors per record (one record per track) and the maximum word count.

2. Performs a read data command with the word count equaling one from each track. The word that is read is checked. If a faulty bit is found anywhere on the track, a status error is reported with the data error bit set. If the data word that is read back is incorrect, the read is executed 10 times and the number of failures in 10 tries is added to the data error count. The disk is formatted and read four times with different data each time. The four data patterns used are 0000, FFFF, AAAA, and 5555. When the disk is being formatted, each track receives different data patterns

from the preceding track. The data used is as follows:

Loop	Track	Data
1	0	0
	1	FFFF
	2	AAAA
	3	5555
	4	0000
	:	:
	MAX	
2	0	FFFF
	1	AAAA
	2	5555
	3	0000
	4	FFFF
	:	:
	MAX	
3	0	AAAA
	1	5555
	2	0000
	3	FFFF
	4	AAAA
	:	:
	MAX	
4	0	5555
	1	0000
	2	FFFF
	3	AAAA
	4	5555
	:	:
	MAX	

2.5.6 Part 6 -- Interactive Write-Protect Test

Part 6 verifies that a power cycle of both the computer and the disk unit does not alter the data on the disk. Part 6 also tests the write-protect function of the drive. Since Part 6 requires user intervention, it has no looping capability. Part 6 consists of subtest 1A.

2.5.6.1 Subtest 1A. Subtest 1A uses the data written during part 5 to verify that a power cycle does not alter data on the disk. Therefore, it is necessary to execute part 5 before executing this subtest. When the test starts execution, it asks you if part 5 (subtest 19) has been run. If you enter a 0 (no), a message is output instructing you to run part 5. If you enter a 1 (yes), the test outputs a message asking if the power has been cycled. If you answer no (0), the test instructs you to cycle power. Turn the power to the computer off, then turn off power to the disk,

turn power on to the disk, and then turn power on to the computer. If you answer yes (1) to the power cycle question, the test verifies that the data on the disk has not been modified by the power cycle.

When the test asks if the system power has been cycled and you answer no, the computer should go into an idle state. If you do not want to cycle the system power, return to the DOCS question VERB? by:

1. Pressing the HALT/SIE button on the computer front panel.

2. Pressing the RUN button.

Upon completion of the power cycle test, the write-protect function of the disk drive is tested. The test instructs you to put the drive in the write-protect mode. The test then attempts to write data to the disk drive. The area where the write was issued to is then read to determine if it has been modified. If the data on the disk has been modified, an error message is output. If it has not, you are asked to press the write-protect switch, which puts the drive in read/write mode. The controller is then checked to verify that the write-protect bit has been cleared and the drive can be written to.

The messages output during subtest 1A are as follows:

```
WRITE PROTECT THE DISK DRIVE CURRENTLY UNDER TEST.
HIT RETURN WHEN READY -

UNPROTECT THE DISK DRIVE CURRENTLY UNDER TEST, PUT IT IN
READ/WRITE MODE. HIT RETURN WHEN READY -
```

2.5.7 Controller Self-Test

The 10-megabyte disk controller has a self-test function that can be useful in determining problems that may exist on the controller that the test cannot pinpoint.

There are two forms of the self-test on the controller. The short test is run every time a command is issued to the controller (goes out of the idle state). The long test is run when a store registers command is issued to the controller, or when a level 0 interrupt (I/O reset, power reset or power fail warning) occurs. Register 2 of the TILINE peripheral control space for the controller is used to return the self-test status. For example, if the controller is at TILINE address >F800, then location >F804 contains the returned self-test status after a command has been issued or any of the preceding situations exist.

When a store registers command is completed successfully, register 2 contains >0000. When an interrupt 0 completes normally, a value of >FF00 is displayed in register 2. Any other values in this register constitute an error condition on the controller. A complete list of the error codes and their definitions can be found in the DS10 Cartridge Disk Controller Depot Maintenance Manual (part number 946262-9701). You can easily inspect the TILINE registers for the controller using the test in one of three ways:

* By executing the SR verb so that a long test is run and the returned status is displayed.

* By executing the DC verb so that the eight registers containing the return conditions from the last command issued can be inspected.

* By executing the DT verb so that the returned status registers from the last 10 commands can be inspected.

3.1 ERROR MESSAGES

When an error occurs during the execution of the DS10PD test, an error message and error number are output. The error message is preceded by a line indicating the subtest number in which the error occurred. These error messages are listed in the following table. Some of the error messages refer to controller status bits. An explanation of these bits can be found in Appendix A.

Error Number	Error Message
11	DID A WRITE AND READ OF ALL BITS IN THE CONTROLLER REGISTERS. EXPECTED THE SAME DATA READ AS WAS WRITTEN. DATA READ = XXXX DATA WRITTEN = XXXX CONTROLLER REGISTER(0-7) = XX
12	SET ALL UNIT SELECT LINES IN REG. 6 OF THE CONTROLLER=0. EXPECTED THE OL AND NR BITS IN REG. 0 TO BE SET. STATUS EXPECTED = XXXX STATUS RETURNED = XXXX
13	DID AN I/O RESET AND READ THE CONTROLLER STATUS, REG. 7. EXPECTED THE IDLE, ERR AND AC BITS IN REG. 7 TO BE SET. STATUS EXPECTED = XXXX STATUS RETURNED = XXXX
14	DID TWO READS OF THE CONTROLLER STATUS, REG. 7. EXPECTED THE LOCKOUT BIT TO BE SET. STATUS EXPECTED = XXXX STATUS RETURNED = XXXX

Error Number	Error Message
15	SELF TEST ERROR AFTER ISSUING A STORE REGISTERS COMMAND REG. 2 OF THE CONTROLLER WAS CHECKED FOR THE SELF TEST RETURN STATUS. STATUS EXPECTED = XXXX STATUS RETURNED = XXXX CONSULT THE MODEL DS10 DEPOT MAINTENANCE MANUAL FOR ERROR STATUS DEFINITIONS BEFORE CONTINUING THE DIAGNOSTIC.
16	STORE REGISTERS ERROR DID A STORE REGISTERS COMMAND AND EXPECTED THE 3 WORDS RETURNED TO COMPARE WITH THE TABLE OF KNOWN VALUES. VALUE RETURNED = XXXX VALUE EXPECTED = XXXX INCORRECT VALUE IS WORD # XX NOTE: Store register values should equal: >0F00, >1430, >1198
20	WITH THE CONTROLLER IDLE BIT SET TO A 1, (CONTROLLER IDLE) THE ATTENTION INTERRUPT MASK BIT IN REG. 0 WAS SET TO CAUSE AN INTERRUPT. THE EXPECTED INTERRUPT WAS NOT RETURNED WITHIN 3 SECONDS.
21	DID A WRITE TO AND THEN A READ FROM THE DISK USING 16 PATTERNS. EXPECTED THE PATTERNS READ TO COMPARE WITH THE PATTERNS WRITTEN. PATTERNS READ XXXX — PATTERNS WRITTEN XXXX
22	DID A WRITE FORMAT TO AND THEN AN UNF. READ FROM A SPECIFIED TRACK. EXPECTED THE FORMAT READ TO COMPARE WITH THE FORMAT WRITTEN. DATA REC. XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX DATA EXP. XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
23	RETRY LOOP ERROR ISSUED A WRITE DATA COMMAND AND TIMED IT TO ALLOW ONLY 1 RETRY (THE CONTROLLER STANDARD), PER SECTOR. THE CONTROLLER WAS STILL RETRYING THE COMMAND WHEN IT TIMED OUT.

Error Number	Error Message
24	A READ FROM AN AREA ON DISK CONTAINING ZEROS TO A MEMORY AREA CONTAINING AAAA'S WAS ISSUED WITH THE TRANSFER INHIBIT BIT SET. DID NOT EXPECT THE MEMORY AREA TO BE CHANGED. DATA RECEIVED XXXX DATA WRITTEN XXXX
25	ID WORD ERROR AFTER CHANGING ID WORD #1 OF A TRACK WITH AN UNF. WRITE DID A WRITE DATA TO THE SAME TRACK. THE EXPECTED CONTROLLER STATUS WAS NOT RECEIVED R7 STATUS EXP = XXXX REC = XXXX
25	ID WORD ERROR AFTER CHANGING ID WORD #2 OF A TRACK WITH AN UNF. WRITE DID A WRITE DATA TO THE SAME TRACK. THE EXPECTED CONTROLLER STATUS WAS NOT RECEIVED R7 STATUS EXP = XXXX REC = XXXX
25	ID WORD ERROR AFTER CHANGING ID WORD #3 OF A TRACK WITH AN UNF. WRITE DID A WRITE DATA TO THE SAME TRACK. THE EXPECTED CONTROLLER STATUS WAS NOT RECEIVED R7 STATUS EXP = XXXX REC = XXXX
25	ID WORD ERROR AFTER CHANGING THE HEADER CRC OF A TRACK WITH AN UNF. WRITE DID A WRITE DATA TO THE SAME TRACK. THE EXPECTED CONTROLLER STATUS WAS NOT RECEIVED R7 STATUS EXP = XXXX REC = XXXX NOTE: The preceding four errors share the same error number because they are all ID errors. The error generating routines are all unique.
26	SEARCH ERROR DID A WRITE OVER THE SYNC. CHARACTER WITH AN UNF. WRITE AND THEN DID AN UNF. READ. THE EXPECTED CONTROLLER STATUS WAS NOT RECEIVED R7 STATUS EXP = XXXX REC = XXXX
27	DATA ERROR AFTER CHANGING THE HEADER CRC OF A TRACK WITH AN UNF. WRITE DID A READ DATA OF THE SAME TRACK. THE EXPECTED CONTROLLER STATUS WAS NOT RECEIVED R7 STATUS EXP = XXXX REC = XXXX

Error Number	Error Message
28	COMMAND TIMER ERROR ISSUED A FORMATTED READ COMMAND WITH THE SECTOR ADDRESS = MAX+6 TO CAUSE A COMMAND TIMER TIMEOUT. RECEIVED THE TIMEOUT BUT THE EXPECTED CONTROLLER STATUS WAS NOT RECEIVED R7 STATUS EXP = XXXX REC = XXXX
29	SEEK INCOMPLETE ERROR AFTER FORMATTING THE LAST TRACK WITH S/R = MAX AND THE WORD COUNT = 100 A WRITE PAST THIS ADDRESS WAS ATTEMPTED AND THE EXPECTED STATUS WAS NOT RECEIVED. R0 STATUS EXP = 04XX , REC = XXXX R7 STATUS EXP = A801 , REC = XXXX
2A	A WRITE COMMAND WITH A BYTE COUNT = 0 WAS ISSUED TO VERIFY THAT NO DATA WOULD BE TRANSFERRED. BUT DATA WAS WRITTEN TO THE DISK.
2B	BUSY FLAG SET ERROR AFTER WRITING THE TPC REG. TO DISK AND READING THEM BACK THE IDLE BIT IN REG. 7, MSB OF THE LAST WORD WRITTEN, SHOULD NOT BE SET SINCE THE CONTROLLER WAS EXECUTING THE COMMAND WHEN REG. 7 WAS WRITTEN. REG. 7 (MSB SHOULD BE 0) WAS XXXX.
2C	TILINE TIMEOUT ERROR ISSUED A STORE REGISTERS COMMAND TO A NONEXISTENT MEMORY LOCATION. THE EXPECTED CONTROLLER STATUS WAS NOT RECEIVED R7 STATUS EXP = XXXX REC = XXXX
2D	WRITE AMP RECOVERY ERROR AFTER FORMATTING TRACKS 0 AND 1 A WRITE WAS ISSUED SPECIFYING 4096 WORDS WHICH SHOULD HAVE CAUSED THE CONTROLLER TO SWITCH HEADS. THE EXPECTED CONTROLLER STATUS WAS NOT RECEIVED R7 STATUS EXP = XXXX REC = XXXX

Error Number	Error Message

2E HEAD SWITCHING ERROR
AFTER FORMATTING MAX HEAD, CYL FF AND CLEARING HEAD 0, CYL 100 A WRITE DATA AND A READ DATA COMMAND WERE ISSUED TO CAUSE THE CONTROLLER TO SWITCH HEADS.

DATA RECEIVED	DATA WRITTEN
XXXX	XXXX

2E HEAD SWITCHING ERROR
AFTER FORMATTING MULTIPLE SECTORS AND TRACKS A READ WAS DONE TO CAUSE THE CONTROLLER TO SWITCH HEADS AND THE EXPECTED CONTROLLER STATUS WAS NOT RECEIVED
R7 STATUS EXP = XXXX REC = XXXX

2F RATE ERROR
ISSUED A READ DATA COMMAND AND THEN CAUSED THE TIMING TO MESS UP. SHOULD HAVE FORCED A RATE ERROR BUT THE EXPECTED CONTROLLER STATUS WAS NOT RECEIVED
R7 STATUS EXP = XXXX REC = XXXX

31 DID A WRITE OF DATA PATTERN TO EACH SECTOR ON TRACK 0. EXPECTED DATA READ BACK TO COMPARE TO DATA WRITTEN.

DATA RECEIVED	DATA WRITTEN
XXXX	XXXX

32 ISSUED A WRITE COMMAND TO THE MAXIMUM SECTOR NUMBER+1, (#21 DECIMAL), AND EXPECTED THE COMMAND TO TIME OUT ON THE ILLEGAL SECTOR NUMBER.
THE EXPECTED CONTROLLER STATUS WAS NOT RECEIVED
R7 STATUS EXP = XXXX REC = XXXX

33 DISK ADDRESSING ERROR
DID WRITE OF 8 WORDS OF DATA TO 1ST SECTOR OF EACH TRACK USING THE CYL NUMBER AS DATA. EXPECTED THE DATA READ TO COMPARE TO THE DATA WRITTEN.

DATA RECEIVED	DATA WRITTEN
XXXX	XXXX

Error Number	Error Message

34 DID A WRITE FORMAT AND THEN A READ DATA ON THE FIRST 100 TRACKS INCREMENTING THE SECTOR/RECORD VALUE FROM 1 TO >15. THE EXPECTED SEC/REC VALUE WAS NOT RETURNED.

DATA RECEIVED	DATA WRITTEN
XXXX	XXXX

41 INSUFFICIENT MEMORY ERROR
NEED TO HAVE AT LEAST 4K WORDS OF MEMORY BEYOND THE END OF THE DIAGNOSTIC TO RUN THIS TEST.

42 MAPPED MEMORY SUBTEST SKIPPED
DID WRITE OF ADDRESS THEN BIAS TO CONSECUTIVE MEMORY LOCATIONS WITH MAP ENABLED. EXPECTED BIAS VALUE TO BE CONVERTED TO THE ADDRESS OF THE LOCATION.
ADDRESS = XXXX , BIAS VALUE = XXXX

43 ERROR IN ADDRESSING UNMAPPED MEMORY
THE CONTROLLER IS SET UP TO READ AND WRITE EVERY ADDRESS INTO ITSELF FROM THE END OF THE DIAGNOSTIC TO THE END OF THE 1ST 32K BLOCK OF MEMORY. THIS ADDRESS DID NOT CONTAIN ITS OWN ADDRESS AS DATA.

DATA RECEIVED	DATA WRITTEN
XXXX	XXXX

44 ERROR IN ADDRESSING MAPPED MEMORY
THE CONTROLLER IS SET UP TO READ AND WRITE MAPPED ADDRESSES FROM MEMORY. A COMPARE IS THEN MADE, THE FOLLOWING ADDRESSES DID NOT COMPARE.

MAP ADDR = XXXX MAP BIAS = XXXX
TILINE ADDR = XXXXXX
EXP DATA = XXXX REC DATA = XXXX

Error Number	Error Message
51	MEDIA INTEGRITY ERROR DID A WRITE FORMAT USING MAX SEC/REC AND MAX WORD COUNT WHILE WRITING VARIABLE DATA PATTERNS. THEN DID A READ TO VERIFY DATA INTEGRITY. BAD TRACK LIST (IN HEXIDECIMAL) CYL HEAD DATA WRITTEN DATA READ # OF ERRORS IN >A RETRIES XXX XX XXXX XXXX X
61	DID A READ OF THE DATA PATTERNS WRITTEN DURING PART 5 EXPECTING THE DATA READ TO COMPARE WITH WHAT WAS WRITTEN BEFORE THE POWER CYCLE. DATA WRITTEN DATA READ CYL ADDR HEAD ADDR XXXX XXXX XXX XX
62	****WARNING**** THE DS10 CONTROLLER IS UNABLE TO SET THE WRITE PROTECT BIT, BIT 2, IN THE CONTROLLER STATUS REGISTER, REG. 0. THE DRIVE CANNOT BE WRITE PROTECTED
63	ISSUED A WRITE AND THEN A READ DATA COMMAND TO THE UNIT UNDER TEST WITH THE WRITE PROTECT BIT SET IN THE CONTROLLER STATUS REGISTER, THE DRIVE WRITE PROTECTED. DATA ON THE DISK WAS MODIFIED THE DISK IS NOT PROTECTED WITH THE WRITE PROTECT SWITCH SET.
64	****WARNING**** THE WRITE PROTECT BIT IN THE CONTROLLER STATUS REGISTER CANNOT BE CLEARED. THE DISK DRIVE CANNOT BE PUT INTO THE READ/WRITE MODE.
C1	AFTER ISSUING A COMMAND THE CONTROLLER FAILED TO GO TO IDLE WITHIN 20 SECONDS.
C2	UNEXPECTED DISK INTERRUPT AT LOCATION XXXX

Error Number	Error Message
C3	THE CONTROLLER HAS TIMED OUT WHILE WAITING FOR THE IDLE BIT TO SET AFTER AN INTERRUPT WAS GENERATED USING THE ATTENTION INTERRUPT MASK BITS.
C4	**STATUS CHECKER ERROR** CONTROLLER STATUS COMP=X ERR=X IDLE=X

DS990R

Universal TILINE(TM) Disk Utility

Universal TILINE(TM) Disk Utility (DS990R)

DS990R

Universal TILINE(TM) Disk Utility

1.1 INTRODUCTION

The Universal TILINE Disk Utility (DS990R) contains tests that can be used to supplement conventional disk drive diagnostics and contains several verbs useful in identifying or intensifying intermittent hardware problems.

DS990R functions in either the read/write or read only mode. In read only mode, DS990R functions properly on disk packs of any format.

In the read only mode, DS990R is particularly effective in detecting intermittent errors when used on the disk pack which originally produced the errors. You can use the supplied utility verbs to intensify the circumstances producing the errors.

You should execute conventional diagnostics to verify the integrity of the controller and its associated disk drive before you use DS990R. If any problems surface during these tests, DS990R is useful in determining the source of the problem and aiding in repair. The utility verbs available allow you to modify the operating characteristics of DS990R to suit your individual requirements.

1.2 TEST REQUIREMENTS

You need the following equipment to execute DS990R:

* Model 990 Computer -- The memory size required to run the test is dependent on the disk drive that you are testing. The minimum for smaller drives is approximately 48K bytes, while the maximum is 72K bytes for larger systems.

* One of the following controllers:
  - DS10 disk controller (TI part number 2262100-0001)
  - DS31 disk controller (TI part number 0974906-0001)
  - DS25/50/200 disk controller (TI part number 0940065-8000)
  - FD1000 disk controller (TI part number 2261690-0001)
  - ECC/LDECC disk controller (TI part number 2269405-0002/2311145-0001)
  - CD1400 disk controller (TI part number 2269405-0001
  - TPBI controller (TI part number 2270820-0001)
  - WD900 controller (TI part number 2244780-0001)
* One of the following disk drives:
  - DS10 (TI part number 0937513-0001)
  - DS31 (TI part number 0960294-0001)
  - DS25 (TI part number 0947524-0001)
  - DS50 (TI part number 0947524-0001)
  - DS80 (TI part number 2308469-0001)
  - DS200 (TI part number 0948992-0001)
  - DS300 (TI part number 2308500-0001)
  - FD1000 (TI part number 2261686-0001)
  - CD1400 (TI part number 2269906-0001)
  - WD500 (TI part number 2532783-0001)
  - WD500A (TI part number 2232480-0001)
  - WD800 (TI part number 2215801-0001)
  - WD800A (TI part number 2245216-0001, 0002, 0003)
  - WD900 138 MB (TI part number 2244790-0001, or -0002)
  - WD900 425 MB (TI part number 2244790-0003, or -0004)

* An interactive device
* A loading device

NOTE

Interactive devices are usually terminals. Error message devices are normally printers. Loading devices are usually controller drives. However, the choice of hardware is so varied that in the case of the Universal Systems Terminal (UST), a single PRO-LITE(TM) computer with a disk drive functions as a loading, interactive, and error message device, simultaneously.

1.3 TEST CHARACTERISTICS

Familiarize yourself with the following characteristics of DS990R before executing the test:

* DS990R operates under the control of DOCS. Information about DOCS operation can be found in Volume 1 of the Unit Diagnostics Handbook.
* Error messages regarding operator supplied parameters are reported to the interactive device in plain language format.
* DS990R interacts with a TILINE controller at the same interrupt level as the interactive device, which is common when both devices are in a communications register unit (CRU) expansion chassis. DS990R checks internally to see if you have specified the proper interrupt level for the interactive device and informs you of any discrepancies.
* DS990R sends a head/cylinder update to the interactive device upon completion of each track being tested. Elapsed or current time of day is appended to the text output.

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* Current time of day is supported by DS990R. Because the DOCS monitor does not support it, current time is maintained only during test execution. If no time (0000) is specified during test initialization or via the CT verb (paragraph 2.5.8), the time reflected on the head/cylinder update is the elapsed time commencing from the start of each test or sequence. If you want the current time to remain accurate, see the explanations for the ST and IU verbs (paragraphs 2.5.7 and 2.5.9) for further information.

* Disk errors in data transfer operations are reported in the same manner as the DX10 operating system, Release 3.0 and later. Both utilize the same DX10 error codes. A specific example can be found in the error messages section of this test.

* This test can be executed in either the read only or read/write modes. DS990R consists of two test parts for the read only mode and four parts if the read/write mode is selected:

  Read Only Mode:

Part	Title
E1	Read Header and Data -- Sequential Mode
E2	Read Header and Data -- With Random Accesses

  Read/Write Mode:

E1	Write and Verify Data -- Sequential Mode
E2	Write and Verify Data -- With Random Accesses
E3	TILINE Controller Data Transfer Test
E4	Trident/CD1400/WDX Data Transfer Test

* In addition to the verbs supplied by DOCS, DS990R contains the following utility and test verbs.

Verb	Function
Test Verbs:	
E1-E4	Execute individual tests, parts 1-4
L1-L4	Loop on individual test parts 1-4
Utility Verbs:	
IT	Initialize test
EA	Execute all test parts in order
LA	Loop on all test parts in order
QR	Quick read (surface mode)
LQ	Looping version of the quick read (surface mode)
QC	Quick read (cylinder mode)
LC	Looping version of the quick read (cylinder mode)
ST	Set time of day
CT	Clear time of day to zero
DB	Display bad track map
IU	Inhibit head/cylinder update
RU	Resume head/cylinder update
IF	Inhibit write format
RF	Resume write format
FD	Format disk (one sector per record)
AF	Absolute write format (one sector per record)
EO	Enable special options
DO	Disable special options
CP	Change head/cylinder parameters
SP	Return to standard parameters
RS	Issue restore command to disk drive
MT	Modify transfer parameters
DP	Disable transfer parameters
HE	Halt on error
CE	Continue on error

* DS990R contains a command issuer package. Verbs relevant to its use are:

Verb	Function
IC	Issue command string
LO	Loop on command string
MC	Modify command list(s)
SC	Show commands

2.1 TEST LOADING

DS990R must be loaded and initialized by DOCS before execution. The DOCS loading procedure is described in Section 3 of the Unit Diagnostics Handbook, General Diagnostic Information, Volume 1, TI part number 0945400-9701.

