NSN-0056-00-472-0000

TI 6490.19

INSTRUCTION BOOK

TANDEM PROCESSING SUBSYSTEM (DIAGNOSTICS)

PART OF

FLIGHT SEVICE AUTOMATION SYSTEM

VOLUME III

CONTROLLED DOCUMENT

CONTRACT DTFA01-81-C-10039

CONTRACTOR

E-SYSTEMS, INC.
GARLAND DIVISION
P.O. BOX 660023
DALLAS, TEXAS 75266-0023

416-21626

3 JUNE 1985

MADE FOR

U.S. DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

PROPRIETARY NOTICE

Tandem will grant to the FAA, with regard to Tandem's proprietary software and hardware manuals, including but not limited to maintenance manuals, Limited Rights in Data in accordance with DAR 7-104.9(a), with the following exceptions:

1. "Government" is limited to "FAA FSAS and MPS Programs only."

2. No right to reproduce is granted.

3. No right to disclose to third parties is granted unless either (a) the third party is authorized by Tandem, in writing, to receive such disclosure; or (b) Tandem has declined, in writing, to assist the FAA in resolving the emergency repair or overhaul work. In no event will the FAA make such disclosure without making such disclosure subject to a suitable prohibition against further use, release, or disclosure.

The rights identified above shall be subject to and in accordance with the Tandem/FAA License Agreement executed by the FAA on 6 December 1984.

VOLUME 3

Serial Number

107

VOLUME 3B

Disc Drive Subsystems Diagnostics

SECOND LEVEL MANUAL

DIAGNOSTIC OPERATING PROCEDURES

NonStop II (TM)

VOLUME 3B

DISC DRIVE SUBSYSTEMS DIAGNOSTICS

(CURRENT)

Copyright © 1982

TANDEM COMPUTERS INCORPORATED
2450 Walsh Avenue
Santa Clara, California 95050

Tandem Part Number 82803

December 1982
Printed in U.S.A.

This document contains information that is protected by copyright. No part of this document may be photocopied, reproduced or translated to another program or system without the prior written consent of Tandem Computers Incorporated.

The following are trademarks of Tandem Computers Incorporated:
Tandem, NonStop, NonStop II, AXCESS, DYNABUS, ENCOMPASS, ENFORM, ENSCRIBE, ENVOY, EXCHANGE, EXPAND, GUARDIAN, TGAL, PATHWAY, XRAY.

CURRENT TABLE OF CONTENTS

VOLUME 3B – DISC DRIVE SUBSYSTEMS DIAGNOSTICS

CHAPTER 1 – TANDEM PRODUCED DISC DRIVE DIAGNOSTICS

PART 1. OFFLINE DISC DRIVE DIAGNOSTICS - OVERVIEW.....

PART 1A. FAST4103, FAST4104, FAST4105, FAST4109, FAST4110, AND FAST4116.....

PART 1B. DISC4103, DISC4104, DISC4105, DISC4109, DISC4110, AND DISC4116.....

PART 1C. DEX4103, DEX4104, DEX4105, DEX4109, DEX4110, AND DEX4116.....

PART 1D. DUT4103, DUT4104, DUT4105, DUT4109, DUT4110, AND DUT4116.....

PART 1E. EDT4103, EDT4104, EDT4105, EDT4109, EDT4110, AND EDT4116.....

PART 1F. FMT4103, FMT4104, FMT4105, FMT4109, FMT4110, AND FMT4116.....

PART 1G. REX4103, REX4104, REX4105, REX4109, REX4110, AND REX4116.....

CHAPTER 1

Tandem Produced Disc Drive Diagnostics

PART 1

Offline Disc Drive Diagnostics

SECOND LEVEL MANUAL

DIAGNOSTIC OPERATING PROCEDURES

NonStop II (TM)

VOLUME 3B, CHAPTER 1, PART 1

OVERVIEW:

OFFLINE DISC DRIVE DIAGNOSTICS

Copyright © 1982

TANDEM COMPUTERS INCORPORATED
2450 Walsh Avenue
Santa Clara, California 95050

Tandem Part Number 82803

October 1982
Printed in U.S.A.

This document contains information that is protected by copyright. No part of this document may be photocopied, reproduced or translated to another program or system without the prior written consent of Tandem Computers Incorporated.

The following are trademarks of Tandem Computers Incorporated:
Tandem, NonStop, NonStop II, AXCESS, DYNABUS, ENCOMPASS, ENFORM, ENSCRIBE, ENVOY, EXCHANGE, EXPAND, GUARDIAN, TGAL, PATHWAY, XRAY.

VOLUME 3B, CHAPTER 1, PART 1

TABLE OF CONTENTS

Par.No.	Title	Page No.
	SECTION 1 DIAGNOSTICS OVERVIEW	
1.0	DIAGNOSTICS OVERVIEW	1-1
1.1	DATA FORMAT	1-3
1.2	PROGRAM SELECTION AND EXECUTION	1-6
1.3	ERROR MESSAGES AND CONDITIONS	1-7
1.4	PRERUN CONSIDERATIONS	1-12

LIST OF ILLUSTRATIONS

Fig.No.	Title	Page No.
1-1	Sector-skipping Format for Data on Disc	1-5
1-2	Format of EIO Status Word	1-7
1-3	Format of IIO Status and Cause Words	1-8

LIST OF TABLES

Table No.	Title	Page No.
1.1	Diagnostics for the NonStop Disc Subsystems	1-2
1.2	Device Characteristics in Sector-skipping Format	1-4
1.3	Error Messages Accompanying Standard SHADOW Messages	1-9

PART 1 - OVERVIEW: OFFLINE DISC DRIVE DIAGNOSTICS
TABLE OF CONTENTS

SECTION 1
DIAGNOSTICS OVERVIEW

1.0 DIAGNOSTICS OVERVIEW

The Tandem NonStop II (TM) system currently supports six different disc subsystems in sector-skipping format. A range of SHADOW diagnostics is provided for the maintenance of each of these subsystems. These diagnostics, the functions they serve, and the subsystems to which they apply, are all listed in Table 1.1, together with the manual reference where detailed descriptions can be found.

NOTE

The NonStop system supports a somewhat different set of disc subsystems and two data formats (track sparing as well as sector skipping). For a list of these subsystems and a description of the relevant diagnostics, refer to NonStop Diagnostic Operating Procedures, Part Number 82802, Volume 3B, Chapter 1, Part 1.

Table 1.1 Diagnostics for the NonStop II Disc Subsystems

DIAGNOSTIC	FUNCTION	MANUAL REF. *	APPLICABLE DISC SUBSYSTEMS
FAST	Cable verifier; provides quick check of controller and data path.	1A	T16/4103 T16/4104 T16/4105/4106 ** T16/4109 T16/4110/4111 ** T16/4116
DISC	Test of disc and controller function.	1B	T16/4103 T16/4104 T16/4105/4106 ** T16/4109 T16/4110/4111 ** T16/4116
DEX	Disc control exerciser; provides command set for interactive testing of disc function.	1C	T16/4103 T16/4104 T16/4105/4106 ** T16/4109 T16/4110/4111 ** T16/4116
DUT	Defect-logging utility program; provides command set for interactive use; allows manipulation of defect log cylinder (DLCYL).	1D	T16/4103 T16/4104 T16/4105/4106 ** T16/4109 T16/4110/4111 ** T16/4116
EDT	Extended data test.	1E	T16/4103 T16/4104 T16/4105/4106 ** T16/4109 T16/4110/4111 ** T16/4116
FMT	Disc pack formatter; formats and verifies the disc pack in sector-skipping format.	1F	T16/4103 T16/4104 T16/4105/4106 ** T16/4109 T16/4110/4111 ** T16/4116
REX	Random exerciser; provides command set for interactive random testing of disc function.	1F	T16/4103 T16/4104 T16/4105/4106 ** T16/4109 T16/4110/4111 ** T16/4116
FHD	Fixed-head test; tests fixed-head portion of the disc.	1G	T16/4109

* In all cases, the manual reference is to the specified part of the present volume and chapter (Volume 3B, Chapter 1).

** The T16/4105 and 4106 disc drives are identical devices, as are the T16/4110 and 4111, except that in each case the first is free standing in the cabinet and the second is drawer mounted.

T16/SL11-01

1.1 DATA FORMAT

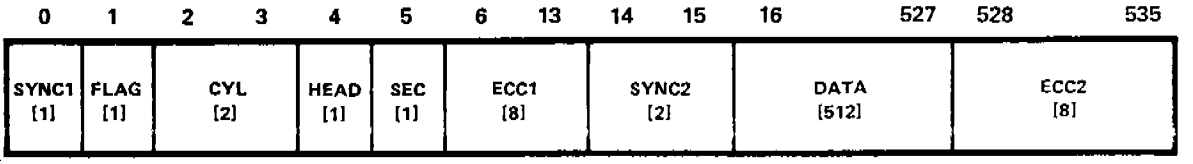
The single data format for disc media currently supported on the NonStop II system is sector skipping. Device characteristics for sector-skipping format are listed in Table 1.2.

In sector skipping, if a sector is defective, only that sector is "skipped;" the data logically stored at that sector address is physically stored in the next sector, and so on, down through the cylinder. Each cylinder allocates a number of spare sectors at the end, allowing for a corresponding number of defective sectors to be handled within the physical boundaries of the cylinder. (The number of spare sectors per cylinder is device-specific; refer to Table 1.2.) If more than that number of defects occur on a given cylinder, the logical addresses for that cylinder are completed on a spare cylinder.

For all media, the basic block of data storage is a sector containing 536 bytes. The sector-skipping interpretation of this basic block is described in Figure 1-1.

Table 1.2 Device Characteristics in Sector-skipping Format

DEVICE CHARACTERISTIC	T16/ 4103	T16/ 4104	T16/ 4105/ 4106	T16/ 4109	T16/ 4110/ 4111	T16/ 4116
Device type	3	2	1	1	3	0
Maximum sector (MAXSECT)	19	29	29	29	29	29
Maximum head (MAXHEAD)	18	18	4	4	9	39
Maximum cylinder (MAXCYL)	814	814	822	822	822	842
Defect list cylinder (DLCYL)	813	813	821	821	821	841
First spare cylinder (FSPCYL)	805	803	811	811	811	831
Last spare cylinder (LSPCYL)	812	812	820	820	820	840
First fixed cylinder (FFXCYL)	-	-	-	896	-	-
Last fixed cylinder (LFXCYL)	-	-	-	915	-	-
Last fixed head (LFXHD)	-	-	-	0	-	-
Spare sectors per cylinder (SPSCYL)	2	2	2	2	4	8
Literal PROM ID (LPRID)	%102	%101	%101 %102	%101 %102	%101 -	%101 %102
Volume label sector (CYL/HEAD/SECT)	0/0/2	0/0/2	0/0/2	0/0/2	0/0/2	0/0/2
Spare track table sector (CYL/HEAD/SECT)	0/0/3	0/0/3	0/0/3	0/0/3	0/0/3	0/0/3



SYNC1 = %360 (Good sector - marks the end of the preceding lockup field allowed for read synchronization and signals that address header is to follow)

%377 (Bad sector - all bytes of the entire sector are filled with ones)

FLAG = %350 (Normal sector - CYL/HEAD/SECT contains the current logical address)

%351 (Defective data area)

%352 (Jump-from-extension sector - CYL/HEAD/SECT contains the physical address of return from extension)

%353 (Spare sector)

%354 (Maximum sector on a track)

%355 (Only good sector on a track)

%356 (Jump-to-extension sector - CYL/HEAD/SECT contains the current physical address of extension)

%357 (End of cylinder)

%377 (Defective header)

ECC1 = [0:6] = Error correction code for address header
[7] = Pad byte of zeros

SYNC2 = [0] = %360
[1] = Pad byte of zeros

DATA = 512 bytes of written data

ECC2 = [0:6] = Error correction code for data portion
[7] = Pad byte of zeros

Figure 1-1 Sector-skipping Format for Data on Disc

1.2 PROGRAM SELECTION AND EXECUTION

Before any of the disc diagnostics can be run, the following system resources must be taken off line and dedicated exclusively to the SHADOW program:

a. The disc drive to be tested and associated controller

b. The processor into which SHADOW is to be loaded.

In addition, the user must have access to the OSP subsystem.

From the OSP terminal, SHADOW is then loaded into the test processor by one of the three customary methods, and the desired Switch Register options may be set in the operator control panel of the test processor. In addition to the standard SHADOW switch settings, special switch settings are defined for certain diagnostics.

After SHADOW is loaded, the appropriate diagnostics for the particular subsystem under test can be loaded and run. The typical SHADOW requests for input are displayed at the OSP terminal as the diagnostic initializes. Initialization cannot complete without appropriate responses from the operator. Thereafter, depending on which program is running, considerable or very little user interaction may be required.

Most of the disc diagnostics perform WRITE operations to the disc volumes under test, destroying whatever data is currently stored on the media. For this reason, if the disc drive under test houses removable media, a scratch pack is customarily installed before the diagnostic is run. When nonremovable media are being tested, unless the disc volume is configured as part of a mirrored pair or a backup of the data exists on tape, the test may have to be retricted to the exercising of READ ONLY functions. Several of the diagnostics offer the READ ONLY option at initialization.

1.3 ERROR MESSAGES AND CONDITIONS

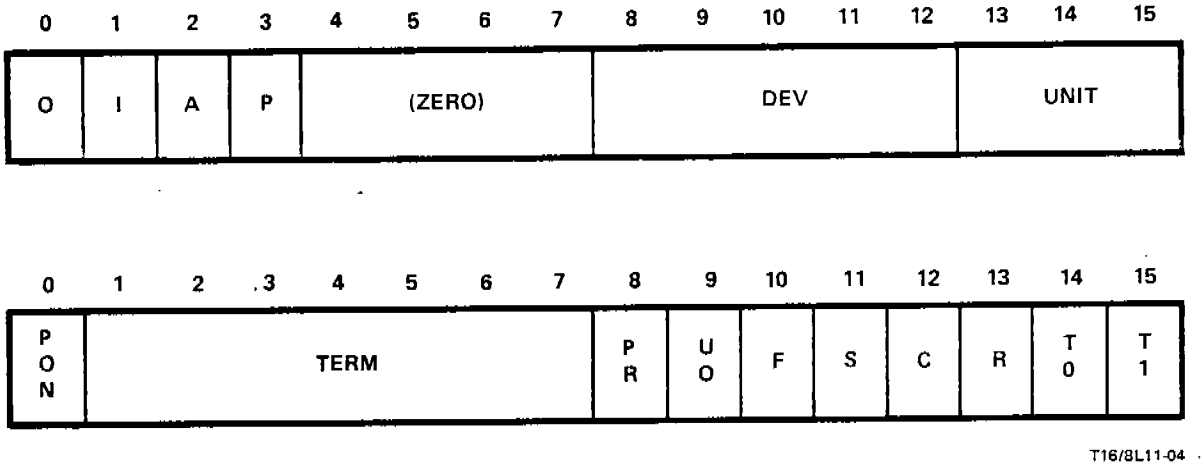
All of the diagnostics utilize the SHADOW error message facility and return the typical SHADOW messages generated by compare errors, EIO status errors, interrupt status errors, and unexpected non-I/O interrupt errors. These messages include the program step number at which failure occurred, the logical unit number of the device under test, and the EIO and IIO status and cause words.

The formats for the return of EIO status and IIO status are given in Figures 1-2 and 1-3, respectively.

Additional messages, correlating errors to specific disc functions, typically accompany the standard SHADOW error message. These messages are determined by values returned in the IIO cause word. The possible messages, the IIO fields that govern them, and the error conditions to which they refer are described in Table 1.3.

O - OWNERSHIP ERROR
I - INTERRUPT PENDING
B - CONTROL UNIT BUSY
P - I/O BUS PARITY ERROR ON EIO

Figure 1-2 Format of EIO Status Word



O	-	OWNERSHIP ERROR	UO	-	UNIT OWNERSHIP ERROR
I	-	INTERRUPT PENDING	F	-	UNIT WRITE FAULT
A	-	CHANNEL TRANSFER ABORT	S	-	UNIT SEEK ERROR
P	-	PARITY ERROR	C	-	UNIT NOT ON CYLINDER
DEV	-	CONTROLLER NUMBER	R	-	UNIT NOT READY
UNIT	-	UNIT NUMBER	T0	-	UNIT TYPE, MSB
PON	-	POWER ON INTERRUPT	T1	-	UNIT TYPE, LSB
PR	-	UNIT READ ONLY			

TERM - ENCODED TERMINATION STATUS (TERMSTAT):

%00	NO ERROR
%01	UNIT ATTENTION
%02	DATA ERROR CORRECTED
%03	ATTEMPT TO WRITE ON PROTECTED UNIT
%04	ILLEGAL ADDRESS
%05	DIRECT ACCESS TO ALTERNATE TRACK
%06	ILLEGAL OPCODE
%07	UNIT STATUS ERROR
%10	BUFFER PARITY ERROR
%11	UNCORRECTABLE DATA ERROR
%12	NO SERVO CLOCKS DURING A WRITE
%13	VERIFY ERROR
%14	HEADER SEARCH FAILED
%15	HEADER ADDRESS MISCOMPARE
%16	ROM PARITY ERROR
%17	UNIT NOT PRESENT
%20	DUPLICATE UNIT NUMBER
%21	UNIT OWNERSHIP ERROR
%22	UNIT NOT READY
%23	READ RETRY SUCCESSFUL WITHOUT OFFSET
%24	READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS
%25	READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS
%26	READ RETRY SUCCESSFUL WITH DATA STROBE LATE
%27	READ RETRY SUCCESSFUL WITH DATA STROBE EARLY
%30	READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS AND DATA STROBE LATE
%31	READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS AND DATA STROBE EARLY
%32	READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS AND DATA STROBE LATE
%33	READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS AND DATA STROBE EARLY
%34	IDLE LOOP DISC CONTROLLER EXERCISER ERROR

Figure 1-3 Format of IIO Status and Cause Words

Table 1.3 Error Messages Accompanying Standard SHADOW Messages

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
TIMEOUT ERROR	IIO CAUSE = -1	A timeout occurred on the controller before the current operation could complete.
DEVICE TYPE ERROR	IIO CAUSE bits <14:15>	The accessed unit returned a different device type from that expected by the controller.
NOT READY ERROR	IIO CAUSE bit <13>	One of the following conditions obtains: a. No disc pack is installed. b. Disc spindle motor is not up to speed. c. Read/write heads are not loaded. d. DC voltages of drive are not within margin. e. Terminator is not present or does not have power.
NOT ON CYLINDER ERROR	IIO CAUSE bit <12>	A seek to an illegal address has been received from the channel, i.e., a cylinder, head, or sector address greater than the maximum legal value has been specified (refer to Table 4.1).
SEEK ERROR	IIO CAUSE bit <11>	Drive is unable to seek to specified address.
WRITE FAULT ERROR	IIO CAUSE bit <10>	One of the following conditions obtains: a. More than one write/read head selected b. Read gate and write gate both true c. Read gate and erase gate both true d. Write current but no erase current e. Erase current but no write current f. Write gate or erase gate but not on cylinder g. DC voltages below margin h. Emergency retract condition
OWNERSHIP ERROR	IIO CAUSE bit <9>	Controller is owned by the other port.
WRITE PROTECT ERROR	IIO CAUSE bit <8>	Write operation attempted to disc drive with WRITE PROTECT switch on.

T16/8L11-05

Table 1.3 Error Messages Accompanying Standard SHADOW Messages (Cont'd)

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
NO TERMSTAT ERROR	TERM = %00	No error.
TERMSTAT ATTENTION ERROR	TERM = %01	One of the following unit attention conditions occurred: a. Selected drive ready (head load sequence) b. I.D. plug changed after drive ready c. Seek complete.
TERMSTAT CORRECTED DATA ERROR	TERM = %02	An error correctable by error correction code (ECC) occurred during a READ operation (≤ 11 bits).
TERMSTAT WRITE ATTEMPT TO PROTECTED UNIT ERROR	TERM = %03	WRITE-type command issued to disc drive with READ ONLY switch enabled.
TERMSTAT ILLEGAL ADDRESS ERROR	TERM = %04	A cylinder address was too large.
TERMSTAT DIRECT ACCESS TO ALT TRACK ERROR	TERM = %05	Not used in sector-skipping format. (In track-sparing, indicates that a READ or WRITE was issued to an alternate track before execution of the routine required to access that track.)
TERMSTAT ILLEGAL OPCODE ERROR	TERM = %06	The controller command in the EIO Address/Command Word is not valid.
TERMSTAT UNIT STATUS ERROR	TERM = %07	One of the following unit status conditions obtains: a. SEEK issued to disc drive with SEEK or NOT ON CYLINDER error b. FAULT or SEEK error occurred during a programmed seek, recalibrate, or head load sequence.
TERMSTAT BUFFER PARITY ERROR	TERM = %10	Incorrect parity in data word read from the controller 4K byte buffer (odd parity maintained).
TERMSTAT UNCORRECTABLE DATA ERROR	TERM = %11	A data record accessed with a READ error burst greater than 11 bits. ECC detected but uncorrectable. Data block could not be recovered with 27 retries using all offset combinations.
TERMSTAT NO SERVO CLOCKS DURING A WRITE	TERM = %12	Record CRC error.