2.2 TEST INITIALIZATION

When DOCS has loaded DS990R, the name and version of the test is output:

```
<<DS990R>>- SYSTEM 990 - UNIVERSAL TILINE DISK UTILITY - VER # 136.85 *N
```

DOCS then executes the Initialize Test (IT) verb by issuing the following prompts:

```
ENTER ADDRESS OF DISK CONTROLLER (DEF = >F800) -
ENTER INTERRUPT LEVEL OF DEVICE (DEF = >0D)    -
ENTER UNIT NUMBER OF DEVICE (DEF = >00)        -
```

If the default values for the parameters are correct, press the RETURN key. Otherwise, enter the correct values.

NOTE

The target disk must be online and ready before you respond to the prompt for the unit number.

The next prompt is:

```
DO YOU WISH TO SPECIFY PARAMETERS (DEF = 0)?   -
```

If you respond with Yes (1), the following prompts appear:

```
ENTER STARTING CYLINDER ADDRESS (DEF = >0000)  -
ENTER ENDING CYLINDER ADDRESS (DEF = >XXXX)    -
ENTER STARTING HEAD ADDRESS (DEF = >00 )       -
ENTER ENDING HEAD ADDRESS (DEF = >XX )         -
RESTRICT RANDOM ACCESSES ALSO (DEF = 0)?       -
```

Reply to the first four prompts. Enter desired values with the indicated number of hexadecimal digits. The last prompt requires a positive or negative response. Enter 1 for Yes, 0 for No. Note that the ending cylinder and head addresses have already been calculated by the routine as defaults.

The next prompt is for the line frequency. Press RETURN for the default of 60 hertz.

```
ENTER LINE FREQUENCY (50HZ=0, 60HZ=1) (DEF = 1)  -
```

You are now prompted for the time of day (military time) in four decimal digits. Press RETURN if the default of 0000 is desired.

```
ENTER TIME - FOUR DIGITS <XXXX>  (DEF = 0000)  -
```

You are now asked whether you wish to use the read only mode. To respond Yes, accept the default (1) by pressing the RETURN key. The default is always positive. If the read/write mode is requested, the following warning appears:

```
**********************************
*  <<<<<<< WARNING >>>>>>>>> *
**********************************

<<PROCEEDING WILL DESTROY THE CONTENTS OF THE DISC >>

TYPE "YES" IF YOU WISH TO CONTINUE (DEF = NO) -
```

The 'specify parameters' sequence ends with a message informing you of the type of disk drive being tested. If the disk being tested were a DS300, then the message would appear as follows:

```
DISK DRIVE DETERMINED TO BE  -  << DS300 >>     -
```

The initialization sequence resumes as DOCS asks you if you want to execute all parts of the DS990R:

```
EXECUTE EA VERB?  (DEF = 1)     -
```

If you accept the default, all tests that are part of the selected mode execute in sequence. The following messages are displayed when the EA verb executes without errors:

- READ ONLY MODE

```
<<< TEST 1 - READ HEADER AND DATA - SEQUENTIAL MANNER >>>
 <<< CURRENT HEAD/CYLINDER = >01 >0197 00:25:25 >>>
<<< TEST 2 - READ HEADER AND DATA - W/RANDOM ACCESSES >>>
 <<< CURRENT HEAD/CYLINDER = >01 >0197 00:45:02 >>>
     LOOP COUNT = >0001

VERB?
```

- READ/WRITE MODE

```
<<< TEST 1 - WRITE AND VERIFY DATA - SEQUENTIAL MANNER >>>
 <<< CURRENT HEAD/CYLINDER = >01 >0197 00:35:21 >>>
<<< TEST 2 - WRITE AND VERIFY DATA - W/RANDOM ACCESSES >>>
 <<< CURRENT HEAD/CYLINDER = >01 >0197 00:55:01 >>>
<<< TEST 3 - TILINE CONTROLLER DATA TRANSFER TEST  >>>
 <<< CURRENT HEAD/CYLINDER = >00 >0000 01:04:14 >>>
<<< TEST 4 - TRIDENT/CD1400/WDX DATA TRANSFER TEST >>>
 <<< CURRENT HEAD/CYLINDER = >00 >0000 01:10:09 >>>
     LOOP COUNT = >0001

VERB?
```

NOTE

The error count (ERRORS = >0000) is cumulative and is reset to zero only at the start of any test or at the start of any looping sequence. Errors can be of both the fatal and nonfatal types.

2.3 TEST VERBS -- READ ONLY MODE

If you selected the read only mode, four test verbs are available: E1, E2, L1, and L2.

2.3.1 E1 Verb

Test 1 reads each track on the target disk on a surface-by-surface basis. As each sector is read, all header words are checked for logical content and consistency. Because the track format is also determined at this time, this test can be executed on a disk pack of any format. After all headers are verified, one of three sequences of events occurs according to the header format of the disk pack being tested.

2.3.1.1 Header Format Zero. If the disk drive being tested is determined to be a WD500, WD500A, WD800, WD800A, or FD100, Test 1 branches to the Header Format Zero sequence, as follows:

* Performs a standard (>0400) unformatted read on each sector and verifies returned information for validity and consistency
* Reads target track data on a sector-by-sector basis, inserting data contiguously in one I/O buffer
* Reads target track data using one access into another I/O buffer
* Does a memory compare data of the contents of the two buffers

2.3.1.2 Header Format One. If the disk drive being tested is determined to be a DS10, DS25, DS31, DS50, or DS200, Test 1 branches to the Header Format One sequence, as follows:

* Performs a standard (>0400) unformatted read on each sector and verifies returned information for validity and consistency. (Note that the drives in this category return physical disk data via this command.)
* Reads target track data using one access into one I/O buffer
* Reads target track data in one access into another I/O buffer
* Does a memory compare data of the contents of the two buffers

2.3.1.3 Header Format Two. If the disk drive being tested is determined to be a DS80, DS300, WD900, or CD1400, Test 1 branches to the Header Format Two sequence, as follows:

* Performs a standard (>0400) unformatted read on each sector and verifies returned information for validity and consistency

* Performs an extended unformatted read (>8400) on each sector, verifies the header words returned, and packs the data field contiguously into one I/O buffer. (Note that this command returns the physical headers along with the data field.)

* Reads target track data in one access into another I/O buffer

* Does a memory compare data of the two buffers

Disk drives in this category can contain data tracks which may have been relocated. If so, an informative message is transmitted to the error message device. The message contains the physical address of the bad track and the address of the track to which it is mapped.

Disk controller status errors are reported in the same manner as with the DX10 operating system. In the event of header word discrepancies, the header word number, expected data, and received data are reported to the error message device.

NOTE

Due to the lengthy execution time of Test 1, particularly with the larger disk drives, this test is not appropriate if a quick check for cyclic redundancy check (CRC) errors is desired. See the description for the QR, QC, and CP utility verbs.

2.3.2 E2 Verb

Test 2 reads the entire data field of each track on a surface-by-surface basis, just as Test 1 does, but does not read each sector. Random accesses are performed to stimulate the servo system of the disk drive. Like Test 1, Test 2 can be executed on disk packs of any format. Each track is processed as follows:

* Perform an unformatted read to determine the track format
* Read the entire target track into memory buffer number 1
* Perform a random access
* Return to the target track
* Read the entire track into memory buffer number 2
* Compare the memory data now residing in both buffers

2.3.3 L1 and L2 Verbs

The L1 and L2 verbs are looping forms of the E1 and E2 verbs. Restrictions which apply to the E1 and E2 verbs apply directly to the L1 and L2 verbs.

2.4 TEST VERBS -- READ/WRITE MODE

If you selected the read/write mode, eight test verbs are available: E1, E2, E3, and E4; and L1, L2, L3, and L4.

2.4.1 E1 Verb

Test 1 tests each track on a surface-by-surface basis. The disk pack being used need not be formatted, because Test 1 formats it as each track is tested. Each track is processed as follows:

* The track is formatted using a format of one sector per record.
* Data patterns >DB6A, >6DB6, >CCCC, >DB67, >AAAA, >E32A, and >DEAD are written from memory buffer number 1.
* Data is read into memory buffer number 2 after each pattern is written.
* Memory buffer number 2 is checked to determine whether it contains the final expected pattern.

NOTE

The patterns written to the track being tested are changed to subsequent patterns by adding to existing data in memory buffer number 1. This method is used so that only one memory verification is necessary to ensure that no corruption of data has occurred.

2.4.2 E2 Verb

Test 2 tests each track on a surface-by-surface basis, as does Test 1, but only two patterns are used. In addition, random accesses are performed between data transfers to stimulate servo activity. Before the start of Test 2, the disk pack is formatted using a format of one sector per record. After the pack is formatted, each track is processed as follows:

* Write a random pattern from memory buffer number 1
* Perform a random access
* Read a pattern into memory buffer number 2
* Perform a random access
* Do a memory compare data in memory buffers number 1 and number 2
* Repeat the preceding sequence using inversion of the data pattern

The initial formatting of the pack is skipped if Test 1 has already been performed, since the pack would already be formatted. Moreover, the format is skipped on subsequent loops of Test 2. Whenever the Initialize Test (IT) or Change Parameters (CP) verbs are processed, the disk pack is again formatted before the start of Test 2, because the test assumes that you have changed the pack or defined a different area of the pack to be tested. See the explanations of the IF and RF utility verbs for further details.

2.4.3 E3 Verb

Test 3 tests the ability of the controller to transfer data accurately. Only one track (track zero) is used. Data patterns are written, read, and memory compared for a period of from two to four minutes, depending on the disk drive type. You can modify the track being utilized by using the CP verb (paragraph 2.5.1).

Two basic data patterns are used in this test. The first data pattern consists of ASCII data that is incremented by one after each pass until the entire set is used. The second data pattern consists of actual program data that is shifted right circular one place after each pass for sixteen passes.

2.4.4 E4 Verb

Test 4 functions just like Test 3, except that the data field is read using other than nominal strobes and offsets. This test concentrates on the disk drive's ability to transfer data reliably. Each read data command is performed using the following options:

* Nominal strobe
* Offset forward
* Offset reverse
* Strobe early
* Strobe late
* Strobe early/offset forward
* Strobe early/offset reverse
* Strobe late/offset forward
* Strobe late/offset reverse

Test 4 is only authorized for use on disk drives capable of the options mentioned above. Like Test 3, the track being used can be changed by using the CP verb.

2.4.5 L1, L2, L3, and L4 Verbs

The L1, L2, L3, and L4 verbs are looping forms of the E1, E2, E3, and E4 verbs. Use the L verbs to call up the same tests that are called up by the E verbs and to cause them to loop for a specific number of repetitions. Restrictions that apply to the E verbs apply directly to the L verbs.

2.5 UTILITY VERBS -- READ ONLY AND READ/WRITE MODES

The utility verbs common to both the read only and read/write modes are:

* CP -- Change Head/Cylinder Parameters
* SP -- Return to Standard Parameters
* RS -- Issue Restore Command to Disk Drives

* DB -- Display Bad Track Map
* EO -- Enable Special Options
* DO -- Disable Special Options
* ST -- Set Time of Day
* CT -- Clear Time of Day to Zero
* IU -- Inhibit Head/Cylinder Update
* RU -- Resume Head/Cylinder Update
* MT -- Modify Transfer Parameters
* DP -- Disable Transfer Parameters
* HE -- Halt on Error
* CE -- Continue on Error
* IT -- Initialize Test
* EA -- Execute All Tests
* LA -- Loop on All Tests

2.5.1 Change Head/Cylinder Parameters (CP) Verb

The Change Head/Cylinder Parameters (CP) verb is used to define a particular area of the disk to be tested. This verb enables the operator to restrict accesses to selected heads and/or cylinders. See paragraph 2.2, Test Initialization, for an example of the prompts.

Before test initialization, the ending head and cylinder addresses determined by the store registers command are preloaded in the prompts as default values. Certain disk drives reserve spare cylinders for use as bad track mapping and/or diagnostic cylinders. These areas can be accessed through the use of the CP verb, but caution must be exercised so that relocated tracks and/or bad track maps are not inadvertently destroyed in the read/write tests or by utility verbs. Note that the initial default value for the ending cylinder address does not include these reserved areas, but the CP verb allows you to enter the last physical cylinder address if desired.

The last prompt of the CP verb refers to the random accesses performed in Test 2 of the read only and read/write modes of operation.

```
RESTRICT RANDOM ACCESSES ALSO (DEF = 0)?
```

If you respond with Yes (1), random accesses are restricted to only those areas specified by the CP verb.

2.5.2 Return to Standard Parameters (SP) Verb

The Return to Standard Parameters (SP) verb sets head/cylinder address ranges modified by the CP verb back to standard parameters.

2.5.3 Issue Restore Command to Disk Drives (RS) Verb

The Issue Restore Command to Disk Drives (RS) verb issues a restore command to the target disk drive. Test initialization must be complete before using this verb.

2.5.4 Display Bad Track Map (DB) Verb

The Display Bad Track Map (DB) verb is used to display bad track information on disk packs that contain a bad track map on the last diagnostic cylinder, or on sector one of track zero for those that do not.

If a disk contains bad track information in sector one, the information contained within it is probably valid.

If no bad tracks are flagged, the following message is sent to the interactive device:

```
<<<<<< NO BAD TRACKS FLAGGED >>>>>>
```

If the bad track map cannot be read due to a status error, or if invalid data was is in it, the following message is displayed:

```
<<<<<< CANNOT OBTAIN BAD TRACK MAP/INVALID DATA >>>>>>
```

If valid bad track data is found, a table that reflects the status of the bad track head address (mapped or unmapped), cylinder address, and number of bits in error is sent to the error message device. All values are in hexadecimal. An example follows:

MAPPED	HEAD	CYLINDER	LENGTH
Y	>0000	>0010	>0020
Y	>0002	>01FE	>0002
Y	>0001	>021F	>0010

where:

Y equals mapped
N equals unmapped

2.5.5 Enable Special Options (EO) Verb

The Enable Special Options (EO) verb is only authorized for disk drives that can read data using other than nominal strobes or while offset. Using the EO verb causes all read data commands to be performed with the following operator specified options:

* OF -- Offset Forward
* OR -- Offset Reverse
* SE -- Strobe Early
* SL -- Strobe Late
* NS -- Nominal Strobe

The prompt for the EO verb is:

ENTER READ DATA OPTIONS DEF = (SE, SL, OF, OR, NS)

Accepting the default values causes each read data command to be performed with all of the preceding options. Choosing certain options changes the default to only those options you chose until you restore the original five options as defaults. You can specify one through five of the previous options, and you must separate multiple options with a comma. Duplicates are permitted. An example of an acceptable answer is:

SE, OF, OF, NS

This option is useful in diagnosing unusual drive problems and in testing drive-to-drive compatibility.

If special options are enabled, the chosen options are appended to the head/cylinder update to serve as a reminder.

2.5.6 Disable Special Options (DO) Verb

The Disable Special Options (DO) verb disables those read data options selected using the EO verb.

2.5.7 Set Time of Day (ST) Verb

The Set Time of Day (ST) verb sets the current time of day, using military format. Input is four decimal digits. This verb is useful in coordinating disk status errors with external disturbances, such as with the output of a Dranetz power line monitor. Disk status errors will reflect the time of occurrence.

Because the DOCS monitor does not support the time of day, current time is only maintained while a test is executing or looping. You should enter the proper time of day immediately before test execution. For accuracy, disable header messages, particularly if they are sent to a slow device and would frequently appear. See the explanation for IU verb in paragraph 2.5.9.

2.5.8 Clear Time of Day to Zero (CT) Verb

The Clear Time of Day to Zero (CT) verb resets the time to zero. So, time reflected on the head/cylinder update is expressed as elapsed time after the start of each test or sequence.

2.5.9 Inhibit Head/Cylinder Update (IU) Verb

The Inhibit Head/Cylinder Update (IU) verb disables the head/cylinder update to the interactive device. If the interactive device is a 911 or 931 VDT, the update does not affect test execution or current time. However, on slower devices such as a 940 EVDT operating at 9600 baud, the update significantly slows test execution and degrades the accuracy of the current elapsed time.

This verb also inhibits the automatic transaction/error count that is output by the command issuer.

2.5.10 Resume Head/Cylinder Update (RU) Verb

The Resume Head/Cylinder Update (RU) verb re-enables the head/cylinder update or transaction/error count disabled by the IU verb.

2.5.11 Modify Transfer Parameters (MT) Verb

The Modify Transfer Parameters (MT) verb modifies the starting sector address and the number of sectors that are transferred on each access. DS990R normally transfers a full track, beginning with sector zero.

The MT verb is useful for aggravating any sectoring and/or head switching problems, or problems related to rapid servo activity. Decreasing the number of sectors to transfer increases servo activity considerably. This is applicable to Test 2 of the read only or read/write tests.

The number of sectors you choose to transfer must not exceed the length of one track. You can choose any valid starting sector. This verb is disabled by execution of the IT or DP verbs.

The prompts for the MT verb are:

```
ENTER NUMBER OF SECTORS TO TRANSFER (DEF = >XX)  -
ENTER STARTING SECTOR ADDRESS (DEF = >00)        -
```

If you selected the read only mode of operation, you are asked if the disk pack is formatted at one sector per record. Exercise care when responding to this prompt, since false errors may be reported in the event of an incorrect answer.

```
IS DISC PACK FORMATTED ONE SECTOR/RECORD (DEF = 1)  -
```

Notice that only the drives designated as Header Format One are capable of variable record formats (DS10, DS31, DS25, DS50, and DS200) and are likely to be found at sites utilizing DX10 operating systems earlier than Release 3.0.

If this verb is used and the mode of operation is read only, the following rules apply:

TEST 1

* All headers are analyzed regardless of the operator specified-starting sector.
* If the target track is not one sector per record, the starting sector is always zero.
* If the disk pack contains tracks that are not one sector per record (variable format), the number of sectors transferred is truncated so that the subsequent track is not accessed.

TEST 2

* The same conditions apply as in Test 1, except that only the first header is read to determine track format.

In order to remind you that this verb is enabled, an asterisk is placed between the head and cylinder address in the auto-update.

Exercise caution when specifying a starting sector and sector count which will cause an access to the subsequent track of the last track being tested. The subsequent track must be readable and/or of the same format as the last track.

2.5.12 Disable Transfer Parameters (DP) Verb

The Disable Transfer Paramters (DP) verb negates the Modify Transfer (MT) verb.

2.5.13 Halt on Error (HE) Verb

The Halt on Error (HE) verb causes a test to halt upon encountering any error or a specific DX10 error code (hard error only).

The following prompt is issued after the execution of this verb:

ENTER DX10 ERROR CODE (>00 = ANY) (DEF = >00) ____ -

Accept the default if you want the test to stop after any error.

If you want to specify that the test stop after only certain specific errors, then enter the error code for that error in the space underlined in the prompt.

2.5.14 Continue on Error (CE) Verb

The Continue on Error (CE) verb disables the Halt on Error (HE) verb.

2.5.15 Initialize Test (IT) Verb

The Initialize Test (IT) verb starts a test or changes the parameters under which a test is run. For information concerning the IT verb prompts, see paragraph 2.2.

2.5.16 Execute All Tests (EA) Verb

The Execute All Tests (EA) verb causes all of the tests available within the chosen mode (read only or read/write) to run for a single execution. For information about which tests will run under which modes, see paragraph 2.2.

2.5.17 Loop on All Tests (LA) Verb

The Loop on All Tests (LA) verb causes all of the tests available to the operator within the chosen mode (read only or read/write) to execute a specific number of times (loops). For information about which tests will run under which modes, see paragraph 2.2.

2.6 UTILITY VERBS -- READ ONLY MODE

The utility verbs common to the read only mode of operation are:

* QR -- Quick Read (Surface Mode)
* LQ -- Looping Quick Read (Surface Mode)
* QC -- Quick Read (Cylinder Mode)
* LC -- Looping Quick Read (Cylinder Mode)

2.6.1 Quick Read (Surface Mode) (QR) Verb

The Quick Read (surface mode) (QR) verb reads each track on a surface-by-surface basis, starting with head 0, cylinder 0. No headers are analyzed, and only the CRC character is used to verify data integrity. Before reading each track, an unformatted read is performed to determine track format. Consequently, this verb can be used to read a disk of any format. The QR verb is the fastest method for reading a disk pack.

The header message output during execution is:

```
<<< QUICK READ OF DATA FIELD IN PROGRESS - TRACK MODE >>>
 <<< CURRENT HEAD/CYLINDER >00  >0000  00:00:00 >>>
```

2.6.2 Looping Quick Read (Surface Mode) (LQ) Verb

The Looping Quick Read (surface mode) (LQ) verb is the looping version of the QR verb. The prompts for this verb are the same as those for the QR verb.

2.6.3 Quick Read (Cylinder Mode) (QC) Verb

The Quick Read (cylinder mode) (QC) verb functions just like the QR verb, except that the disk pack is read on a cylinder basis.

The header message output during execution is:

```
<<< QUICK READ OF DATA FIELD IN PROGRESS - CYLINDER MODE >>>
 <<< CURRENT HEAD/CYLINDER >00  >0000  00:00:00 >>>
```

2.6.4 Looping Quick Read (Cylinder Mode) (LC) Verb

The Looping Quick Read (cylinder mode) (LC) verb is the looping version of the QC verb. The prompts for this verb are the same as those for the QC verb.

2.7 UTILITY VERBS -- READ/WRITE MODE

Utility verbs common to the read/write mode of operation are:

* FD -- Format Disk
* AF -- Absolute Write Format
* IF -- Inhibit Format (Test 2)
* RF -- Resume Format (Test 2)

2.7.1 Format Disk (FD) Verb

The Format Disk (FD) verb formats a disk pack at a format of one sector per record. No surface analysis is performed.

2.7.2 Absolute Write Format (AF) Verb

The Absolute Write Format (AF) verb formats a disk pack that is capable of bad track relocation. You should use this verb with extreme caution, since indiscriminate use can lead to loss of data and/or require that the target pack be reformatted via DSKSA or the DX10 IDS utility.

2.7.3 Inhibit Format (IF) Verb

The Inhibit Format (IF) verb only affects operation of Test 2 if the read/write mode is selected (see paragraph 2.5.1).

Before the start of Test 2, the pack is formatted at a maximum format whenever the routine assumes that a new disk pack has been inserted (IT and CP verbs). Since both Test 2 and the CP verb format the disk pack, you can avoid redundant reformatting of the disk pack being used by using the IF verb.

2.7.4 Resume Format (RF) Verb

The Resume Format (RF) verb resumes automatic pack formatting in Test 2 of the read/write mode.

2.8 COMMAND ISSUER VERBS

Verbs common to the command issuer package are:

* MC -- Modify Command
* SC -- Show Commands
* IC -- Issue Command
* LO -- Loop on Command

DS990R contains a command issuer package that uses up to eight TILINE lists that reside internal to DS990R. The TILINE lists, for purposes of issuing and/or modifying them, are numbered 0 through 8.

The Enable Options verb affects the execution of read data commands executed by the command issuer. Refer to paragraph 2.5.5 for details on the EO verb.

2.8.1 Modify Command (MC) Verb

The Modify Command (MC) verb modifies any one or more of the eight TILINE lists resident in DS990R. The first prompt encountered after the MC verb is invoked is:

```
COMMAND NUMBER (DEF = 00)   -
```

Enter a number from 0 to 7 to specify the TILINE lists that you wish to modify and press the RETURN key. The next prompt is:

```
BYTE POSITION (0-E) (DEF = 00)   -
```

Enter a number from 0 to >E, in increments of two, to indicate the byte offset into the list you wish to modify.

The next output is the number of the TILINE list (0 through 7) followed by the offset and the contents. To modify the data, enter the new data as four hexadecimal digits, and then press the RETURN key. The routine automatically goes to the next position in the list. Press the RETURN key if you do not want to modify the data in the current position. You can continue to press the RETURN key to access succeeding lists.