T16/8L11-06

Table 1.3 Error Messages Accompanying Standard SHADOW Messages (Cont'd)

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
TERMSTAT VERIFY ERROR	TERM = %13	Data read into the buffer does not compare with I/O channel data.
TERMSTAT HEADER SEARCH FAILURE	TERM = %14	One of the following header search conditions occurred: a. No headers on addressed track could be read. b. No sector match among headers on addressed track.
TERMSTAT HEADER ADDRESS MISCOMPARE	TERM = %15	Cylinder address or head address does not compare with the address loaded into the cylinder or head address registers.
TERMSTAT ROM PARITY ERROR	TERM = %16	Incorrect parity in microprogram instruction word read from ROM (odd parity maintained).
TERMSTAT UNIT NOT PRESENT ERROR	TERM = %17	Proper I.D. plug not installed.
TERMSTAT DUPLICATE UNIT NUMBER ERROR	TERM = %20	Plugs with the same I.D. installed in more than one disc drive.
TERMSTAT UNIT OWNERSHIP ERROR	TERM = %21	Disc drive owned by other controller.
TERMSTAT UNIT NOT READY ERROR	TERM = %22	Drive is not up to speed with the heads loaded.

T16/8L11-07

1.4 PRERUN CONSIDERATIONS

Before any of the disc diagnostics can be run, steps must be taken to allocate the system resources necessary for SHADOW and to ensure that the diagnostic run has minimum impact on system performance.

NOTE

> Factors to be considered when estimating down time include not only the run times for the diagnostics to be used, but also the time which may be required for reformatting and reviving the discs after the diagnostics are completed. The times required for these procedures can vary from several hours to overnight, depending on such factors as size of the disc pack and system load.

The necessary prerun procedures are ordinarily handled by the local system manager, or at least with the concurrence of the system manager. The standard preparations include:

a. Obtaining access to the OSP subsystem.

NOTE

> Refer to the OSP User Guide, for a description of the setup procedure for diagnostics.

b. Taking the necessary steps to ensure that user processes currently running in the test processor remain operational when that processor is taken off line. The procedure is as follows:

1. Execute the following COMINT command at a terminal with an operating Command Interpreter to determine which processes, if any, are currently running without backup:

STATUS <cpu>, PRI

2. If there are any user processes operating without backup in the processor to be taken off line, restart them in a processor that is to remain operational if they are required for normal system operation.

NOTE

When a processor is taken off line, all processes currently operating in that processor in NonStop mode automatically revert to the backup processor assigned to them. The COMINT command PPD is described in the GUARDIAN Operating System Command Language and Utilities Manual, Part Number 82073.

c. Transferring to another processor the path preference of all controllers with preferred paths currently assigned to the processor to be taken off line. The procedure is as follows:

1. Execute the PUP command LISTDEV to determine which controllers currently have preferred paths assigned in the test processor.

2. For all affected controllers, execute the PUP command PRIMARY to reassign the preferred path to the backup processor.

3. Execute a command like FUP SUBVOLS or PUP LISTBAD to exercise the new primary data path and ensure access to devices.

4. Reexecute the PUP command LISTDEV to verify that the switch takes place.

NOTE

The PUP commands LISTBAD, LISTDEV, and PRIMARY are described in the NonStop II System Operations Manual, Part Number 82075.

d. If the disc volume to be tested is running in NonStop mode (i.e., operating with a mirrored volume), examining the mirror volume for bad tracks and making the necessary provisions for the REVIVE procedure.

NOTE

Once the disc volume under test is serviced, it is revived from its mirror volume if the subsystem is so configured. Otherwise, the data is restored from tape or the original pack is replaced on the drive. If the mirror volume contains unrecorded defects, these defects automatically cause the REVIVE to abort. Therefore, the mirror volume should be inspected in advance, and the reported defects skipped. A smooth REVIVE procedure is thereby ensured. The facility for examining and sparing bad tracks is provided by the PUP program. The required commands are LISTBAD, LISTSPARES, and SPARE. These commands are described in the NonStop II System Operations Manual, Part Number 82075. REVIVE is also a PUP procedure.

e. Taking the necessary steps to protect user data stored on the disc volumes to be tested. The options are as follows

1. If the disc drive to be tested houses removable media, remove the user disc pack and replace with scratch pack. (The T16/4103 T16/4104, and T16/4105/4106 disc drives contain removable media.)

2. If the disc drive to be tested houses nonremovable media, perform a backup of the media on magnetic tape. (The disc drives containing nonremovable media are the T16/4109, the T16/4110/4111, and the T16/4116.)

NOTE

Backup of an entire disc volume may take several hours or more, depending on such factors as system load and storage capacity of the disc drive under test.

f. Taking off line the processor to be loaded with SHADOW. The procedure for taking a processor off line is described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 2.

g. Taking off line the disc drive to be tested and the associated controller.

NOTE

The facility for taking disc drives off line is provided by the PUP program. The required commands are STOPOPENS, REMOVE, and DOWN. (Once the STOPOPENS command is issued, the system is accessible only through the PUP program until the DOWN command successfully completes. REMOVE must be used instead of DOWN when taking off line a disc volume that is operating with a mirror volume. Never use PUP STOPOPEN on $SYSTEM.) These commands are described in the NonStop II System Operations Manual, Part Number 82075. A disc controller is off line only when all the disc drives to which it is attached are off line.

If a T16/4109 disc drive is to be tested, both the moving and fixed-head portions of the disc (each assigned a different physical unit number) must be taken off line. Since the drives are dual ported, both paths to both portions of the disc must be off line.

PART 1A

FAST 4103, FAST 4104, FAST 4105
FAST 4109, FAST 4110, FAST 4116

SECOND LEVEL MANUAL

DIAGNOSTIC OPERATING PROCEDURES

NonStop II (TM) Systems

VOLUME 3B, CHAPTER 1, PART 1A

FAST4103, FAST4104, FAST4105, FAST4109,
FAST4110, AND FAST4116 DISC DIAGNOSTICS

Copyright © 1982

TANDEM COMPUTERS INCORPORATED
2450 Walsh Avenue
Santa Clara, California 95050

Tandem Part Number 82803

October 1982
Printed in U.S.A.

This document contains information that is protected by copyright. No part of this document may be photocopied, reproduced or translated to another program or system without the prior written consent of Tandem Computers Incorporated.

The following are trademarks of Tandem Computers Incorporated:
Tandem, NonStop, NonStop II, AXCESS, DYNABUS, ENCOMPASS, ENFORM, ENSCRIBE, ENVOY, EXCHANGE, EXPAND, GUARDIAN, TGAL, PATHWAY, XRAY.

VOLUME 3B, CHAPTER 1, PART 1A

TABLE OF CONTENTS

Par.No.	Title	Page No.
	SECTION 1 INTRODUCTION	
1.0	INTRODUCTION	1-1
	SECTION 2 OVERVIEW	
2.0	OVERVIEW	2-1
2.1	PROGRAM SELECTION AND EXECUTION	2-2
	SECTION 3 COMMANDS	
3.0	COMMANDS	3-1
	SECTION 4 ERROR CONDITIONS AND DISPOSITIONS	
4.0	ERROR CONDITIONS AND DISPOSITIONS	4-1
4.1	ERROR INFORMATION APPENDED TO SHADOW ERROR MESSAGES	4-6
4.2	OTHER ERROR MESSAGES RETURNED BY THE FAST DIAGNOSTICS	4-10
	SECTION 5 RUN PROCEDURES	
5.0	RUN PROCEDURES	5-1
5.1	PREPARATIONS FOR RUNNING THE FAST DIAGNOSTICS	5-3
5.2	RUN PROCEDURE FOR THE FAST DIAGNOSTICS	5-5

TABLE OF CONTENTS (Cont'd)

LIST OF ILLUSTRATIONS

Fig.No.	Title	Page No.
4-1	Format of EIO Status Word	4-2
4-2	Format of IIO Status and Cause Words	4-3
4-3	Sector-skipping Format for Data on Disc	4-4
5-1	Sample Successful Run of FAST4105	5-2

LIST OF TABLES

Table No.	Title	Page No.
1.1	Disc Subsystem Diagnostics for the NonStop II System	1-2
2.1	Tests Performed by the FAST Diagnostics	2-3
4.1	Device Characteristics in Sector-skipping Format	4-5
4.2	Error Messages Accompanying Standard SHADOW Messages	4-7
4.3	Other Error Messages Generated by the FAST Diagnostics	4-10
5.1	Checklist for the FAST Diagnostics	5-4
5.2	Switch Register Options Available for the FAST Diagnostics	5-6

PART 1A - FAST4103/FAST4104/FAST4105/FAST4109/FAST4110/FAST4116
TABLE OF CONTENTS

SECTION 1
INTRODUCTION

1.0 INTRODUCTION

This chapter describes six SHADOW diagnostics, FAST4103, FAST4104, FAST4105, FAST4109, FAST4110, and FAST4116. These diagnostics, sometimes called the cable verifiers, are designed to test controller and cable functions. They can be used, respectively, to test a T16/4103, 4104, 4105/4106, 4109, 4110/4111, or 4116 disc drive configured with a T16/3106 controller on a NonStop II system.

When a Tandem disc subsystem is faulty, the FAST diagnostics can be run to determine the types of errors being produced and to help isolate the probable area of failure. After the suspected area of failure is corrected, these programs can be run again as end tests to ensure that the errors are eliminated.

The FAST diagnostics run without respect to disc pack format. On a NonStop II system, however, it is assumed that the format is sector skipping. Discretion must be exercised when executing these programs because they destroy data on the disc.

The FAST diagnostics are one of seven sets of SHADOW diagnostic programs provided for the NonStop II disc subsystems. Refer to Table 1.1 for a list of the other available diagnostics.

FAST4103, FAST4104, FAST4105, FAST4109, FAST4110, and FAST4116 are written for SHADOW Rev level D00 and are compatible with all Rev levels of the disc controller and disc drives.

Table 1.1 Disc Subsystem Diagnostics for the NonStop II System *

SUBSYSTEM	DIAGNOSTIC	MANUAL REF. **
T16/4103 drive - T16/3106 ctrl	FAST4103	Part 1A
	DISC4103	Part 1B
	DEX4103	Part 1C
	DUT4103	Part 1D
	EDT4103	Part 1E
	FMT4103	Part 1F
	REX4103	Part 1G
T16/4104 drive - T16/3106 ctrl	FAST4104	Part 1A
	DISC4104	Part 1B
	DEX4104	Part 1C
	DUT4104	Part 1D
	EDT4104	Part 1E
	FMT4104	Part 1F
	REX4104	Part 1G
T16/4105 drive - T16/3106 ctrl ***	FAST4105	Part 1A
T16/4106 drive - T16/3106 ctrl	DISC4105	Part 1B
	DEX4105	Part 1C
	DUT4105	Part 1D
	EDT4105	Part 1E
	FMT4105	Part 1F
	REX4105	Part 1G
T16/4109 drive - T16/3106 ctrl	FAST4109	Part 1A
	DISC4109	Part 1B
	DEX4109	Part 1C
	DUT4109	Part 1D
	EDT4109	Part 1E
	FMT4109	Part 1F
	REX4109	Part 1G
	FHD4109	Part 1H
T16/4110 drive - T16/3106 ctrl ***	FAST4110	Part 1A
T16/4111 drive - T16/3106 ctrl	DISC4110	Part 1B
	DEX4110	Part 1C
	DUT4110	Part 1D
	EDT4110	Part 1E
	FMT4110	Part 1F
	REX4110	Part 1G
T16/4116 drive - T16/3106 ctrl ***	FAST4116	Part 1A
	DISC4116	Part 1B
	DEX4116	Part 1C
	DUT4116	Part 1D
	EDT4116	Part 1E
	FMT4116	Part 1F
	REX4116	Part 1G

* A somewhat different subset of disc subsystems is supported on the NonStop (TM) system, some in sector-skipping format and some in track-sparing format. For a complete list of the disc subsystems supported on the NonStop system and of the applicable diagnostics, refer to NonStop Diagnostic Operating Procedures, Part Number 82802, Volume 3B, Chapter 1, Part 1.

** In all cases, the general manual reference is to Volume 3B, Chapter 1, of NonStop II Diagnostic Operating Procedures, Part Number 82803.

*** The T16/4105 and 4106 disc drives are identical devices, as are the T16/4110 and 4111, except that in each case the first is free standing in the cabinet and the second is drawer mounted.

T16/8L11A-01

SECTION 2
OVERVIEW

2.0 OVERVIEW

The FAST diagnostics are typically used as quick tests of the data path of the disc drive/controller subsystems under test. If a cable verifier fails, the controller or connecting cables are immediately indicated as faulty.

The FAST diagnostics are designed to test one controller, an optional secondary controller, and up to eight drives at any one time. A preformatted disc pack must be mounted on the drive since the cable verifiers do not write address headers (format the pack).

> CAUTION
>
> The FAST diagnostics are designed for use primarily in manufacturing; in the field, because they can destroy data on the disc, they must be used with extreme caution.

The FAST diagnostics are run from the OSP terminal. Before any of them can be run, the following system resources must be taken off line and dedicated exclusively to the SHADOW program:

a. The disc drive to be tested and the associated controller

b. The processor into which SHADOW is to be loaded (the procedure for taking processor modules off line is described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 2)

SHADOW is then loaded into the test processor by one of the three customary methods, and the desired Switch Register options may be set in the operator control panel of the test processor. Refer to Table 5.2 for a description of the Switch Register options for the FAST diagnostics. The SHADOW load procedure is described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 1).

2.1 PROGRAM SELECTION AND EXECUTION

After SHADOW is loaded, the appropriate FAST diagnostic for the particular disc subsystem under test can be loaded and run. The typical SHADOW requests for input are displayed at the OSP terminal as the program initializes. Initialization cannot complete without appropriate user responses.

The FAST diagnostics present the following options at program initialization:

a. READ ONLY mode

b. Bypass write/read/verify test on primary cylinders

c. Continuous looping of the diagnostic.

When initialization is complete, the diagnostic begins with basic controller checks. When these procedures are complete for all devices under test, the main test begins execution for the first device under test. The main test reads address headers and performs a series of write/read/verify operations at selected disc addresses. Certain of these operations can be suppressed by the run modes selected at initialization. The tests performed by the FAST diagnostics and the screen displays that signal them are listed in Table 2.1.

The FAST diagnostics display standard SHADOW error messages, as appropriate to the conditions detected (unless error printout is suppressed in the panel switches). If the number of errors for a device under test reaches 100 in the course of the basic controller checks, or if the operator chooses to delete the device from the test list as a result of the check for valid volume I.D., the program does not execute the main test for that device but proceeds directly to the next device to be tested.

When the main test is completed on all devices under test, if LOOP CONTINUOUSLY is enabled, the program prompts for user instruction to begin again. If the appropriate user instruction is received, the diagnostic repeats, starting with the basic controller checks. Otherwise, an error summary is displayed, the program terminates, and SHADOW returns to conversational mode.

Run times for the FAST diagnostics vary, depending on such factors as the number of options exercised, the storage capacity of the disc drive under test, and so on. The settings of the panel switches can also affect the course of any given run of the diagnostic. Factors to be considered when estimating down time include not only the run times for the diagnostics to be used, but also the time which may be required for reformatting and reviving the discs after the diagnostics are completed. The times required for these procedures vary from an hour or less to as long as overnight, depending on such factors as system load and disc pack size. The approximate run time for the FAST diagnostics (per drive, per loop) is eight to ten minutes.

Table 2.1 Tests Performed by the FAST Diagnostics (FAST4103, FAST4104, FAST4105, FAST4109, FAST4110, and FAST4116)

SCREEN DISPLAY	EXPLICATION
*** BASIC CONTROLLER CHECKS ***	Message displayed when the basic controller checks begin. The program performs the following operations: a. Issues SET CYLINDER and SET HEAD/SECTOR commands with 18 test patterns. Then reads and verifies the cylinder, head, and sector registers. b. Writes 18 test patterns to the buffer, then reads and compares the data written. c. Fills the buffer with random data patterns, then reads and compares the data written. d. Issues SEEK commands to head 0, sector 0, of all cylinders, incrementing from 0:MAXCYL and then decrementing from MAXCYL:0.
PUN %: xxx VOLUME NAME IS xxxxxxxx <RETURN> TO CONTINUE, ANY CHAR TO ABORT	Message displayed when the program checks for valid volume ID. If the user elects to abort, the device is deleted from the list of those to be tested before the program proceeds to the next unit to be tested. If the user elects to continue, the program proceeds directly to the next unit to be tested.
*** DRIVE CHECKS *** -UNIT UNDER TEST %: xxx -DEVICE UNDER TEST IS % xxx	Message displayed before the main body of the diagnostic begins execution.
-READ HEAD 0/SECTOR 0 ON ALL CYLINDERS	Message displayed when the program begins the read of headers on all cylinders, at head 0, sector 0.
-READ CYLINDER [TESTCYL]/SECTOR 0 ON ALL HEADS	Message displayed when the program begins the read of headers on all heads of one of two possible test cylinders: cylinder 0 when the diagnostic is running in default mode, and MAXCYL when writing on the primary cylinders has been outlawed at initialization. (For the device-specific values of MAXCYL, refer to Table 4.1.)
-READ CYLINDER [MAXCYL]/HEAD 0 ON ALL SECTORS	Message displayed when the program begins the read of headers on all sectors of MAXCYL.
-WRITE CYLINDER ADDRESS ON HEAD 0/SECTOR 0 CYL RANGE: [0,FIRSTSPARECYL-1]	(Not performed in READ ONLY mode or when access to the primary cylinders is outlawed.) Message displayed when the program begins the WRITE portion of the write/read/verify test of all cylinders.

Table 2.1 Tests Performed by the FAST Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
-READ CYLINDER [TESTCYL]/HEAD 0 ON ALL SECTORS	Message displayed when the program begins the read of headers on all sectors of one of two possible test cylinders: cylinder 0 when the diagnostic is running in default mode, and MAXCYL when writing on the primary cylinders has been outlawed at initialization.
-WRITE CYLINDER ADDRESS ON HEAD 0/SECTOR 0 CYL RANGE: [0,FIRSTSPARECYL-1]	(Not performed in READ ONLY mode or when access to the primary cylinders is outlawed.) Message displayed when the program begins the WRITE portion of the write/read/verify test of all cylinders.
-READ/VERIFY CYLINDER DATA PATTERN CYL RANGE: [0,FIRSTSPARECYL-1]	(Not performed in READ ONLY mode or when access to the primary cylinders is outlawed.) Message displayed when the program begins the READ/VERIFY portion of the write/read/verify test of all cylinders.
-WRITE PATTERN WITH HEAD DATA ON: CYLINDER [MAXCYL]/SECTOR 0, ALL HEADS	(Not performed in READ ONLY mode.) Message displayed when the program begins the WRITE portion of the write/read/verify test on all heads of MAXCYL.
-READ/VERIFY PATTERN WITH HEAD DATA	(Not performed in READ ONLY mode.) Message displayed when the program begins the READ/VERIFY portion of the write/read/verify test on all heads of MAXCYL.
-WRITE PATTERN WITH SECTOR DATA ON: CYLINDER [MAXCYL]/HEAD 0, ALL SECTORS	(Not performed in READ ONLY mode.) Message displayed when the program begins the WRITE portion of the write/read/verify test on all sectors of MAXCYL.
-READ/VERIFY PATTERN WITH SECTOR DATA	(Not performed in READ ONLY mode.) Message displayed when the program begins the READ/VERIFY portion of the write/read/verify test on all sectors of MAXCYL.

T16/8L11A-03

SECTION 3
COMMANDS

3.0 COMMANDS

FAST4103, FAST4104, FAST4105, FAST4109, FAST4110, and FAST4116 contain no program-defined or program-specific commands. They require the SHADOW RUN command for program execution. If the user wishes to implement the NOSTRIP option, the SHADOW OPTION command must also be invoked. (SHADOW defaults to option STRIP.)

SECTION 4
ERROR CONDITIONS AND DISPOSITIONS

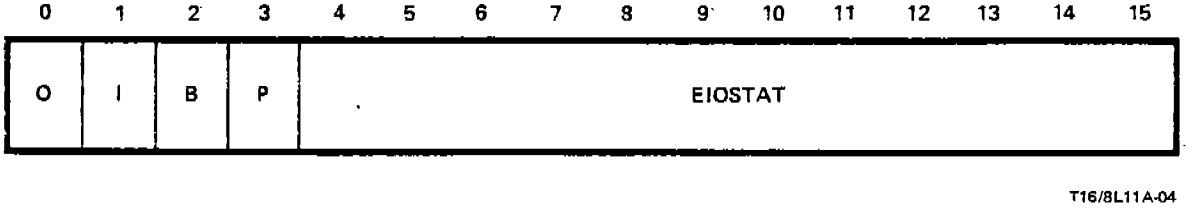
4.0 ERROR CONDITIONS AND DISPOSITIONS

FAST4103, FAST4104, FAST4105, FAST4109, FAST4110, and FAST4116 utilize the SHADOW error message facility and return the standard SHADOW messages generated by compare errors, EIO status errors, interrupt status errors, and unexpected non-I/O interrupt errors. These messages include the program step number at which failure occurred, the logical unit number of the device under test, and the EIO and IIO status and cause words.

When a SHADOW error message is returned, the sequence of events producing the error can be determined by cross-referencing the error message with the program listing of the currently executing diagnostic. The formats for the return of EIO status and IIO status are given in Figures 4-1 and 4-2, respectively. The sector skipping format for data is shown in Figure 4-3. The device characteristics of the T16/4103, 4104, 4105/4106, 4109, 4110/4111, and 4116 disc drives in sector-skipping format are listed in Table 4.1.

The FAST diagnostics append an additional message to the standard SHADOW IIO error message. This additional message, which correlates the error to a specific disc function, is determined by values encoded in specific fields of the IIO status and cause words. The possible messages, the IIO fields that govern them, and the error conditions they indicate are described in Table 4.2.

In addition, certain unique error conditions result in the display of special error messages. These messages, together with the error summary generated when the program completes execution, are described in Table 4.3.



O - OWNERSHIP ERROR
I - INTERRUPT PENDING
B - CONTROL UNIT BUSY
P - I/O BUS PARITY ERROR ON EIO

Figure 4-1 Format of EIO Status Word

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
O	I	A	P	(ZERO)				DEV					UNIT		

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PON	TERM							PR	UO	F	S	C	R	T0	T1

T16/8L11A-05

O - OWNERSHIP ERROR
I - INTERRUPT PENDING
A - CHANNEL TRANSFER ABORT
P - PARITY ERROR
DEV - CONTROLLER NUMBER
UNIT - UNIT NUMBER
PON - POWER ON INTERRUPT
PR - UNIT READ ONLY

UO - UNIT OWNERSHIP ERROR
F - UNIT WRITE FAULT
S - UNIT SEEK ERROR
C - UNIT NOT ON CYLINDER
R - UNIT NOT READY
T0 - UNIT TYPE, MSB
T1 - UNIT TYPE, LSB

TERM - ENCODED TERMINATION STATUS (TERMSTAT):

%00 NO ERROR
%01 UNIT ATTENTION
%02 DATA ERROR CORRECTED
%03 ATTEMPT TO WRITE ON PROTECTED UNIT
%04 ILLEGAL ADDRESS
%05 DIRECT ACCESS TO ALTERNATE TRACK
%06 ILLEGAL OPCODE
%07 UNIT STATUS ERROR
%10 BUFFER PARITY ERROR
%11 UNCORRECTABLE DATA ERROR
%12 NO SERVO CLOCKS DURING A WRITE
%13 VERIFY ERROR
%14 HEADER SEARCH FAILED
%15 HEADER ADDRESS MISCOMPARE
%16 ROM PARITY ERROR
%17 UNIT NOT PRESENT
%20 DUPLICATE UNIT NUMBER
%21 UNIT OWNERSHIP ERROR
%22 UNIT NOT READY
%23 READ RETRY SUCCESSFUL WITHOUT OFFSET
%24 READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS
%25 READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS
%26 READ RETRY SUCCESSFUL WITH DATA STROBE LATE
%27 READ RETRY SUCCESSFUL WITH DATA STROBE EARLY
%30 READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS AND DATA STROBE LATE
%31 READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS AND DATA STROBE EARLY
%32 READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS AND DATA STROBE LATE
%33 READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS AND DATA STROBE EARLY
%34 IDLE LOOP DISC CONTROLLER EXERCISER ERROR

Figure 4-2 Format of IIO Status and Cause Words

0	1	2 3	4	5	6 13	14 15	16 527	528 535
SYNC1 [1]	FLAG [1]	CYL [2]	HEAD [1]	SEC [1]	ECC1 [8]	SYNC2 [2]	DATA [512]	ECC2 [8]

T16/8L11A-06

SYNC1 = %360 (Good sector - marks the end of the preceding lockup field allowed for read synchronization and signals that address header is to follow)

%377 (Bad sector - all bytes of the entire sector are filled with ones)

FLAG = %350 (Normal sector - CYL/HEAD/SECT contains the current logical address)

%350 (Defective data area)

%352 (Jump-from-extension sector - CYL/HEAD/SECT contains the physical address of return from extension)

%353 (Spare sector)

%354 (Maximum sector on a track)

%355 (Only good sector on a track)

%356 (Jump-to-extension sector - CYL/HEAD/SECT contains the current physical address of extension)

%357 (End of cylinder)

%377 (Defective header)

ECC1 = [0:6] = Error correction code for address header
[7] = Pad byte of zeros

SYNC2 = [0] = %360
[1] = Pad byte of zeros

DATA = 512 bytes of written data

ECC2 = [0:6] = Error correction code for data portion
[7] = Pad byte of zeros

Figure 4-3 Sector-skipping Format for Data on Disc

Table 4.1 Device Characteristics in Sector-skipping Format

DEVICE CHARACTERISTIC	T16/ 4103	T16/ 4104	T16/ 4105/ 4106	T16/ 4109	T16/ 4110/ 4111	T16/ 4116
Device type	3	2	1	1	3	0
Maximum sector (MAXSECT)	19	29	29	29	29	29
Maximum head (MAXHEAD)	18	18	4	4	9	39
Maximum cylinder (MAXCYL)	814	814	822	822	822	842
Defect list cylinder (DLCYL)	813	813	821	821	821	841
First spare cylinder (FSPCYL)	805	803	811	811	811	831
Last spare cylinder (LSPCYL)	812	812	820	820	820	840
First fixed cylinder (FFXCYL)	-	-	-	896	-	-
Last fixed cylinder (LFXCYL)	-	-	-	915	-	-
Last fixed head (LFXHD)	-	-	-	0	-	-
Spare sectors per cylinder (SPSCYL)	2	2	2	2	4	8
Literal PROM ID (LPRID)	%102	%101	%101 %102	%101 %102	%101 -	%101 %102
Volume label sector (CYL/HEAD/SECT)	0/0/2	0/0/2	0/0/2	0/0/2	0/0/2	0/0/2
Spare track table sector (CYL/HEAD/SECT)	0/0/3	0/0/3	0/0/3	0/0/3	0/0/3	0/0/3

4.1 ERROR INFORMATION APPENDED TO SHADOW ERROR MESSAGES

In conjunction with the standard SHADOW error message, the FAST diagnostics typically display one of a number of error messages together with the contents of the controller registers. This error message is determined by IIO status. The form of the error message is as follows:

<error message>

CYL xxx HEAD xx SECT xxx FLAGS xxx COUNT xxx ADD xxx

The various messages that may appear in <error message> are listed and explained in Table 4.2. CYL/HEAD/SECT reflects the disc address of the sector accessed by the command; FLAGS returns the value of the header flag in the accessed sector (refer to Figure 4-3); COUNT reflects the bytecount returned by the operation; and ADD reflects the current address of the controller buffer.

Table 4.2 Error Messages Accompanying Standard SHADOW Messages

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
TIMEOUT ERROR	IIO CAUSE = -1	A timeout occurred on the controller before the current operation could complete.
DEVICE TYPE ERROR	IIO CAUSE bits <14:15>	The accessed unit returned a different device type from that expected by the controller.
NOT READY ERROR	IIO CAUSE bit <13>	One of the following conditions obtains: a. No disc pack is installed. b. Disc spindle motor is not up to speed. c. Read/write heads are not loaded. d. DC voltages of drive are not within margin. e. Terminator is not present or does not have power.
NOT ON CYLINDER ERROR	IIO CAUSE bit <12>	A seek to an illegal address has been received from the channel, i.e., a cylinder, head, or sector address greater than the maximum legal value has been specified (refer to Table 4.1).
SEEK ERROR	IIO CAUSE bit <11>	Drive is unable to seek to specified address.
WRITE FAULT ERROR	IIO CAUSE bit <10>	One of the following conditions obtains: a. More than one write/read head selected b. Read gate and write gate both true c. Read gate and erase gate both true d. Write current but no erase current e. Erase current but no write current f. Write gate or erase gate but not on cylinder g. DC voltages below margin h. Emergency retract condition
OWNERSHIP ERROR	IIO CAUSE bit <9>	Controller is owned by the other port.
WRITE PROTECT ERROR	IIO CAUSE bit <8>	Write operation attempted to disc drive with WRITE PROTECT switch on.

T16/8L11A-07

Table 4.2 Error Messages Accompanying Standard SHADOW Messages (Cont'd)

ERROR MESSAGE	IIO.CAUSE WORD	INDICATED ERROR CONDITION
NO TERMSTAT ERROR	TERM = %00	No error.
TERMSTAT ATTENTION ERROR	TERM = %01	One of the following unit attention conditions occurred: a. Selected drive ready (head load sequence) b. I.D. plug changed after drive ready c. Seek complete.
TERMSTAT CORRECTED DATA ERROR	TERM = %02	An error correctable by error correction code (ECC) occurred during a READ operation (≤ 11 bits).
TERMSTAT WRITE ATTEMPT TO PROTECTED UNIT ERROR	TERM = %03	WRITE-type command issued to disc drive with READ ONLY switch enabled.
TERMSTAT ILLEGAL ADDRESS ERROR	TERM = %04	A cylinder address was too large.
TERMSTAT DIRECT ACCESS TO ALT TRACK ERROR	TERM = %05	Not used in sector-skipping format. (In track-sparing, indicates that a READ or WRITE was issued to an alternate track before execution of the routine required to access that track.)
TERMSTAT ILLEGAL OPCODE ERROR	TERM = %06	The controller command in the EIO Address/Command Word is not valid.
TERMSTAT UNIT STATUS ERROR	TERM = %07	One of the following unit status conditions obtains: a. SEEK issued to disc drive with SEEK or NOT ON CYLINDER error b. FAULT or SEEK error occurred during a programmed seek, recalibrate, or head load sequence.
TERMSTAT BUFFER PARITY ERROR	TERM = %10	Incorrect parity in data word read from the controller 4K byte buffer (odd parity maintained).
TERMSTAT UNCORRECTABLE DATA ERROR	TERM = %11	A data record accessed with a READ error burst greater than 11 bits. ECC detected but uncorrectable. Data block could not be recovered with 27 retries using all offset combinations.
TERMSTAT NO SERVO CLOCKS DURING A WRITE	TERM = %12	Record CRC error.

T16/8L11A-08

Table 4.2 Error Messages Accompanying Standard SHADOW Messages (Cont'd)

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
TERMSTAT VERIFY ERROR	TERM = %13	Data read into the buffer does not compare with I/O channel data.
TERMSTAT HEADER SEARCH FAILURE	TERM = %14	One of the following header search conditions occurred: a. No headers on addressed track could be read. b. No sector match among headers on addressed track.
TERMSTAT HEADER ADDRESS MISCOMPARE	TERM = %15	Cylinder address or head address does not compare with the address loaded into the cylinder or head address registers.
TERMSTAT ROM PARITY ERROR	TERM = %16	Incorrect parity in microprogram instruction word read from ROM (odd parity maintained).
TERMSTAT UNIT NOT PRESENT ERROR	TERM = %17	Proper I.D. plug not installed.
TERMSTAT DUPLICATE UNIT NUMBER ERROR	TERM = %20	Plugs with the same I.D. installed in more than one disc drive.
TERMSTAT UNIT OWNERSHIP ERROR	TERM = %21	Disc drive owned by other controller.
TERMSTAT UNIT NOT READY ERROR	TERM = %22	Drive is not up to speed with the heads loaded.

T16/8L11A-09

4.2 OTHER ERROR MESSAGES RETURNED BY THE FAST DIAGNOSTICS

In addition to the error messages described in paragraph 4.1, certain error messages are displayed at the OSP terminal as the FAST diagnostics execute. These messages are annotated in Table 4.3.

Table 4.3 Other Error Messages Generated by the FAST Diagnostics (FAST4103/FAST4104/FAST4105/FAST4109/FAST4110/FAST4116)

SCREEN DISPLAY	EXPLICATION
CYLINDER REGISTER ERROR, DATA IS xxxxxxxx xxxxxxxx DATA SHOULD BE xxxxxxxx xxxxxxxx	Message displayed during basic controller checks if a pattern read back from the cylinder register differs from the test pattern loaded into that register by the LOAD CYLINDER statement. (Register values are displayed in binary.)
HEAD REGISTER ERROR, DATA IS xxxxxxxx DATA SHOULD BE xxxxxxxx	Message displayed during basic controller checks if a pattern read back from the head register differs from the test pattern loaded into that register by the LOAD CYLINDER statement. (Register values are displayed in binary.)
SECTOR REGISTER ERROR, DATA IS xxxxxxxx DATA SHOULD BE xxxxxxxx	Message displayed during basic controller checks if a pattern read back from the sector register differs from the test pattern loaded into that register by the LOAD CYLINDER statement. (Register values are displayed in binary.)
<RETURN TO CONTINUE>	Message displayed if a SEEK error occurs during the check for valid volume ID. The program suspends execution until the user responds with a carriage return.
** ERROR LIMIT REACHED, DEVICE %xxx NOT TESTED **	Message displayed under two conditions when the program attempts to begin execution of the main body of the diagnostic: a. If the number of errors for a device under test reached 100 in the course of the basic controller checks. b. If the operator chose to delete the device from the test list as a result of the check for valid volume ID.
SEEK RETRY	Message displayed if at any time during program execution a SEEK operation fails during a COLD LOAD, READ, or READ WITHOUT TRANSFER. Execution of the SEEK is then attempted up to three more times, and the message is repeated with each try. If the SEEK succeeds on any of these tries, the operation then proceeds normally.

T16/8L11A-10

Table 4.3 Other Error Messages Generated by the FAST Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
SEEK FAILED	Message displayed if a SEEK operation that has failed on initial attempt fails on all three retries. The operation is then attempted as many as 27 more times, with nine different offsets.
READ RETRY...CONTROL CODE=% xxx	Message displayed each time a seek/read operation that has failed is retried with a different offset. The octal value displayed in the CONTROL CODE field is the value returned in the TERM field of the IIO cause word. It indicates the particular offset combination just tried. The sequence of offsets and corresponding control codes are as follows; the entire sequence is repeated up to three full times: a. No offset (%23) b. Servo offset minus (%24) c. Servo offset plus (%25) d. Data strobe late (%26) e. Data strobe early (%27) r. Data strobe late and servo offset minus (%30) g. Data strobe early and servo offset minus (%31) f. Data strobe late and servo offset plus (%32) i. Data strobe early and servo offset plus (%33).
*** DISK CANNOT BE TESTED -- TOO MANY DEFECTS ON CYL [MAXCYL] *** Alternatives: 1 - Get new scratch pack 2 - Use DISC41xx or ODSC41xx(track-sparing) 3 - Write on primary cylinders	Message displayed if a failure occurs during the read of headers on all sectors of MAXCYL.
* FAST41xx ERROR SUMMARY * TIMEOUTS xxxxxxx NOT ON CYLINDERS xxxxxxx SEEK ERRORS xxxxxxx DATA ERRORS CORRECTED xxxxxxx ILLEGAL ADDRESSES xxxxxxx DATA UNCORRECTABLES xxxxxxx HEADER SEARCH FAILS xxxxxxx PASS COUNTER xxxxxxx	Error summary displayed when the program completes execution.

T16/8L11A-11

SECTION 5
RUN PROCEDURES

5.0 RUN PROCEDURES

> CAUTION
>
> Many of the procedures provided in the FAST diagnostics perform WRITE operations to the disc volumes under test. If these procedures are executed with the user volumes in place, user and system data are destroyed. Extreme care must therefore be taken. If the disc drive under test houses removable media, a scratch pack can be installed. In the case of nonremovable media, unless the disc volume is configured as part of a mirrored pair or a backup of the data exists on tape, the test may have to be restricted to the exercising of read-only functions.

A sample successful run of a FAST diagnostic is illustrated in Figure 5-1. The test case uses a 128-MB disc drive (T16/4110), configured as drive number %2 on controller number %1. The illustration assumes SHADOW loaded and bits <3>, <4>, and <5> of the Switch Register in the OFF position. Refer to Table 5.2 for the definition of all applicable switch settings.

For the user unfamiliar with SHADOW in general or with the FAST diagnostics in particular, the system preparations necessary for running diagnostics are described in paragraph 5.1; a step-by-step run procedure follows in paragraph 5.2.

```
T9404D00.SHADOW  01APR81  00:00
>RUN FAST4110 <cr>

MANUFACTURING CABLE VERIFIER
T9472A02.FAST4110 (A02) 02APR82
ONE 3106 CONTROLLER W/UP TO 8 UNITS


INPUT THE PRIMARY CONTROLLER NUMBER
? % 11 <cr>
INPUT THE SECONDARY CONTROLLER NUMBER
? <cr>
INPUT THE DRIVE NUMBER
? %2 <cr>
INPUT THE DRIVE NUMBER
? <cr>
READONLY (Y/N) ?
? N <cr>
CAN THE DATA BE OVERWRITTEN ON PRIMARY CYLINDERS (Y/N) ?
? Y <cr>
LOOP TEST CONTINUOUSLY?
? N <cr>
*** BASIC CONTROLLER CHECKS ***

PUN %: 12  VOLUME NAME IS   [[[[[[[[
<RETURN> TO CONTINUE, ANY CHAR TO ABORT
? <cr>

*** DRIVE CHECKS ***

-UNIT UNDER TEST %: 12
-DEVICE UNDER TEST IS % 12
-READ HEAD 0/SECTOR 0 ON ALL CYLINDERS
-READ CYLINDER 822/SECTOR 0 ON ALL HEADS
-READ CYLINDER 822/HEAD 0 ON ALL SECTORS
-WRITE CYLINDER ADDRESS ON HEAD 0/SECTOR 0
 CYL RANGE: 0,810
-READ/VERIFY CYLINDER DATA PATTERN
 CYL RANGE: 0,810
-WRITE PATTERN WITH HEAD DATA ON:
 CYLINDER 822/SECTOR 0, ALL HEADS
-READ/VERIFY PATTERN WITH HEAD DATA
-WRITE PATTERN WITH SECTOR DATA ON:
 CYLINDER 822/HEAD 0, ALL SECTORS
-READ/VERIFY PATTERN WITH SECTOR DATA


*    ERROR SUMMARY FOR FAST4110    *

  TIMEOUTS                    0
  NOT ON CYLINDERS            0
  SEEK ERRORS                 0
  DATA ERRORS CORRECTED       0
  ILLEGAL ADDRESSES           0
  DATA UNCORRECTABLES         0
  HEADER SEARCH FAILS         0
  PASS COUNTER                1

!!!!!!!!!!   E N D   OF   F A S T 4 1 1 0   !!!!!!!!!!
```

Note: 128-Mb disc drive (T16/4110), drive number %2, controller number %1. SHADOW loaded and panel switches <3>, <4>, and <5> switched off.

T16/8L11A-12

Figure 5-1 Sample Successful Run of FAST4110

5.1 PREPARATIONS FOR RUNNING THE FAST DIAGNOSTICS

Before any diagnostic is run, certain steps must be taken to allocate the system resources necessary for SHADOW and to ensure that the diagnostic run has minimum impact on system performance. The necessary procedures are ordinarily performed by the local system manager, or at least with the concurrence of the system manager. They include:

a. Obtaining access to the OSP subsystem

b. Transferring to another processor all user processes currently running in the processor to be taken off line

c. Transferring to another processor the path preference of all controllers with preferred paths currently assigned to the processor to be taken off line

d. Taking whatever precautions are indicated to protect the data stored on the disc volume to be tested

e. Taking off line the processor to be loaded with SHADOW

f. Taking off line the disc subsystem (controller and drive) to be tested.

> CAUTION
>
> If a T16/4109 disc drive is to be tested, both the moving and fixed-head portions of the disc (each assigned a different physical unit number) must be taken off line. Since the drives are dual ported, both paths to both portions of the disc must be off line.

These steps are described in detail elsewhere in the NonStop II Diagnostic Operating Procedures, Part Number 82803; those that deal with preparing the system in general for SHADOW, in Volume 1, Chapter 2, Parts 1 and 2; and those that deal with preparing the disc subystem in particular, in Volume 3B, Chapter 1, Part 1.

A checklist of the requirements for the FAST diagnostics, both those that must be available on the system and those that must be supplied by the customer engineer, is given in Table 5.1.

Table 5.1 Checklist for the FAST Diagnostics

REQUIREMENTS	SOURCE
A functioning OSP subsystem and terminal.	On site.
A processor that can be taken off line and dedicated to SHADOW.	On site.
A tape drive unit (if SHADOW is to be loaded from tape).	On site.
a. The tape drive must be physically connected to the test processor if SHADOW is I/O loaded from tape. b. The tape drive must be physically connected to the processor that is to read the tape if SHADOW is bus loaded through an offline processor. c. The tape drive must be physically connected to a processor running GUARDIAN (TM) if SHADOW is bus loaded through an online processor.	
Scratch pack or packs to substitute for the user packs during diagnostic execution (if removable media are to be tested).	On site.
SHADOW operating system. *	Either on site, in disc storage, or supplied by C.E. on cold load tape.
The appropriate FAST diagnostic program for the disc drive type under test (refer to Table 1.1).	Either on site, in disc storage, or supplied by C.E. on cold load tape.

* There are two distinct versions of the SHADOW operating system, one for the NonStop system (usually denoted as ZZDIAG1.SHADOW) and the other for the NonStop II system (usually denoted as ZZDIAG1.SHADOW). If loading from tape, ensure that the correct version is present on the tape and specify it during the load procedure.

5.2 RUN PROCEDURE FOR THE FAST DIAGNOSTICS

> CAUTION
>
> It is possible to run SHADOW diagnostics from the OSP in two or more processors concurrently. However, only one test process can communicate with the OSP at a time. For this reason, no more than one diagnostic process is ordinarily run on a system at any given time.

To run one of the FAST diagnostics, first ensure that the preparations listed in paragraph 5.1 are taken and then proceed as follows:

a. Load SHADOW into the test processor.