For example, the following is an example of output in response to the MC verb when you are using command number 0, byte position number 0 as parameters:

```
#0 - 0000 0000
   - 0002 0200
   - 0004 0100
   - 0006 0000
   - 0008 0120
   - 000A XXXX *
   - 000C 0800
   - 000E 1000 **
#1 - 0000 0000
   - 0002 0200
   - 0004 0100
     .
     .
     .
```

* The memory address for data is stored in this position. This position points to the end of DS990R and is always preloaded by the test.

** The default for the last word of each TILINE list is >1000 since each command is executed with the disk controller interrupt enabled.

Press the Command key to exit.

2.8.2 Show Command (SC) Verb

The Show Command (SC) verb displays all eight of the TILINE lists on the interactive device. The output is as follows:

```
#0 - 0000 0200 0100 0000 0120 XXXX 0800 1000
#1 - 0000 0200 0100 0000 0120 XXXX 0800 1000
#2 - 0000 0200 0100 0000 0120 XXXX 0800 1000
#3 - 0000 0200 0100 0000 0120 XXXX 0800 1000
#4 - 0000 0201 0100 01FE 0120 XXXX 0400 1000
#5 - 0000 0200 0100 0010 0120 XXXX 0800 1000
#6 - 0000 0201 0100 0000 0120 XXXX 0200 1000
#7 - 0000 0200 0100 0000 0120 XXXX 0800 1000
```

Notice that different unit numbers can be accessed using the SC verb.

2.8.3 Issue Command (IC) Verb

The Issue Command (IC) verb executes one or more of the TILINE lists in any sequence, up to a string of eight characters. Duplicates are permitted.

The first prompt of the IC verb is:

```
COMMAND STRING (0-7) DEF = (0       )    -
```

If you accept the default, only TILINE list number 0 is executed. If multiple TILINE lists were executed in a previous use of the IC verb, the prompt default would reflect only those lists executed. For example:

```
COMMAND STRING (0-7) DEF = (62201   )    -
```

The preceding prompt indicates that the last run of the IC verb used command number 6, followed by two successive repetitions of command number 2, followed by command number 0 and then ended with command number 1.

Following the prompt for the command string, a prompt for the status options is displayed:

```
STATUS OPTION (0=IGNORE, 1=CHECK, 2=HALT ON SUCCESSFUL) (DEF=1) ?
```

The status options are defined as follows:

* 0=IGNORE status -- The TILINE lists are executed without reporting errors.
* 1=CHECK status -- Status errors are reported to the error message device.
* 2=HALT ON SUCCESSFUL -- The TILINE lists are executed until a successful operation is detected. At this time, the successful list is output in the same format as a status error. The error code is >00 in this case.

As soon as the status option is specified, the selected TILINE lists(s) are executed. Following the execution of the TILINE lists(s), the following message is sent to the interactive device:

```
<<< TRANSACTIONS = >0001  ERRORS = >0000  >>>
```

2.8.4 Loop on Command (LO) Verb

The Loop on Command (LO) verb is used to loop on a TILINE list or a string of lists. Generally, the same prompts and rules apply as for the IC verb. The only variation occurs when the HALT ON SUCCESSFUL status option is chosen. When a successful operation is detected, a halt does not occur, but the succeeding list is reported to the error message device in the same manner as for the IC verb.

While looping on the TILINE list(s), the transaction/error count is periodically updated on the interactive device. The update occurs immediately following the detection of errors. This update can be inhibited by using the IU verb, as described in paragraph 2.5.9.

3.1 ERROR MESSAGES

When an error is detected by DS990R, a self-explanatory error message is sent to the error message device. Clarification for certain error codes is furnished when necessary as part of the error message. The DS990R error messages are listed in the following paragraphs.

NOTE

The error messages that follow are exact representations of what appears on your error message device. A hyphen (-) on the left marks the beginning of each message. This hyphen can be used to tell when one error message ends and another begins. It is supplied because, unlike other diagnostics, DS990R does not number its error messages.

3.1.1 Operator Error Messages

The DS990R operator error messages are as follows:

```
- <<<<<<<< INCORRECT PARAMETER SPECIFIED >>>>>>>>

- <<<< VERB REQUEST NOT ACCEPTED - INITIALIZATION NOT
  COMPLETE >>>>

--            **************************
              * <<<<<< WARNING >>>>>>> *
              **************************

   << DS990R HAS DETECTED AN ERRONEOUS INTERRUPT LEVEL >>
   << FOR THE INTERACTIVE DEVICE - CORRECT AND PERFORM  >>
   << AN "IT".                                          >>

- <<<< VERB NOT AUTHORIZED FOR DISC TYPE OR PARAMETERS
  SPECIFIED >>>>

- <<<< END ADDRESS LESS THAN START ADDRESS >>>>

- <<<< INSUFFICIENT MEMORY - TASK DESTROYED >>>>

- <<<< CANNOT ACCESS CONTROLLER AT ADDRESS SPECIFIED >>>>
```

3.1.2 Informative Messages

The DS990R informative messages are as follows:

- <<< RESTORE EXECUTED TO CLEAR "US" OR "PC" BIT >>>

- *** TRACK RELOCATED - HEAD/CYL >00 >0000 TO >00 >0000 ***

3.1.3 Error Messages -- Read Only and Read/Write Modes

The DS990R error messages common to read only and read/write modes are as follows:

- <<< TIMED OUT WHILE WAITING FOR TRUE ATTENTION LINE >>>

- <<< CANNOT DETERMINE DISC DRIVE TYPE FROM STORE REGISTERS >>>

- <<<< ERROR ON RESTORE/STORE REGISTERS >>>>

- <<<< SPURIOUS INTERRUPT RECEIVED - TASK ABORTED >>>>

- <<<< CANNOT OBTAIN BAD TRACK MAP/INVALID DATA >>>>

- <<<< WARNING! REAL TIME CLOCK FAILURE >>>>

- <<<< 00:01:54 DSXX ERR=18 A= >C0F0 0200 0100 0000 0120 8614 0800 A801
  ** F=07 B= >0000 0200 0100 0000 0120 8614 0800 1000

  ** See Note 3

  Notes:

  1. The error code corresponds to the DX10 error code. See Volume VI, DX10 Error Reporting and Recovery Manual (0946250-9706).

  2. The "B=" line reflects the TILINE image passed to the controller. The "A=" line reflects the TILINE image returned.

  3. If the error was a device check (ERR=1B), and the test device is a DS80/300 drive, the specific reason for the error will be supplied in the field denoted as "**" in the above example. Any one of the following may be returned in this field:

IDXERR	- Index error
SH*RDY/	- Set head while not ready
SC*RDY/	- Set cylinder while not ready
SKERR	- Seek error
WRT*RDY/	- Write while not ready
WRT*RDONLY	- Write while read only
WRT*(U+R+O)	- Write while offtrack/read gate offset
HDFAULT	- No or multiple head select
IWFAULT	- Write current fault
RWUSF	- Read/write unsafe

```
                XXXXXXXXXX   - Error in obtaining fault data

-  $$$$$$$$ MEMORY DATA MISCOMPARE $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
   EXPECTED MEMORY DATA     =>4453     ADDRESS = >08614
   RECEIVED MEMORY DATA     =>4451     ADDRESS = >0A400
   ------------------------------------------------------------------
   00:02:16 DSXX ERR=00  A =>00F0 0200 0117 0000 0000 8734 0800 C800
                 S=00    B =>0000 0200 0100 0000 0120 8614 0800 1000
   ------------------------------------------------------------------
   @WSP1 CONTENTS         =>0028 62D4 00CB 0002 0200 0100 0000 1B00
                          =>A400 0800 1000 63CE 70FC 04DC 6BD8 C00F
   @WSP2 CONTENTS         =>0000 60A6 0000 0090 0117 0180 0000 1000
                          =>0000 70FC F820 6E42 0000 60C4 721A D00F
   ------------------------------------------------------------------
   SAVED PC               =>6E46
   ------------------------------------------------------------------
```

3.1.4 Error Messages -- Read Only Mode

The error messages common to the read only mode are as follows:

```
-  $$$$$$$$ HEADER WORD XXXX MISCOMPARED  $$$$$$$$$$$$$$$$$$$$$$$$$$
   EXPECTED: >0000
   RECEIVED: >0010
   ------------------------------------------------------------------
     *  The number of the I.D. word which miscompared will be
        reflected in the first line of this message.
     *  Current controller status follows this message.


-  $$$$$$$ I.D. WORD COUNT EXCEEDS MAXIMUM RANGE  $$$$$$$$$$$$$$$$$$
   EXPECTED: >0090
   RECEIVED: >0100
   ------------------------------------------------------------------
     *  Current controller status follows this message.


-  $$$$$$$$$ ILLOGICAL HEADER WORD TWO  $$$$$$$$$$$$$$$$$$$$$$$$$$$$
   EXPECTED: >0018
   RECEIVED: >0001
   ------------------------------------------------------------------
     *  Current controller status follows this message.
```

3.1.5 Error Messages -- Read/Write Mode

The single error message common to the read/write mode is:

```
- <<<< ERROR ON WRITE FORMAT - FATAL ERROR >>>>
```

DSKCOM

COMMON DISK DRIVE TEST

COMMON DISK DRIVE TEST (DSKCOM)

DSKCOM

Common Disk Drive Test

1.1 INTRODUCTION

The Common Disk Drive Test (DSKCOM) contains the high-level tests for disks that interface (logically or physically) to either the 990 TILINE(TM) or the Peripheral Bus Interface (TPBI).

DSKCOM verifies the operation of the CD1400, DS80, DS300, WD800, (8-inch Winchester), the WD900 (138- and 425-megabyte CDC Winchesters), and the WD500, WD500A and WD800A (5 1/4-inch Winchesters) disk systems. It can also verify the operation of the double-sided double-density (DSDD) drive associated with the WD500 (WD500-DSDD) or WD500A (WD500A-DSDD).

NOTE

WD500-DSDD refers to both WD500-DSDD and WD500A-DSDD when used in prompts.

Before using DSKCOM, you should have already executed a low-level diagnostic (DSKCD1, DSKCD2, DSKWD5, DSKWD8, or WDFLPY) to verify the specific operation of the controller and its associated disk drive.

1.2 TEST REQUIREMENTS

You need the following equipment to execute DSKCOM:

* A Model 990 Computer with a minimum of 64K bytes of memory (where K equals 1024) or a Business System computer with 64K bytes of memory

TILINE is a trademark of Texas Instruments Incorporated.

* If you are using a 990 computer, you need one of the following controllers:
  - CD1400 disk controller (TI part number 2269405-0001 or -0002)
  - WD900 disk controller (TI part number 2244780-0001)
  - TPBI controller (TI part number 2270820-0001)
* One of the following disk drives:
  - CD1400 (TI part number 2269906-XXXX)
  - DS80 (TI part number 2308469-XXXX)
  - DS300 (TI part number 2308500-XXXX)
  - 5 1/4-inch Winchester WD500 (without DSDD diskette drive (TI part number 2532738-XXXX); with DSDD diskette drive (TI part number 2532783-XXXX)
  - 5 1/4-inch Winchester WD500A (TI part number 2232480-XXXX)
  - 8-inch Winchester (TI part number 2215801-XXXX)
  - WD900 Winchester 138 or 425 megabyte (TI part number 2244790-XXXX)
  - WD800A 38, 69, or 114 megabyte (TI part number 2245216-XXXX)
* An interactive terminal
* A loading device

1.3 TEST CHARACTERISTICS

Familiarize yourself with the following characteristics of DSKCOM before executing the test:

* DSKCOM executes under the Diagnostic Operational Control System (DOCS). Volume 1 of the Unit Diagnostics Handbook contains information about DOCS operation.

* When you execute DSKCOM immediately after a low-level test, the initialization parameters from the low-level test pass automatically to DSKCOM. The parameters that DSKCOM receives are displayed on the interactive device; you can accept them or reinitialize the parameters.

* DSKCOM is the high-level disk test and assumes that a low-level test has been performed previously. A low-level test is a test specific to a certain controller and drive; in contrast, DSKCOM is a general disk drive test that is not specific to a certain controller.

* You cannot use DSKCOM with a write-protected disk.

* All of the disk systems that DSKCOM can test have the last two (innermost) cylinders on the disk designated as diagnostic cylinders, which are accessible only to diagnostic tests. These cylinders are not included by the CYLINDERS/DRIVE value returned by the Store Registers command. Diskettes do not have designated diagnostic cylinders, but the two innermost cylinders are used as the diagnostic cylinders. If you execute DSKCOM on a diskette drive, you must use a known good scratch diskette for testing, since you cannot save disk data on these drives. If you execute DSKCOM on a fixed-disk drive, the disk diagnostic cylinders allow testing without destroying data on the disk. When possible, all writes to the disk are made to the diagnostic cylinders.

* The DS80, DS300, WD800A, and WD900 systems also have spare cylinders that are used for bad track relocation. These cylinders, like the diagnostic cylinders, are not included in the CYLINDERS/DRIVE value returned by the Store Registers command. See the DSKSA diagnostic (included in this volume) if you need further explanation of bad track relocation.

* DSKCOM uses the second diagnostic cylinder, head 0, to record the bad track maps on the disk. The bad track map is a list of all the known bad tracks on the disk. DSKCOM avoids these bad tracks by checking the bad track map before issuing any test command to the drive. Only the DSKSA Format Diagnostic Tracks (FC) or Surface Analysis (SA) verbs can modify the bad track map. See DSKSA for further details. The size of the bad track map varies, depending on the disk size and its ability to relocate bad tracks. The bad track maps are sized according to the type of disk system. They are as follows:

  - CD1400, WD800, WD500, and WD500A: 64 entries

  - DS80: 128 entries

- DS300: 256 entries

- WD900: 192 entries -- 138 megabyte
  384 entries -- 425 megabyte

- WD800A: 128 entries -- 38 megabyte
  192 entries -- 69 megabyte
  256 entries -- 114 megabyte

- WD500-DSDD, WD500A-DSDD: 0 entries (a pseudonull map is used)

* It is very important that the integrity of the bad track map be maintained. Therefore, before attempting to read the bad track map, DSKCOM performs a quick read-write-read test to ensure the drive does not destroy the bad track map while attempting to read it into memory. Since the diagnostic tracks are not guaranteed to be error free, nine identical copies of the bad track map are recorded on the disk (three groups of three maps each). Refer to Table 1 for the sector addresses that the three groups use. DSKCOM uses the following procedure for reading the bad track map:

  - DSKCOM performs the quick read-write-read test. If the test fails, it writes a message that indicates the problem. You are then allowed to attempt to read the first group of maps. If the first attempt to read the maps fails, do not attempt another. Instead, use the utility verbs to investigate the drive problem.

  - If the quick read-write-read test passes, the diagnostic tries to find two copies of the map in the first group that match completely. If DSKCOM finds a match, the task is complete. If it does not find a match, it writes a message that indicates the problem. You are then allowed to attempt to read the second group of maps. If the attempt to read the maps fails, do not attempt another. Instead, use the utility verbs to investigate the drive problem.

* It is possible (but highly improbable) that the quick read-write-read test sectors or the bad track map sectors are bad enough to cause attempts to read the maps to fail. Before attempting to read the third group of maps (or the second group, if you are testing the WD800A), make sure the disk drive does not have any hardware problems. Do not use the bad track map track while investigating the problem. Use any of the other diagnostic tracks.

Table 1 Bad Sector Addresses

Disk System	Group 1	Group 2	Group 3
CD1400	A, B, C	D, E, F	10, 11, 12
5 1/4-inch Winchester	A, B, C	D, E, F	10, 11, 12
8-inch Winchester	A, B, C	D, E, F	10, 11, 12
DS80	21, 19, 05	31, 10, 09	35, 21, 0D
DS300	21, 19, 05	31, 10, 09	35, 21, 0D
WD900 138 megabyte	8, 12, 16	28, 32, 36	48, 52, 56
WD900 425 megabyte	10, 17, 24	40, 47, 54	70, 77, 84
WD800A	4, 8, C	10, 18, 1C	Not Applicable

* In all the tests and verbs that are part of DSKCOM, major differences occur in the way a disk drive performs its testing. The CD1400, DS80, DS300, and WD900 use the Extended Unformatted Read (>8400) command (with a byte count of >106) when performing a read. This command allows header data verification along with the data field verification. The WD800, WD500, WD500A, WD800A, WD500-DSDD, and WD500A-DSDD use the ordinary Read (>0200) command (with a byte count of >100) when performing a read. The command performs no header verification. Instead, DSKCOM uses the status returned by the controller to verify the data field for these disk types. These different read types and verification schemes are necessary because of the hardware differences in the disk drives. Since this paragraph explains the differences, the test descriptions do not repeat the explanation. Read commands are referred to simply as Read commands, and different verification schemes are referred to as data verification.

NOTE

A value preceded by a right angle bracket (>) indicates a hexadecimal value.

* DSKCOM includes six parts. You can execute the entire diagnostic or any of its parts. Each part is divided into tests that you can execute separately. The following is a list of the six parts and the tests included in each:

Part	Title	Tests
1	Disk Interface	11
2	Disk Addressing	21-24
3	Cross Boundary	31-33
4	Controller Status	41-43
5	Memory Addressing	51-52
6	Drive	61-62

* Some of the longer tests display front panel activity.

* DSKCOM displays a test execution time. However, errors during test execution can cause a test to run longer than expected. If any test executes longer than the time displayed without reporting errors or showing front panel activity, the test has most likely hung up on an error.

* DSKCOM supplies verbs in addition to those that come with DOCS. Most DSKCOM test verbs are divided into two categories: test execution verbs and utility verbs. Test execution verbs execute one or more of the DSKCOM parts or tests.

Test Execution

Verb	Function
CA	Loop on All Parts Not Requiring User Interaction
CT	Loop on an Individual Test on All Available Units
EA	Execute All Test Parts One Time on Primary Unit
ET	Execute an Individual Test or Part One Time on Primary Unit
LA	Loop on All Parts Not Requiring User Interaction on Primary Unit
LT	Loop on an Individual Test on Primary Unit

Utility verbs help you isolate errors that are detected during the execution of test parts:

Utility Verb	Function
AL	Head Alignment
BC	Build Command Status Block
CD	Compare Data
CR	Seek Exerciser
DB	Display Bad Track Map
DC	Display Controller Status
DS	Display Drive Status (CD1400, DS80, and DS300 only)
DT	Display Trace Table
EN	Enable Options
EX	Exerciser
FD	Format Disk
IC	Issue Command
IM	Issue Multiple Commands
IN	Interchange Test
IT	Initialize Test
LO	Loop on Commands
PE	Print Error Counts
PS	Unit Switch
PV	Print Verb Descriptions
RD	Read Disk
RS	Reset Hardware
SR	Store Registers

2.1 TEST INITIALIZATION

DOCS must load and initialize DSKCOM before execution can begin. Volume 1 of the Unit Diagnostics Handbook explains the DOCS loading procedure. When DOCS loads DSKCOM, it writes the name and version of the test, as follows:

```
DSKCOM - COMMON CONTROLLER / DISK DIAGNOSTIC.
  VERSION # = JJJ/YY XX

FOR USE WITH THE FOLLOWING DISKS:
CD1400, DS80, DS300, WD800, WD500, WD500A,
DSDD-WD500/WD500A, WD900, WD800A, OTHER
```

where:

JJJ = Julian date
YY = Year
XX = Revision level

During initialization, DOCS issues a series of prompts. For each prompt, if the default value shown is correct, press the RETURN key. Otherwise, enter the correct value and then press RETURN. Enter all initialization values in hexadecimal unless noted otherwise.

2.1.1 Special Initialization Using Passed Parameters

If you execute a low-level disk test before DSKCOM, DSKCOM lists any parameters passed to it. It then displays those values and the following prompt:

```
DO YOU WANT TO RE-INITIALIZE THE TEST? DEF=0
```

Verify that the passed parameters are correct. If they are correct and as desired, respond to the prompt by accepting the default 0 (no). DSKCOM then uses the low-level test parameters and initialization is complete. The normal initialization prompts would not appear.

If you wish to modify the parameters, enter 1 (yes). In this case, you enter the normal initialization procedure. You will use one of two types of procedures; normal initialization on all computers except S200, or normal initialization on an S200 computer.

2.1.2 Normal Initialization on All Computers Except S200

If the computer you are initializing is other than an S200 the following prompts appear:

ENTER TILINE ADDRESS: DEF= F800 -
The switches on the disk controller board indicate the TILINE address of the disk.

ENTER INTERRUPT LEVEL: DEF= D -
The interrupt plug wiring on the computer chassis determines the disk interrupt level.

RUN TEST WITH INTERRUPTS ENABLED? (0=NO, 1=YES) DEF=1 -
If you accept the default (1), the diagnostic takes over the hardware interrupt vector and verifies that command completion generated the correct interrupts. If you enter 0, DSKCOM does not use interrupts. Instead, it uses polling to verify command completion.

ENTER LINE FREQUENCY: (0=50, 1=60HZ) DEF=1 -
Select the line frequency used by the central processing unit (CPU) instead of that of the disk drive if they differ.

ENTER PRIMARY UNIT TO TEST: (0, 1, 2, 3) DEF=0 -
The drive (unit) that you select becomes the primary target of the test. The wording of the prompt changes if you choose to test additional units in response to the ENTER OTHER UNITS prompt. The wording of this prompt changes to ENTER OTHER UNIT TO TEST.

ENTER DISK TYPE:
FOR CD1400 (REMOVABLE: 0=16MB, FIXED: 1=16MB, 2=48MB, 3=80MB)
FOR TRIDENT (4=DS80, 5=DS300)
FOR WINCHESTERS (WD800 6=43MB, 7=18MB, 8=WD500, A=WD500A)
FOR FLOPPIES (9=DSDD-WD500, WD500A)
FOR WD900 (C=138MB, D=425MB)
FOR WD800A (E=38MB, F=69MB, 10=114MB)
FOR OTHER USE (B) DEF=0
The primary type is tested by the single-unit test verbs (EA, ET, LA, LT). Select one of the following disks:

* CD1400 removable 16 megabyte disk (0)
* CD1400 16 megabyte fixed disk (1)
* CD1400 48 megabyte fixed disk (2)
* CD1400 80 megabyte fixed disk (3)

* Trident DS80 (4)
* Trident DS300 (5)
* WD800 43 megabyte (6)
* WD800 18 megabyte (7)
* WD500 (8)
* WD500A (A)
* WD900 138 megabyte (B)
* WD900 425 megabyte (C)
* WD800A 38 megabyte (E)
* WD800A 69 megabyte (F)
* WD800A 114 megabyte (10)
* DSDD in a 5 1/4-inch Winchester environment (9)
* Other (B) -- This option causes DSKCOM to skip the store registers verification and to consider the disk to be a flexible diskette. The lockout bit is only treated as valid by controllers that use it.

(*) SAVE DISK DATA ? **ANSWER THIS CAREFULLY** DEF= 0
Your response to this prompt determines whether the program saves or destroys data on the disk. If you accept the default (1), you inhibit writing over data for that unit. All testing is then performed on the diagnostic cylinders. If you enter 0, you destroy the disk data.

If you entered 9 or B (flexible diskettes or other) in response to the ENTER DISK TYPE prompt, you cannot enter 1 (yes) in response to this prompt. The following message appears to tell you to install a scratch disk:

SAVE DATA NOT ALLOWED - USE FORMATTED SCRATCH DISK

ENTER OTHER TEST UNITS: (0-3 TERMINATE WITH F), DEF=F -
You can test up to three other disk drives (units) in addition to the primary drive under test. Execution of the CA, CT, or EX verb initiates testing of the primary and secondary disk drives.

For each additional unit that you specify, the prompts with an asterisk (*) appear, beginning with ENTER OTHER UNIT TO TEST.