> CAUTION
>
> There are two distinct versions of the SHADOW operating system, one for the NonStop system (usually denoted as ZZDIAG1.SHADOW) and the other for the NonStop II system (usually denoted as ZZDIAG2.SHADOW). If loading from tape, ensure that the correct version is present on the tape and specify it during the load procedure. There are three methods for loading SHADOW: I/O cold load from tape, bus cold load from tape, and online load from tape or disc. They are described in detail in the NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 1.

b. Set desired Switch Register options in the operator control panel of the test processor. (Refer to Table 5.2 for a list of panel switches defined for the FAST diagnostics.)

c. At the SHADOW prompt (>) on the OSP screen, enter the command:

```
RUN <filename>
```

where <filename> is FAST4103, FAST4104, FAST4105, FAST4109, FAST4110, or FAST4116. (Refer to Figure 5-1 for further illustration.)

Table 5.2 Switch Register Options Available for the FAST Diagnostics *

SWITCH	FUNCTION
<0>	(Standard SHADOW function) If toggled on and off, generates a user break request and returns the SHADOW interpreter to conversational mode, where it waits for further instruction.
<3>	(Standard SHADOW function) If placed in the ON position, suppresses error printout and enables setting of the special numerics ERROR# and COMPERR#. Refer to the Diagnostic Languages Manual, Part Number 82848, for a description of the special numerics ERROR# and COMPERR#.
<4>	(Standard SHADOW function) If placed in the ON position, suppresses error printout, disables setting of the special numerics ERROR# and COMPERR#, and disables ERROR limit decrement.
<5>	(Standard SHADOW function) If placed in the ON position, causes a program halt on I/O error.

* Switches <1>, <2>, <6>, and <7> are not defined for the FAST diagnostics; switches <8> through <15> reflect the I/O address.

NOTE

Execution of the RUN command causes the program to initialize and the program name to be displayed at the OSP terminal. Several requests for user input follow. Actual program execution commences only when the last request is honored.

d. When the following request is displayed at the OSP terminal, respond as indicated:

```
INPUT THE PRIMARY CONTROLLER NUMBER
?
```

1. Enter at the prompt the physical unit number (in octal) of the disc controller to be tested.

2. Depress carriage return.

e. When the following request is displayed at the OSP terminal, enter one of two responses, as indicated:

```
INPUT THE SECONDARY CONTROLLER NUMBER
?
```

1. If the secondary controller associated with the primary controller specified in step d is to be tested, enter the physical unit number of the secondary (in octal) and depress carriage return.

2. If the secondary is not to be tested, simply depress carriage return.

NOTE

The only logical limitation on the secondary controller number is that it not be the same as the primary for any given disc drive. If the same number is erroneously entered for both primary and secondary, the program prompts until an acceptable secondary number is received.

f. When the following request is displayed at the OSP terminal, respond as indicated:

```
INPUT DRIVE NUMBER
?
```

1. Enter at the prompt the physical unit number (in octal) of the first disc drive to be tested.

2. Depress carriage return.

NOTE

This request for input is repeated up to eight times, as long as an acceptable drive number is received after each display of the request. Carriage return alone terminates the input and causes the next request to be displayed.

The T16/4109 drive requires two I/O addresses (one for the moving heads and one for the fixed heads). So that FAST4109 can test both parts of the disc, the valid range of drive numbers for FAST4109 is limited to [0,3] instead of the customary range [0,7]. The upper half of the range [4,7] is reserved for internally identifying the fixed-head portions of the disc drives specified by the lower half (i.e., drive number 4 is the fixed-head portion of drive number 0, and so on).

g. When the following request is displayed at the OSP terminal, enter one of two responses, as indicated:

```
READONLY?
?
```

1. Enter **Y** at the prompt and depress carriage return to restrict the diagnostic to read-only mode.

2. Enter **N** at the prompt and depress carriage return to permit WRITE operations to the disc pack in place.

CAUTION

In default mode, the FAST diagnostics perform WRITE operations to the disc volumes under test. If these operations are performed with the user volumes in place, user and system data are destroyed. READONLY should always be invoked unless thorough precautions can be taken to protect the user data. If the disc drive under test houses removable media, a scratch pack can be installed. In the case of nonremovable media, unless the disc volume is configured as part of a mirrored pair or a backup of the data exists on tape, the test may have to be restricted to the exercising of READONLY functions (or at least to WRITES only to MAXCYL, an option described in step h).

h. When the following request is displayed at the OSP terminal, enter one of two responses, as indicated:

```
CAN THE DATA BE OVERWRITTEN ON PRIMARY CYLINDERS (Y/N) ?
?
```

1. Enter **Y** at the prompt and depress carriage return to permit WRITE operations to be performed to all cylinders of the pack.

2. Enter **N** at the prompt and depress carriage return to restrict WRITE operations to MAXCYL only.

i. When the following request is displayed at the OSP terminal, enter one of two responses, as indicated:

```
LOOP TEST CONTINUOUSLY?
?
```

1. Enter **Y** at the prompt and depress carriage return to enable multiple passes of the diagnostic.

2. Enter **N** at the prompt and depress carriage return to restrict the running of the diagnostic to a single pass.

NOTE

When this input is received, initialization is complete. The program begins execution with the basic controller checks. Refer to paragraphs 4.1 and 4.2 for a description of the error messages that can be returned during these checks.

j. When the following request is displayed (on completion of the basic controller checks), enter one of two responses, as indicated:

```
PUN %: xxx  VOLUME NAME IS xxxxxxxx
<RETURN> TO CONTINUE, ANY CHAR TO ABORT
```

1. Enter any character and depress carriage return to bypass further testing of the specified disc volume.

2. Simply depress carriage return to continue the test.

k. Analyze any errors generated.

NOTE

If continuous looping is enabled, the program performs multiple passes of the diagnostic tests until instructed (by user break request) to halt. SHADOW then returns to conversational mode and waits for further instruction. Refer to Section 4 for a description of the error messages returned by the FAST diagnostics.

l. If the problem can be isolated to a faulty controller or to a faulty connecting cable, replace either the controller or the cable, whichever is malfunctioning.

m. If the results of the FAST diagnostic are inconclusive, try to isolate the problem further by running another of the diagnostics provided for the disc-drive type under test. (Refer to Table 1.1.)

CAUTION

The FAST diagnostics can invalidate the format of a disc pack. When testing with a FAST diagnostic is complete, it is necessary to run the appropriate disc pack formatter to restore valid sector-skipping format to the disc pack. Either the PUP FORMAT facility or the appropriate SHADOW formatter (FMT) may be used for this purpose. In cases where the contents of DLCYL have been lost, the PUP FORMAT facility must be used. To provide for adequate restoration of DLCYL in such cases, it is essential that a tape or hard copy of the vendor defect list information stored on DLCYL when first formatted by Tandem manufacturing be available. If a tape copy exists, it can be loaded directly onto the reformatted disc. If only a hard copy exists, the defects must be entered one by one, using the appropriate SHADOW defect-logging utility program (DUT). The PUP FORMAT procedure is described in the NonStop II System Operations Manual, Part Number 82075. The FMT programs are described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 3B, Chapter 1, Part 1F; the DUT programs, in Part 1D.

SECOND LEVEL MANUAL

DIAGNOSTIC OPERATING PROCEDURES

NonStop II (TM) Systems

VOLUME 3B, CHAPTER 1, PART 1B

DISC4103, DISC4104, DISC4105, DISC4109, DISC4110,
AND DISC4116 DISC DIAGNOSTICS

Copyright © 1982

TANDEM COMPUTERS INCORPORATED
2450 Walsh Avenue
Santa Clara, California 95050

Tandem Part Number 82803

October 1982
Printed in U.S.A.

This document contains information that is protected by copyright. No part of this document may be photocopied, reproduced or translated to another program or system without the prior written consent of Tandem Computers Incorporated.

The following are trademarks of Tandem Computers Incorporated:
Tandem, NonStop, NonStop II, AXCESS, DYNABUS, ENCOMPASS, ENFORM, ENSCRIBE, ENVOY, EXCHANGE, EXPAND, GUARDIAN, TGAL, PATHWAY, XRAY.

VOLUME 3B, CHAPTER 1, PART 1B

TABLE OF CONTENTS

Par.No.	Title	Page No.
	SECTION 1 INTRODUCTION	
1.0	INTRODUCTION	1-1
	SECTION 2 OVERVIEW	
2.0	OVERVIEW	2-1
2.1	PROGRAM SELECTION AND EXECUTION	2-2
	SECTION 3 COMMANDS	
3.0	COMMANDS	3-1
	SECTION 4 ERROR CONDITIONS AND DISPOSITIONS	
4.0	ERROR CONDITIONS AND DISPOSITIONS	4-1
4.1	ERROR INFORMATION APPENDED TO SHADOW ERROR MESSAGES	4-6
4.2	OTHER ERROR MESSAGES RETURNED BY THE DISC DIAGNOSTICS	4-10
	SECTION 5 RUN PROCEDURES	
5.0	RUN PROCEDURES	5-1
5.1	PREPARATIONS FOR RUNNING THE DISC DIAGNOSTICS	5-4
5.2	RUN PROCEDURE FOR THE DISC DIAGNOSTICS	5-6

TABLE OF CONTENTS (Cont'd)

LIST OF ILLUSTRATIONS

Fig.No.	Title	Page No.
4-1	Format of EIO Status Word	4-2
4-2	Format of IIO Status and Cause Words	4-3
4-3	Sector-skipping Format for Data on Disc	4-4
5-1	Sample Successful Run of DISC4110	5-2

LIST OF TABLES

Table No.	Title	Page No.
1.1	Disc Subsystem Diagnostics for the NonStop II System	1-2
2.1	Tests Performed by the Disc and Controller Diagnostics	2-4
4.1	Device Characteristics in Sector-skipping Format	4-5
4.2	Error Messages Accompanying Standard SHADOW Messages	4-7
4.3	Other Error Messages Generated by the DISC Diagnostics	4-10
5.1	Checklist for the DISC Diagnostics	5-5
5.2	Switch Register Options Available for the DISC Diagnostics	5-7

TABLE OF CONTENTS

SECTION 1
INTRODUCTION

1.0 INTRODUCTION

This chapter describes six SHADOW diagnostics, DISC4103, DISC4104, DISC4105, DISC4109, DISC4110, and DISC4116. These diagnostics are designed as tests of disc and controller function and can be used, respectively, to test a T16/4103, 4104, 4105/4106, 4109, 4110/4111, or 4116 disc drive on a Tandem NonStop II (TM) system. To accept these programs, the drive must be formatted for sector skipping and configured with a T16/3106 disc controller.

Used primarily in the corrective maintenance process, the DISC diagnostics can be run to determine the types of errors being produced and to help isolate the probable area of failure. After the suspected area of failure is corrected, these programs can be run again as end tests to ensure that the errors are eliminated.

The DISC diagnostics are one of seven sets of SHADOW diagnostic programs provided for the NonStop II disc subsystems. Refer to Table 1.1 for a list of the other available diagnostics.

DISC4103, DISC4104, DISC4105, DISC4109, DISC4110, and DISC4116 are written for SHADOW Rev level D00 and are compatible with all Rev levels of the disc controller and disc drives.

Table 1.1 Disc Subsystem Diagnostics for the NonStop II System *

SUBSYSTEM	DIAGNOSTIC	MANUAL REF. **
T16/4103 drive - T16/3106 ctrl	FAST4103	Part 1A
	DISC4103	Part 1B
	DEX4103	Part 1C
	DUT4103	Part 1D
	EDT4103	Part 1E
	FMT4103	Part 1F
	REX4103	Part 1G
T16/4104 drive - T16/3106 ctrl	FAST4104	Part 1A
	DISC4104	Part 1B
	DEX4104	Part 1C
	DUT4104	Part 1D
	EDT4104	Part 1E
	FMT4104	Part 1F
	REX4104	Part 1G
T16/4105 drive - T16/3106 ctrl ***	FAST4105	Part 1A
T16/4106 drive - T16/3106 ctrl	DISC4105	Part 1B
	DEX4105	Part 1C
	DUT4105	Part 1D
	EDT4105	Part 1E
	FMT4105	Part 1F
	REX4105	Part 1G
T16/4109 drive - T16/3106 ctrl	FAST4109	Part 1A
	DISC4109	Part 1B
	DEX4109	Part 1C
	DUT4109	Part 1D
	EDT4109	Part 1E
	FMT4109	Part 1F
	REX4109	Part 1G
	FHD4109	Part 1H
T16/4110 drive - T16/3106 ctrl ***	FAST4110	Part 1A
T16/4111 drive - T16/3106 ctrl	DISC4110	Part 1B
	DEX4110	Part 1C
	DUT4110	Part 1D
	EDT4110	Part 1E
	FMT4110	Part 1F
	REX4110	Part 1G
T16/4116 drive - T16/3106 ctrl ***	FAST4116	Part 1A
	DISC4116	Part 1B
	DEX4116	Part 1C
	DUT4116	Part 1D
	EDT4116	Part 1E
	FMT4116	Part 1F
	REX4116	Part 1G

* A somewhat different subset of disc subsystems is supported on the NonStop (TM) system, some in sector-skipping format and some in track-sparing format. For a complete list of the disc subsystems supported on the NonStop system and of the applicable diagnostics, refer to NonStop Diagnostic Operating Procedures, Part Number 82802, Volume 3B, Chapter 1, Part 1.

** In all cases, the general manual reference is to Volume 3B, Chapter 1, of NonStop II Diagnostic Operating Procedures, Part Number 82803.

*** The T16/4105 and 4106 disc drives are identical devices, as are the T16/4110 and 4111, except that in each case the first is free standing in the cabinet and the second is drawer mounted.

T16/8L11B-01

SECTION 2
OVERVIEW

2.0 OVERVIEW

The DISC diagnostics are designed to exercise all physical and logical paths in the controller and disc drive. These diagnostics permit the thorough testing of one controller and up to eight drives. If the disc packs under test house removable media (T16/4103, 4104, and 4105), a scratch pack with valid sector-skipping format is normally used so that all tests can be performed. However, if necessary, a read-only test can be performed. A read-only pass executes a subset of the tests executed by a full pass of the diagnostic.

The DISC diagnostics can also be used either to exercise the given disc drive/controller subsystem as a unit, or to exercise the controller alone. In the latter mode, only the disc controller registers and buffer are exercised. If testing of a controller alone is desired, the program must receive only the number of that controller when it prompts for controller and drive numbers at initialization.

The DISC diagnostics are run from the OSP terminal. Before any DISC diagnostic can be run, the following system resources must be taken off line and dedicated to the SHADOW program:

a. The disc drive to be tested and the associated controller

b. The processor into which SHADOW is to be loaded (the procedure for taking processor modules off line is described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 2)

SHADOW is then loaded into the test processor by one of the three customary methods, and the desired Switch Register options may be set in the control panel of the test processor. Refer to Table 5.2 for a description of the Switch Register options for the DISC diagnostics. The SHADOW load procedure is described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 1.

2.1 PROGRAM SELECTION AND EXECUTION

After SHADOW is loaded, the appropriate DISC diagnostic for the particular subsystem under test can be loaded and run. The typical SHADOW requests for input are displayed at the OSp terminal as the program initializes. Initialization cannot complete without appropriate responses from the operator. After initialization, the program proceeds with minimal further interaction.

All of the programs report the SHADOW error messages appropriate to the conditions detected (unless error printout is suppressed in the panel switches). Additional information relating the error to a specific disc function typically accompanies the standard SHADOW message. Refer to Section 4 for a description of all error messages displayed at the OSP terminal.

The DISC diagnostics present the following options at program initialization:

a. Test of controller only

b. Read-only pass to the disc drive

c. ECC check on data

d. Continuous looping of the diagnostic

e. Restart when done.

When initialization is complete, the DISC diagnostics begin with basic controller checks, followed by display of spare tracks information. When these procedures are complete for all devices under test, the main body of the diagnostic begins execution with the first device to be tested.

When the main body of the diagnostic completes one pass for each of the devices under test, the passcount is incremented. If continuous looping is enabled, the main body of the diagnostic begins another pass. If looping is disabled, but restart is enabled, an error summary is displayed, and the program reinitializes and prompts for operator response to the run-time options. If neither looping nor restart is enabled, the error summary is simply displayed and the program terminates with an END OF TEST message.

Run times for the DISC diagnostics vary, depending on such factors as the number of options exercised, the storage capacity of the disc drive under test, and so on. The settings of the panel switches can also affect the course of any given run of the diagnostic. Factors to be considered when estimating down time include not only the run times for the diagnostics to be used, but also the time which may be required for reformatting and reviving the discs after the diagnostics are completed. The times required for these procedures vary from an hour or less to as long as overnight, depending on such factors as system load and disc pack size. A typical diagnostic run takes less than half an hour.

The functions tested by the DISC diagnostics are listed in sequence in Table 2.1, together with the screen displays that accompany them during a normal, error-free run of the diagnostic. (The tests are numbered in Table 2.1 strictly as an aid to sequential presentation; they do not exist in the program as independently numbered entities).

Table 2.1 Tests Performed by the Disc and Controller Diagnostics (DISC4103, DISC4104, DISC4105, DISC4109, DISC4110, and DISC4116)

TEST NO.	SCREEN DISPLAY	DESCRIPTION
1		Program checks for presence of defect-skipping controller microcode.
2	THE LITERAL ID CODE OF CNTRLLR % xx IS %xx <--	Program reads and displays the unit literal PROM revision level.
3		Program tests ability to set and clear PROM parity error.
4		Program performs Set Cylinder and Set Head/Sector commands with 65 test patterns. Then reads and verifies the cylinder, head, and sector registers.
5		Program writes 65 test patterns to the buffer, then reads and compares the data written.
6		Program fills the buffer with random data patterns, then reads and compares the data written.
7		Program performs Seek commands at head 0, sector 0 of all cylinders, incrementing from 0:MAXCYL and then decrementing from MAXCYL:0.
8		Program checks for presence of defect-skipping formatted pack by checking flag in address 0,0,0.
9	VOLUME NAME IS xxxxxxxx UNIT: xxx <RETURN> TO CONTINUE, ANY CHAR TO ABORT	Program checks for valid system volume label in address 0,0,3. (Not performed in READ ONLY mode.)
10	---- SPARE TRACK INFORMATION FOR DEV % xxx *** CONTENTS OF SPARE TRACK POINTER TABLE *** xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx <RETURN> TO CONTINUE, ANY CHAR TO STOP	Program checks Spare Tracks Table (STT) for valid cylinder numbers and lists contents of STT, 64 entries at a time, until all the contents are displayed or until the user elects to stop.

T16/8L118-02

Table 2.1 Tests Performed by the Disc and Controller Diagnostics (Cont'd)

TEST NO.	SCREEN DISPLAY	DESCRIPTION
11	CYL xxx IS EXTENDED ON CYL xxx HEAD xx	IF STT is valid, program lists extensions in use.
12	DEVICE UNDER TEST IS % xxx PASS # xx	Program performs reads to all cylinders, at random head and sector numbers. Data is not examined.
13		Program forces Not-on-Cylinder and tests status.
14		Program attempts to seek to nonexistent cylinder and verifies Illegal Address status.
15		Program tests secondary controller ownership, priority select, ownership error, and release. (If no secondary controller is specified during initialization, these checks are not performed.)
16	WRITE/READ/VERIFY AT CYL/HEAD/SECT: xxx/xx/xx	Program writes, reads, and verifies 65 data patterns at track 0, head 0, sector 0, and at the maximum nonspare address. (Not performed in READ ONLY mode.)
17	*** CHECKSUM TESTS, PUN % xxx *** -CHECK: PROPER # BYTES	Program writes, reads, and compares checksum blocks for 1- to 8-sector jobs. (Not performed in READ ONLY mode.)
18	-CHECK: PATTERNS	Program writes and reads 120 data patterns into checksum blocks. (Not performed in READ ONLY mode.)
19		Program tests no-checksum operation by comparing data from 8 reads of 1 to 8 sectors with the same sectors read by checksummed reads.
20		Program tests that a zero byte count causes channel abort when device has a nonzero byte count.
21		Program tests that controller makes no reconnect if it has a zero byte count.
22		Program tests Interrupt Pending Abort status.

T16/8L11B-03

Table 2.1 Tests Performed by the Disc and Controller Diagnostics (Cont'd)

TEST NO.	SCREEN DISPLAY	DESCRIPTION
23		Program tests Controller Busy status.
24		Program tests that Take Ownership does not clear Controller Busy.
25		Program tests header checksum error detection by altering header at track 0, head 0, sector 0. (Not performed in READ ONLY mode.)
26		Program tests error correction and status reporting with 8- and 11-bit errors, and various background patterns, using unallocated spare cylinders.
27		Program checks uncorrectable data error detection and unconditional read command.
28		Program tests detection of Header Search failure.
29	SCANNING FOR A DEFECT-FREE TEST AREA, PUN % xxx -TEST AREA; START/END CYL: xxx/xxx WARNING !! TO STOP THIS TEST RAISE SWITCH BIT 1 AND WAIT! USE OF 'ESC' OR 'BREAK' WILL REQUIRE SUBSEQUENT USE OF MANUAL RECOVERY TECHNIQUES	Program searches for 5 defect-free cylinders for rollover tests and, when a suitable test area is found, displays test area boundaries. (Not performed in READ ONLY mode.)
30	*** ROLLOVER & WORSTCASE HEADER SEARCH TESTS, PUN % xxx *** -EXTENSION TEST WILL USE CYL: xxx	Program begins rollover tests; finds an unused spare cylinder for cylinder extension tests. (Not performed in READ ONLY mode.)
31	CP: 1	Control point 1 - Program tests formatting of a normal cylinder. (Not performed in READ ONLY mode.)
32	CP: 2	Control point 2 - Program tests formatting of header only. (Not performed in READ ONLY mode.)
33	CP: 3	Control points 3 and 4 - Program tests formatting of two cylinders with minimum extensions. (Not performed in READ ONLY mode.)