After you have answered the appropriate prompts for the units you specified, the diagnostic displays a summary of the save data parameters. You can receive one of two messages for each unit:

UNIT #X - ***DISK DATA WILL BE DESTROYED***

or

UNIT #X - DISK DATA WILL BE SAVED

Verify that the summary is correct before answering the next prompt:

ARE YOU SURE YOU WANT TO RUN THE TEST WITH THESE DISK SAVE DATA PARAMETERS?
ANSWER THIS CAREFULLY (0=NO, 1=YES) DEF=0

This prompt serves as a double check to make certain you want to proceed. If you later want to change any of the initialization parameters, reexecute the IT verb. After you respond to this prompt, the following message appears:

WRITE PROTECT ALL DRIVES NOT TESTED

EXECUTE EA VERB? DEF= X

Accept the default or enter the appropriate response.

Initialization is now complete. If you do not execute the EA verb, control returns to DOCS and the VERB? prompt appears. You may execute any DOCS or DSKCOM verb.

2.1.3 Normal Initialization on an S200 Computer

If the computer you are initializing is an S200, the following prompts appear:

ENTER GROUP OF UNITS TO TEST? (0=4-7, 1=0-3) DEF=1 -

Accept the default if you want to test a unit (drive) in the range 0 through 3. Enter 0 if you want to test a unit in the range 4 through 7.

If you accept the default in response to the previous prompt, the following prompt appears:

ENTER UNIT TO TEST: (0,1,2,3) DEF=0 -

The drive (unit) that you select becomes the primary target of the test.

If you enter 0 in response to the ENTER GROUP OF UNITS TO TEST? prompt, the following prompt appears:

ENTER 0 TO TEST UNIT 4, 1 TO TEST UNIT 5, 2 TO TEST UNIT 6, OR 3 TO TEST UNIT 7 -

Enter the appropriate number for the unit you want to select.

The following prompts marked with an asterisk (*) appear each time you want to select a unit. If you do not accept the default (terminate) in response to the ENTER OTHER UNITS TO TEST prompt, DSKCOM tells you to enter the value of the unit you want to select. The prompts marked with an asterisk will then appear again.

(*) ENTER DISK TYPE:
FOR CD1400 (REMOVABLE: 0=16MB, FIXED: 1=16MB, 2=48MB, 3=80MB)
FOR TRIDENT (4=DS80, 5=DS300) DEF=0
FOR WINCHESTERS (6=8"(43MB), 7=8"(18MB), 8=WD500, A=WD500A)
FOR WD900 (C=138 MB, D=425 MB)
FOR WD800A (E=38 MB, F=69 MB, 10=114 MB)
FOR FLOPPIES (9=DSDD - WD500/WD500A)
FOR OTHER USE (B) DEF=8

The primary type is tested by the single-unit test verbs (EA, ET, LA, LT). If you are performing normal initialization on an S200 computer, you can only select one of the following disk types:

* WD500 (8)
* WD500A (A)
* DSDD in a 5 1/4-inch Winchester environment (9)
* Other (B) -- This option causes DSKCOM to skip the store registers verification and to consider the disk to be a flexible diskette. The lockout bit is treated as valid by controllers that use it.

(*) SAVE DISK DATA? **CAREFULLY ANSWER THIS** (0=NO, 1=YES) DEF=1

Your response determines whether the program saves or destroys data on the disk. If you accept the default (1), you inhibit writing over data except for the diagnostic cylinders. If you enter 0, you destroy the disk data.

If you entered 9 or B (flexible diskettes or other) in response to the ENTER DISK TYPE prompt, you cannot enter 1 (yes) in response to this prompt. The following message appears to tell you to install a scratch disk:

SAVE DATA NOT ALLOWED - USE FORMATTED SCRATCH DISK

(*) ENTER OTHER UNITS TO TEST: (0-3 TERMINATE WITH F) DEF=F -
You can test up to three other units (drives) in addition to the primary drive under test. Execution of the CA, CT, or EX verbs initiates testing of the primary and secondary disk drives.

After you have answered the appropriate prompts for the units you specified, the diagnostic displays a summary of the save data parameters. You can receive one of two messages for each unit:

UNIT #X - ***DISK DATA WILL BE DESTROYED***

or

UNIT #X - DISK DATA WILL BE SAVED

Verify that the summary is correct before answering the next prompt:

ARE YOU SURE YOU WANT TO RUN THE TEST WITH THESE DISK SAVE DATA PARAMETERS?
ANSWER THIS CAREFULLY (0=NO, 1=YES) DEF=0
This prompt serves as a double check to make certain you want to proceed. If you later want to change any of the initialization parameters, reexecute the IT verb. After you respond to this prompt, the following message appears:

WRITE PROTECT ALL DRIVES NOT TESTED

EXECUTE EA VERB? DEF= X
Accept the default or enter the appropriate response.

Initialization is now complete. If you do not execute the EA verb, control returns to DOCS and the VERB? prompt appears. You may execute any DOCS or DSKCOM verb.

2.2 PROCEDURE FOR INCOMING QUALITY CONTROL (IQC)

Use the following procedure when executing DSKCOM to evaluate new disks or disk drives for IQC. The procedure assumes that you have executed DSKSA on the disk packs.

1. Execute the EA verb to completely test the disk drive capabilities.

2. Repeat step 1 for each remaining available unit.

3. Execute the PS verb (on CD1400 units only) to test the head alignment.

4. Execute the EX verb, using its full capabilities. Use the options to write on the disk and to exercise all available units.

2.2.1 Procedure for Unit Test and Field Test

When testing a disk unit that contains a formatted disk pack, you need not execute the FC or SA verb in DSKSA. Determine whether the disks contain data that should be saved. If so, specify the save data option at test initialization. DSKCOM then skips those tests that write to the data area of the disk. It writes to only the diagnostic cylinder(s). Remember to check that the hardware write-protect status is correct.

The following verbs perform the most comprehensive testing: EA, CA, and EX. First, execute the EA verb on each available unit. Then, use the CA and EX verbs to exercise the equipment until you halt the test.

2.3 TEST VERBS

Most DSKCOM test verbs are divided into two categories: test execution verbs and utility verbs. Test execution verbs execute one or more of the DSKCOM parts or tests.

Test Execution Verb	Function
CA	Loop on All Parts Not Requiring User Interaction
CT	Loop on an Individual Test on All Available Units
EA	Execute All Test Parts One Time on Primary Unit
ET	Execute an Individual Test or Part One Time on Primary Unit
LA	Loop on All Parts Not Requiring User Interaction on Primary Unit
LT	Loop on an Individual Test on Primary Unit

Utility verbs help you isolate errors that are detected during the execution of test parts:

Utility Verb	Function
AL	Head Alignment
BC	Build Command Status Block
CD	Compare Data
CR	Seek Exerciser
DB	Display Bad Track Map
DC	Display Controller Status
DS	Display Drive Status (CD1400, DS80, and DS300 only)
DT	Display Trace Table
EN	Enable Options
EX	Exerciser
FD	Format Disk
IC	Issue Command
IM	Issue Multiple Commands
IN	Interchange Test
IT	Initialize Test
LO	Loop on Commands
PE	Print Error Counts
PS	Unit Switch
PV	Print Verb Descriptions
RD	Read Disk
RS	Reset Hardware
SR	Store Registers

In addition, you can use the IT (Initialize Test) verb to reinitialize the DSKCOM parameters. The test execution verbs are discussed in paragraphs 2.3.1. through 2.3.6. The utility verbs are discussed in paragraphs 2.3.7 through 2.3.27. The IT verb is discussed in paragraph 2.3.28.

Verb messages covered in this documentation include header messages and prompts that you must respond to before a specified verb or test will execute. However, supplemental messages can also appear during the execution of a verb or test. All verb messages appear in TTY mode.

2.3.1 Loop on All Parts Not Requiring User Interaction (CA) Verb

The CA verb loops on all parts not requiring user interaction on all available units. It begins execution on the first drive specified during test initialization. When testing on that drive is complete, it tests the second drive specified, the third specified, and so forth.

The CA verb prompts appear as follows:

```
 CA-LOOP ALL PARTS - ALL UNITS
THIS VERB WILL SWITCH TEST UNITS
```

```
UNIT #X - ***DISK DATA WILL BE DESTROYED***
```
This message appears for each unit that you specified in the ENTER UNIT TO TEST prompt during initialization.

```
ARE YOU SURE YOU WANT TO RUN THE TEST WITH THESE DISK SAVE DATA
PARAMETERS? **ANSWER THIS CAREFULLY** (0=NO, 1=YES) DEF=0
```
Verify that the disk data parameters are correct for each unit before continuing. If you are unsure of proceeding with these parameters, accept the default (0). The VERB? prompt then appears. Reexecute the IT verb to change the parameters.

```
ENTER LOOP COUNT (DEF=0002) -
```
Enter the number of loops you want the verb to execute.

To halt the execution of this verb, press the CMD key.

2.3.2 Loop on an Individual Test on All Available Units (CT) Verb

The CT verb executes on the following:

* An individual test on each available drive
* A part on each available drive

When you enter this verb, it prompts you to indicate the number of the test or part. As the test completes on the first drive, the verb writes the loop count, switches to the next available drive, and writes a message stating which drive is under test. To halt the CT verb, press the CMD key.

The CT verb prompts appear as follows:

```
 CT-LOOP ONE TEST - ALL UNITS
THIS VERB WILL SWITCH TEST UNITS
```

```
UNIT #X - ***DISK DATA WILL BE DESTROYED***
```
This message appears for each unit that you specified in the ENTER UNIT TO TEST prompt during initialization.

```
ARE YOU SURE YOU WANT TO RUN THE TEST WITH THESE DISK SAVE DATA
PARAMETERS?  **ANSWER THIS CAREFULLY** (0=NO; 1=YES) DEF=0)
```
If you are unsure of proceeding, accept the default (0). Reexecute the IT verb to change the parameters.

```
EXECUTE TEST # (EX. 1X,2X,ETC.) OR PART # (EX. 10,20,60, ETC.) -
```
Refer to paragraph 2.3.4, the ET verb description, for an explanation of this prompt.

```
ENTER LOOP COUNT (DEF=0002)
```
Enter the number of loops you want the verb to execute.

2.3.3 Execute All Test Parts One Time on Primary Unit (EA) Verb

The EA verb executes all tests one time on the primary unit. The EA verb prompt appears as follows:

```
EA-EXECUTE ALL PARTS - ONE UNIT
```

2.3.4 Execute an Individual Test or Part One Time on Primary Unit (ET) Verb
The ET verb executes an individual test or a part one time on the primary unit. The ET verb prompt appears as follows:

```
ET-EXECUTE ONE TEST - ONE UNIT

EXECUTE TEST # (EX. 1X,2X,ETC.) OR PART # (EX. 10,20,60, ETC.)
     Enter the number of the test or part you want to execute.
```

In DSKCOM, a part is a collection of individual tests. Test verbs can execute a part as well as individual tests, as shown by the following sample responses to the ET verb:

Response	Meaning
11	Execute Test 1 of Part 1
23	Execute Test 3 of Part 2
10	Execute all tests in Part 1
40	Execute all tests in Part 4

2.3.5 Loop on All Parts Not Requiring User Interaction on Primary Unit (LA) Verb
The LA verb continually executes all of the parts not requiring user interaction on the primary unit. This verb does not execute any test that requires user interaction. To halt this verb, press the CMD key. The prompt for the verb appears as follows:

```
LA-LOOP ALL PARTS - ONE UNIT

ENTER LOOP COUNT (DEF=0002)
     Enter the number of loops you want the verb to execute.
```

2.3.6 Loop on an Individual Test on Primary Unit (LT) Verb
The LT verb continuously executes an individual test on the primary unit. To halt this verb, press the CMD key.

The LT verb prompts appear as follows:

LT-LOOP ONE TEST - ONE UNIT

EXECUTE TEST # (EX. 1X,2X,ETC.) OR PART # (EX. 10,20,60, ETC.)
Refer to the ET verb description for an explanation of this prompt.

ENTER LOOP COUNT (DEF=0002)
Enter the number of loops you want the verb to execute.

2.3.7 Head Alignment (AL) Verb
The AL verb uses a Read command to seek the selected cylinder address. If the seek completes successfully, you may assume that head alignment is correct.

The AL verb prompt appears as follows:

AL-HEAD ALIGNMENT

CYL ADDR (DEC)? DEF=0000 - COMPLETE
Enter (in decimal) the address of the cylinder to be read.

2.3.8 Build Command Status Block (BC) Verb

By executing the BC verb, you can build an eight-word command in main memory. You can then issue this command to a controller or drive by executing any one of the IC, IM, or LO verbs.

The BC verb prompts appear as follows:

```
BC-BUILD COMMAND STATUS BLOCK

STARTING ADDRESS OF BLOCK? (DEF=XXXX) -
     Enter the address in main memory where you want the eight-
     word block to begin.

HOW MANY COMMANDS DO YOU WANT? (DEF=0001) -
     Enter the number of commands that you want. For each
     command that you desire, the verb will prompt you to provide
     input for eight words (0 through 7).

INPUT WORD #0 (DEF=XXXX) -
     Accept the default or enter the desired hexadecimal value.

INPUT WORD #1 (DEF=XXXX) -
     Accept the default or enter the desired hexadecimal value.

INPUT WORD #2 (DEF=XXXX) -
     Accept the default or enter the desired hexadecimal value.

INPUT WORD #3 (DEF=XXXX) -
     Accept the default or enter the desired hexadecimal value.

INPUT WORD #4 (DEF=XXXX) -
     Accept the default or enter the desired hexadecimal value.

INPUT WORD #5 (DEF=XXXX) -
     Accept the default or enter the desired hexadecimal value.

INPUT WORD #6 (DEF=XXXX) -
     Accept the default or enter the desired hexadecimal value.

INPUT WORD #7 (DEF=XXXX) -
     Accept the default or enter the desired hexadecimal value.
```

2.3.9 Compare Data (CD) Verb

Starting at the two addresses you enter, the CD verb compares two blocks of data word by word until it reaches the number of words that you designate.

The CD verb prompts appear as follows:

```
CD - COMPARE DATA

START ADDR - 1ST BLOCK DATA?  DEF = XXXX
     Specify the starting address of the first block of data.

START ADDR - 2ND BLOCK DATA?  DEF = YYYY
     Specify the starting address of the second block of data.

HOW MANY WORDS TO COMPARE?  DEF = ZZZZ
     Specify the number of words that you want to compare.
```

Enter all values in hexadecimal.

For each two words of data in the blocks that do not compare, the verb issues an error message. The error message indicates the addresses of the two words and the data found in each. Then, the verb continues with the next set of words until it compares all of the words in the two blocks.

Upon completion, the following message appears:

```
     COMPARE COMPLETE WITH XXXX ERRORS FOUND
```

2.3.10 Seek Exerciser (CR) Verb

The CR verb continually exercises the seek servo of the disk drive according to the patterns that you establish. You can execute this verb to provide multiple access modes for use in scoping test points used for troubleshooting.

The verb avoids bad tracks, as indicated by the disk bad track map, in the following way. Prior to issuing each Unformatted Read command, the verb determines if the address is in the bad track map. If it is, the next available good track is used instead. With this technique, the desired servo exercise can be performed in spite of bad tracks on the disk.

The following command block shows the four methods of exercising the servo: continuous seek, sequential forward, sequential forward/reverse, or walking X-N seek.

```
VERB ? -CR

 CR-SEEK EXERCISER
ENTER:
1-CONT SEEK
2-SEQ FWD
3-SEQ FWD/REV
4-WALKING X-N
DEF=1 -
```

Accept the default or enter the correct value (2, 3, or 4) of the method you want to select.

```
ENTER LOOP COUNT (DEF=0000)-
```

If you accept the default, the verb executes continuously until you halt the option by pressing the CMD key. If you select a nonzero value, the verb terminates after the specified number of loops.

2.3.10.1 Option 1 -- Continuous Seek. This option alternates the head position of the disk drive between two decimal cylinder addresses.

When you select this option, the following prompts appear:

```
CYL ADDR (DEC)?  DEF=0000 -
```

Accept the default or specify the first cylinder address (in decimal). Make sure you do not enter the address of a bad track.

```
CYL ADDR (DEC)?  DEF=XXXX -
```

Accept the default or specify the second cylinder address (in decimal). Make sure you do not enter the address of a bad track.

When the option is finished executing, the following message appears:

***ERROR COUNTS: DATA=XXXX TIMING=XXXX, STATUS=XXXX, RETRYS=XXXX

2.3.10.2 Option 2 -- Sequential Forward. This option places the head at cylinder address 0 and seeks forward to other cylinder addresses, according to the interval you specify (0, interval, interval, ..., N). It seeks forward until it reaches the maximum cylinder address. Then, the option returns the head to cylinder 0 and repeats the procedure.

When you select the sequential forward option, the following prompt appears:

CYL INTERVAL (DEC)? DEF=010
Accept the default or enter the value of the interval (in decimal) you want to use.

2.3.10.3 Option 3 -- Sequential Forward/Reverse. This option places the head at cylinder address 0 and seeks forward to other cylinder addresses, according to the interval you specify (0, interval, interval ... N). It seeks forward until it reaches the maximum cylinder address. Then, it moves the head in the reverse direction at the specified address interval (N, negative interval, negative interval, ... 0) until it reaches cylinder 0. In this manner, the head is moved back and forth at specified intervals between cylinder 0 and the maximum cylinder address.

When you select this option, the following prompt appears:

CYL INTERVAL (DEC)? DEF=010
Accept the default or enter the value of the interval (in decimal) that you want to use.

2.3.10.4 Option 4 -- Walking X-N. X is the beginning cylinder address (0); N is a cylinder address that you specify. This option moves the disk head back and forth between cylinder address X and cylinder address N. The value of X increases by 1 for each walk until it reaches N.

When you select this option, the following prompt appears:

CYL ADDR (DEC)? DEF=0410 -
Accept the default or specify a cylinder address (in decimal). This cylinder address is referred to as N. Make sure you do not enter the address of a bad track. Also, if you enter an address greater than the maximum cylinder address, the prompt appears again. Enter an address that is less than the maximum address.

2.3.11 Display Bad Track Map (DB) Verb

The DB verb reads the bad track map from the disk and displays it on the DOCS interactive and error message device. The DB verb prompt appears as follows:

```
DB - DISPLAY BAD TRACK MAP
```

The output appears in the following format:

```
                    BAD TRACK MAP

MAPPED    CYL ADR    CYL ADR    HEAD ADR    DEFECT
FLAG=*    (DEC)      (HEX)      (DEC)       LENGTH
-------------------------------------------------
          XXXX       XXXX       XX          XXX
          XXXX       XXXX       XX          XXX
          XXXX       XXXX       XX          XXX
```

An asterisk (*) under the MAPPED FLAG column indicates that the head address at the specified cylinder address is mapped. An asterisk entry can appear only when you are using a DS80, DS300, or WD900 disk type. The DEFECT LENGTH column lists entries according to the number of bits.

Refer to paragraph 1.3 for a description of what disk systems support the bad track map and for an explanation of how to obtain bad track maps.

If you attempt to execute the DB verb on a system that does not support bad track maps, the following message appears:

```
VERB NOT APPLICABLE FOR DRIVE SELECTED
```

2.3.12 Display Controller Status (DC) Verb

The DC verb writes the status of the disk controller to the terminal. It reads the controller slave registers, formats them, and then writes them to the terminal in the following manner:

```
DC - DISPLAY CONTROLLER REGISTERS
CONTROLLER STATUS
DISK STATUS  CMD  HEAD  S/R  SECT  CYL   BYTE CNT
    XXXX     XXXX  XX    XX   XX    XXXX    XXXX
MEM ADR  UNIT  CONT STAT
XXXXXX    XX      XXXX
```

If the EN verb set ALT not equal to PRIMARY, a second line is displayed for the alternate TPCS.

The abbreviations in the DC verb output are as follows:

* DISK STATUS -- The status of the selected drive is obtained from controller register 0. The status value is composed of the sum of the values that indicate the current condition of the drive (X = irrelevant). For example, the status value AXXX indicates the offline (8XXX) and write-protected (2XXX) conditions.

Value	Meaning
8XXX	Offline
4XXX	Not Ready
2XXX	Write Protect
1XXX	Unsafe
X8XX	End-of-Cylinder
X4XX	Seek Incomplete
X2XX	Offset Active
XYXX	Pack Change

NOTE

If you receive a 1 for the Y in drive status for disk, the 1 designates a pack change. On the other hand, if you execute one of the command verbs (IC, IM, or LO), the drive status is read from word 0 of your command stream, with bit 7 designating the use of either slave A or slave B. If you enter 0 for bit 7 (word 0 = 000), slave A is referenced. If you enter 1 (word 0 = 100), slave B is referenced. After a command is issued, the drive itself determines the value of the drive status; then, the particular drive resets this bit to a predetermined setting. Refer to the EN verb to determine how to set up a slave B.

This feature is not available on an S200 computer.

* CMD -- Command number (Register 1, with the head address masked off)

Value	Command
0000	Store registers
0100	Write format
0200	Read data (see proper installation and operation manual for meaning of various read types)
0300	Write data
0400	Read unformatted (Trident headers only)
0500	Write unformatted
0600	Seek
0700	Restore
4100	Relocate (DS80, DS300, WD800A, and WD900 only)
8400	Read unformatted
C100	Absolute write (DS80, DS300, WD800A, and WD900 only)

* HEAD -- Surface address: >0 through >MAXHEAD.

* S/R -- Sectors per record; the effective value of S/R is always 01.

* SECT -- Sector address and sector number: >0 through >MAXSECTOR.

* BYTE CNT -- Byte count for the data transfers remaining.

* CYL A -- Cylinder address: >0 through >MAXCYLINDER.

* MEM ADR -- TILINE memory address for data transfers.

* UNIT -- Number of the unit, as follows:

Number	Unit
08	0
04	1
02	2
01	3

* CONT STAT -- The controller status is taken from register 7 of the CSB and indicates the status of the controller.

Value	Meaning
8XXX	Idle
4XXX	Complete
2XXX	Error
1XXX	Interrupt enable
X8XX	Lockout
X4XX	Retry
X2XX	Error correction code (ECC) used
X1XX	Abnormal completion
XX8X	Memory error
XX4X	Data error
XX2X	TILINE time-out
XX1X	ID error
XXX8	Rate error
XXX4	Command timer delay
XXX2	Search error
XXX1	Unit error

NOTE

The retry status (X4XX) appears when any command requires one or more retries to execute. You can establish thresholds for the maximum occurrences of RETRY or SEEK INC status. You can suppress error messages so they are not printed until after the threshold has been reached. Refer to the EN verb for more information.

2.3.13 Display Drive Status (DS) Verb

The DS verb checks for drive status errors.

NOTE

You must execute the Store Registers (SR) verb before the DS verb will execute correctly.