T16/8L11B-04

Table 2.1 Tests Performed by the Disc and Controller Diagnostics (Cont'd)

TEST NO.	SCREEN DISPLAY	DESCRIPTION
34	CP: 5	Control point 5 - Program tests normal formatting of first extension. (Not performed in READ ONLY mode.)
35	CP: 6	Control point 6 - Program tests formatting of second extension with a skip in sector 0. (Not performed in READ ONLY mode.)
36	CP: 7	Control point 7 - Program tests formatting of a cylinder with an extension over one track long. (Not performed in READ ONLY mode.)
37	CP: 8	Control point 8 - Program tests normal formatting of the long extension. (Not performed in READ ONLY mode.)
38	CP: 9	Control point 9 - Program tests formatting a cylinder with one header error in the maximum sector of head 2. (Not performed in READ ONLY mode.)
39	CP: 10	Control point 10 - Program checks a normal head rollover. (Not performed in READ ONLY mode.)
40	CP: 11	Control point 11 - Program checks a normal cylinder rollover. (Not performed in READ ONLY mode.)
41	CP: 12	Control point 12 - Program checks head rollover across header checksum. (Not performed in READ ONLY mode.)
42	CP: 13	Control point 13 - Program performs an unconditional read with physical addressing. (Not performed in READ ONLY mode.)
43	CP: 14	Control point 14 - Program checks head rollover with correctable data errors. (Not performed in READ ONLY mode.)
44	CP: 15	Control point 15 - Program creates a correctable error two sectors before end of track (EOT). (Not performed in READ ONLY mode.)

T16/8L11B-05

Table 2.1 Tests Performed by the Disc and Controller Diagnostics (Cont'd)

TEST NO.	SCREEN DISPLAY	DESCRIPTION
45	CP: 16	Control point 16 - Program creates a correctable error on EOT sector. (Not performed in READ ONLY mode.)
46		Program checks a normal 5-sector write/read across an extension (reads 2 sectors in primary, 2 in extension, 1 in next primary). (Not performed in READ ONLY mode.)
47		Program repeats 5-sector write/read with correctable data error 2 sectors before the jump sector. (Not performed in READ ONLY mode.)
48		Program repeats 5-sector write/read with formatted defect in first extension sector. (Not performed in READ ONLY mode.)
49		Program repeats 5-sector write/read with correctable error 2 sectors before the jump-back sector. (Not performed in READ ONLY mode.)
50		Program repeats 5-sector write/read with correctable errors in both extension sectors. (Not performed in READ ONLY mode.)
51		Program reads across EOT in long extension. (Not performed in READ ONLY mode.)
52		Program reads across EOT in extension with correctable error in EOT sector. (Not performed in READ ONLY mode.)
53	-------- END OF BREAK WARNING !!--------	Program restores normal format of test cylinders. (Not performed in READ ONLY mode.)
54	*** RANDOM POSITION/LENGTH READ CHECK ***	Program tests 10000 random position and length reads.
55		(DISC4109 only) Program performs write/reads to fixed head tracks, overlapping with moving head seeks. (Not performed in READ ONLY mode.)

T16/8L11B-06

SECTION 3
COMMANDS

3.0 COMMANDS

DISC4103, DISC4104, DISC4105, DISC4109, DISC4110, and DISC4116 contain no program-defined or program-specific commands. They require the SHADOW RUN command for program execution. If the user wishes to implement the NOSTRIP option, the SHADOW OPTION command must also be invoked. (SHADOW defaults to option STRIP.)

SECTION 4
ERROR CONDITIONS AND DISPOSITIONS

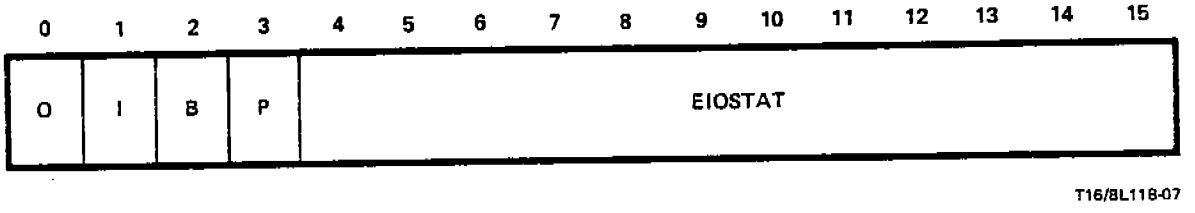
4.0 ERROR CONDITIONS AND DISPOSITIONS

DISC4103, DISC4104, DISC4105, DISC4109, DISC4110, and DISC4116 utilize the SHADOW error message facility and return the typical SHADOW messages generated by compare errors, EIO status errors, interrupt status errors, and unexpected non-I/O interrupt errors. These messages include the program step number at which failure occurred, the logical unit number of the device under test, and the EIO and IIO status and cause words.

When a SHADOW error message is returned, the sequence of events producing the error can be determined by cross-referencing the error message with the program listing of the currently executing diagnostic. The formats for the return of EIO status and IIO status are given in Figures 4-1 and 4-2, respectively. The format of data on the disc is shown in Figure 4-3. The device characteristics of the T16/4103, 4104, 4105/4106, 4109, 4110/4111, and 4116 disc drives in sector-skipping format are listed in Table 4.1.

The DISC diagnostics append an additional message to the standard SHADOW error message. This message, which correlates the error to a specific disc function, is determined by values encoded in certain fields of the IIO cause word. The possible messages, the IIO fields that govern them, and the error conditions they indicate are described in Table 4.2.

Other error messages are displayed at the the OSP terminal as certain portions of the diagnostic run or when certain conditions are detected. These messages are described in Table 4.3.



O - OWNERSHIP ERROR
I - INTERRUPT PENDING
B - CONTROL UNIT BUSY
P - I/O BUS PARITY ERROR ON EIO

Figure 4-1 Format of EIO Status Word

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
O	I	A	P	(ZERO)				DEV					UNIT		

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PON	TERM							PR	UO	F	S	C	R	T0	T1

T16/8L11B-08

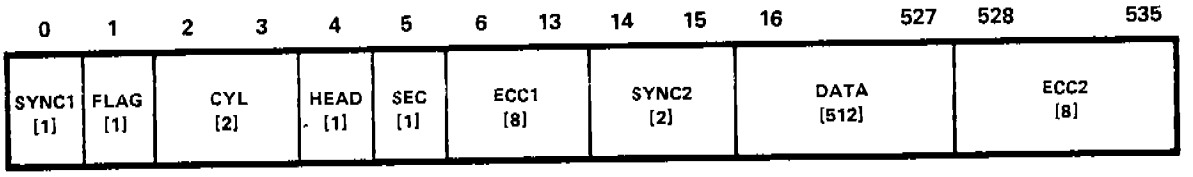
O - OWNERSHIP ERROR
I - INTERRUPT PENDING
A - CHANNEL TRANSFER ABORT
P - PARITY ERROR
DEV - CONTROLLER NUMBER
UNIT - UNIT NUMBER
PON - POWER ON INTERRUPT
PR - UNIT READ ONLY

UO - UNIT OWNERSHIP ERROR
F - UNIT WRITE FAULT
S - UNIT SEEK ERROR
C - UNIT NOT ON CYLINDER
R - UNIT NOT READY
T0 - UNIT TYPE, MSB
T1 - UNIT TYPE, LSB

TERM - ENCODED TERMINATION STATUS (TERMSTAT):

%00 NO ERROR
%01 UNIT ATTENTION
%02 DATA ERROR CORRECTED
%03 ATTEMPT TO WRITE ON PROTECTED UNIT
%04 ILLEGAL ADDRESS
%05 DIRECT ACCESS TO ALTERNATE TRACK
%06 ILLEGAL OPCODE
%07 UNIT STATUS ERROR
%10 BUFFER PARITY ERROR
%11 UNCORRECTABLE DATA ERROR
%12 NO SERVO CLOCKS DURING A WRITE
%13 VERIFY ERROR
%14 HEADER SEARCH FAILED
%15 HEADER ADDRESS MISCOMPARE
%16 ROM PARITY ERROR
%17 UNIT NOT PRESENT
%20 DUPLICATE UNIT NUMBER
%21 UNIT OWNERSHIP ERROR
%22 UNIT NOT READY
%23 READ RETRY SUCCESSFUL WITHOUT OFFSET
%24 READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS
%25 READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS
%26 READ RETRY SUCCESSFUL WITH DATA STROBE LATE
%27 READ RETRY SUCCESSFUL WITH DATA STROBE EARLY
%30 READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS AND DATA STROBE LATE
%31 READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS AND DATA STROBE EARLY
%32 READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS AND DATA STROBE LATE
%33 READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS AND DATA STROBE EARLY
%34 IDLE LOOP DISC CONTROLLER EXERCISER ERROR

Figure 4-2 Format of IIO Status and Cause Words



SYNC1 = %360 (Good sector - marks the end of the preceding lockup field allowed for read synchronization and signals that address header is to follow)

%377 (Bad sector - all bytes of the entire sector are filled with ones)

FLAG = %350 (Normal sector - CYL/HEAD/SECT contains the current logical address)

%351 (Defective data area)

%352 (Jump-from-extension sector - CYL/HEAD/SECT contains the physical address of return from extension)

%353 (Spare sector)

%354 (Maximum sector on a track)

%355 (Only good sector on a track)

%356 (Jump-to-extension sector - CYL/HEAD/SECT contains the current physical address of extension)

%357 (End of cylinder)

%377 (Defective header)

ECC1 = [0:6] = Error correction code for address header
[7] = Pad byte of zeros

SYNC2 = [0] = %360
[1] = Pad byte of zeros

DATA = 512 bytes of written data

ECC2 = [0:6] = Error correction code for data portion
[7] = Pad byte of zeros

Figure 4-3 Sector-skipping Format for Data on Disc

Table 4.1 Device Characteristics in Sector-skipping Format

DEVICE CHARACTERISTIC	T16/ 4103	T16/ 4104	T16/ 4105/ 4106	T16/ 4109	T16/ 4110/ 4111	T16/ 4116
Device type	3	2	1	1	3	0
Maximum sector (MAXSECT)	19	29	29	29	29	29
Maximum head (MAXHEAD)	18	18	4	4	9	39
Maximum cylinder (MAXCYL)	814	814	822	822	822	842
Defect list cylinder (DLCYL)	813	813	821	821	821	841
First spare cylinder (FSPCYL)	805	803	811	811	811	831
Last spare cylinder (LSPCYL)	812	812	820	820	820	840
First fixed cylinder (FFXCYL)	-	-	-	896	-	-
Last fixed cylinder (LFXCYL)	-	-	-	915	-	-
Last fixed head (LFXHD)	-	-	-	0	-	-
Spare sectors per cylinder (SPSCYL)	2	2	2	2	4	8
Literal PROM ID (LPRID)	%102	%101	%101 %102	%101 %102	%101 -	%101 %102
Volume label sector (CYL/HEAD/SECT)	0/0/2	0/0/2	0/0/2	0/0/2	0/0/2	0/0/2
Spare track table sector (CYL/HEAD/SECT)	0/0/3	0/0/3	0/0/3	0/0/3	0/0/3	0/0/3

PART 1B - DISC4103/DISC4104/DISC4105/DISC4109/DISC4110/DISC4116
ERROR CONDITIONS AND DISPOSITIONS

4.1 ERROR INFORMATION APPENDED TO SHADOW ERROR MESSAGES

In conjunction with the standard SHADOW error message, the DISC diagnostics typically display one of a number of error messages together with the contents of the controller registers. This error message is decoded from the TERM field of the IIO cause word. (Refer to Figure 4.2.) The form of the error message is as follows:

```
<error message>

** CONTROLLER REGISTER CONTENTS **
CYL xxx HEAD xx SECT xxx FLAGS xxx COUNT xxx ADD xxx
```

The various messages that may appear in the <error message> field are listed and explained in Table 4.2. CYL/HEAD/SECT reflects the disc address of the sector accessed by the command; FLAGS returns the value of the header flag in the accessed sector (refer to Figure 4-3); COUNT reflects the bytecount returned by the operation; and ADD reflects the current address of the controller buffer. If the error that occurs is critical, the following message accompanies the initial message:

```
CRITICAL ERROR, <RETURN> TO CONTINUE
```

Table 4.2 Error Messages Accompanying Standard SHADOW Messages

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
TIMEOUT ERROR	IIO CAUSE = -1	A timeout occurred on the controller before the current operation could complete.
DEVICE TYPE ERROR	IIO CAUSE bits <14:15>	The accessed unit returned a different device type from that expected by the controller.
NOT READY ERROR	IIO CAUSE bit <13>	One of the following conditions obtains: a. No disc pack is installed. b. Disc spindle motor is not up to speed. c. Read/write heads are not loaded. d. DC voltages of drive are not within margin. e. Terminator is not present or does not have power.
NOT ON CYLINDER ERROR	IIO CAUSE bit <12>	A seek to an illegal address has been received from the channel, i.e., a cylinder, head, or sector address greater than the maximum legal value has been specified (refer to Table 4.1).
SEEK ERROR	IIO CAUSE bit <11>	Drive is unable to seek to specified address.
WRITE FAULT ERROR	IIO CAUSE bit <10>	One of the following conditions obtains: a. More than one write/read head selected b. Read gate and write gate both true c. Read gate and erase gate both true d. Write current but no erase current e. Erase current but no write current f. Write gate or erase gate but not on cylinder g. DC voltages below margin h. Emergency retract condition
OWNERSHIP ERROR	IIO CAUSE bit <9>	Controller is owned by the other port.
WRITE PROTECT ERROR	IIO CAUSE bit <8>	Write operation attempted to disc drive with WRITE PROTECT switch on.

T16/BL11B-10

Table 4.2 Error Messages Accompanying Standard SHADOW Messages (Cont'd)

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
NO TERMSTAT ERROR	TERM = %00	No error.
TERMSTAT ATTENTION ERROR	TERM = %01	One of the following unit attention conditions occurred: a. Selected drive ready (head load sequence) b. I.D. plug changed after drive ready c. Seek complete.
TERMSTAT CORRECTED DATA ERROR	TERM = %02	An error correctable by error correction code (ECC) occurred during a READ operation (≤ 11 bits).
TERMSTAT WRITE ATTEMPT TO PROTECTED UNIT ERROR	TERM = %03	WRITE-type command issued to disc drive with READ ONLY switch enabled.
TERMSTAT ILLEGAL ADDRESS ERROR	TERM = %04	A cylinder address was too large.
TERMSTAT DIRECT ACCESS TO ALT TRACK ERROR	TERM = %05	Not used in sector-skipping format. (In track-sparing, indicates that a READ or WRITE was issued to an alternate track before execution of the routine required to access that track.)
TERMSTAT ILLEGAL OPCODE ERROR	TERM = %06	The controller command in the EIO Address/Command Word is not valid.
TERMSTAT UNIT STATUS ERROR	TERM = %07	One of the following unit status conditions obtains: a. SEEK issued to disc drive with SEEK or NOT ON CYLINDER error b. FAULT or SEEK error occurred during a programmed seek, recalibrate, or head load sequence.
TERMSTAT BUFFER PARITY ERROR	TERM = %10	Incorrect parity in data word read from the controller 4K byte buffer (odd parity maintained).
TERMSTAT UNCORRECTABLE DATA ERROR	TERM = %11	A data record accessed with a READ error burst greater than 11 bits. ECC detected but uncorrectable. Data block could not be recovered with 27 retries using all offset combinations.
TERMSTAT NO SERVO CLOCKS DURING A WRITE	TERM = %12	Record CRC error.

T16/8L11B-11

Table 4.2 Error Messages Accompanying Standard SHADOW Messages (Cont'd)

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
TERMSTAT VERIFY ERROR	TERM = %13	Data read into the buffer does not compare with I/O channel data.
TERMSTAT HEADER SEARCH FAILURE	TERM = %14	One of the following header search conditions occurred: a. No headers on addressed track could be read. b. No sector match among headers on addressed track.
TERMSTAT HEADER ADDRESS MISCOMPARE	TERM = %15	Cylinder address or head address does not compare with the address loaded into the cylinder or head address registers.
TERMSTAT ROM PARITY ERROR	TERM = %16	Incorrect parity in microprogram instruction word read from ROM (odd parity maintained).
TERMSTAT UNIT NOT PRESENT ERROR	TERM = %17	Proper I.D. plug not installed.
TERMSTAT DUPLICATE UNIT NUMBER ERROR	TERM = %20	Plugs with the same I.D. installed in more than one disc drive.
TERMSTAT UNIT OWNERSHIP ERROR	TERM = %21	Disc drive owned by other controller.
TERMSTAT UNIT NOT READY ERROR	TERM = %22	Drive is not up to speed with the heads loaded.

T16/8L118-12

4.2 OTHER ERROR MESSAGES RETURNED BY THE DISC DIAGNOSTICS

In addition to the error messages described in paragraph 4.1, certain error messages occur during each of the three parts of the DISC diagnostics. These three parts are: basic controller checks, display of spare tracks information, and main body of the diagnostic. The special error messages relative to each are annotated in Table 4.3.

Table 4.3 Other Error Messages Generated by the DISC Diagnostics (DISC4103/DISC4104/DISC4105/DISC4109/DISC4110/DISC4116)

SCREEN DISPLAY	EXPLICATION
MESSAGES DURING THE BASIC CONTROLLER CHECKS	
CONTROLLER % xx DOES NOT DO DEFECT SKIPPING	Message displayed if the controller under test does not have sector-skipping microcode. The diagnostic then aborts.
CYLINDER REGISTER ERROR, DATA IS xxxxxxxx xxxxxxxx DATA SHOULD BE xxxxxxxx xxxxxxxx	Message displayed if a pattern read back from the cylinder register differs from the test pattern loaded into that register by the LOAD CYLINDER statement. (Register values are displayed in binary.)
HEAD REGISTER ERROR, DATA IS xxxxxxxx DATA SHOULD BE xxxxxxxx	Message displayed if a pattern read back from the head register differs from the test pattern loaded into that register by the LOAD HEAD statement. (Register values are displayed in binary.)
SECTOR REGISTER ERROR, DATA IS xxxxxxxx DATA SHOULD BE xxxxxxxx	Message displayed if a pattern read back from the sector register differs from the test pattern loaded into that register by the LOAD SECTOR statement. (Register values are displayed in binary.)
PACK MOUNTED ON DRIVE % xxx IS NOT IN 'DEFECT-SKIP' FORMAT UNIT WILL BE DELETED FROM TEST	Message displayed if a non-sector-skipping pack is encountered when the packs mounted on each of the disc drives specified for test are checked for sector-skipping format.

T16/8L11B-13

Table 4.3 Other Error Messages Generated by the DISC Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
MESSAGES ACCOMPANYING DISPLAY OF SPARE TRACKS INFORMATION	
ERROR ---- SPARE TRACK TABLE IS NOT VALID	Message displayed when the program performs the spare track table validity check, if a cylinder number below FSPCYL or above LSPCYL, or a head number below 0 or above MAXHEAD, is recorded for any entry in the spare track table. After displaying this message, the program proceeds to the spare track information for the next unit under test.
>>>>>>>>> NO CYLINDERS HAVE BEEN EXTENDED <<<<<<<<<	Message displayed if all cylinders contain the normal number of usable sectors and there are no entries in the spare track table.
CAN'T FIND ADDR OF ALTERNATE FOR CYL xxx	Message displayed if the jump sector is missing from a cylinder listed in the spare track table.
MESSAGES DURING MAIN BODY OF DIAGNOSTIC	
PAUSE	Message displayed if a compare error occurs at any point during the checksum length test. The program then suspends execution until a carriage return is entered.
CAN'T TEST HEADER ECC ON DEV % xxx	Message displayed during the Header ECC test if the test for a given device cannot complete normally because physical header 0,0,0 is not formatted as a normal sector.
ECC CASES NOT CHECKED ON DEV % xxx	Message displayed during the Header ECC test if the program is executing in read-only mode without the option PERFORM ECC CHECK ON DATA (offered at initialization). The ECC checks are then skipped.
EXCESSIVE MEDIA ERRORS PREVENT CHECKING ROLLOVERS ON DEV %	Message displayed if the device under test does not have five consecutive defect-free cylinders for the rollover and extension tests. The tests are then skipped.