If no errors exist in the CD1400 controller, the DS verb displays the following message:

```
** CD1400 DRIVE STATUS:
NO DRIVE STATUS ERRORS EXIST:
** CD1400 DRIVE MICROPROCESSOR FAULT STATUS:
NO DRIVE MICROPROCESSOR FAULTS EXIST
```

If the DS verb detects an error on the CD1400, the following message appears:

```
THE FOLLOWING DRIVE STATUS ERR EXIST: secondary message
```

One or more of the following secondary messages accompanies the preceding message:

```
INTERNAL WRITE PROTECT
SEEK ERROR
HEAD SELECT FAULT
VOLTAGE FAULT
WRITE OR READ FAULT
WRITE OR READ OFF CYLINDER
WRITE FAULT
NO HEAD SELECT FAULT
```

In addition, the DS verb determines the specific fault status of the CD1400 and writes one or more of the following messages:

```
**CD1400 DRIVE MICROPROCESSOR FAULT STATUS

OPERATION PHASE: (secondary message from the following list)

LAST VALID CYL = XXX
```

The list of secondary messages is as follows:

```
NO DRIVE MICROPORCESSOR FAULTS EXIST
RETURN TO TRACK CENTER
WAIT FOR COARSE SEEK COMPLETION
AFTER SEEK SETTLING
IDLE LOOP
RETURN TO ZERO MOTION
END OF VELOCITY TABLE
HEAD LOAD
AWAIT AGC DURING HEAD LOAD
AWAIT TRACK CENTER-LOAD OR RTZ
SETTLING-LOAD OR RTZ
OFFSET ACTIVE
CLEAR OFFSET SETTLING
***DRIVE ERR: INVALID PHASE***
SPINDLE DIDN'T START/STOP 2 MIN AFTER
  ERSOL/ERSTP WAS NOTED
SPINDLE START > 70 SEC
NO SPINDLE MOVEMENT
NO DRIVE TO SOLID STATE RELAY
SOLID STATE RELAY FAILURE
STOP TIMEOUT
EMERGENCY RETRACT FAILURE
NORMAL RETRACT FAILURE
CYL ADR >822
OFF TRACK >1200 USEC
UNEXP AGC IN HEAD LOAD
LOST AGC
RPM FAULT
LOST SPEED PULSES
ALLOWED TIME EXPIRED
NO TRACK LOCK IN SETTLING
UNABLE TO READ FAULT STATUS
**** ERROR: WRONG # OF BYTES FOR CYL ADR
```

If no errors exist in the DS80 or DS300 drives, the DS verb displays the following message:

```
** DS80/300 DRIVE FAULT STATUS:
NO DRIVE STATUS ERRORS EXIST:
```

If errors occur in the DS80 or DS300 drive, one or more of the following messages appears:

```
SKINC                          WRT*RDONLY
SETHD*RDY/                     R/W UNSAFE

RETRACT HDS                    WRT*(UTH+RD+OSA)
SETCYL*RDY/                    IDXERR
```

HDS NOT EXTENDED	HEAD FAULT
SKIDXER	NOT AT SPEED
EMERG RET	IWFAULT
WRT*NOT RDY	DC USF

If you attempt to execute the DS verb on any system other than a CD1400, DS80, or DS300, the following message appears:

VERB NOT AVAILABLE FOR THIS DISK TYPE AT THIS TIME

2.3.14 Display Trace Table (DT) Verb

The DT verb writes the returned status of the last ten commands issued. At the completion of every command, the Command Issuer subroutine stores the eight words of the TILINE peripheral control space (TPCS) in a trace table. This table contains the resulting status of each of the last ten commands issued to the controller. The format of the output is the same as that of the DC verb. The DT verb prompt appears as follows:

DT - DISPLAY TRACE TABLE

2.3.15 Enable Options (EN) Verb

The EN verb allows you to enable or disable certain execution options. The prompt for the EN verb is as follows:

EN-ENABLE OPTIONS

ENABLE CONTINUOUS TRACE? (0=NO, 1=COMMANDS, 2=STATUS, 3=BOTH) DEF=0

Enter 3 if you want a continuous trace for both the commands and their completion status. Enter 1 if you want a trace for only the commands. Enter 2 if you want a trace for only the command completion status. Enter 0 if you do not want the continuous trace at all.

ENABLE ERROR THRESHOLDS (0=NO, 1=RETRY ONLY, 2=RETRY OR SEEK INC ONLY?) DEF=1-

Accept the default if you want to allow threshold retry only. Otherwise, enter 0 for no threshold or 2 for a RETRY or SEEK INC threshold.

THRESHOLD FOR UNIT X? DEF=0003 -

Accept the default or enter another threshold for the unit under test.

ENTER ALTERNATE TPCS TILINE ADDRESS: DEF= F800 -
Accept the default if you do not want to use an alternate TPCS TILINE address (the default is the same as the address for the primary unit). Enter an alternate address if you want to issue commands to (or monitor the status of) a disk at a different TILINE address associated with the alternate TPCS.

ENTER INT LEVEL: DEF=D -
Accept the default if you do not want to specify an interrupt level for an alternate TPCS address (the default is the same as the interrupt level for the primary unit). Otherwise, enter the interrupt level associated with the alternate address. The interrupt plug wiring on the computer chassis determines the interrupt level associated with the alternate TPCS.

Use the ENTER ALTERNATE TPCS TILINE ADDRESS and ENTER INTERRUPT LEVEL options if you want to issue commands to or monitor the status of a disk at a different TILINE address.

Use the ENABLE ERROR THRESHOLDS and THRESHOLD FOR UNIT X options if you want to inhibit printing error messages for RETRY or SEEK INC, until the number of these status conditions exceeds the threshold. This disk status is always printed. When the IT or RS verb is executed, the count of RETRY or SEEK INC status occurrences is cleared.

2.3.16 Exerciser (EX) Verb

The EX verb exercises the disk capabilities just as an actual applications user does. You can exercise a single disk drive or multiple disk drives. You have the option of exercising the disk with a variety of both Read and Write commands. You can also exercise the disk only with Read commands to preserve disk data.

The EX verb chooses between the following five operations and then performs them continuously (and randomly) until either the verb completes or you halt it. Depending on the drive, it may not use all five operations. The verb maintains status and data error counts and writes them upon verb termination.

* Read with transfer inhibited -- The microprocessor on the disk controller board performs redundancy checks for data errors. The status error count increases whenever a data error occurs.

* Read -- In this case, a single sector is read and the data is verified. The read type and the data verification method depend upon the disk type. Refer to paragraph 1.3 for an explanation of read types and data verification methods.

* Read known data, checking the data -- This operation consists of reading data previously written by the exerciser. If the data read contains known data patterns, and a good status is returned, the data is compared to the data written. The address, included in the data at the time of writing, is checked for accuracy.

* Writing long records of object code, with the address in the data -- The address is included in the first four words of the data written and consists of the head, cylinder, sector, and unit. The remainder of the record consists of test program object code. The length of the written record ranges from a minimum of eight bytes to the maximum number of bytes per track. The address words are saved for comparison when a read occurs.

* Writing worst-case patterns data, beginning with the address of the write at the beginning of the data -- This operation writes >0500 words, five sectors, of data. Words 1 through 4 contain the head, cylinder, sector, and drive unit addresses. Words 5 through 500 contain one of six possible worst-case data patterns or a random pattern. The address words and the pattern are saved for comparison when a read occurs.

The number of operations the verb performs depends upon disk type:

Disk Type	Operations
DSDD	>0030
5 1/4" Winchester	>0200
All others	>1388 (if verb is performed on one unit) The number of heads multiplied by the number of cylinders, (if performed on more than one unit)

The EX verb uses a random number generator in setting up the head address, cylinder address, sector address, and byte count. The disk drives are switched randomly. The byte count is limited to the maximum number of bytes in one track.

Before executing each read or write, the EX verb determines if the track is in the bad track table. It does not attempt to read or write to any track in the bad track table.

No command is given to write to cylinder 0 or to either of the diagnostic cylinders. This is to avoid writing on bad track map data.

The status error count is increased each time an operation completes with the error flag set in the controller status register. The data error count is increased whenever a discrepancy occurs in checking data obtained by a read operation.

The prompts for the EX verb are as follows:

EX-EXERCISER

EXERCISE ALL UNITS? DEF=0 -
Enter 1 if you want to exercise all units.

UNIT #X - ***DISK DATA WILL BE DESTROYED***
This message appears for each unit that you specified in the ENTER UNIT TO TEST prompt during initialization.

ARE YOU SURE YOU WANT TO RUN THE TEST WITH THESE DISK SAVE DATA PARAMETERS? **ANSWER THIS CAREFULLY** (0=NO, 1=YES) DEF=0
Verify that the disk data parameters are correct for each unit before continuing. If you are unsure of proceeding with these parameters, accept the default (0). The VERB? prompt then appears. Reexecute the IT verb to change the parameters.

If you are sure of proceeding, enter 1 to begin execution.

RUN UNTIL INTERRUPTED? DEF=0 -
Accept the default if you want the verb to complete on its own. Enter 1 if you want the verb to execute continuously until you press the CMD key.

When the verb begins execution, the following message appears:

EXERCISER NOW BEING PERFORMED

At completion, the EX verb issues the following message:

ERROR COUNTS: DATA=XXXX STATUS=XXXX TIMING=XXXX RETRYS=XXXX

2.3.17 Format Disk (FD) Verb

The FD verb formats almost the entire disk pack. The diagnostic cylinders are not formatted and you have the option of formatting cylinder 0. The status checker monitors the status register during verb execution and reports any errors to the interactive device.

The FD verb prompts appear as follows:

```
FD-FORMAT DISK

DO YOU WISH TO FORMAT CYLINDER 0, HEAD 0
** THIS WILL DESTROY THE OS BAD TRACK MAP ** ? DEF=0 -
```

Enter 1 if you want to destroy the map; accept the default if you do not.

```
YOU WILL HAVE TO RUN "SA" VERB ON "DSKSA" TO RE-CREATE THE OS BAD
TRACK MAP.
```

This message appears if you chose to destroy the OS bad track map. If you want to recreate the map, you must use the Execute Surface Analysis (SA) verb in the DSKSA diagnostic. The DSKSA diagnostic is also included in this volume.

```
ARE YOU SURE YOU WANT TO FORMAT ALL OF UNIT # X ? DEF=0 -
```

If you enter 1, the FD verb performs the following operations on all tracks except those on the diagnostic cylinders:

* Formats the tracks with one sector per record
* Writes 0 values to the tracks

When the verb completes, the following message appears:

```
FORMAT DISK COMPLETE
```

2.3.18 Issue Command (IC) Verb

The IC verb issues a command to the controller or drive from a hexadecimal memory address that you enter. The command is eight words long. To set up the command, you can use the BC verb or the DOCS Modify Memory (.MM) verb.

The IC verb prompts appear as follows:

```
IC-ISSUE COMMAND

STARTING ADDR OF COMMAND (DEF=XXXX)
```

Accept the default or select another address. The default starting address displayed is the beginning address of a 32-word block that DSKCOM does not modify. You should build commands in this area if you want to save them. You can build any number of commands there, but only the first four are guaranteed to be protected.

```
CHECK STATUS?(0=NO, 1=YES) DEF=1
```

Accept the default if you want to check the status of the target controller or drive. Any errors found are reported. If you enter 0, no status checking is performed. However, you can still use the DC or DT verbs to display the returned status.

To select which slave the IC command addresses, reset bit 7 in register 0 to address slave A; set bit 7 to address slave B.

2.3.19 Issue Multiple Commands (IM) Verb

The IM verb issues multiple commands from memory to the controller or drive. The commands require eight words each and must be stored in consecutive memory locations.

The IM verb prompts appear as follows:

```
IM - ISSUE MULTIPLE COMMANDS

STARTING ADDR OF COMMAND (DEF=XXXX)
```

Accept the default or select another address. The default starting address displayed is the beginning address of a 32-word block that DSKCOM does not modify. You should build commands in this area if you want to save them. You can build any number of commands there, but only the first four are guaranteed to be protected.

```
HOW MANY COMMANDS?(DEF=XXXX)
```

Enter a hexadecimal number greater than zero.

CHECK STATUS?(0=NO, 1=YES)DEF=1

Accept the default if you want to check the status of the target controller or drive. Any errors found are reported. If you enter 0, no status checking is performed. However, you can still use the DC or DT verbs to display the returned status.

To select which slave the IM command addresses, reset bit 7 in register 0 to address slave A; set bit 7 to address slave B.

2.3.20 Interchange Test (IN) Verb

The IN verb verifies the interchangeability of disk media on a specific drive by reading prerecorded data from a specially formatted disk. You can build this disk by executing Test 61, the Read Channel Margin Test, which places worst-case data patterns on the disk.

The IN verb reads the data patterns and checks them, writing an error message if a discrepancy occurs. It uses the same read routine as the Read Channel Margin Test to verify that data is read correctly from the media.

If the disk has not been formatted by Test 61, you can still execute the IN verb. In this case, the verb relies only on the built-in microcoded Error Correction Code (ECC) to detect bad read operations. The IN verb prompts are as follows:

IN-INTERCHANGE TEST

ARE TEST PATTERNS ON DISK? DEF=0 -

If the disk has been formatted by the Read Channel Margin Test, enter 1; otherwise, accept the default (0).

LOOP? (DEF=0) -

Enter 1 if the test is to be looped continuously; otherwise, accept the default (0).

2.3.21 Loop on Multiple Commands (LO) Verb

The LO verb is similar to the IM verb. However, when the LO verb completes the last command, the verb returns to the first command and loops in the command list until you either press the CMD key or the loop count expires. The verb outputs the loop count (number of times it has executed) to the computer front panel. The test does not perform this operation on an S200 computer, since it has no front panel. The LO verb prompts appear as follows:

```
LO--LOOP ON COMMANDS

STARTING ADDR OF COMMAND (DEF=XXXX)
```

Accept the default or select another address. The default starting address displayed is the beginning address of a 32-word block that DSKCOM does not modify. You should build commands in this area if you want to save them. You can build any number of commands there, but only the first four are guaranteed to be protected.

```
HOW MANY COMMANDS?(DEF=XXXX)
```

Enter a hexadecimal number greater than zero.

```
CHECK STATUS?(0=NO, 1=YES) DEF=1 -
```

Accept the default if you want to check the status of the target controller or drive. Any errors found are reported. If you enter 0, no status checking is performed. However, you can still use the DC or DT verbs to display the returned status.

```
NUMBER OF LOOP COUNT? DEF=0000 -
```

If you accept the default, the LO verb loops on the command list indefinitely. You can exit out of the loop at any time by pressing the ESC key.

2.3.22 Print Error Counts (PE) Verb

The PE verb writes the current error counts in hexadecimal to the I/O device in the following format:

```
PE - PRINT ERROR COUNTS
***ERROR COUNTS: DATA = WWWW TIMING = YYYY STATUS = XXXX
RETRYS= ZZZZ
```

If the previous operation was a CA, CT, LA, or LT verb, then the following is also printed:

```
LOOP COUNT = NNNN
```

2.3.23 Unit Switch (PS) Verb

The PS verb verifies the ability of the controller to correctly address the fixed and removable drives. It also allows you to alternate the drive addresses. Before executing this verb, you must enter the IT verb to initialize the test for the two drives under test. The PS verb writes the following message when it executes:

```
LOOP? (DEF=0) -
```

Enter 1 (for yes) or accept the default of 0 (for no). If you did not specify two units at initialization, the following message appears:

```
TWO UNITS ON SAME PHYSICAL DRIVE MUST BE AVAILABLE
```

You must then execute the IT verb to initialize the second unit.

The verb writes data to the first diagnostic track on each drive, reads the data, and checks it. The verb performs this cycle 50 times for one loop. If the data does not compare, the verb writes the following message, indicating the expected and received data:

```
PACK SWITCH ERROR
EXP: XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
REC: XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
```

The verb increases the data error count every time data does not compare and writes the data that did not compare to the terminal when the verb completes execution.

Alternating between the first unit and second unit under test, the verb executes a series of reads (with data transfer inhibited on cylinder 1, head 0). The status error count increases each time the hardware microcode redundancy check detects a read error.

This verb is not operational on Winchesters. If you try to select it, the following message appears:

```
VERB NOT APPLICABLE FOR DRIVE SELECTED
```

2.3.24 Print Verbs (PV) Verb

The PV verb lists and briefly describes all available DSKCOM test verbs on the interactive device.

2.3.25 Read Disk (RD) Verb

The RD verb verifies that data after a read matches the data before the read. It also verifies that a disk is formatted correctly. It executes a Read command for every sector on the number of tracks that you specify. All outputs for the RD verb are in decimal. Enter your response to the following prompts in decimal:

RD-READ DISK

READ ENTIRE DISK? (DEF=1) -
If you accept the default, the RD verb reads the entire disk and the prompts marked with an asterisk do not appear. Instead, the verb obtains the necessary head and cylinder information from the Store Registers parameters. If you enter 0, the prompts marked with an asterisk (*) appear.

BEGIN HEAD ADR (DEC)? (DEF=00) - (*)
Accept the default or enter another head address.

END HEAD ADR (DEC)? (DEF=00) - (*)
Accept the default or enter another head address.

BEGIN CYL (DEC)? (DEF=0000) - (*)
Accept the default or enter another cylinder address.

END CYL (DEC)? (DEF=maximum cylinder address) - (*)
Accept the default or enter another cylinder address.

At completion, the RD verb issues the following message:

ERROR COUNTS: DATA = WWWW STATUS = XXXX TIMING = YYYY RETRYS = ZZZZ

If the data does not compare, the verb increases the data error count and writes the expected and received data.

If the verb detects a status error, the status error count increases and the Status Checker routine writes an error message. When the verb completes execution, it writes the error count to the terminal.

2.3.26 Reset Hardware (RS) Verb

The RS verb issues a Hardware I/O Reset and a Restore command to each drive under test. You can use it to reinitialize the hardware and disk controller whenever an UNSAFE or NOT READY condition is set. This verb also initializes the command trace table by clearing the buffer where the table is stored. You should examine the controller to ensure that the fault light did not turn on during the test. The RS verb writes the following message when it executes:

```
RS - RESET AND RESTORE DONE

  HARDWARE RESET AND RESTORE DONE
```

2.3.27 Store Registers (SR) Verb

Use the SR verb to obtain the Store Registers values of the drive under test. It performs a Store Registers command and writes the disk descriptor words in the following format:

```
SR - STORE REGISTERS
TOTAL WORD COUNT= >XXXX
SECT/TRACK = >XX      OVERHEAD/RECORD =>XX
TRACKS/CYL =>XX       CYL/DRV =>XXXX
```

NOTE

The CYLINDERS/DRIVE value does not include diagnostic cylinders or spare cylinders (if available).

2.3.28 Initialize Test (IT) Verb

After you load DSKCOM, DOCS executes the IT verb automatically to begin initialization. You may execute the IT verb afterwards to reinitialize the original parameters.

2.4 TEST DESCRIPTIONS

The following paragraphs describe the DSKCOM test parts and their tests.

2.4.1 Part 1 -- Disk Interface Test (Test 11)

Test 11 issues a Store Registers command to the controller and then checks the controller status. It compares the returned descriptor words to a table of known good values for the type of disk indicated during test initialization. All the disk drives are checked in this manner. If the descriptor words do not compare with any of the lists in the table, Test 11 writes an error message.

2.4.2 Part 2 -- Disk Addressing Tests

Part 2 consists of Tests 21 through 24. This part does not write to the disk.

2.4.2.1 Test 21 -- Sector Addressing Test. Test 21 checks the disk drives ability to address and write to every sector on a track. The test writes the sector address into every sector on diagnostic cylinder #1 in ascending order. It then reads and compares the data in descending order.

2.4.2.2 Test 22 -- Track Addressing Logic Test. Test 22 verifies the track addressing logic. It performs a read of sector 0 on all good tracks of the first two cylinders. All remaining tracks of head 0 are then read. The data returned is checked and an error is reported if a discrepancy is found.

2.4.2.3 Test 23 -- Jitter Addressing Test. Test 23 verifies the ability of the disk to perform read operations in rapid sequence. It begins reading at the center cylinder on surface 0 and alternately increases and decreases cylinder addresses until it reaches cylinder 0 or the maximum cylinder address.

Upon completion of each Read command, the test verifies the data returned. Incorrect data results in an error being reported. The test writes a count of any errors detected at test completion.

2.4.2.4 Test 24 -- Random Read Test. Test 24 verifies the ability of the disk to perform read operations in rapid sequence by issuing Read commands in random order. The type of Read command issued and the way the data is verified depends on the disk type. The number of Read commands executed during the test depends on the drive size.

The test uses a random-number generator to obtain random values for the head address, cylinder address, sector address, and byte count. These values are held within the disk parameter limits, as determined by the Store Registers command. A new random address is generated for each successive Read command. As stated previously, the bad track map is checked before any command is issued; if the command attempts to access a bad track, the verb generates a new random address for the command. If an error occurs, the test increases the proper error count and displays an error message. When the test completes, it writes a count of any errors detected.

2.4.3 Part 3 -- Cross Boundary Tests
Part 3 consists of Tests 31 through 33.

2.4.3.1 Test 31 -- Cross Sector Boundary Test. Test 31 verifies that a write continues to the next sector when the write occurs on a sector whose byte count exceeds the bytes-per-sector parameter. The test also ensures that the unused portion of the second sector is 0. The test is performed on all sectors except the last.

2.4.3.2 Test 32 -- Cross Head Boundary Test. Test 32 ensures that a write crosses to the next head when the write occurs on the last sector of a head whose byte count exceeds the bytes-per-record parameter. The test is performed on all heads except the last.

2.4.3.3 Test 33 -- Cross Cylinder Boundary Test. Test 33 ensures that a write crosses to the next cylinder when the write occurs on the last cylinder of the last head and the byte count of that head exceeds the bytes-per-record parameter.

2.4.4 Part 4 -- Controller Status Tests
Part 4 consists of Tests 41 through 43. This part checks for special conditions in the controller status and disk status registers. It issues commands that force the error bits in the status registers to set. The test then verifies that the correct bits have been set. The first diagnostic cylinder is used in all tests that write to the disk.

2.4.4.1 Test 41 -- Verify Transfer Inhibit Test. Test 41 checks the operation of the transfer inhibit bit in word 1 of the eight-word command format. The test reads sector 0 on the first diagnostic cylinder with the transfer inhibit bit set in a read buffer; then, it checks the read buffer to verify that the data has not been changed.

2.4.4.2 Test 42 -- Zero Word Count, Zero Write Test. Test 42 ensures that a sector is filled with zeros when a Write command specifying a word count of zeros is issued. The test first issues a Write Data command that sets the word count to zeros and the write buffer to >FFFF in sector 0 of the first diagnostic cylinder. It then issues a Read Data command to the sector and checks the read buffer to verify that it contains all zeros.

2.4.4.3 Test 43 -- TILINE Time-Out Test. This test is skipped when an S200 computer is the host. Test 43 checks the TILINE time-out bit in controller register 7 as follows:

1. Issues a Store Registers command to the disk, specifying a nonexistent memory location (>FBFE) as the target memory address
2. Checks for the following conditions:
   * If a controller IDLE does not occur before two real-time clock pulses, an error message appears.
   * If a controller IDLE occurs before two real-time clock pulses, the test checks the controller status (register 7) to verify that the correct status is returned.

2.4.5 Part 5 -- Memory Tests
Part 5 consists of Tests 51 and 52, which use the first diagnostic cylinder. If, in the case of either test, the test cannot find a good track, the following message is displayed and the test is skipped:

DIAGNOSTIC CYLINDER #1 IS TOO BAD - TEST SKIPPED

2.4.5.1 Test 51 -- Unmapped Memory Addressing. Test 51 tests the ability of the controller to read and write to unmapped 990 memory (that is, every memory location from the end of the DSKCOM diagnostic program to the end of usable unmapped memory). All of this memory is used as a large read and write buffer. Test 51 operates in the following manner:

1. Loads each word of the memory buffer with its own address.
2. Writes the buffer to the first diagnostic cylinder, head 0, of the disk.
3. Clears the memory buffer.
4. Reads the data written to the disk back into the memory buffer.
5. Checks each word of the buffer to verify that it contains its own address.

2.4.5.2 Test 52 -- Mapped Memory Addressing. Test 52 verifies the ability of the controller to read and write to locations in mapped memory. If the system has no mapped memory, this test is skipped.

The test determines which 8K-byte blocks of mapped memory are available and then performs the following procedure on each one:

1. Sets up a >0080-byte buffer of data at the beginning of the 8K-byte block. Each pair of words in the buffer contains the processor address and the mapped bias.
2. Writes the >0080-byte buffer from mapped memory to the disk.
3. Clears the buffer.
4. Reads the >0080 bytes of data from the disk back to the mapped memory buffer.
5. Checks each data pair to verify that it contains its correct address and bias.