T16/8L11B-14

Table 4.3 Other Error Messages Generated by the DISC Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
MESSAGES DURING MAIN BODY OF DIAGNOSTIC	
CYLINDER IS INCREMENTED, SET BREAK POINT TO FIND OUT WHY START CYL: xxx / xx / xx CNTLR ADDR (C/H/S): xxx / xx / xx SECTORCOUNT: xxxx	Message displayed if the formatting procedure repeated throughout the rollover tests results, at any point, in a discrepancy between the controller address and the starting cylinder. The program then suspends execution.
HEADER AREA MISCOMPARE AFTER FORMATHDR41xx	Message displayed if a compare error occurs in the header area during the test of header format.
DATA AREA MISCOMPARE AFTER FORMATHDR41xx	Message displayed if a compare error occurs in the data area during the test of header format.
-ADDITONAL ERRORS ENCOUNTERED	Message displayed if one of the primary tracks under test fails. Another cylinder is then sought for continuation of the test.
EXCESSIVE MEDIA ERRORS PREVENT CHECKING ROLLOVERS ON DEV %	Message displayed if no new cylinder can be found for continuation of the rollover tests after one of the primary tracks has failed. The rollover and extension tests are then discontinued.
ERROR PREVENTS EXTENSION CHECKS ON UNIT % xxx CYL: xxx	Message displayed if the last spare track on the extension cylinder is invalid. Another spare cylinder is then sought.
-NO MORE SPARE CYLINDERS, BYPASSING EXTENSION TEST	Message displayed if no more spare cylinders are available when another is needed for continuation of the extension tests. The extension tests are then discontinued.
PAUSE ON ERROR, <RETURN> TO CONTINUE	Message displayed whenever a compare error occurs during the extension tests. The program then suspends execution.

T16/8L118-15

Table 4.3 Other Error Messages Generated by the DISC Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
MESSAGES DURING MAIN BODY OF DIAGNOSTIC	
** EXTENSION TEST ERRORS **	Message displayed when the extension tests are complete if one or more compare errors have occurred.
RETRY FOLLOWING ERROR REFORMATTING CYL = xxx	Message displayed if a new defect is discovered in the test cylinders when the pretest format is being restored at the end of the extension tests. The program retries the operation until no errors are detected and displays the message with each retry.
ERROR AT CYL/HEAD/SECT/BC: xxx/xx/xx/xxxx PAUSE ON ERROR, <RETURN> TO CONTINUE	Message displayed if an error occurs during the random reads. The program then suspends execution.
* DISC41xx ERROR SUMMARY * TIMEOUTS xxxxxxx NOT ON CYLINDERS xxxxxxx SEEK ERRORS xxxxxxx DATA ERRORS CORRECTED xxxxxxx ILLEGAL ADDRESSES xxxxxxx DATA UNCORRECTABLES xxxxxxx HEADER SEARCH FAILS xxxxxxx	Error summary displayed when the program completes execution. If LOOP DIAGNOSTIC is enabled, the passcount is incremented by one and diagnostic execution begins again.

T16/8L11B-16

PART 1B - DISC4103/DISC4104/DISC4105/DISC4109/DISC4110/DISC4116
ERROR CONDITIONS AND DISPOSITIONS

SECTION 5
RUN PROCEDURES

5.0 RUN PROCEDURES

> CAUTION
>
> Many of the procedures provided in the DISC diagnostics perform WRITE operations to the disc volumes under test. If these procedures are executed with the user volumes in place, user and system data are destroyed. Extreme care must therefore be taken. If the disc drive under test houses removable media, a scratch pack can be installed. In the case of nonremovable media, unless the disc volume is configured as part of a mirrored pair or a backup of the data exists on tape, the test may have to be restricted to the exercising of read-only functions.

A sample successful run of a DISC diagnostic is illustrated in Figure 5-1. The test case uses a 128-MB disc drive (T16/4110), configured as drive number %2 on controller number %1. The illustration assumes SHADOW loaded and bits <3>, <4>, and <5> of the Switch Register in the OFF position. (Refer to Table 5.2 for the definition of all applicable switch settings.)

For the user unfamiliar with SHADOW in general or with the DISC diagnostics in particular, the system preparations necessary for running diagnostics are described in paragraph 5.1; a step-by-step run procedure follows in paragraph 5.2.

```
T9404D00.SHADOW  01APR81  00:00
>RUN DISC4110 <cr>

DISK AND CONTROLLER SHADOW DIAGNOSTIC
T9472A02.DISC4110 (A02) 01APR82
UP TO TWO 3106 CONTROLLERS, UP TO EIGHT DRIVES

WARNINGS:

-MEDIA IN SECTOR-SKIPPING FORMAT
-RE-FORMAT MEDIA IF YOU ALLOW PROGRAM TO WRITE DATA

INPUT PRIMARY CONTROLLER NUMBER
? %1 <cr>
INPUT SECONDARY CONTROLLER NUMBER, IF ANY
? <cr>
INPUT DRIVE NUMBER
? %2 <cr>
INPUT DRIVE NUMBER
? <cr>
PERFORM READ ONLY PASS
? N <cr>
LOOP DIAGNOSTIC?
? N <cr>
RESTART WHEN DONE?
? N <cr>

THE LITERAL ID CODE OF CNTRLLR % 1 IS %101 <--

VOLUME NAME IS  [[[[[[[[  UNIT: 12
<RETURN> TO CONTINUE, ANY CHAR TO ABORT
? <cr>

---- SPARE TRACK INFORMATION FOR DEV % 12
*** CONTENTS OF SPARE TRACK POINTER TABLE ***
  0     0    -1    -1     1     0   811     0
  0     0     0     0     0     0     0     0
  0     0     0     0     0     0     0     0
  0     0     0     0     0     0     0     0
  0     0     0     0     0     0     0     0
  0     0     0     0     0     0     0     0
  0     0     0     0     0     0     0     0
  0     0     0     0     0     0     0     0

<RETURN> TO CONTINUE, ANY CHAR TO STOP
? n <cr>

>>>>>>>>>>  NO CYLINDERS HAVE BEEN EXTENDED  <<<<<<<<<<

DEVICE UNDER TEST IS % 12   PASS # 1

WRITE/READ/VERIFY AT CYL/HEAD/SECT: 810   9   25

***  CHECKSUM TESTS, PUN % 12  ***
-CHECK: PROPER # BYTES

-CHECK: PATTERNS
```

T16/8L11B-17

Figure 5-1 Sample Successful Run of DISC4110

```
SCANNING FOR A DEFECT-FREE TEST AREA, PUN % 12

-TEST AREA; START/END CYL:  10   14

                                WARNING !!
TO STOP THIS TEST RAISE SWITCH BIT 1 AND WAIT!  USE OF ´ESC´ OR
´BREAK´ WILL REQUIRE SUBSEQUENT USE OF MANUAL RECOVERY TECHNIQUES

*** ROLLOVER & WORSTCASE HEADER SEARCH TESTS, PUN % 12 ***

-EXTENSION TEST WILL USE CYL: 811

CP: 1
CP: 2
CP: 3
CP: 5
CP: 6
CP: 7
CP: 8
CP: 9
CP: 10
CP: 11
CP: 12
CP: 13
CP: 14
CP: 15
CP: 16

-------- END OF BREAK WARNING !!--------

*** RANDOM POSITION/LENGTH READ CHECK ***

*    DISC4110  ERROR SUMMARY      *

  TIMEOUTS                    0
  NOT ON CYLINDERS            0
  SEEK ERRORS                 0
  DATA ERRORS CORRECTED       0
  ILLEGAL ADDRESSES           0
  DATA UNCORRECTABLES         0
  HEADER SEARCH FAILS         0

!!!!!!!!!!!   E N D   OF   D I S C 4 1 1 0   !!!!!!!!!!
```

Note: 128-Mb disc drive (T16/4110), drive number %2, controller number %1. SHADOW loaded and panel switches <3>, <4>, and <5> switched off.

T16/8L118-18

Figure 5-1 Sample Successful Run of DISC4110 (Cont´d)

PART 1B - DISC4103/DISC4104/DISC4105/DISC4109/DISC4110/DISC4116
RUN PROCEDURES

5.1 PREPARATIONS FOR RUNNING THE DISC DIAGNOSTICS

Before any diagnostic is run, certain steps must be taken to allocate the system resources necessary for SHADOW and to ensure that the diagnostic run has minimum impact on system performance. The necessary procedures are ordinarily performed by the local system manager, or at least with the concurrence of the system manager. They include:

a. Obtaining access to the OSP subsystem

b. Transferring to another processor all user processes currently running in the processor to be taken off line

c. Transferring to another processor the path preference of all controllers with preferred paths currently assigned to the processor to be taken off line

d. Taking whatever precautions are indicated to protect the data stored on the disc volume to be tested

e. Taking off line the processor to be loaded with SHADOW

f. Taking off line the disc subsystem (controller and drive) to be tested.

> CAUTION
>
> If a T16/4109 disc drive is to be tested, both the moving and fixed-head portions of the disc (each assigned a different physical unit number) must be taken off line. Since the drives are dual ported, both paths to both portions of the disc must be off line.

These steps are described in detail elsewhere in the NonStop II Diagnostic Operating Procedures, Part Number 82803; those that deal with preparing the system in general for SHADOW, in Volume 1, Chapter 2, Parts 1 and 2; and those that deal with preparing the disc subystem in particular, in Volume 3B, Chapter 1, Part 1.

A checklist of the requirements for the DISC diagnostics, both those that must be available on the system and those that must be supplied by the customer engineer, is given in Table 5.1.

Table 5.1 Checklist for the DISC Diagnostics

REQUIREMENTS	SOURCE
A functioning OSP subsystem and terminal.	On site.
A processor that can be taken off line and dedicated to SHADOW.	On site.
A tape drive unit (if SHADOW is to be loaded from tape). a. The tape drive must be physically connected to the test processor if SHADOW is I/O loaded from tape. b. The tape drive must be physically connected to the processor that is to read the tape if SHADOW is bus loaded through an offline processor. c. The tape drive must be physically connected to a processor running GUARDIAN (TM) if SHADOW is bus loaded through an online processor.	On site.
Scratch pack or packs to substitute for the user packs during diagnostic execution (if removable media are to be tested).	On site.
SHADOW operating system. *	Either on site, in disc storage, or supplied by C.E. on cold load tape.
The appropriate DISC diagnostic program for the disc drive type under test (refer to Table 1.1).	Either on site, in disc storage, or supplied by C.E. on cold load tape.

* There are two distinct versions of the SHADOW operating system, one for the NonStop system (usually denoted as ZZDIAG1.SHADOW) and the other for the NonStop II system (usually denoted as ZZDIAG2.SHADOW). If loading from tape, ensure that the correct version is present on the tape and specify it during the load procedure.

5.2 RUN PROCEDURE FOR THE DISC DIAGNOSTICS

> CAUTION
>
> It is possible to run SHADOW diagnostics from the OSP in two or more processors concurrently. However, only one test process can communicate with the OSP at a time. For this reason, no more than one diagnostic process is ordinarily run on a system at any given time.

To run one of the DISC diagnostics, first ensure that the preparations listed in paragraph 5.1 are taken and then proceed as follows:

a. Load SHADOW into the test processor.

> CAUTION
>
> There are two distinct versions of the SHADOW operating system, one for the NonStop system (usually denoted as ZZDIAG1.SHADOW) and the other for the NonStop II system (usually denoted as ZZDIAG2.SHADOW). If loading from tape, ensure that the correct version is present on the tape and specify it during the load procedure. There are three methods for loading SHADOW: I/O cold load from tape, bus cold load from tape, and online load from tape or disc. They are described in detail in the NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 1.

b. Set desired Switch Register options in the operator control panel of the test processor. (Refer to Table 5.2 for a list of panel switches defined for the DISC diagnostics.)

c. At the SHADOW prompt (>) on the OSP screen, enter the command:

RUN <filename>

where <filename> is DISC4103, DISC4104, DISC4105, DISC4109, DISC4110, or DISC4116. (Refer to Figure 5-1 for further illustration.)

Table 5.2 Switch Register Options Available for the DISC Diagnostics *

SWITCH	FUNCTION
<0>	(Standard SHADOW function) If toggled on and off, generates a user break request and returns the SHADOW interpreter to conversational mode, where it waits for further instruction.
<1>	(DISC-specific function) If placed in the ON position, causes processing to stop.
<3>	(Standard SHADOW function) If placed in the ON position, suppresses error printout and enables setting of the special numerics ERROR# and COMPERR#. Refer to the Diagnostic Languages Manual, Part Number 82848, for a description of the special numerics ERROR# and COMPERR#.
<4>	(Standard SHADOW function) If placed in the ON position, suppresses error printout, disables setting of the special numerics ERROR# and COMPERR#, and disables ERROR limit decrement.
<5>	(Standard SHADOW function) If placed in the ON position, causes a program halt on I/O error.

* Switches <2>, <6>, and <7> are not defined for the DISC diagnostics, and switches <8> through <15> reflect the I/O address.

CAUTION

The program is now initializing. The program name is displayed at the OSP terminal, along with the following warnings:

```
WARNINGS:
-MEDIA IN SECTOR-SKIPPING FORMAT
-REFORMAT MEDIA IF YOU ALLOW PROGRAM TO
 WRITE DATA
```

The disc and controller diagnostics destroy data on the disc and should therefore be used with discretion. If the user chooses to proceed, the program displays several requests for input. Actual program execution commences only when the last request is honored.

d. When the following request is displayed at the OSP terminal, respond as indicated:

```
INPUT PRIMARY CONTROLLER NUMBER
?
```

1. Enter (in octal) the physical unit number of the disc controller to be tested.

2. Depress carriage return.

e. When the following request is displayed at the OSP terminal, respond as indicated:

```
INPUT SECONDARY CONTROLLER NUMBER, IF ANY
?
```

1. If the secondary controller associated with the primary controller specified in step d is to be tested, enter (in octal) the physical unit number of the secondary and depress carriage return.

2. If the secondary is not to be tested, simply depress carriage return.

NOTE

The only logical limitation on the secondary controller number is that it not be the same as the primary for any given disc drive. If the same number is erroneously entered for both primary and secondary, the program prompts until an acceptable secondary number is received.

f. When the following request is displayed at the OSP terminal, respond as indicated:

```
INPUT DRIVE NUMBER
?
```

1. Enter (in octal) the physical unit number of the first disc drive to be tested.

2. Depress carriage return.

NOTE

This request for input is repeated up to eight times, as long as an acceptable drive number is received after each display of the request. Receipt of carriage return only terminates the input and causes the next request to be displayed.

The T16/4109 drive requires two I/O addresses for complete identification (one for the moving heads and one for the fixed heads). So that DISC4109 can test both parts of the disc, the valid range of drive numbers for DISC4109 is limited to [0,3] instead of the customary range [0,7]. The upper half of the range [4,7] is reserved for identifying internally the fixed-head portions of the disc drives specified by the lower half (i.e., drive number 4 is the fixed-head portion of drive number 0, and so on).

> To test a primary controller alone, simply depress carriage return at the first request for drive number. Do not attempt to do this with more than one controller specified.

g. When the following request is displayed at the OSP terminal, make one of two responses, as indicated:

```
PERFORM READ ONLY PASS
?
```

1. Enter **Y** at the prompt and depress carriage return if only those tests that perform reads to the disc are required.

2. Enter **N** at the prompt and depress carriage return if all tests, including those that write to the disc, are required.

h. When the following request is displayed at the OSP terminal, make one of two responses, as indicated:

```
PERFORM ECC CHECK ON DATA?
(REQUIRES WRITING ON UNUSED SPARE TRACKS)
?
```

1. Enter **Y** at the prompt and depress carriage return if an ECC check on data is required.

2. Enter **N** at the prompt and depress carriage return if an ECC check on data is not required.

NOTE

This option is given only when read-only mode has been selected.

i. When the following request is displayed at the OSP terminal, make one of two responses, as indicated:

```
LOOP DIAGNOSTIC?
?
```

1. Enter **Y** at the prompt and depress carriage return if multiple passes of the main body of the diagnostic are required.

2. Enter **N** at the prompt and depress carriage return if only a single pass of the main body of the diagnostic is required.

j. When the following request is displayed at the OSP terminal, make one of two responses, as indicated:

```
RESTART WHEN DONE?
?
```

1. Enter **Y** at the prompt and depress carriage return if the diagnostic is to reinitialize when a full pass is complete, allowing for a new set of controllers and drives to be selected for test.

2. Enter **N** at the prompt and depress carriage return if no reinitialization of the diagnostic is required when the currently selected test completes.

NOTE

When this input is received, initialization is complete. The program begins execution with the basic controller checks. Refer to paragraphs 4.1 and 4.2 for a description of the error messages that can be returned during these checks.

k. If READ ONLY PASS is enabled, proceed to step 1. If it is not enabled, proceed as follows when the following message is displayed (at the end of basic controller checks for each drive under test):

```
VOLUME NAME IS     xxxxxxxx

<RETURN> TO CONTINUE, ANY OTHER CHAR TO ABORT
?
```

1. Depress carriage return to continue the test.

2. Enter any character at the prompt to abort the test.

NOTE

If the user elects to continue, data on the disc is destroyed during subsequent testing. The program first displays the contents of the spare tracks table and then proceeds to the main tests of disc and controller functions. If continuous looping is enabled, the program performs multiple passes of the main tests until instructed (by user break request) to halt. If continuous looping is disabled, or if a user break request is executed, the program terminates. Then, if restart is enabled, the program reinitializes, allowing a new set of controllers and drives to be selected for test. Otherwise, SHADOW returns to conversational mode, where it waits for further instruction.

l. Analyze any errors generated. (Refer to Section 4 for a description of possible error conditions.)

m. If the problem can be isolated to a faulty cable or to the drive as a unit, replace the faulty part. (Refer to the appropriate maintenance manual for a description of replacement procedures.)

n. If the results of the DISC diagnostic are inconclusive, try to isolate the problem further by running another of the diagnostics for sector-skipping format. (Refer to Table 1.1.)

CAUTION

The DISC diagnostics can invalidate the format of a disc pack. When testing with a DISC diagnostic is complete, it is necessary to run the appropriate disc pack formatter to restore valid sector-skipping format to the disc pack. Either the PUP FORMAT facility or the appropriate SHADOW formatter (FMT) may be used for this purpose. In cases where the contents of DLCYL have been lost, the PUP FORMAT facility must be used. To provide for adequate restoration of DLCYL in such cases, it is essential that a tape or hard copy of the vendor defect list information stored on DLCYL when first formatted by Tandem manufacturing be available. If a tape copy exists, it can be loaded directly onto the reformatted disc. If only a hard copy exists, the defects must be entered one by one, using the appropriate SHADOW defect-logging utility program (DUT). The PUP FORMAT procedure is described in the NonStop II System Operations Manual, Part Number 82075. The FMT programs are described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 3B, Chapter 1, Part 1F; the DUT programs, in Part 1D.

o. When diagnostic testing is complete, perform the following:

1. Notify the system manager that the serviced disc volume is now ready to be returned to system use.

NOTE

The facility for bringing disc volumes on line is provided by the PUP commands UP and REVIVE. The UP command is used to bring on line a volume that is not part of a mirrored pair. Any volumes configured to operate as part of a mirrored pair must be brought on line with the REVIVE command. The PUP commands UP and REVIVE are described in the NonStop II System Operations Manual, Part Number 82075.

2. Assist the customer in verifying the integrity of any disc volumes that have been serviced and in restoring the system to normal performance.

NOTE

The procedure for reloading a processor that is off line is described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 3.

PART 1C

DEX 4103, DEX 4104, DEX 4105
DEX 4109, DEX 4110, DEX 4116

SECOND LEVEL MANUAL

DIAGNOSTIC OPERATING PROCEDURES

NonStop II (TM) Systems

VOLUME 3B, CHAPTER 1, PART 1C

DEX4103, DEX4104, DEX4105, DEX4109, DEX4110
AND DEX4116 DISC DIAGNOSTICS

Copyright © 1982

TANDEM COMPUTERS INCORPORATED
2450 Walsh Avenue
Santa Clara, California 95050

Tandem Part Number 82802

October 1982
Printed in U.S.A.

This document contains information that is protected by copyright. No part of this document may be photocopied, reproduced or translated to another program or system without the prior written consent of Tandem Computers Incorporated.

The following are trademarks of Tandem Computers Incorporated:
Tandem, NonStop, NonStop II, AXCESS, DYNABUS, ENCOMPASS, ENFORM, ENSCRIBE, ENVOY, EXCHANGE, EXPAND, GUARDIAN, TGAL, PATHWAY, XRAY.

VOLUME 3B, CHAPTER 1, PART 1C

TABLE OF CONTENTS

Par.No. Title Page No.

SECTION 1
INTRODUCTION

1.0 INTRODUCTION.....1-1

SECTION 2
OVERVIEW

2.0 OVERVIEW.....2-1
2.1 PROGRAM SELECTION AND EXECUTION.....2-2

SECTION 3
COMMANDS

3.0 COMMANDS.....3-1
3.1 COMMAND SET FOR THE DEX DIAGNOSTICS.....3-1
3.1.1 CC - CHECK CYLINDER Command.....3-4
3.1.2 CN - SEND CONTROL Command.....3-5
3.1.3 CP - COMPARE BUFFERS Command.....3-6
3.1.4 CY - SET CYLINDER Command.....3-7
3.1.5 DP - DUPLICATE BUFFER Command.....3-8
3.1.6 DR - DUMP READ$ Command.....3-9
3.1.7 DW - DUMP WRITE$ Command.....3-11
3.1.8 EM - EXECUTE MEMORY Command.....3-13
3.1.9 EW - EDIT WRITE$ Command.....3-14
3.1.10 EX - EXIT Command.....3-15
3.1.11 FM - FORMAT Command.....3-16
3.1.12 HD - SET HEAD Command.....3-18
3.1.13 LH - LIST HEADERS Command.....3-19
3.1.14 LL - LOOP Command.....3-20
3.1.15 LT - READ LITERAL PROM Command.....3-21
3.1.16 MC - INCREMENT CYLINDER Command.....3-22
3.1.17 MH - INCREMENT HEAD Command.....3-23
3.1.18 MS - INCREMENT SECTOR Command.....3-24

TABLE OF CONTENTS (Cont'd)

Par.No.	Title	Page No.
3.1.19	PT - INITIALIZE PATTERN Command	3-25
3.1.20	RB - READ BUFFER Command	3-27
3.1.21	RD - READ Command	3-28
3.1.22	RF - READ FULL SECTOR Command	3-29
3.1.23	RR - READ REGISTERS Command	3-30
3.1.24	SC - SET SECTOR Command	3-31
3.1.25	SK - SEEK Command	3-32
3.1.26	SM - STORE MEMORY Command	3-33
3.1.27	TT - TAKE OWNERSHIP Command	3-34
3.1.28	VM - READ MICROCODE VERSION Command	3-35
3.1.29	WB - WRITE BUFFER Command	3-36
3.1.30	WF - WRITE FULL SECTOR Command	3-37
3.1.31	WT - WRITE Command	3-38

SECTION 4
ERROR CONDITIONS AND DISPOSITIONS

4.0 ERROR CONDITIONS AND DISPOSITIONS....4-1
4.1 ERROR INFORMATION APPENDED TO SHADOW ERROR MESSAGES....4-6
4.2 OTHER ERROR MESSAGES RETURNED BY THE DEX DIAGNOSTICS....4-10

SECTION 5
RUN PROCEDURES

5.0 RUN PROCEDURES....5-1
5.1 PREPARATIONS FOR RUNNING THE DEX DIAGNOSTICS....5-3
5.2 RUN PROCEDURE FOR THE DEX DIAGNOSTICS....5-5

LIST OF ILLUSTRATIONS

Fig.No.	Title	Page No.
4-1	Format of EIO Status Word	4-2
4-2	Format of IIO Status and Cause Words	4-3
4-3	Sector-skipping Format for Data on Disc	4-4
5-1	Sample Successful Run of DEX4110	5-2

TABLE OF CONTENTS (Cont'd)

LIST OF TABLES

Table No.	Title	Page No.
1.1	Disc Subsystem Diagnostics for the NonStop II System	1-2
3.1	Command Set for the DEX DIAGNOSTICS	3-2
3.2	Function Requests Recognized by SEND CONTROL Command	3-5
3.3	Messages Displayed during Execution of the DUMP READ$ Command	3-10
3.4	Messages Displayed during Execution of the DUMP WRITE$ Command	3-12
3.5	Messages Displayed during Execution of the EDIT WRITE$ Command	3-14
3.6	Messages Displayed during Execution of the FORMAT Command	3-17
3.7	Prompts Displayed during Execution of the INITIALIZE PATTERNS Command	3-26
3.8	Prompts Displayed during Execution of the READ BUFFER Command	3-27
3.9	Prompts Displayed during Execution of the WRITE BUFFER Command	3-36
4.1	Device Characteristics in Sector-skipping Format	4-5
4.2	Error Messages Accompanying Standard SHADOW Messages	4-7
4.3	Other Error Messages Generated by the DEX Diagnostics	4-10
5.1	Checklist for the DEX Diagnostics	5-4
5.2	Switch Register Options Available for the DEX Diagnostics	5-6
5.3	Possible Opening Series of Commands	5-10

PART 1C - DEX4103/DEX4104/DEX4105/DEX4109/DEX4110/DEX4116
TABLE OF CONTENTS

SECTION 1
INTRODUCTION

1.0 INTRODUCTION

This chapter describes six SHADOW diagnostics, DEX4103, DEX4104, DEX4105, DEX4109, DEX4110, and DEX4116. These diagnostics are designed as disc control exercisers (DEX) and can be used, respectively, to test a T16/4103, 4104, 4105/4106, 4109, 4110/4111, or 4116 disc drive on a Tandem NonStop II (TM) system. To accept these programs, the drive must be formatted for sector skipping and configured with a T16/3106 disc controller.

Used primarily in the corrective maintenance process, the DEX diagnostics can be run to determine the types of errors being produced and to help isolate the probable area of failure. After the suspected area of failure is corrected, these programs can be run again as end tests to ensure that the errors are eliminated.

The DEX diagnostics are one of seven sets of SHADOW diagnostic programs provided for the NonStop II disc subsystems. Refer to Table 1.1 for a list of the other available diagnostics.

NOTE

> The REX diagnostics, one of these other sets, are very similar to the DEX diagnostics. While offering many of the functions available in DEX, the REX diagnostics have powerful added capabilities; chiefly, a number of commands that enable random exercising of the disc pack.

The DEX diagnostics are written for SHADOW Rev level D00 and are compatible with all Rev levels of the disc controllers and drives.

Table 1.1 Disc Subsystem Diagnostics for the NonStop II System *

SUBSYSTEM	DIAGNOSTIC	MANUAL REF. **
T16/4103 drive - T16/3106 ctrl	FAST4103	Part 1A
	DISC4103	Part 1B
	DEX4103	Part 1C
	DUT4103	Part 1D
	EDT4103	Part 1E
	FMT4103	Part 1F
	REX4103	Part 1G
T16/4104 drive - T16/3106 ctrl	FAST4104	Part 1A
	DISC4104	Part 1B
	DEX4104	Part 1C
	DUT4104	Part 1D
	EDT4104	Part 1E
	FMT4104	Part 1F
	REX4104	Part 1G
T16/4105 drive - T16/3106 ctrl ***	FAST4105	Part 1A
T16/4106 drive - T16/3106 ctrl	DISC4105	Part 1B
	DEX4105	Part 1C
	DUT4105	Part 1D
	EDT4105	Part 1E
	FMT4105	Part 1F
	REX4105	Part 1G
T16/4109 drive - T16/3106 ctrl	FAST4109	Part 1A
	DISC4109	Part 1B
	DEX4109	Part 1C
	DUT4109	Part 1D
	EDT4109	Part 1E
	FMT4109	Part 1F
	REX4109	Part 1G
	FHD4109	Part 1H
T16/4110 drive - T16/3106 ctrl ***	FAST4110	Part 1A
T16/4111 drive - T16/3106 ctrl	DISC4110	Part 1B
	DEX4110	Part 1C
	DUT4110	Part 1D
	EDT4110	Part 1E
	FMT4110	Part 1F
	REX4110	Part 1G
T16/4116 drive - T16/3106 ctrl ***	FAST4116	Part 1A
	DISC4116	Part 1B
	DEX4116	Part 1C
	DUT4116	Part 1D
	EDT4116	Part 1E
	FMT4116	Part 1F
	REX4116	Part 1G

* A somewhat different subset of disc subsystems is supported on the NonStop (TM) system, some in sector-skipping format and some in track-sparing format. For a complete list of the disc subsystems supported on the NonStop system and of the applicable diagnostics, refer to NonStop Diagnostic Operating Procedures, Part Number 82802, Volume 3B, Chapter 1, Part 1.

** In all cases, the general manual reference is to Volume 3B, Chapter 1, of NonStop II Diagnostic Operating Procedures, Part Number 82803.

*** The T16/4105 and 4106 disc drives are identical devices, as are the T16/4110 and 4111, except that in each case the first is free standing in the cabinet and the second is drawer mounted.

T16/8L11C-01

SECTION 2
OVERVIEW

2.0 OVERVIEW

The DEX diagnostics define a set of commands that the user can invoke singly or in various sequences to test a wide range of disc control functions. These programs are interactive; the user inputs a command, and the program performs the indicated operation and reports error status. With these programs, the user can compose and run complete diagnostic tests of a disc subsystem tailored to the needs of a given situation.

The command set for the DEX diagnostics consists of a series of two-letter mnemonics, in some cases followed by an optional parameter. Commands can be combined into a command string, comprised of two or more commands separated by commas. A command string is executed, function by function, until either the end of the string or a syntax or parameter error is detected. If a parameter is specified for any command, it is entered directly after the command, without intervening space or punctuation. The maximum legal parameter value is 4095. For a description of the command set for the DEX diagnostics, refer to Section 3.

The DEX diagnostics are run from the OSP terminal. Before any of them can be run, the following system resources must be taken off line and dedicated exclusively to the SHADOW program:

a. The disc drive to be tested and the associated controller

b. The processor into which SHADOW is to be loaded (the procedure for taking processor modules off line is described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 2)

SHADOW is then loaded into the test processor by one of the three customary methods, and the desired Switch Register options may be set in the operator control panel of the test processor. Refer to Table 5.2 for a description of the Switch Register options for the DEX diagnostics. The SHADOW load procedure is described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 1.

2.1 PROGRAM SELECTION AND EXECUTION

After SHADOW is loaded, the appropriate disc control exerciser for the particular subsystem under test can be loaded and run. The typical SHADOW requests for input are displayed at the OSP terminal as the program initializes. Initialization cannot complete without appropriate responses from the operator. Proper program execution requires that the first response to the request for command string input be a TAKE OWNERSHIP command. Thereafter, the program continues to prompt for command string input after each command string is executed. A possible opening command string is as follows:

TT,CN16,CN2,CN64

This command string accomplishes the following operations:

a. Take ownership

b. Priority select

c. Unit clear

d. Recalibrate.

All of the programs report the SHADOW error messages appropriate to the conditions detected (unless error printout is suppressed in the panel switches). Execution of many of the commands results in the display of additional specific error information or requests for further input. Refer to Section 3 for a description of the prompts displayed by certain commands, and to Section 4 for a description of all error messages that may be displayed at the OSP terminal.

Invoking the EXIT command (EX) does not terminate the diagnostic or return the terminal to SHADOW conversational mode; it merely causes processing to stop for the device under test and the DEX program to reinitialize. To terminate the diagnostic and return to SHADOW conversational mode, either bit <0> of the Switch Register must be toggled on and off or the ESCAPE key depressed at the OSP terminal.

Because the DEX diagnostics are interactive programs, run times vary widely, depending on such factors as the number of commands invoked, the number of options exercised, the storage capacity of the disc drive under test, and so on. The settings of the panel switches can also affect the course of any given run of the diagnostic. Most individual commands take less than 30 seconds to execute, but certain commands, such as CHECK CYLINDER (CC) and FORMAT (FM), can take considerably longer. Factors to be considered when estimating down time include not only the run times for the diagnostics to be used, but also the time which may be required for reformatting and reviving the discs after the diagnostics are completed. The times required for these procedures vary from an hour or less to as long as overnight, depending on such factors as system load and disc pack size.

SECTION 3
COMMANDS

3.0 COMMANDS

The DEX diagnostics contain a program-defined command set for interactive use during execution. The command names for this command set consist of two-letter mnemonics, in some instances accompanied by an optional parameter. With them, the program user can compose and run tests of a disc subsystem tailored to the needs of a given situation. The command set for the DEX diagnostics is described in paragraph 3.1.

In addition, the DEX diagnostics require the SHADOW RUN command for program execution. If the user wishes to implement the NOSTRIP option, the SHADOW OPTION command must also be invoked. (SHADOW defaults to option STRIP.)

3.1 COMMAND SET FOR THE DEX DIAGNOSTICS

The command set for the DEX diagnostics is summarized in Table 3.1. Descriptions of the individual commands follow in paragraphs 3.1.1 through 3.1.31. Each description consists of a metalinguistic definition of the command, using the Backus-Naur/Normal Form (BNF), followed by discussion and examples.

NOTE

A metalanguage is a set of symbols and associated conventions for defining exhaustively the syntax of another language. BNF notation is a metalanguage devised and commonly in use for the description of programming languages. For that reason, it is employed here. The conventions observed by BNF notation are further explained in the NonStop II Diagnostic Operating Procedures, Part Number 82803, Appendix A.

Table 3.1 Command Set for the Disc Control Exerciser Programs (DEX4103, DEX4104, DEX4105, DEX4109, DEX4110, and DEX4116)

COMMAND	FUNCTION	PARAMETER	DEFAULT
CC	Run CHECK command for whole cylinder	cylinder number	current
CN	Issue control request to disc	function	0
CP	Compare READ$ and WRITE$ buffers	number of bytes	512
CY	Set current disc cylinder address (no EIO issued)	cylinder number	0
DP	Copy the READ$ buffer into the WRITE$ buffer	character	N/A
DR	Dump READ$ buffer to terminal	N/A	N/A
DW	Dump WRITE$ buffer to terminal	N/A	N/A
EM	Execute stored command string	N/A	N/A
EW	Edit the WRITE$ buffer	first byte number	0
EX	Exit exerciser	N/A	N/A
FM	Format a whole cylinder	N/A	N/A
HD	Set current disc head address (no EIO issued)	head number	0
LH	List headers for current cylinder	starting head	0
LL	Loop command sequence	number of times	1
LT	Read and Dump Literal Prom ID (refer to Table 4.1 for the device-specific values of LPRID)	N/A	N/A
MC	Increment cylinder (no EIO issued)	number to be added to current	1

Table 3.1 Command Set for the Disc Control Exerciser Programs (Cont'd)

COMMAND	FUNCTION	PARAMETER	DEFAULT
MH	Increment head (no EIO issued)	number to be added to current	1
MS	Increment sector (no EIO issued)	number to be added to current	1
PT	Initialize patterns in buffers	N/A	N/A
RB	Read buffer	N/A	N/A
RD	Read from current disc address	number of bytes	512
RF *	Read full sector to current address	number of sectors	1
RR	Read/print current controller registers	N/A	N/A
SC	Set current disc sector address (no EIO issued)	sector number	0
SK	Seek to current disc address	N/A	N/A
SM	Store last command string	N/A	N/A
TT	Take ownership	N/A	N/A
VM	Read and dump microcode version number	N/A	N/A
WB	Write buffer	N/A	N/A
WT	Write to current disc address	number of bytes	512
WF *	Write full sector to current address	N/A	N/A

* - These commands assume physical addressing and ignore sector-skipping format.

3.1.1 CC - CHECK CYLINDER Command

The form of the CHECK CYLINDER command is as follows:

```
check_cylinder_command  ::=  CC [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to MAXCYL
  MAXCYL  ::=  { 814 | 822 | 842 }
```

Execution of the CHECK CYLINDER command (CC) causes the controller to scan all sectors on the cylinder indicated in the parameter, looking for header and data errors. The results are reported in the READ$ buffer, and defects are displayed at the OSP terminal. (Refer to Table 4.3 for the special error message generated if a seek error occurs during command execution.)

If no cylinder number is specified, the parameter defaults to the current cylinder (i.e., the cylinder most recently accessed by preceding commands). The legal range for the parameter is [0,MAXCYL]. (Refer to Table 4.1 for the possible values of MAXCYL.)

The format of the defect display is as follows:

```
                DEFECTS FOR CYLINDER xxx

          TERM (%B)                HEAD   SECTOR
%Bx xxx xxx xxx xxx xxx   xx      xx
%Bx xxx xxx xxx xxx xxx   xx      xx
    .    .    .    .    .    .    .
%Bx xxx xxx xxx xxx xxx   xx      xx
```

NOTE

The relevant error codes (in octal) returned in column TERM are: %02 - correctable data error; %11 - uncorrectable data error; %14 - header search failure.

Examples:

```
CY25,CC          ! defaults to cylinder 25 and causes all
                 ! sectors on cylinder 25 to be scanned for
                 ! header and data errors
                 !
CC351            ! causes all sectors on cylinder 351 to be
                 ! scanned for header and data errors
```

3.1.2 CN - SEND CONTROL Command

The form of the SEND CONTROL command is as follows:

send_control_command ::= CN [parameter]

parameter ::= integer_constant
integer_constant ::= { 0 | 1 | 2 | 4 | 8 | 16 | 32 | 64 | 128 }

Execution of the SEND CONTROL command (CN) causes the function request indicated in the parameter to be sent to the controller. If no function is specified, the parameter defaults to zero (0). The valid function requests are listed in Table 3.2.

Example:

CN64 ! issues a RECALIBRATE to the controller

Table 3.2 Function Requests Recognized by SEND CONTROL Command

PARAMETER	BIT	OCTAL EQUIVALENT	FUNCTION
128	8	%200	Data Strobe Early
64	9	%100	Recalibrate
32	10	%40	Unit Release
16	11	%20	Priority Select
8	12	%10	Servo Offset Minus
4	13	%4	Servo Offset Plus
2	14	%2	Unit Clear
1	15	%1	Data Strobe Late
0	-	0	No operation

3.1.3 CP - COMPARE BUFFERS Command

The form of the COMPARE BUFFERS command is as follows:

```
compare_buffers_command  ::=  CP [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to 4095
```

Execution of the COMPARE BUFFERS command (CP) causes a standard SHADOW COMPARE statement to be executed on the contents of the READ$ and WRITE$ buffers. The number specified in the parameter determines the number of bytes compared. If no number is specified, the parameter defaults to 512. Only the first ten miscompares are listed. The legal range for the parameter is [0,4095].

Examples:

```
  WT,RD,CP              ! performs a SHADOW COMPARE operation on 512
                        ! bytes of the READ$ and WRITE$ buffers
                        !
  WT100,RD100,CP100     ! performs a SHADOW COMPARE operation on 100
                        ! bytes of the READ$ and WRITE$ buffers
```

3.1.4 CY - SET CYLINDER Command

The form of the SET CYLINDER command is as follows:

```
set_cylinder_command  ::=  CY [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to MAXCYL
  MAXCYL  ::=  { 814 | 822 | 842 }
```

Execution of the SET CYLINDER command (CY) causes the address of the current cylinder to be set to the number specified in the parameter. If no cylinder number is specified, the parameter defaults to zero (0). The legal range of values for the parameter is [0,MAXCYL]. (Refer to Table 4.1 for the possible values of MAXCYL.)

Examples:

```
CY                  ! sets the current cylinder address to 0
                    !
CY101               ! sets the current cylinder address to 101
```

3.1.5 DP - DUPLICATE BUFFER Command

The form of the DUPLICATE BUFFER command is as follows:

```
duplicate_buffer_command  ::=  DP [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to 255
```

Execution of the DUPLICATE BUFFER command (DP) causes the contents of the READ$ buffer to be copied into the WRITE$ buffer. If no parameter or a parameter less than 0 or greater than 255 (%377) is specified, the program simply copies the contents of READ$ into WRITE$. If any other value for the parameter is specified, the program copies the contents of READ$ into WRITE$ and sets WRITE$[20] equal to the parameter to facilitate ECC checkout. The legal range for the parameter is [0,255].

Examples:

```
PT,DP                 ! copies the contents of the READ$ buffer into
                      ! the WRITE$ buffer
                      !
DP10                  ! copies READ$ TO WRITE$ and sets WRITE$[20] =
                      ! 10 for ECC checkout.
```

3.1.6 DR - DUMP READ$ Command

The form of the DUMP READ$ command is as follows:

dump_read$_command ::= DR

Execution of the DUMP READ$ command (DR) causes the contents of the READ$ buffer to be displayed at the OSP terminal. Execution of the command generates certain requests for input (size of buffer, dump mode). User response determines the format of the display. Refer to Table 3.3 for a description of the screen displays that occur during command execution.

Example:

```
DR                    ! displays the contents of the READ$ buffer
                      ! as specified by user response to the
                      ! requests for input generated by the command
```

Table 3.3 Messages Displayed during Execution of the DUMP READ$ Command

SCREEN DISPLAY	EXPLICATION
SIZE OF BUFFER IN BYTES	Prompt requesting the user to indicate the number of bytes in the buffer. A user input between 1 and 4095 is expected.
INPUT DUMP MODE: A(SCII) OR O(CTAL)	Prompt requesting the user to indicate the mode in which the buffer contents are to be displayed. A user response of A causes the contents of the data buffer to be displayed in ASCII; a user response of O causes the contents of the data buffer to be displayed in octal.
CHECKSUM BUFFER xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx	Format for display of contents of the checksum buffer.
DATA BUFFER %xxxxxxxx : y PRESS RETURN TO CONTINUE DUMP, ANY CHARACTER TO STOP	Format for address-by-address display of contents of the data buffer if the selected dump mode is ASCII. The contents of the data buffer are displayed address by address as long as the user elects to continue or until the entire buffer is displayed. The program then prompts for the next command input.
DATA BUFFER %xxxxxxxx : yyyyyyyy yyyyyyyy yyyyyyyy yyyyyyyy yyyyyyyy yyyyyyyy yyyyyyyy yyyyyyyy PRESS RETURN TO CONTINUE DUMP, ANY CHARACTER TO STOP	Format for address-by-address display of contents of the data buffer if the selected dump mode is octal. The contents of the data buffer are displayed address by address as long as the user elects to continue or until the entire buffer is displayed. The program then prompts for the next command input.

T16/8L11C-02

3.1.7 DW - DUMP WRITE$ Command

The form of the DUMP WRITE$ command is as follows:

dump_write$_command ::= DW

Execution of the DUMP WRITE$ command (DW) causes the contents of the WRITE$ buffer to be displayed at the OSP terminal. Execution of the command generates certain requests for input (size of buffer, dump mode). User response determines the format of the display. Refer to Table 3.4 for a description of the screen displays that occur during command execution.