The test skips any part of an 8K-byte segment that fails to initialize.

2.4.6 Part 6 -- Read Channel Margin Test and Short Exerciser Test
Part 6 consists of Tests 61 and 62.

2.4.6.1 Test 61 -- Read Channel Margin Test. Test 61 detects a read channel margin loss by reducing the normal margin. First, it formats particular cylinders and surfaces with certain data patterns. After writing the patterns, the test reads them with any of nine available Read Data commands that use strobes and offsets, (except the WD800A, which has no strobes nor offsets), so all reads are nominal. The commands test the margin in the drive's read channel by reducing the margin with strobes and offsets. This operation detects any errors due to an insufficient margin. The selected data patterns allow optimum detection; the selected disk addresses allow the greatest variation within the available time.

The following cylinders and heads are formatted and read, in the sequence listed:

Cylinders	Head
The first 6 adjacent good cylinders	0 to max.
(max./2)-3 to (max./2)+2	0 to max.
max-5 to max.	0 to max.

NOTE

This test avoids bad tracks in the above cylinder ranges. If the test discovers a bad track, it finds the first set of six adjacent good tracks on the same surface where it found the bad track.

The following worst-case patterns are used in formatting and reading the disk:

>6DB6, >DB6A, >CCCC, >DB67, >AAAA, >E32A

The following read types are used on all drives except the WD800A, which uses only the first read type:

```
READ DATA
READ DATA, STROBE EARLY
READ DATA, STROBE LATE
READ DATA, OFFSET REVERSE
READ DATA, OFFSET FORWARD
READ DATA, STROBE EARLY, OFFSET REVERSE
READ DATA, STROBE EARLY, OFFSET FORWARD
READ DATA, STROBE LATE, OFFSET REVERSE
READ DATA, STROBE LATE, OFFSET FORWARD
```

Each of the preceding types of Read commands is used as follows:

1. The entire track is read with data transfer inhibited. The controller board microprocessor uses the ECC to detect redundancy errors. If a failure occurs, an error message appears and the status error count is increased.

2. The first five sectors of the track are read as the data is being transferred. The test program compares each word read against the data pattern expected. Any discrepancy results in an error message, which specifies the pattern expected, the pattern received, the cylinder number, and the head number. In addition, a discrepancy increases the data error count.

2.4.6.2 Test 62 -- Short Exerciser Test. Test 62 performs the same operations as the EX verb except that it performs no unit switching. Also, it does not execute any writes if you select the save data option. The number of operations the verb performs depends upon disk type:

Disk Type	Operations
DSDD	>0030
5 1/4" Winchester	>0200
All others	>1388 (if verb is performed on one unit) The number of heads multiplied by the number of cylinders (if performed on more than one unit)

3.1 ERROR MESSAGES

DSKCOM issues two types of error messages: error messages that are common to DSKCD1, DSKCD2, DSKCOM, and DSKSA and those that are specific to DSKCOM. Paragraph 3.1.1 describes the common error messages; paragraph 3.1.2 describes the specific error messages.

3.1.1 Common Error Messages

The following error messages common to DSKCD1, DSKCD2, and DSKCOM are described and grouped according to functional subroutines:

Verify Store Registers Subroutine

```
***ERROR 001B
STORE REGISTER VALUES DIDN'T AGREE WITH THE DISK TYPE ENTERED
DURING "IT"
EXPECTED VALUES FOR A   XXXXXXXX
 WORD1 = XXXX   WORD 2 = XXXX   WORD 3=XXXX
RECEIVED VALUES FOR A   XXXXXXXX
 WORD1 = XXXX   WORD 2 = XXXX   WORD 3=XXXX

***ERROR 001E
MISCOMPARE BYTES - ADDRESS=XXXX  BYTE=XX -- ADDRESS=XXXX  BYTE=XX
```

Check Write Subroutine

```
>0019
CAN'T DESTROY DIAGNOSTIC BAD TRACK MAP
TRACK MAP

***ERROR 001D
ILLEGAL COMMAND ISSUED - BYTE COUNT TOO LARGE
```

Jitter Addressing and Random Reads Subroutine

```
***ERROR 008E
UNFORMATTED READ DOESN'T OBTAIN CORRECT VALUES
EXPECTED WORD1 = XXXX   WORD 2 = XXXX   WORD 3=XXXX
RECEIVED WORD1 = XXXX   WORD 2 = XXXX   WORD 3=XXXX
```

Check Write Protect Subroutine

***ERROR 000F
NO WRITE TO NONDIAG CYL WHEN SAVE DATA OPTION IS CHOSEN

Command Issuer Subroutine

***ERROR 0011
NO DONE INTERRUPT - WAITED 10 SECONDS - AFTER COMMAND
(The IDLE bit in controller word 7 failed to go true after 10 seconds.)

***ERROR 0012
NO IDLE - WAITED 5 SECONDS - AFTER COMMAND

***ERROR 0013
STILL BUSY - WAITED 5 SECONDS - AFTER SEEK OR RESTORE

***ERROR 0014
NO GATED ATTENTION INTERRUPT - WAITED 5 SECONDS

***ERROR 0015
IDLE BIT DIDN'T SET - WAITED 2 SECONDS

***ERROR 001F NO IDLE BIT SET - WAITED 30 SECONDS

***ERROR 008F RESTORE, AFTER ID OFF-TRACK ERROR FAILED --- CTL STATUS = XXXX

NOTE

This message is displayed only for the WD800A. It means that the previous command generated an ID Off-Track error and that the Restore command used to correct this condition failed with the status shown in the error message.

Disk Interrupt Subroutine

***ERROR 0016
UNEXPECTED INTERRUPT OCCURRED - PC =XXXX

***ERROR 0017
EXPECTED INTERRUPT OCCURRED AT WRONG TIME: REG 7= XXXX

***ERROR 0018
ATTENTION MASK & LINE MISMATCH - AFTER EXPECTED GATED INTERRUPT
REG 0= XXXX

***ERROR 00A4
INTERRUPT RECEIVED WITH IDLE BIT NOT SET

***ERROR 00A5
UNEXPECTED CHANGE OF TPCS REGISTER

Diagnostic Cylinder Subroutine

***ERROR 0021
*** BAD TRACK MAP IS NOT VALID ***
*** RUN DSKSA TO RESTORE THE MAP ***

General Information Subroutine

***ERROR 0022
MISCOMPARE OF DATA AT ADDR=XXXX DATA=XXXX -- ADDR=XXXX DATA=XXXX

***ERROR 001C
CONTROLLER STATUS
DISK STATUS CMD HEAD S/R SECT CYL BYTE CNT
XXXX XXXX XX XX XX XXXX XXXX
MEM ADR UNIT CONT STAT
XXXXXX XX XXXX

This error message appears when a status error occurs. This message is similar to the output from the Display Controller Status (DC) verb. (See the verb description for an explanation of error conditions.)

3.1.2 Specific Error Messages
The following error messages specific to DSKCOM are described and grouped according to test or verb.

Test 21 Error Message

***ERROR 0030
SECTOR ADDRESSING ERR REC'D SECTOR # XX -- EXCP'D XX
DATA READ XX

Test 31 Error Messages

***ERROR 0034
CROSS SECTOR BOUNDARY TEST ZEROING ERROR

***ERROR 0035
CROSS SECTOR BOUNDARY DATA ERR BETWEEN SEC. # XX & SEC. # XX

Test 32 Error Message

***ERROR 0036
CROSS HEAD BOUNDARY ERR

Test 33 Error Message

***ERROR 0037
CROSS CYLINDER BOUNDARY ERROR

Test 41 Error Messages

***ERROR 003D
READ DATA XFERED WITH XFER INHIBIT BIT SET

Test 42 Error Messages

***ERROR 0040
>128 ZERO WORDS WRITTEN DURING WRITE DATA WITH WORD COUNT= 0

***ERROR 0041
NON-ZERO WORD WRITTEN DURING WRITE DATA WITH WORD COUNT= 0

Test 43 Error Messages

***ERROR 004A
STORE REGS TO NON-EXISTENT MEM RETURNED WRONG STATUS
STATUS EXP= A820 -- RCVD= XXXX

```
***ERROR 0048
STORE REGS TO NON-EXISTENT MEM DIDN'T COMPLETE IN 8 MS
STATUS = XXXX
```

Test 51 Error Message

```
***ERROR 0088
ERR IN ADDRING UNMAPPED MEM
CONTROLLER IS SET UP TO READ & WRITE EVERY ADDR
INTO ITSELF FROM END OF DIAG TO END OF
1ST 32K BLOCK OF MEM THIS ADDR DIDN'T
CONTAIN ITS OWN ADDR AS DATA
ADDR = XXXX   DATA = XXXX
```

Test 52 Error Messages

```
***ERROR 008A
MAPPED MEM SUBTEST SKIPPED
DID WRITE OF ADDR THEN BIAS TO CONSECUTIVE MEM
LOCATIONS WITH MAP ENABLED. EXPECTED BIAS VALUE TO BE
CONVERTED TO THE ADDR OF LOCATION
ADDR= XXXXXX  BIAS VALUE= XXXXXX
```

Test 61 Error Messages

```
***ERROR 009B
STATUS ERROR WHILE READING

***ERROR 009C
DATA COMPARISON ERROR

***ERROR 009D
PATTERN XXXX    HEAD ADDRESS XXX    CYLINDER ADDRESS XXXX
```

Test 62 Error Message

```
***ERROR 00A0
READ ERROR ON WORD: XXXX  EXPECTED: XXXX  RECEIVED: XXXX
```

Reset Verb Error Message

```
***ERROR 0061
UTC >20 SEC TO BECOME NOT BUSY AFTER A RESET
```

Pack Switch Verb Error Message

***ERROR 0098
PACK SWITCH ERR

General Error Message

***ERROR 0038
UNABLE TO PERFORM TEST - SAVE DISK DATA HAS BEEN SELECTED AND DIAGNOSTIC CYLINDERS ARE TOO BAD TO RUN THIS TEST

DSKSA

DISK SURFACE ANALYSIS

DISK SURFACE ANALYSIS TEST (DSKSA)

DSKSA

Disk Surface Analysis

1.1 INTRODUCTION

The Disk Surface Analysis Test (DSKSA) is a verb module that analyzes the disk media. It is not a diagnostic that performs specific hardware tests.

You can use DSKSA to perform any of the following functions:

* A complete surface analysis of a disk surface
* A partial surface analysis of a disk surface, limited to specific tracks
* An investigation of disk media problems, using the utility verbs designed for troubleshooting

To perform a surface analysis in DSKSA, use the Execute Surface Analysis (SA) verb. Do not perform a surface analysis on a disk that contains data that you want to save, since the SA verb destroys the data on the disk. If you are unsure about the need to retain the data, back up the data on another disk before you execute the SA verb on the target disk.

1.2 TEST REQUIREMENTS

You need the following equipment to execute DSKSA:

* A Model 990 Computer with a minimum of 64K bytes of memory (where K equals 1024) or a Business System computer with 64K bytes of memory

* If you are using a 990 computer, you need one of the following controllers:

  - CD1400 disk controller (TI part number 2269405-0001 or -0002)

  - TILINE(TM) Peripheral Bus Interface (TPBI) controller (TI part number 2270820-0001)

  - WD900 disk controller (TI part number 2244780-0001 through 0004)

* One of the following disk or diskette drives:

  - CD1400 (TI part number 2269906-XXXX)

  - DS80 (TI part number 2308469-XXXX)

  - DS300 (TI part number 2308500-XXXX)

  - WD500 (without double-sided double-density (DSDD) diskette drive (TI part number 2532738-XXXX); with DSDD diskette drive (TI part number 2532783-XXXX)

  - WD500A (TI part number 2232480-XXXX)

  - WD800 (TI part number 2215801-XXXX)

  - 138 megabyte WD900 (TI part number 2244790-0001, -0002)

  - 425 megabyte WD900 (TI part number 2244790-0003, -0004)

  - 38, 69, 114 megabyte WD800A Winchester drives (TI part number 2245216-0001, -0002, -0003)

* An interactive terminal

* A loading device

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1.3 TEST CHARACTERISTICS

Familiarize yourself with the following characteristics of DSKSA before executing the test:

* DSKSA executes under the Diagnostic Operational Control System (DOCS). Volume 1 of the Unit Diagnostics Handbook contains information about DOCS operation.

* DSKSA supplies verbs in addition to those that come with DOCS. See paragraph 2.3 for a description of the verbs available.

* Bad track handling is dependent upon the system on which you run DSKSA:

  - The DS80, DS300, WD900, and WD800A disk systems use bad track relocation.

  - Instead of using bad track relocation, the CD1400 and Winchester (WD) systems place the location of bad tracks in a bad track map.

  - Diskette drive systems simply output the location of bad tracks after execution of DSKSA.

* The CD1400, DS80, DS300, WD900, WD500, WD500A, and WD800 disk systems utilize the two innermost cylinders on the disk as diagnostic cylinders, which are accessible only to diagnostic tests. These cylinders are not included by the CYLINDERS/DRIVE value returned by the Store Registers command.

* The DS80, DS300, WD900, and WD800A systems also have ten spare cylinders which are used for bad track relocation. These cylinders, like the diagnostic cylinders, are not included in the CYLINDERS/DRIVE value returned by the Store Registers command.

* DSKSA uses the second diagnostic cylinder, head 0, to record the bad track map on hard disks (a bad track map is not kept for diskette systems). The bad track map is a list of all the known bad tracks on the disk. Only the Format Diagnostic Tracks (FC) or Surface Analysis (SA) verbs can modify the bad track map. The size of the bad track map varies according to disk size and the disk's ability to relocate bad tracks. The sizes of different bad track maps are as follows, according to the type of disk system:

- CD1400, WD800, WD500, and WD500A Winchester: 64 entries
- DS80: 128 entries
- DS300: 256 entries
- 138 megabyte WD900: 192 entries
- 425 megabyte WD900: 384 entries
- 38 megabyte WD800A: 128 entries
- 69 megabyte WD800A: 192 entries
- 114 megabyte WD800A: 256 entries

* DSKSA does not keep a bad track map on diskettes.

* It is very important to maintain the integrity of the bad track map. Therefore, before attempting to read the bad track map, DSKSA performs a quick read-write-read test to ensure the drive does not destroy the bad track map while attempting to read it into memory. Since the diagnostic tracks are not guaranteed to be error free, nine identical copies of the bad track map are recorded on the disk (three groups of three maps, except the WD800A, which has two groups of three maps). Refer to Table 1 for the sector addresses that the three groups use. DSKSA uses the following procedure for reading the bad track map:

  - DSKSA performs the quick read-write-read test. If the test fails, it writes a message that indicates the problem. Then, it allows you to attempt to read the first group of maps. If the first attempt to read the maps fails, do not attempt another. Instead, use the utility verbs to investigate the drive problem.

  - If the quick read-write-read test passes, the diagnostic tries to find two copies of the map in the first group that match completely. If DSKSA finds a match, the task is complete. If it does not find a match, it writes a message that indicates the problem. Then, it allows you to attempt to read the second group of maps. If the attempt to read the maps fails, do not attempt another. Instead, use the utility verbs to investigate the drive problem.

* It is possible (but highly improbable) that the quick read-write-read test sectors or the bad track map sectors are bad enough to cause attempts to read the

maps to fail. Before attempting to read the third group of maps, use the appropriate diagnostic to make sure the disk drive does not have any hardware problems. Do not use the bad track map track while investigating the problem. Use any of the other diagnostic tracks.

Table 1 Bad Sector Addresses

Disk System	Group 1	Group 2	Group 3
CD1400	0A, 0B, 0C	0D, 0E, 0F	10, 11, 12
WD500, WD500A	0A, 0B, 0C	0D, 0E, 0F	10, 11, 12
WD800	0A, 0B, 0C	0D, 0E, 0F	10, 11, 12
D680	2D, 19, 05	31, 1D, 09	35, 21, 0D
DS300	2D, 19, 05	31, 1D, 09	35, 21, 0D
WD900 (138 megabyte)	08, 12, 16	28, 32, 36	48, 52, 56
WD900 (425 megabyte)	10, 17, 24	40, 47, 54	70, 77, 84
WD800A	4, 8, 4	10, 18, 1C	N/A
Diskette Systems	N/A	N/A	N/A

2.1 TEST INITIALIZATION

DOCS must load and initialize DSKSA before execution can begin. Volume 1 of the Unit Diagnostics Handbook explains the loading procedure.

When loading DSKSA, DOCS writes the name and version of the test as follows:

```
DSKSA - DISK SURFACE ANALYSIS.  VERSION 208/84 *J

FOR USE WITH THE FOLLOWING DISKS:
CD1400, DS80, DS300, WD800, WD900, WD500A, DSDD-WD500/WD500A,
WD900, WD800A, AND OTHER
```

During initialization, DOCS issues a series of prompts. For each prompt, if the default value shown is correct, press the RETURN key. Otherwise, enter the correct value. Enter all initialization values in hexadecimal. Two types of initialization procedures are available: initialization on a 990 computer and on an S200 computer.

2.1.1 Initialization on All Computers Except S200

If the computer you are initializing is other than an S200, the following prompts appear:

ENTER TILINE ADDRESS: DEF= F800 -
Switches on the disk controller board indicate the TILINE address of the disk.

ENTER INTERRUPT LEVEL: DEF= D -
The interrupt plug wiring on the computer chassis determines the disk interrupt level.

RUN TEST WITH INTERRUPTS ENABLED? (0=NO, 1=YES) DEF=1 -
If you accept the default (1), the diagnostic takes over the hardware interrupt vector and verifies that command completion generated the correct interrupts. If you enter 0, DSKSA does not use interrupts but uses polling instead to verify command completion. If you accept the default (1), the test always uses the hardware interrupt vector. If you enter 0, the interrupts are masked and are not used.

ENTER LINE FREQUENCY: (0=50, 1=60HZ) DEF=1 -
Select the line frequency used by the central processing unit (CPU) instead of that of the disk drive if they differ.

ENTER PRIMARY UNIT TO TEST: (0, 1, 2, 3) DEF=0 -
The drive (unit) that you select becomes the primary target of the test.

(*) ENTER DISK TYPE:
FOR CD1400 (REMOVABLE: 0=16MB, FIXED: 1=16MB, 2=48MB, 3=80MB)
FOR TRIDENT (4=DS80, 5=DS300)
FOR WINCHESTER (WD800: 6=43MB, 7=18MB, 8=WD500, A=WD500A)
FOR FLOPPIES (9=DSDD - WD500/WD500A)
FOR WD900 (C=138MB, D=425MB)
FOR WD800A (E= 38MB, F= 69MB, 10= 114MB
FOR OTHER USE (B) DEF = 0

Select one of the following supported disks:

* CD1400 16 megabyte removable disk (0)
* CD1400 16 megabyte fixed disk (1)
* CD1400 48 megabyte fixed disk (2)
* CD1400 80 megabyte fixed disk (3)
* Trident DS80 (4)
* Trident DS300 (5)
* WD800 43 megabyte (6)
* WD800 18 megabyte (7)
* WD500 (8)
* WD500A (A)
* DSDD-WD500/WD500A (9)
* WD900 138 megabyte (C)
* WD900 425 megabyte (D)
* WD800A 38 megabyte (E)
* WD800A 69 megabyte (F)
* WD800A 114 megabyte (10)
* Other (B)

NOTE

Selecting type B (Other) causes DSKSA to skip the verification of Store Registers values. DSKSA operation in this case is similar to DSKSA operation on floppy drives. If the controller uses the lockout bit, this bit is reflective of status conditions: 1 (on) signifies good status; 0 (off) signifies bad status. You can analyze the T25, T50, and T200 disk drives by selecting type B.

SAVE DISK DATA ? **ANSWER THIS CAREFULLY** DEF=1 -0

Your response to this prompt determines whether the program saves or destroys data on the disk. If you accept the default (1), you inhibit writing over data except for the diagnostic cylinders. If you enter 0, you allow the disk data to be destroyed. You should accept the default only when you want to perform disk troubleshooting tasks, since this inhibits execution of the SA verb.

After you have answered the appropriate prompts for the units you specified, the diagnostic displays a summary of the save data parameters. You can receive one of two messages for each unit:

UNIT #0 - ***DISK DATA WILL BE DESTROYED***

or

UNIT #0 - DISK DATA WILL BE SAVED

Verify that the summary is correct before answering the next prompt:

ARE YOU SURE YOU WANT TO RUN THE TEST WITH THESE DISK SAVE DATA PARAMETERS?
ANSWER THIS CAREFULLY (0=NO, 1=YES) DEF=0 -1

This prompt serves as a double check to make certain you want to proceed. If you enter 0 (no), DSKSA returns to the beginning of the initialization routine. If you enter 1 (yes), the following message appears:

WRITE PROTECT ALL DRIVES NOT TESTED

EXECUTE EA VERB? DEF= X

Accept the default or enter the appropriate response. If you choose to execute the verb, the Surface Analysis (SA) verb executes immediately.

Initialization is now complete. Control returns to DOCS and the VERB? prompt appears. You may execute any DOCS or DSKSA verb.

2.1.2 Initialization on an S200 Computer

If the computer you are initializing is an S200, the following prompts appear:

ENTER GROUP OF UNITS TO TEST? (0=4-7, 1=0-3) DEF=1 -

Accept the default if you want to test a unit (drive) in the range 0 through 3. Enter 0 if you want to test a unit in the range 4 through 7.

If you accept the default in response to the previous prompt, the following prompt appears:

ENTER PRIMARY UNIT TO TEST: (0,1,2,3) DEF=0 -

The drive (unit) that you select becomes the primary target of the test.

If you enter 0 in response to the ENTER GROUP OF UNITS TO TEST? prompt, the following prompt appears:

ENTER 0 TO TEST UNIT 4, 1 TO TEST UNIT 5, 2 TO TEST UNIT 6, OR 3 TO TEST UNIT 7 -

Enter the appropriate number for the unit you want to select.

(*) ENTER DISK TYPE:
FOR CD1400 (REMOVABLE: 0=16MB, FIXED: 1=16MB, 2=48MB, 3=80MB)
FOR TRIDENT (4=DS80, 5=DS300)
FOR WINCHESTERS (6=8"(43MB), 7=8"(18MB), 8=WD500, A=WD500A)
FOR FLOPPIES (9=DSDD-WD500/WD500A)
FOR WD900 (C=138MB, D=425MB)
FOR WD800A (E= 38MB, F= 69MB, 10= 114MB
FOR OTHER USE (B) DEF = 0

If you are performing initialization on an S200 computer, you can only select one of the following disk types:

* WD500 (8)
* WD500A (A)
* DSDD-WD500/WD500A (9)
* Other (B)

(*) SAVE DISK DATA? **CAREFULLY ANSWER THIS** (0=NO, 1=YES) DEF=1

Your response determines whether the program saves or destroys data on the disk. If you accept the default (1), you inhibit writing over data except for the diagnostic cylinders. If you enter 0, you destroy the disk data.

After you have answered the appropriate prompts for the units you specified, the diagnostic displays a summary of the save data parameters. You can receive one of two messages for each unit:

UNIT #X - ***DISK DATA WILL BE DESTROYED***

or

UNIT #X - DISK DATA WILL BE SAVED

Verify that the summary is correct before answering the next prompt:

ARE YOU SURE YOU WANT TO RUN THE TEST WITH THESE DISK SAVE DATA PARAMETERS?
ANSWER THIS CAREFULLY (0=NO, 1=YES) DEF=0

This prompt serves as a double check to make certain you want to proceed. If you enter 0 (no), DSKSA returns to the beginning of the initialization routine. If you enter 1 (yes), the following message appears:

WRITE PROTECT ALL DRIVES NOT TESTED

EXECUTE EA VERB? DEF= 1

Accept the default (1) if you want to execute the Surface Analysis (SA) verb immediately; enter 0 if you do not.

Initialization is now complete. Control returns to DOCS and the VERB? prompt appears. You may execute any DOCS or DSKSA verb.

2.2 TEST PROCEDURE FOR INCOMING QUALITY CONTROL (IQC)

Use the following procedure when executing DSKSA to evaluate new disks or disk drives for IQC:

1. Use the FC verb to format the diagnostic cylinder(s) and write the initial bad track map.

2. Use the SA verb to perform the surface analysis and to add the bad tracks discovered during analysis to the bad track map.

2.3 LOADING

Volume 1 of the Unit Diagnostics Handbook explains the loading procedure.

2.4 TEST VERBS

As DSKSA does not execute any tests, only utility verbs and the IT verb are available for your use. Utility verbs help you isolate errors that are detected during the execution of the surface analysis.

Utility Verb	Function
BC	Build command
DB	Display bad track map
DC	Display controller status
DT	Display trace table
EN	Enable trace
FC	Format diagnostic tracks
FD	Format disk
IC	Issue command
IM	Issue multiple commands
LO	Loop on multiple commands
PV	Print verbs
RD	Read disk
RS	Reset hardware
SA	Execute surface analysis
SR	Store registers

You may also use the Initialize Test (IT) verb to modify the initialization parameters. Verb messages covered in this documentation include header messages and prompts that you must respond to before a specified verb can execute. However, supplemental messages can also appear during the execution of a verb or test. All verb messages appear in TTY mode.

2.4.1 Build Command (BC) Verb

By executing the BC verb, you can build an eight-word command in main memory. You can then issue this command to a controller or drive by executing the IC verb.

The BC verb prompts appear as follows:

BC-BUILD COMMAND STATUS BLOCK

STARTING ADDRESS OF BLOCK? (DEF=XXXX) -
Enter the adress in main memory where you want the eight-word block to begin.

HOW MANY COMMANDS DO YOU WANT? (DEF=0001) -
Enter the number of commands that you want. For each command that you desire, the verb will prompt you to provide input for eight words (0 through 7).

INPUT WORD #0 (DEF=XXXX) -
Accept the default or enter the desired hexadecimal value.

INPUT WORD #1 (DEF=XXXX) -
Accept the default or enter the desired hexadecimal value.

INPUT WORD #2 (DEF=XXXX) -
Accept the default or enter the desired hexadecimal value.

INPUT WORD #3 (DEF=XXXX) -
Accept the default or enter the desired hexadecimal value.

INPUT WORD #4 (DEF=XXXX) -
Accept the default or enter the desired hexadecimal value.

INPUT WORD #5 (DEF=XXXX) -
Accept the default or enter the desired hexadecimal value.

INPUT WORD #6 (DEF=XXXX) -
Accept the default or enter the desired hexadecimal value.

INPUT WORD #7 (DEF=XXXX) -
Accept the default or enter the desired hexadecimal value.

2.4.2 Display Bad Track Map (DB) Verb

The DB verb reads the bad track map from the disk and displays it on the DOCS interactive device. The output appears in the following format:

```
DB-DISPLAY BAD TRACK MAP

                BAD TRACK MAP

MAPPED    CYL ADR    CYL ADR    HEAD ADR    DEFECT
FLAG=*     (DEC)      (HEX)      (DEC)      LENGTH
-------------------------------------------------
           XXXX       XXXX       XX          XXX
           XXXX       XXXX       XX          XXX
           XXXX       XXXX       XX          XXX
```

An asterisk (*) under the MAPPED FLAG column indicates that the track is mapped. An asterisk entry can appear only when you are using a DS80, DS300, WD900, or WD800A. Entries under the DEFECT LENGTH column are given according to the number of bits.

Refer to paragraph 1.3 for an explanation of how bad track maps are obtained.

2.4.3 Display Controller Status (DC) Verb

The DC verb writes the status of the disk controller to the terminal. It reads the controller slave registers, formats them, and then writes them to the terminal in the following manner:

```
  DC-DISPLAY CONTROLLER REGISTERS
CONTROLLER STATUS
DISK STATUS  CMD  HEAD  S/R  SECT  CYL   BYTE CNT
    XXXX     XXXX  XX    XX   XX   XXXX    XXXX
MEM ADR  UNIT  CONT STAT
XXXXXX    XX      XXXX
```

If you select an alternate TILINE peripheral control space when you execute the EN verb, the DC verb displays an additional set of controller status registers.

The abbreviations in the DC verb output are as follows:

* DISK STATUS -- The status of the selected drive, obtained from controller register 0. The status value is composed of the sum of the values that indicate the current condition of the drive (X = irrelevant). For example, the offline (8XXX) and write-protected (2XXX) conditions are indicated by the status value AXXX.

Value	Meaning
8XXX	Offline
4XXX	Not ready
2XXX	Write protect
1XXX	Unsafe
X8XX	End-of-cylinder
X4XX	Seek incomplete
X2XX	Offset active
X1XX	Pack change

NOTE

If you receive a 1 for the Y in drive status for disk, the 1 designates a pack change. On the other hand, if you execute one of the command verbs (IC, IM, or LO), the drive status is read from word 0 of your command stream, with bit 7 designating the use of either slave A or slave B. If you enter 0 for bit 7 (word 0 = 000), slave A is referenced. If you enter 1 (word 0 = 100), slave B is referenced. After a command is issued, the drive itself determines the value of the drive status; then, the particular drive resets this bit to a predetermined setting.

This feature is not available on an S200 computer.

* CMD -- Command number (register 1, with the head address masked off, the last two nibbles appearing as 00):

Value	Command
0000	Store registers
0100	Write format
0200	Read data (see proper installation and operation manual for meaning of various read types)
0300	Write data
0400	Read unformatted (Trident headers only)
0500	Write unformatted
0600	Seek
0700	Restore
4100	Relocate (DS80, DS300, WD800A, and WD900 only)
8400	Read unformatted
C100	Absolute write (DS80, DS300, WD800A, and WD900 only)

* HEAD -- Surface address: >0 through >MAXHEAD. (A right angle bracket preceding a value indicates a hexadecimal value.)

* S/R -- Sectors per record; the effective value of S/R is always 01.

* SECT -- Sector address and sector number: >0 through >MAXSECTOR.

* CYL A -- Cylinder address: >0 through >MAXCYLINDER.

* BYTE CNT -- Byte count for the data transfers remaining.

* MEM ADR -- TILINE memory address for data transfers.

* UNIT -- Number of the unit, as follows:

Number	Unit
08	0
04	1
02	2
01	3

* CONT STATUS -- The controller status is taken from register 7 of the Command Status Block (CSB) and indicates the status of the controller.

Value	Meaning
8XXX	Idle
4XXX	Complete
2XXX	Error
1XXX	Interrupt enable
X8XX	Lockout
X4XX	Retry
X2XX	Error correcting code (ECC) used
X1XX	Abnormal completion
XX8X	Memory error
XX4X	Data error
XX2X	TILINE time-out
XX1X	ID error
XXX8	Rate error
XXX4	Command timer delay
XXX2	Search error
XXX1	Unit error

NOTE

The retry status (X4XX) appears when any command requires one or more retries to execute. You can suppress error messages so they are not printed until after the threshold has been reached. Refer to the EN verb for more information.

2.4.4 Display Trace Table (DT) Verb

The DT verb writes the returned status of the last ten commands issued. At the completion of every command, the Command Issuer subroutine stores the eight words in the TILINE Peripheral Control Space (TPCS) in a trace table. This table contains the resulting status of each of the last ten commands issued to the controller. The format of the output is the same as that of the DC verb.

2.4.5 Enable Options (EN) Verb

The EN verb allows an operator to enable or disable certain execution options. The prompt for the EN verb is as follows:

ENABLE CONTINUOUS TRACE? (0=NO, 1=COMMANDS, 2=STATUS, 3=BOTH) DEF=0

Enter 3 if you want a continuous TPBI trace for both the commands and their completion status. Enter 1 if you want a trace for only the commands. Enter 2 if you want a trace for only the command completion status. Accept the default if you do not want the continuous trace at all.

ENABLE ERROR THRESHOLDS(0=NO, 1=RETRY ONLY, 2=RETRY OR SEEK INC ONLY)? DEF=1 -

Accept the default if you want to establish error thresholds for retries; enter 2 to establish them for both retries and seek incompletes. Establish error thresholds if you want to inhibit printing error messages for retries and/or seek incompletes. However, disk status always prints. The status count for retries or seek incompletes is cleared each time you execute either the IT or RS verb. If you do not want thresholds, enter 0.

THRESHOLD FOR UNIT X? DEF=0003 -

Accept the default or enter another limit for the unit under test.

ENTER ALTERNATE TPCS TILINE ADDRESS: DEF= F800 -

Accept the default if you do not want to use an alternate TPCS address (the default is the same as the address for the primary unit). Enter an alternate address if you want to issue commands to (or monitor the status of) a disk at a different TILINE address. The switches on a controller determine the secondary TILINE address associated with the alternate TPCS.

ENTER INTERRUPT LEVEL: DEF=E -

Accept the default if you do not want to specify an interrupt level for an alternate TPCS address (the default is the same as the interrupt level for the primary unit). Otherwise, enter the interrupt level associated with the alternate address. The interrupt plug wiring on the computer chassis determines the interrupt level associated with the alternate TPCS.

You cannot select the last two options (concerning the alternate TPCS) when you are using a Business System computer.

Use the ENTER ALTERNATE TPCS TILINE ADDRESS and ENTER INTERRUPT LEVEL options if you want to issue commands to or monitor the status of a disk at a different TILINE address.

Use the ENABLE ERROR THRESHOLDS and THRESHOLD FOR UNIT X options if you want to inhibit printing error messages for RETRY or SEEK INC, until the number of these status conditions exceeds the threshold. This disk status is always printed. When the IT or RS verbs are executed, the count of RETRY or SEEK INC status occurrences is cleared.

2.4.6 Format Diagnostic Tracks (FC) Verb

The FC verb performs the following functions:

1. Displays all existing bad tracks.
2. Allows user to destroy the initial bad track map found on the disk and to begin with a null map instead.
3. Allows user to enter tracks into the bad track map.
4. Allows the user to examine the map and delete any track that does not have the mapped bit set.
5. If the drive is a WD800A, the Test Parameter Cylinder and the Formatter Bad Track Map are initialized. The spare tracks are formatted using the SA Assist command (>4400) if the user has chosen to use a null map.
6. Formats the diagnostic cylinders.
7. Writes nine copies of the bad track map, (6 for WD800A), on head 0 of the second diagnostic cylinder.
8. Executes Write commands and data verification operations on the second diagnostic cylinder.

The FC verb first attempts to read the maps from the diagnostic cylinders. If the verb does not find an existing map on the disk or if the verb finds a map on the disk that is free of defective tracks, it writes out the following message:

```
FC - FORMAT DIAGNOSTIC CYLINDERS

NO DEFECTIVE TRACKS IN MAP
```

If the verb did not find a map on the disk it now creates a null table.

If the verb finds an existing bad track map on the disk, it writes it out as follows:

MAPPED FLAG=*	CYL ADR (DEC)	CYL ADR (HEX)	HEAD ADR (DEC)	DEFECT LENGTH
	XXXX	XXXX	XX	XXX

This map becomes the initial bad track map.

Next, the verb formats the diagnostic cylinders and writes out the following message upon completion:

DIAGNOSTIC CYLINDERS FORMATTING COMPLETE

The FC verb displays the following messages. (All FC verb values are written in decimal.)

DELETE MAP IF PRESENT? (DEF=0) -

If you accept the default, the verb uses the initial bad track table found on the disk. If you enter 1 (yes), the verb destroys the table found on the disk and initially uses a null table. You should not destroy the initial bad track table found on the disk unless you have a special reason for doing so.

If the drive is a WD800A and the response is 1 (yes), the verb not only deletes the map but also formats the spare cylinders, using the SA Assist command (>4400), and initializes the WD800A formatter Bad Track Map with the Maintenance command (>15).

ENTER BAD TRACKS IN DECIMAL (USE FFFF TO END):
CYLINDER ADDRESS - <XXXX> HEAD ADDRESS - <XX>
DEFECT LENGTH (DEF=2) - <XX> OK? (DEF=1) -

By responding to these prompts, you can add the locations of any bad tracks to the table. These locations, along with those in the initial bad track table, form a new bad track table. Accept the defaults or enter the correct length (in bits) of the bad tracks you want to add to the bad track map. If a 0 (no) is entered in response to the OK? prompt, the track just entered is ignored. The TRY AGAIN message is displayed, and the above prompt is again displayed. To terminate, enter >FFFF in response to any of the prompts.

WANT TO EXAMINE/EDIT THE BAD TRACK MAP? (DEF=1) -

A 1 (yes) response to this prompt allows the user to examine the bad track map and delete any mistakes in the map. If a 0 (no) response is given, then the EXAMINE/EDIT function is skipped and the formatting of the diagnostic cylinders is started.

SELECT FUNCTION: 0= NEXT PAGE, 1= DELETE A TRACK, 2= ALL DONE (DEF= 0)

If a 1 (yes) was entered in response to the EXAMINE/EDIT prompt, up to ten tracks from the Bad Track Map are displayed in the same format used for the DB verb, followed by the above prompt.

Entering 0 (NEXT PAGE) will display the next ten tracks in the Bad Track Map. If all the tracks in the map have been displayed, LAST PAGE OF MAP DISPLAYED. WILL START OVER. appears and the first part of the map is shown again.

Entering 1 (DELETE A TRACK) will allow a track to be removed from the Bad Track Map. Enter the cylinder address, head address, and the defect length of the track to be deleted in response to the following prompts:

ENTER TRACK TO DELETE IN DECIMAL (USE FFFF TO ABORT):
CYLINDER ADDRESS - <XXXX> HEAD ADDRESS - <XX>
DEFECT LENGTH (DEF = 2) - XX OK? (DEF= 1) -

If the track is one of the tracks currently displayed, and it is not mapped, (the Mapped Flag bit on, its bit set to 1), TRACK HAS BEEN DELETED is displayed, followed by the updated map and the SELECT prompt. The TRACK NOT DELETED. MUST BE DISPLAYED AND/OR NOT MAPPED! message means that the track was not on the page last displayed, or it had the Mapped Flag on.

Entering a 2 (ALL DONE) in response to the SELECT prompt halts the examine/edit function and begins the formatting of the diagnostic cylinders.

The FC verb updates the bad track map and writes nine copies (in three groups of three maps each) to head 0 of the second diagnostic cylinder. It verifies that at least two out of the three maps in each group match.

After writing the bad track map, the verb writes five sectors of read test data to the following locations on the second diagnostic cylinders:

Disk System	Cylinder Sector Locations (in Hexadecimal)
CD1400	08, 1F, 1E, 09, 33
DS80 and DS300	17, 04, 03, 18, 2C
WD500	03, 07, 04 06, 05
WD800	16, 17, 18, 19, 1A
WD900 138 megabyte	02, 03, 04, 05, 06
WD900 425 megabyte	02, 03, 04, 05, 06
WD800A Winchester	14, 15, 16, 17, 20

NOTE

The FC verb is not intended to replace the SA verb (paragraph 2.4.14). The FC verb does not relocate any bad tracks entered for the DS80, DS300, and WD900 systems. The SA verb performs that function. If the drive is a WD800A, the disk may require that the ND verb of DSKWD8 be executed before execution of the FC or SA verb. (See the ND verb description in the DSKWD8 section of this manual for more information on when this must be done.) In addition, when using unformatted disks, you must execute the FC verb before executing the SA verb.

2.4.7 Format Disk (FD) Verb

The FD verb formats almost the entire disk pack. The diagnostic cylinders are not formatted and you have the option of formatting cylinder 0. The status checker monitors the status register during verb execution and reports any errors to the interactive device.

The FD verb prompts appear as follows:

```
FD-FORMAT DISK

DO YOU WISH TO FORMAT CYLINDER 0, HEAD 0
AND DESTROY THE OS BAD TRACK MAP ? DEF=0 -
```

Enter 1 if you want to destroy the map; accept the default if you do not.

```
YOU WILL HAVE TO RUN "SA" VERB ON "DSKSA" TO RE-CREATE THE OS BAD
TRACK MAP.
```

This message appears if you chose to destroy the OS bad track map. If you want to recreate the map, you must use the SA verb.

```
ARE YOU SURE YOU WANT TO FORMAT ALL OF UNIT # X ? DEF=0 -
```

If you enter 1, the FD verb performs the following operations on all tracks except those on the diagnostic cylinders:

* Formats the tracks with one sector per record
* Writes 0 values to the tracks

When the verb completes, the following message appears:

```
FORMAT DISK COMPLETE
```

2.4.8 Issue Command (IC) Verb

The IC verb issues a command to the controller or drive from a hexadecimal memory address that you enter. The command is eight words long. To set up the command, you can use the BC verb or the DOCS Modify Memory (.MM) verb.

The IC verb prompts appear as follows:

IC-ISSUE COMMAND

STARTING ADDR OF COMMAND? (DEF=XXXX) -
Accept the default or select another address. The default starting address displayed is the beginning address of a 32-word block that DSKSA does not modify. You should build commands in this area if you want to save them. You can build any number of commands there, but only the first four are guaranteed to be protected.

CHECK STATUS?(0=NO,1=YES) (DEF= 1) -
Enter 1 if you want to check the status of the target controller or drive. Any errors found are reported. If you enter 0, no status checking is performed. However, you can still use the DC or DT verbs to display the returned status.

2.4.9 Issue Multiple Commands (IM) Verb

The IM verb issues multiple commands to the controller or drive from memory. The commands require eight words each and must be stored in consecutive memory locations.

The IM verb prompts appear as follows:

STARTING ADDR OF COMMAND? DEF=XXXX -
Accept the default or select another address. The default starting address displayed is the beginning address of a 32-word block that DSKSA does not modify. You should build commands in this area if you want to save them. You can build any number of commands there, but only the first four are guaranteed to be protected.

HOW MANY COMMANDS? (DEF= XXXX) -
Enter the number of commands desired.

CHECK STATUS?(0=NO,1=YES) (DEF= 1) -
Accept the default if you want to check the status of the target controller or drive. Any errors found are reported. If you enter 0, no status checking is performed. However, you can still use the DC or DT verbs to display the returned status.

2.4.10 Loop on Multiple Commands (LO) Verb

The LO verb is similar to the IM verb. However, when the LO verb completes the last command, the verb returns to the first command and loops in the command list until you either press the CMD key or the loop count expires. The verb outputs the loop count (number of times it has executed) in hexadecimal to the computer front panel. The count is in the following format:

Bits 0-3	Bits 4-7	Bits 8-11	Bits 12-15
X	X	X	X

This operation is not performed on computers that do not have a front panel.

The LO verb prompts appear as follows:

```
LO--LOOP ON COMMANDS

STARTING ADDR OF COMMAND?  DEF=XXXX -
```

Accept the default or select another address. The default starting address displayed is the beginning address of a 32-word block that DSKSA does not modify. You should build commands in this area if you want to save them. You can build any number of commands there, but only the first four are guaranteed to be protected.

```
HOW MANY COMMANDS?  (DEF=XXXX) -
```

Accept the default or enter another value.

```
CHECK STATUS?(0=NO, 1=YES) DEF=1 -
```

Accept the default if you want to check the status of the target controller or drive. Any errors found are reported. If you enter 0, no status checking is performed. However, you can still use the DC or DT verbs to display the returned status.

```
NUMBER OF LOOPS?  DEF=XXXX -
```

If you accept the default, the LO verb loops on the command list indefinitely. You can exit out of the loop at any time by pressing the ESC key.

2.4.11 Print Verbs (PV) Verb

The PV verb lists and briefly describes all available DSKSA test verbs on the interactive device.

2.4.12 Read Disk (RD) Verb

The RD verb verifies that data after a read matches the data before the read. It also verifies that a disk is formatted correctly. It executes a Read command for every sector on the number of tracks that you specify. All outputs for the RD verb are in decimal.

Enter your response to the following prompts in decimal:

```
RD-READ DISK

READ ENTIRE DISK?  (DEF=1) -
     If you accept the default, the RD verb reads the entire disk
     and the prompts marked with an asterisk do not appear.
     Instead, the verb obtains the necessary head and cylinder
     information from the Store Registers parameters. If you
     enter 0, the prompts marked with an asterisk (*) appear.

BEGIN HEAD ADR(DEC)(DEF=00) - (*)
     Accept the default or enter another head address.

END HEAD ADR(DEC)(DEF=00) - (*)
     Accept the default or enter another head address.

BEGIN CYL (DEC)?(DEF=0000) - (*)
     Accept the default or enter another cylinder address.

END CYL (DEC)?  (DEF=maximum cylinder address) - (*)
     Accept the default or enter another cylinder address.

At completion, the RD verb issues the following message:

ERROR COUNTS: DATA = WWWW STATUS = XXXX TIMING = YYYY RETRYS = ZZZZ
```

If the data does not compare, the verb increases the data error count and writes the expected and received data.

If the verb detects a status error, the status error count increases and the Status Checker routine writes an error message. When the verb completes execution, it writes the error count to the terminal.

NOTE

RD verb execution varies according to the type of disk drives being used. The CD1400, DS80, DS300, and WD900 use the Extended Unformatted Read (>8400) command (with a byte count of >106) when performing a read. This command allows header data verification along with the data field verification. The 8-inch Winchester and the 5 1/4-inch Winchester use the ordinary Read (>0200) command (with a bit count of >100) when performing a read. The command performs no header verification. Instead, DSKSA uses the status returned by the controller to verify the data field for these disk types. These different read types and verification schemes are necessary because of the hardware differences in the disk drives.

2.4.13 Reset Hardware (RS) Verb

The RS verb issues a Hardware Input/Output (I/O) Reset command (it also issues a PBI Reset command on an S200 computer) and a Restore command to each drive under test. You can use this verb to reinitialize the hardware and disk controller whenever an UNSAFE or NOT READY condition is set. It also initializes the command trace table by clearing the buffer where the table is stored. You should examine the controller to ensure that the fault light did not turn on during the test. The RS verb outputs the following message when it executes:

HARDWARE RESET AND RESTORE DONE

2.4.14 Execute Surface Analysis (SA) Verb

Surface analysis is a media analysis routine. It writes specific data patterns to a disk surface and reads the patterns back, verifying congruence.

The SA verb performs the following operations:

1. Obtains the operation parameters
2. Obtains the present bad track map from the disk
3. Executes the surface analysis
4. Adds any bad tracks found to the present map
5. Performs bad track reallocation (DS80, DS300, WD800A, and WD900 only)
6. Creates a new bad track map
7. Places the OS bad track map on head 0, cylinder 0
8. Reports any bad track conditions
9. Checks for format errors

NOTE

The presence of format errors does not imply bad media.

For all unformatted disks, you must execute the FC verb before executing the SA verb. The SA verb performs a surface analysis on the entire disk pack or any segment of its cylinders.

The verb offers you three preset detection options for performing a surface analysis over an entire disk pack, each with a different probability of finding a defect on the pack under analysis. The longer the verb execution time, the higher the probability of finding a defect. Choose the detection option according to the amount of time available and the desired probability of finding a defect. The three preset options have fixed run times. You can select the option you want to use in response to the SELECT LENGTH prompt, described in paragraph 2.4.13.2.

DSKSA allows a fourth option: customizing the analysis by modifying the values of the SA verb parameters. To modify the parameters, enter 1 (yes) in response to the DO YOU WANT TO SPECIFY PARAMETERS? prompt (described in paragraph 2.4.13.2). By allowing you to specify the desired beginning and ending addresses, this option allows you to perform a partial surface analysis.

Use a partial surface analysis to perform a quick mapping in the following cases:

* When you use the FC verb to enter tracks into the bad track map
* When you suspect that only a specific area of a disk pack is bad

All options display the approximate run time before analysis begins.

NOTE

If you execute the surface analysis over an entire disk pack on DS80, DS300, WD800A, and WD900 systems, the SA verb uses the Absolute Format command (>C100), which destroys all mapped tracks and their assigned spaces. (Note that on a WD800A the Absolute Format command is not used. The SA assist command (>4400) performs an Absolute Format function which has the same effect on the mapping and the assigned spaces.) In this case, DSKSA reallocates bad tracks all over again. If you execute a partial surface analysis, the SA verb uses the Normal Format command (>100), which does not destroy the mapped tracks.

2.4.14.1 Bad Track Maps. The SA verb enters the address of each defective track found into the existing bad track map that was read from the disk. Upon completion, the SA verb writes the addresses of the bad tracks to the diagnostic cylinders and to the operating system map, which is found on cylinder 0, head 0.

If the SA verb is aborted for any reason, it does not update the bad track map. Also, if the maximum number of bad tracks for a disk is reached, the SA verb can no longer update the bad track map. However, the verb still writes an error message for each bad track to the interactive device. This message indicates that the bad track was not included in the bad track map.

2.4.14.2 SA Verb Execution. The SA verb displays the following prompt:

```
MEDIA SURFACE ANALYSIS
**** ALL NUMBERS ARE IN DECIMAL EXCEPT DATA PATTERN ****
WANT TO SPECIFY PARAMETERS? DEF=0 -
```

If you accept the default, the following additional prompt appears. The prompt specifies how long each option takes to execute.

```
SELECT LENGTH: 1=XXXX MIN, 2=XXXX MIN, 3=XXXX MIN? DEF=1 -)
```

Accept the default or select another option.

The following list shows the parameter values you should use for any of the disk systems except Winchesters when you accept the default to the previous prompt:

Parameters	Option 1	Option 2	Option 3
Read types (4)	Strobe early Strobe late Offset reverse Offset forward	Same as 1	Same as 1
Data patterns (2)	DB6A and 6DB6	Same as 1	Same as 1
Writes for each pattern	2	4	8

Notice that the only variable in the table is the number of writes for each pattern. A larger number of patterns means a longer time period for test execution. However, a larger number of patterns also means an increased probability of detecting errors.

To modify the parameters, enter 1 (yes) in response to the DO YOU WANT TO SPECIFY PARAMETERS? prompt. Do not attempt to modify parameters unless you are familiar with the operation of the DSKSA diagnostic. The prompts for each parameter appear as follows:

```
---------------------------------------------------------------
# OF DATA PATTERNS? (MAX = 6) DEF=N -
PATTERN 1? DEF=XXXX -


PATTERN N? DEF=XXXX -
# OF WRITES/PATTERN? DEF=XXXX-
---------------------------------------------------------------
READ WITH OFFSET FORWARD? DEF=X -
READ WITH OFFSET REVERSE? DEF=X -
* READ WITH STROBE EARLY? DEF=X -
* READ WITH STROBE LATE? DEF=X -
** READ WITH NOMINAL STROBE? DEF=X -
READ WITH STROBE EARLY AND OFFSET FORWARD? DEF=X -
READ WITH STROBE EARLY AND OFFSET REVERSE? DEF=X -
READ WITH STROBE LATE AND OFFSET FORWARD? DEF=X -
READ WITH STROBE LATE AND OFFSET REVERSE? DEF=X -

  For Winchesters, except for WD800A, the only READ prompts that
  appear are marked with an asterisk.. For the WD800A, only the
  Nominal READ prompt is displayed.  For the WD500, WD500A, and
  DSDD-WD500/WD500A, only those READ prompts marked with a
  double asterisk appear.
---------------------------------------------------------------
BEGIN CYL ADDRESS? DEF=0000 -
ENDING CYL ADDRESS? DEF=XXXX -
BEGIN HEAD ADDRESS? DEF=000 -
ENDING HEAD ADDRESS? DEF=XXX -
  The defaults for the ending addresses are the maximum addresses.
---------------------------------------------------------------
APPROX RUN TIME = XXXXXX MIN. (given in decimal)

SHOULD INCOMING QUALITY CONTROL TERMINATION PARAMETERS BE USED?
(DEF=0) -
  See paragraph 2.4.14.6
---------------------------------------------------------------
SURFACE ERROR LIMIT?(DEF=0010) -
  This prompt appears only on a WD800 system.
---------------------------------------------------------------
```

During execution, the front panel lights display the cylinder count (except on Business System computers, which do not have front panels).

For each track that contains any type of read error, the SA verb writes data in the following format:

**** ALL NUMBERS ARE OUTPUT IN DECIMAL EXCEPT DATA PATTERN ****

TWPL = #FAILURES/READ TYPE/WRITE/PATTERN/LOCATION
WPL = #FAILURE/WRITE/PATTERN/LOCATION
PL = #FAILURE/PATTERN/LOCATION
L = #FAILURE/LOCATION

ERROR TYPE	CYL NO.	HEAD NO.	DATA PATTERN	READ TYPES OF	OR	SE	SL	NS	EF	ER	LF	LR	NUMBER OF FAILURES
XXXX	XXXX	XXXX	XXXX	X	X	X	X	X	X	X	X	X	TWPL =XXXX WPL =XXXX PL =XXXX L =XXXX LENG =XXXX
XXXX	XXXX	XXXX	XXXX	X	X	X	X	X	X	X	X	X	TWPL =XXXX WPL =XXXX PL =XXXX L =XXXX LENG =XXXX

**** MEDIA ERRORS FOUND ****

The following descriptions explain the data that the SA verb writes in this report:

ERROR TYPE — Type (hard or soft) of error at this head and cylinder.

CYL NO. — Number of the cylinder on which the defects were found.

HEAD NO. — Number of the head on which the defects were found.

DATA PATTERN — Data pattern read when a defect was found at a particular head and cylinder.

READ TYPES — Read type being used when a defect was found, employing a particular data pattern at a particular location. An asterisk (*) under a particular column indicates the read types.

- OF — Read with offset forward.
- OR — Read with offset reverse.
- SE — Read with strobe early.
- SL — Read with strobe late.
- NS — Read with nominal strobe.

EF	Read with strobe early and offset forward.
ER	Read with strobe early and offset reverse.
LF	Read with strobe late and offset forward.
LR	Read with strobe late and offset reverse.
TWPL	Number of failures/read type/write/pattern/location.
WPL	Number of failures/write/pattern/location.
PL	Number of failures/pattern/location.
L	Number of failures/location.
LENG	Length of the defect from first bit in error through last bit in error.

The surface analysis uses the following variables and constants to determine hard, soft, and miscellaneous error types:

```
SOFT WRITE COUNT    = 5*(initial # WRITES/PATTERN)
SOFT TRY READS      = 5
MAXIMUM MISC. ERROR COUNT = 10
MAXIMUM TWPL = 3
MAXIMUM  WPL = 1.5*(#READ TYPES)
MAXIMUM   PL = 1.25*(#READ TYPES)*(current # WRITES/PATTERN)
MAXIMUM    L = (#READ TYPES)((initial #WRITES/PATTERN)
               *(#PATTERNS DONE) + (current #WRITES/PATTERN)
               *(total #PATTERNS - #PATTERNS DONE))
```

Defects are hard errors if one or more of the following problems occur:

* If more than 60 percent of the reads for any single read type (TWPL) fail.
* If more than 45 percent of the reads for any write (WPL) fail. This is true only if the number of read types is greater than 1.
* If more than 37.5 percent of the reads for any pattern (PL) fail.
* If more than 30 percent of the reads of any location (L) fail.

Defects that occur but do not exceed the parameters given above for hard errors are considered soft errors.

2.4.14.3 Bad Track Relocation (DS80, DS300, WD800A, and WD900 Only). The algorithm that the SA verb uses to relocate bad tracks depends on the type of disk being analyzed. (For CD1400 and Winchester disks, the verb reports all bad tracks to the operating system bad track map.) The operating system avoids these bad tracks. Using the Relocate command (>4100), the verb tries to map all bad tracks, if possible, onto good spare tracks. A good spare is one that is not in the bad track map and one that is not already assigned as a spare. The maximum number of spare tracks available for mapping is 80 for a DS80 disk, 190 for a DS300 disk, 160 for the 138 megabyte WD900, and 384 for the 425 megabyte WD900. The 38 megabyte WD800A has 50 spares. The 69 megabyte WD800A has 90 spares. The 114 megabyte WD800A has 150 spares.

If enough spare tracks are not available to handle all the bad tracks, the verb relocates the bad tracks according to the following scheme:

* The SA verb does not map those tracks with the smallest defect bit length (length equals 1).

* The SA verb writes those tracks with a defect bit length greater than 1 to the operating system bad track map. The operating system avoids these bad tracks.

2.4.14.4 Disk Bad Track Map Report. On DS80, DS300, WD800A, and WD900 systems, the disk bad track map report tells you whether bad tracks were reallocated or not. On all other systems, the report lists the bad tracks under the NOT REALLOCATED column, since bad track mapping is not available for systems other than DS80, DS300, WD900, or WD800A. For all sytems, the report tells you whether the disk is good or bad. The report uses the following format:

	RECORDED	RE-ALLOCATED	NOT RE-ALLOCATED
BAD TRACKS WITH DEFECT LENGTH >5 -	XXXX	XXXX	XXXX
BAD TRACKS WITH DEFECT LENGTH 2-5 -	XXXX	XXXX	XXXX
BAD TRACKS WITH DEFECT LENGTH =1 -	XXXX	XXXX	XXXX
TOTALS -	XXXX	XXXX	XXXX

(DEFECT LENGTH is given in number of bits.)

2.4.14.5 Summary Report. At the end of execution, the SA verb prints a summary report that breaks down the total number of bad tracks, the previous number of bad tracks, and the bad tracks added during the current surface analysis. The report appears as follows:

```
(GOOD/BAD) DISK PACK

   ** TOTAL BAD TRACKS = XXXX
   ** PREVIOUS BAD TRACKS = XXXX NEW TRACKS ADDED = XXXX **
```

If you are using a WD800 system and you specified 2 in response to the SURFACE ERROR LIMIT? prompt, the report issues the following warning message if the number was exceeded during SA verb execution:

```
   ** MAXIMUM SURFACE ERROR LIMIT EXCEEDED **
```

2.4.14.6 SA Abort Criteria. If you specify 1 (yes) in response to the SHOULD INCOMING QUALITY CONTROL TERMINATION PARAMETERS BE USED? prompt (see paragraph 2.4.14.2), the verb continually checks the ongoing errors against the SA abort criteria during the surface analysis. If you enter 0, the abort criteria are not used. If you are using a WD800 system, you may enter 2 to specify that you do not want to use the abort criteria but that you want the SA verb to print a warning message if the number you specified in SURFACE ERROR LIMIT prompt is exceeded.

WD900 drives may be configured as two logical units per drive. If this is the case then a WD900 XXX megabyte split refers to the capacities and parameters of one of the logical units. If it is not specified as split, then consider the entire physical drive as one logical unit.

The abort criteria allow early termination as soon as the verb determines that a disk does not meet the incoming test requirements. These requirements follow established media specifications for vendors and are as follows:

Type of Disk	Maximum Number of Errors	Maximum Number of Errors per Head	Maximum Defect Length
CD1400:			
16 megabyte removable	7	--	7
16 megabyte fixed	7	--	--
48 megabyte fixed	21	--	--
80 megabyte fixed	35	--	--
DS80	37	--	--
DS300	100	--	--
WD900 138 megabyte	140	--	--
WD900 138 megabyte split	70	--	--
WD900 425 megabyte	336	--	--
WD900 425 megabyte split	168	--	--
WD800 43 megabyte	42	--	--
WD800 18 megabyte	20	--	--
WD500	16	4	--
WD500A	32	--	--

Type of Disk	Heads That Must Be Error-Free
CD1400:	
16 megabyte removable	All heads of cylinders 0, 1, & 822
16 megabyte fixed	All heads of cylinders 0, 1, & 822
48 megabyte fixed	All heads of cylinders 0 & 822
80 megabyte fixed	All heads of cylinders 0 & 822
DS80	Head 0 of cylinders 0 & 814 Head 1 of cylinder 0
DS300	Head 0 of cylinders 0 & 814 Head 1 of cylinder 0
WD900 138 megabyte	Head 0,1,5,6 of cylinder 0 Head 0,5 of cylinder 822
WD900 425 megabyte	Head 0,1,12,13 of cylinder 0 Head 0,12 of cylinder 710
WD800 43 megabyte	Head 0 of cylinders 0 & 652 Head 1 of cylinder 0
WD800 18 megabyte	Head 0 of cylinders 0 & 652 Head 1 of cylinder 0
WD500/WD500A	Head 0 of cylinder 0 Head 1 of cylinder 0
WD800A (All)	Head 0 of cylinder 0 Head 4 of cylinder 0

2.4.15 Store Registers (SR) Verb

Use the SR verb to obtain the Store Registers values of the drive under test. It performs a Store Registers command and writes the disk descriptor words in the following format:

```
 SR - STORE REGISTERS
TOTAL WORD COUNT= >XXXX
SECT/TRACK = >XX            OVERHEAD/RECORD = >XX
TRACKS/CYL =>XX             CYL/DRV = >XXXX
```

NOTE

The CYL/DRV value does not include the number of diagnostic cylinders or spare cylinders (if available).

2.4.16 Initialize Test (IT) Verb

After DSKSA is loaded, DOCS executes the IT verb automatically to begin initialization. You may execute the IT verb afterwards to reinitialize the original parameters.

3.1 ERROR MESSAGES

DSKSA issues two types of error messages: error messages mhat are common to DSKCD1, DSKCD2, DSKCOM, and DSKSA and those that are specific to DSKSA. Paragraph 3.1.1 describes the common error messages; paragraph 3.1.2 describes the specific error messages.

3.1.1 Common Error Messages

The following error messages common to DSKCD1, DSKCD2, DSKCOM, and DSKSA are described and grouped according to functional subroutines:

Verify Store Registers Subroutine

```
***ERROR 001B
STORE REGISTER VALUES DIDN'T AGREE WITH THE DISK TYPE ENTERED
DURING "IT"
EXPECTED VALUES FOR A
 WORD1 = XXXX   WORD 2 = XXXX   WORD 3=XXXX
RECEIVED VALUES FOR A
 WORD1 = XXXX   WORD 2 = XXXX   WORD 3=XXXX

***ERROR 001E
MISCOMPARE BYTES - ADDRESS=XXXX  BYTE=XX -- ADDRESS=XXXX  BYTE=XX
```

Check Write Subroutine

```
>0019
CAN'T DESTROY DIAGNOSTIC BAD TRACK MAP

***ERROR 001D
ILLEGAL COMMAND ISSUED - BYTE COUNT TOO LARGE
```

Jitter Addressing and Random Reads Subroutine

```
***ERROR 008E
UNFORMATTED READ DOESN'T OBTAIN CORRECT VALUES
EXPECTED WORD1 = XXXX   WORD 2 = XXXX   WORD 3=XXXX
RECEIVED WORD1 = XXXX   WORD 2 = XXXX   WORD 3=XXXX
```

Check Write Protect Subroutine

***ERROR 000F
NO WRITE TO NONDIAG CYL WHEN SAVE DATA OPTION IS CHOSEN

Command Issuer Subroutine

***ERROR 0011
NO DONE INTERRUPT - WAITED 10 SECONDS - AFTER COMMAND
(The IDLE bit in controller word 7 failed to go true after 10 seconds.)

***ERROR 0012
NO IDLE - WAITED 5 SECONDS - AFTER COMMAND

***ERROR 0013
STILL BUSY - WAITED 5 SECONDS - AFTER SEEK OR RESTORE

***ERROR 0014
NO GATED ATTENTION INTERRUPT - WAITED 5 SECONDS

***ERROR 0015
IDLE BIT DIDN'T SET - WAITED 2 SECONDS

***ERROR 001F
NO IDLE BIT SET - WAITED 30 SECONDS

***ERROR 008F
RESTORE, AFTER ID OFF-TRACK ERROR FAILED --- CTL STATUS = XXXX
This message is displayed only for the WD800A. It means that the previous command generated an ID Off-Track error and the Restore command used to correct this condition failed with the status shown in the error message.

Disk Interrupt Subroutine

***ERROR 0016
UNEXPECTED INTERRUPT OCCURRED - PC =XXXX

***ERROR 0017
EXPECTED INTERRUPT OCCURRED AT WRONG TIME: REG 7= XXXX

***ERROR 0018
ATTENTION MASK & LINE MISMATCH - AFTER EXPECTED GATED INTERRUPT
REG 0= XXXX

***ERROR 00A4
INTERRUPT RECEIVED WITH IDLE BIT NOT SET

***ERROR 00A5
UNEXPECTED CHANGE OF TPCS REGISTER

Diagnostic Cylinder Subroutine

***ERROR 0021
*** BAD TRACK MAP IS NOT VALID ***
*** RUN DSKSA TO RESTORE THE TABLE ***

General Information Subroutine

***ERROR 0022
MISCOMPARE OF DATA AT ADDR=XXXX DATA=XXXX -- ADDR=XXXX DATA=XXXX

***ERROR 001C
CONTROLLER STATUS
DISK STATUS CMD HEAD S/R SECT CYL BYTE CNT
XXXX XXXX XX XX XX XXXX XXXX
MEM ADR UNIT CONT STAT
XXXXXX XX XXXX

This error message appears when a status error occurs. This message is similar to the output from the Display Controller Status (DC) verb. See the verb description for an explanation of error conditions.

3.1.2 Specific Error Messages

The error messages specific to DSKSA are described as follows:

***ERROR 0001
SURFACE ANALYSIS HAS BEEN ABORTED BECAUSE INCOMING QUALITY CONTROL TEST PARAMETERS HAVE BEEN EXCEEDED

***ERROR 0002
*** THE BAD TRACK MAP IS NOW FULL ***
*** BAD TRACKS NOT BEING RECORDED ANY MORE ***

***ERROR 0003
SA WILL NOT RUN - WILL DESTROY DATA ON DISK

APPENDIX A

Controller Status Words

Figure A-1 represents the TILINE Peripheral Control Space (TPCS) controller status words. Use the information in this illustration to decode any status words reported by a diagnostic test in an error or informational message.

CONTROL WORD	CPU BYTE ADDRESS
0	F800
1	F802

DISK STATUS

0	1	2	3	4	5	6	7	8 9 10 11	12 13 14 15
OFF LINE	NOT READY	WRITE PROTECT	UNIT CHECK	END OF CYLINDER	SEEK INCOMPLETE	SPARE		ATTN(0-3)	ATTMSK(0-3)

ATTN(n)XATTMSK(n)=INTERRUPT
BIT 4-TRIDENT DRIVES ONLY

COMMAND AND SOURCE

0	1	2	3	4	5	6	7	8 9	10	11	12 13 14 15
SPARE		STROBE EARLY	STROBE LATE	TRANSFER INHIBIT	DISK COMMANDS			OFFSET HEAD	OFFSET HEAD FORWARD		HEAD ADDRESS

BITS 2,3,4,8,9 - TRIDENT DRIVES ONLY. ALL OTHER BITS APPLY TO DS31 AND DS10.

DISK COMMANDS
000 STORE REGISTER PARAMETERS

	0		7	8		15
WORD 1	0	WORDS PER TRACK				15
WORD 2	0	SECTOR/TRACK	7	8	OVERHEAD	15
WORD 3	0	TRACKS/CYL	4	5	CYLINDER/UNIT	15

001 WRITE FORMAT
010 READ DATA
011 WRITE DATA
100 READ UNFORMATED PARAMETERS

	0		4	5		15
WORD 1	0	HEAD	4	5	CYLINDER	15
WORD 2	0	SECTOR/RECORD	7	8	SECTOR ADDRESS	15
WORD 3	0	WORD COUNT				15

101 WRITE UNFORMATED
110 SEEK
111 RESTORE

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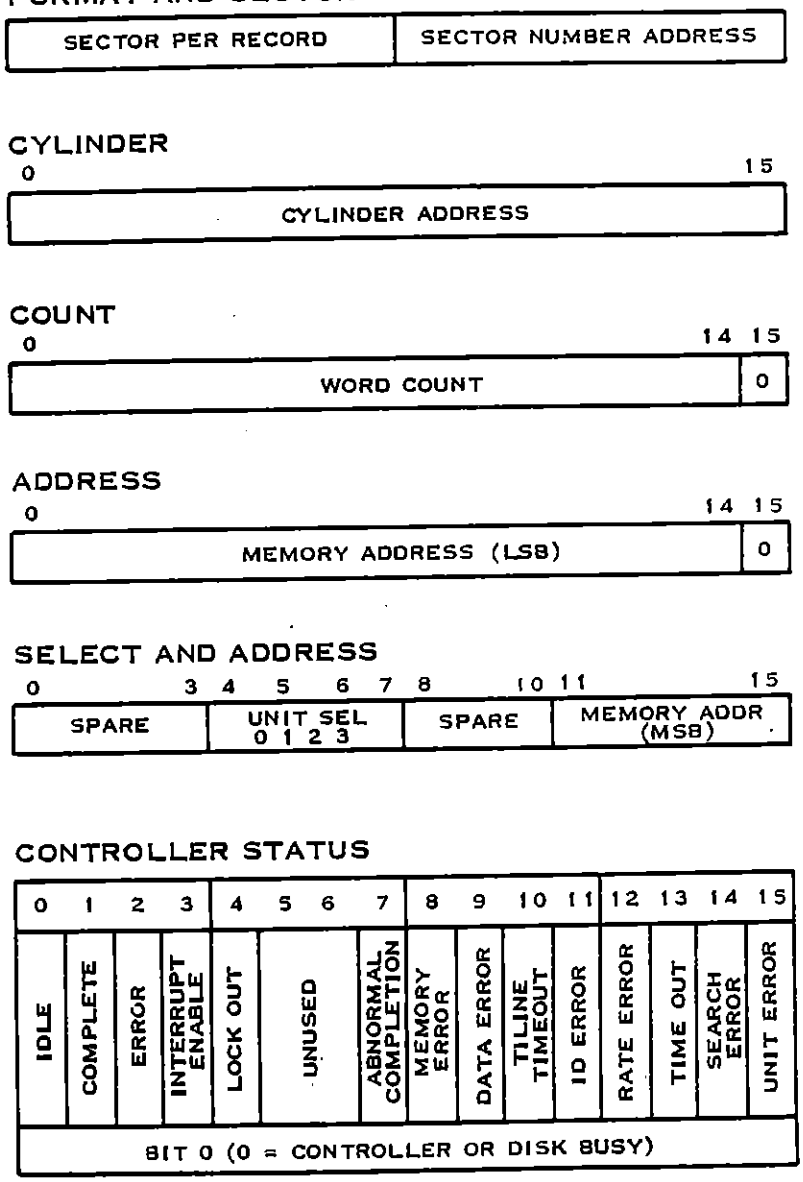
CONTINUED

Figure A-1. TPCS Controller Status Words, Page 1 of 2

CONTROL WORD	CPU BYTE ADDRESS	
2	F804	FORMAT AND SECTOR
3	F806	CYLINDER
4	F808	COUNT
5	F80A	ADDRESS
6	F80C	SELECT AND ADDRESS
7	F80E	CONTROLLER STATUS



* THE INFORMATION IN CONTROL WORD 7 APPLIES ONLY WHEN BIT 0 IS SET TO 1

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Figure A-1. TPCS Controller Status Words, Page 2 of 2

USER'S RESPONSE SHEET

Manual Title: Unit Diagnostics Handbook, Volume 3, Diagnostics for 990 Mass Storage Devices (945400-9703)

Manual Date: December 1985 **Date of This Letter:** _____

User's Name: _____ **Telephone:** _____

Company: _____ **Office/Department:** _____

Street Address: _____

City/State/Zip Code: _____

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