Example:

```
DW                    ! displays the contents of the WRITE$ buffer
                      ! as specified by user response to the
                      ! requests for input generated by the command
```

Table 3.4 Messages Displayed during Execution of the DUMP WRITE$ Command

SCREEN DISPLAY	EXPLICATION
SIZE OF BUFFER IN BYTES	Prompt requesting the user to indicate the number of bytes in the buffer. A user input between 1 and 4095 is expected.
INPUT DUMP MODE: A(SCII) OR O(CTAL)	Prompt requesting the user to indicate the mode in which the buffer contents are to be displayed. A user response of A causes the contents of the data buffer to be displayed in ASCII; a user response of O causes the contents of the data buffer to be displayed in octal.
CHECKSUM BUFFER xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx	Format for display of contents of the checksum buffer.
DATA BUFFER %xxxxxxxx : y PRESS RETURN TO CONTINUE DUMP, ANY CHARACTER TO STOP	Format for address-by-address display of contents of the data buffer if the selected dump mode is ASCII. The contents of the data buffer are displayed address by address as long as the user elects to continue or until the entire buffer is displayed. The program then prompts for the next command input.
DATA BUFFER %xxxxxxxx : yyyyyyyy yyyyyyyy yyyyyyyy yyyyyyyy yyyyyyyy yyyyyyyy yyyyyyyy yyyyyyyy PRESS RETURN TO CONTINUE DUMP, ANY CHARACTER TO STOP	Format for address-by-address display of contents of the data buffer if the selected dump mode is octal. The contents of the data buffer are displayed address by address as long as the user elects to continue or until the entire buffer is displayed. The program then prompts for the next command input.

T16/8L11C-03

3.1.8 EM - EXECUTE MEMORY Command

The form of the EXECUTE MEMORY command is as follows:

execute_memory_command ::= EM

Execution of the EXECUTE MEMORY command (EM) causes the last command string saved in memory by the SM command (refer to paragraph 3.1.26) to be displayed and reexecuted. If no string is currently stored when the command is executed, the following message is displayed:

** NO STRING STORED **

Example:

```
CY10,SK,SM,EM          ! reexecutes the command string "CY10,SK"
                       ! stored in memory by the preceding STORE
                       ! MEMORY command
```

3.1.9 EW - EDIT WRITE$ Command

The form of the EDIT WRITE$ command is as follows:

```
edit_write$_command  ::=  EW [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to 4095
```

The EDIT WRITE$ command (EW) allows the operator to edit the WRITE$ buffer starting with the byte number specified in the parameter. If no byte number is specified, the parameter defaults to zero (0). The legal range of values for the parameter is [0,4095]. A new value may be entered for each byte in the specified range; the value for a given byte is left unchanged if an empty response is received (i.e., if a carriage return alone is entered). An entry of negative one (-1) terminates the edit. Refer to Table 3.5 for a description of the messages displayed during command execution.

Examples:

```
EW                  ! initiates an edit of the WRITE$ buffer
                    ! starting with byte 0
                    !
EW130               ! initiates an edit of the WRITE$ buffer
                    ! starting with byte 130
```

Table 3.5 Messages Displayed during Execution of the EDIT WRITE$ Command

SCREEN DISPLAY	EXPLICATION
BYTE # xxxx = % yyyyyyyy **INPUT NEG. VALUE TO ESCAPE **	Prompt requesting the user to input a new value for the specified byte. The byte # specified by the prompt is that specified in the EDIT WRITE$ parameter. When the new value is received, the program displays the updated value (see description of next message) and then prompts for a new value for the next byte number in the WRITE$ buffer. This process is repeated for all following bytes in the buffer, or until a negative value is entered to terminate the edit. When the user terminates the edit, the program prompts for the next command input.
NEW VALUE = % xxxxxxxx	Message displayed when the new value for the specified byte is received.

T16/8L11C-04

3.1.10 EX - EXIT Command

The form of the EXIT command is as follows:

exit_command ::= EX

Execution of the EXIT command (EX) causes exerciser mode to terminate and the program to reinitialize, allowing a new controller and disc number to be specified for testing.

Example:

```
EX                    ! terminates exerciser mode for the device
                      ! under test and returns to program
                      ! initialization for selection of another
                      ! device for testing
```

3.1.11 FM - FORMAT Command

The form of the FORMAT command is as follows:

format_command ::= FM

Execution of the FORMAT command (FM) causes a whole cylinder to be formatted in sector-skipping format. The command defaults to the current cylinder set in the control program. The data in the WRITE$ buffer is used in formatting. The program checksums the first 510 bytes and writes a checksum in bytes 510 and 511 that results in the data checksummable to: %360/%0. If an extension cylinder is required, the program displays a message indicating that no extension was attempted. (For a description of this and other possible error messages that may be generated during command execution, refer to Table 4.3.)

> CAUTION
>
> The FORMAT command can invalidate the general formatting of a pack since it does not update the system Spare Tracks Table.

Execution of the command requires user response to several requests for input. Unless the user directs otherwise, the FORMAT command uses the CC (Check Cylinder) command to find the defects to skip on the current cylinder. If Check Cylinder is not elected, the cylinder is assumed to be defect-free, and it is not checked. Refer to Table 3.6 for a description of the prompts for input displayed during command execution.

Example:

```
CY10,FM              ! formats cylinder 10 in sector-skipping
                     ! format
```

Table 3.6 Messages Displayed during Execution of the FORMAT Command

SCREEN DISPLAY	EXPLICATION
DO YOU REALLY WANT TO INVALIDATE HEADERS ON CYL xxx	Prompt, when the command is invoked, requesting that the user indicate his awareness that execution of the FORMAT command invalidates headers on the formatted cylinder. If the user response is Y, the program proceeds with execution of the FORMAT command. If user response is N, the program aborts the FORMAT command and prompts for the next command input.
USE DEFECTS FROM "CHECK CYLINDER"?	Prompt requesting that the user indicate whether the FORMAT procedure should issue a CHECK CYLINDER command to determine which sectors are already declared defective on the cylinder to be formatted. A user response of Y or N is expected.

T16/8L11C-05

3.1.12 HD - SET HEAD Command

The form of the SET HEAD command is as follows:

```
set_head_command  ::=  HD [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to MAXHEAD
  MAXHEAD  ::=  { 4 | 9 | 18 | 39 }
```

Execution of the SET HEAD command (HD) causes the address of the current head to be set to the number specified in the parameter. If no number is specified, the parameter defaults to head number zero (0). The legal range of values for parameter is [0,MAXHEAD]. (Refer to Table 4.1 for the possible values of MAXHEAD.)

Examples:

```
  HD                    ! sets the current head address to 0
                        !
  HD1                   ! sets the current head address to 1
```

3.1.13 LH - LIST HEADERS Command

The form of the LIST HEADERS command is as follows:

```
list_headers_command  ::=  LH [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to MAXHEAD
  MAXHEAD  ::=  { 4 | 9 | 18 | 39 }
```

Execution of the LIST HEADERS command (LH) causes the headers for a whole cylinder to be listed. The command defaults to the current cylinder set in the control program. If a parameter is specified, it is interpreted as a starting head address. The legal range of values for parameter is [0,MAXHEAD]. (Refer to Table 4.1 for the possible values of MAXHEAD.) When the command is executed, information for the first twenty headers is listed in the following format:

PHEAD	PSECT	SYNC%	FLAG%	CYL	HEAD	SECT
xx	xx	xxx	xxx	xxx	xx	xx
xx	xx	xxx	xxx	xxx	xx	xx
.	.	.	.	.	.	.
xx	xx	xxx	xxx	xxx	xx	xx

<RETURN> TO CONTINUE DUMP OR ANY CHAR. TO STOP

If the user elects to continue with the listing of headers, the information for the next twenty headers is displayed in the same format. This procedure continues for each set of twenty headers until all headers are displayed or until the user terminates command execution.

Examples:

```
CY10,LH        ! causes the headers for cylinder 10 to be
               ! listed
               !
CY10,LH4       ! causes the headers for cylinder 10 to be
               ! listed, starting at head 4.
```

3.1.14 LL - LOOP Command

The form of the LOOP command is as follows:

```
loop_command  ::=  LL [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to 4096
```

Execution of the LOOP command (LL) causes the sequence of commands bounded by the start of the command string (or by a previous LOOP command in the string) to be repeated. The number of times the command string is to be repeated is specified in the parameter. If no number of repetitions is specified, the parameter defaults to 1. The legal range for the parameter is [0,4095].

Examples:

```
CY10,SK,CY20,SK,LL    ! loops the preceding sequence of commands one
                      ! time
                      !
CY10,SK,CY20,SK,LL10  ! loops the preceding sequence of commands 10
                      ! times
```

3.1.15 LT - READ LITERAL PROM Command

The form of the READ LITERAL PROM command is as follows:

read_literal_PROM_command ::= LT

Execution of the READ LITERAL PROM command (LT) causes the literal PROM ID to be read and displayed at the OSP terminal. The form of the display is as follows:

```
** LITERAL PROM ID %: xxx
```

Example:

```
LT                    ! displays the literal PROM ID
```

3.1.16 MC - INCREMENT CYLINDER Command

The form of the INCREMENT CYLINDER command is as follows:

```
increment_cylinder_command  ::=  MC [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range -MAXCYL to MAXCYL
  MAXCYL  ::=  { 814 | 822 | 842 }
```

Execution of the INCREMENT CYLINDER command (MC) causes the current cylinder address to be shifted by the value specified in the parameter. If no value is specified, the parameter defaults to 1. The legal range of values for the parameter is [-MAXCYL, MAXCYL]. (Refer to Table 4.1 for the device-specific values of MAXCYL.)

Examples:

```
MC          ! increments the current cylinder address by 1
            !
MC10        ! increments the current cylinder address by 10
            !
MC-10       ! decrements the current cylinder address by 10
```

3.1.17 MH - INCREMENT HEAD Command

The form of the INCREMENT HEAD command is as follows:

```
increment_head_command  ::=  MH [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range -MAXHEAD to MAXHEAD
  MAXHEAD  ::=  { 4 | 9 | 18 | 39 }
```

Execution of the INCREMENT HEAD command (MH) causes the current head address to be shifted by the value specified in the parameter. If no value is specified, the parameter defaults to 1. The legal range of values for the parameter is [-MAXHEAD, MAXHEAD]. (Refer to Table 4.1 for the device-specific values of MAXHEAD.)

Examples:

```
MH        ! increments the current head address by 1
          !
MH10      ! increments the current head address by 10
          !
MH-10     ! decrements the current head address by 10
```

3.1.18 MS - INCREMENT SECTOR Command

The form of the INCREMENT SECTOR command is as follows:

```
increment_sector_command  ::=  MS [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range -MAXSECT to MAXSECT
  MAXSECT  ::=  { 19 | 29}
```

Execution of the INCREMENT SECTOR command (MS) causes the current sector address to be shifted by the value specified in the parameter. If no value is specified, the parameter defaults to 1. The legal range of values for the parameter is [-MAXSECT, MAXSECT]. (Refer to Table 4.1 for the device-specific values of MAXSECT.)

Examples:

```
MS          ! increments the current sector address by 1
            !
MS10        ! increments the current sector address by 10
            !
MS-10       ! decrements the current sector address by 10
```

3.1.19 PT - INITIALIZE PATTERN Command

The form of the INITIALIZE PATTERN command is as follows:

initialize_pattern_command ::= PT

Execution of the INITIALIZE PATTERN command (PT) causes a repeating test pattern to be stored in either the READ$ or the WRITE$ buffer. Execution of the command requires user response to several requests for input (buffer to be modified, input mode, pattern). The user must enter from 0 to 16 integers in the range [0,255] or a character string up to 72 ASCII characters in length. Carriage return alone terminates the input. The data entered is repeated as necessary to fill the entire READ$ or WRITE$ buffer. Refer to Table 3.7 for a description of the prompts for input displayed during command execution.

Example:

```
PT                    ! causes a repeating pattern to be stored in
                      ! the buffer as specified by user response
                      ! to certain prompts
```

Table 3.7 Prompts Displayed during Execution of the INITIALIZE PATTERN Command

SCREEN DISPLAY	EXPLICATION
INPUT BUFFER TO MODIFY: R(EAD) OR W(RITE) OR C(HECKSUM)	Prompt requesting that the user indicate the name of the buffer to be modified. The expected user response is R, W, or C.
INPUT MODIFYING MODE: A(SCII) OR O(CTAL)	Prompt requesting that the user indicate the mode by which the specified buffer (see description of preceding message) is to be modified. A user response of A causes the contents of the previously specified buffer to be modified in ASCII; a user response of O causes the contents of the previously specified buffer to be modified in octal.
INPUT ASCII STRING	Prompt, if the specified mode is ASCII, requesting that the user enter the ASCII string with which the buffer is to be modified. When the user response is received, the buffer is modified.
INPUT, IN OCTAL, DATA PATTERNS	Prompt, if the specified mode is octal, requesting that the user enter the data patterns with which the buffer is to be modified. When the user response is received, the buffer is modified.

T16/8L11C-06

3.1.20 RB - READ BUFFER Command

The form of the READ BUFFER command is as follows:

read_buffer_command ::= RB

Execution of the READ BUFFER command (RB) reads the contents of the controller buffer and places it in the READ$ buffer. Refer to Table 3.8 for a description of the prompts for input displayed during command execution. (For a description of the special error message generated if a read error occurs during command execution, refer to Table 4.3.)

Example:

```
RB                    ! reads the contents of the controller buffer
                      ! and places it in READ$
```

Table 3.8 Prompts Displayed during Execution of the READ BUFFER Command

SCREEN DISPLAY	EXPLICATION
ENTER FIRST ADDRESS TO READ	Prompt requesting that the user enter the buffer address at which to begin the read operation. An address between 0 and 4095 is expected.
ENTER BYTECOUNT	Prompt requesting that the user enter the number of bytes to be read starting at the specified address. A number between 1 and 4096 is expected.

T16/8L11C-07

3.1.21 RD - READ Command

The form of the READ command is as follows:

```
read_command  ::=  RD [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to 4095
```

Execution of the READ command (RD) causes a read to be performed to the sector addressed by the last SEEK command (SK). The address used for seek operations is that set by one of several possible prior commands (CY, HD, SC, MC, MH, MS, CC, LH, FM, or EM). If a SEEK command has not been performed, the sector or sectors addressed depend on the state of the controller registers. The number of bytes to be read is specified in the parameter. If no number is specified, the parameter defaults to 512. The legal range of values for the parameter is [0,4095].

Examples:

```
CY,HD,SC,SK,RD        ! reads 512 bytes of data starting at address
                      ! 0,0,0
                      !
CY,HD,SC,SK,RD100     ! reads 100 bytes of data starting at address
                      ! 0,0,0
```

3.1.22 RF - READ FULL SECTOR Command

The form of the READ FULL SECTOR command is as follows:

```
read_full_sector_command  ::=  RF [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to 7
```

Execution of the READ FULL SECTOR command (RF) causes a full-sector READ to be performed at the sector addressed by the last SEEK command (SK). The address used for seek operations is that set by one of several possible prior commands (CY, HD, SC, MC, MH, MS, CC, LH, FM, or EM). If a SEEK command has not been performed, the sector or sectors addressed depend on the state of the controller registers. The number of sectors to be read is specified in the parameter. If no number is specified, the parameter defaults to 1. The legal range of values for the parameter is [0,7]. The READ FULL SECTOR command assumes physical addressing and ignores sector skipping.

Examples:

```
CY,HD,SC,SK,RF        ! reads one full sector starting at address
                      ! 0,0,0
                      !
CY,HD,SC,SK,RF2       ! reads 2 full sectors starting at address
                      ! 0,0,0
```

3.1.23 RR - READ REGISTERS Command

The form of the READ REGISTERS command is as follows:

read_registers_command ::= RR

Execution of the READ REGISTERS command (RR) causes the current contents of the controller registers to be displayed at the OSP terminal. The format of this display is as follows:

```
CONTENTS OF CONTROLLER REGISTERS
CYL =  xxx   HEAD =  xx   SECT =  xx
FLAGS =  % x xxx xxx xxx xxx xxx
SECTOR COUNT =  xxx
BUFADD = xxxx
```

CYL/HEAD/SECT reflects the disc address of the sector accessed by the command; FLAGS returns the value of the header flag in the accessed sector (refer to Figure 4-3); COUNT reflects the bytecount returned by the operation; and ADD reflects the current address of the controller buffer.

Example:

```
RR                    ! displays the contents of the controller
                      ! registers
```

3.1.24 SC - SET SECTOR Command

The form of the SET SECTOR command is as follows:

```
set_sector_command  ::=  SC [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to MAXSECT
  MAXSECT  ::=  { 19 | 29 }
```

Execution of the SET SECTOR command (SC) causes the address of the current sector to be set to the number specified in the parameter. If no number is specified, the parameter defaults to sector number zero (0). The legal range of values for parameter is [0,MAXSECT]. (Refer to Table 4.1 for the possible values of MAXSECT.)

Examples:

```
SC                  ! sets the current sector address to 0
                    !
SC10                ! sets the current sector address to 10
```

3.1.25 SK - SEEK Command

The form of the SEEK command is as follows:

seek_command ::= SK

Execution of the SEEK command (SK) causes a seek operation to be performed to the current disc address. This address is established by one of several possible prior commands (CY, HD, SC, MC, MH, MS, CC, LH, FM, or EM).

Example:

```
CY,HD,SC,SK          ! seeks to address 0,0,0
```

3.1.26 SM - STORE MEMORY Command

The form of the STORE MEMORY command is as follows:

store_memory_command ::= SM

Execution of the STORE MEMORY command (SM) causes the last command string without syntactical errors to be saved for possible later reexecution. Commands that require user interaction or that contain parameters may be included. Only one command string may be in memory at any given time.

Example:

```
CY10,SK,SM          ! saves the command string "CY10,SK" for later
                    ! reexecution
```

3.1.27 TT - TAKE OWNERSHIP Command

The form of the TAKE OWNERSHIP command is as follows:

take_ownership_command ::= TT

Execution of the TAKE OWNERSHIP command (TT) causes the diagnostic to take ownership of the device under test.

Example:

```
TT                    ! takes ownership of the device under test
```

3.1.28 VM - READ MICROCODE VERSION Command

The form of the READ MICROCODE VERSION command is as follows:

read_microcode_version_command ::= VM

Execution of the READ MICROCODE VERSION command (VM) causes the current version of the microcode to be displayed at the OSP terminal. The form of this display is as follows:

MICROCODE VERSION ID = % xxx

(For a description of the special error message generated if the device under test does not have defect-skipping microcode, refer to Table 4.3.)

Example:

```
VM                    ! displays the current version of the microcode
```

3.1.29 WB - WRITE BUFFER Command

The form of the WRITE BUFFER command is as follows:

write_buffer_command ::= WB

Execution of the WRITE BUFFER command (WB) writes data from the WRITE$ buffer into the controller buffer. Refer to Table 3.9 for a description of the prompts for input displayed during command execution.

Example:

```
WB                    ! writes data in the WRITE$ buffer
```

Table 3.9 Prompts Displayed during Execution of the WRITE BUFFER Command

SCREEN DISPLAY	EXPLICATION
ENTER BYTE ADDRESS	Prompt requesting that the user enter the buffer address at which to begin the write operation. An address between 0 and 4095 is expected.
ENTER BYTECOUNT	Prompt requesting that the user enter the number of bytes to be written starting at the specified address. A number between 1 and 4095 is expected.

T16/8L11C-08

3.1.30 WF - WRITE FULL SECTOR Command

The form of the WRITE FULL SECTOR command is as follows:

write_full_sector_command ::= WF

Execution of the WRITE FULL SECTOR command (WF) causes a full-sector write to be performed at the sector addressed by the last SEEK command (SK). The address used for seek operations is that set by one of several possible prior commands (CY, HD, SC, MC, MH, MS, CC, LH, FM, or EM). If a SEEK command has not been performed, the sector or sectors addressed depend on the state of the controller registers. The WRITE FULL SECTOR command assumes physical addressing and ignores sector skipping. (For a description of the special error message generated if command execution results in a WRITE to DLCYL, refer to Table 4.3.)

Examples:

```
CY,HD,SC,WF        ! writes one full sector starting at address
                   ! 0,0,0
                   !
CY,HD,SC,WF2       ! writes 2 full sectors starting at address
                   ! 0,0,0
```

3.1.31 WT - WRITE Command

The form of the WRITE command is as follows:

```
write_command  ::=  WT [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to 4095
```

Execution of the WRITE command (WT) causes a write to be performed to the sector addressed by the last SEEK command (SK). The address used for seek operations is that set by one of several possible prior commands (CY, HD, SC, MC, MH, MS, CC, LH, FM, or EM). If a SEEK command has not been performed, the sector or sectors addressed depend on the state of the controller registers. The number of bytes to be written is specified in the parameter. If no number is specified, the parameter defaults to 512. The legal range of values for the parameter is [0,4095]. (For a description of the special error message generated if command execution results in an attempt to write to DLCYL, refer to Table 4.3.)

Examples:

```
CY,HD,SC,WT          ! writes 512 bytes of data starting at address
                     ! 0,0,0
                     !
CY,HD,SC,WT100       ! writes 100 bytes of data starting at address
                     ! 0,0,0
```

SECTION 4
ERROR CONDITIONS AND DISPOSITIONS

4.0 ERROR CONDITIONS AND DISPOSITIONS

The DEX diagnostics utilize the SHADOW error message facility and return the typical SHADOW messages generated by compare errors, EIO status errors, interrupt status errors, and unexpected non-I/O interrupt errors. These messages include the program step number at which failure occurred, the logical unit number of the device under test, and the EIO and IIO status and cause words.

When a SHADOW error message is returned, the sequence of events producing the error can be determined by cross-referencing the error message with the program listing of the currently executing diagnostic. The formats for the return of EIO status and IIO status are given in Figures 4-1 and 4-2, respectively. The format of data on the disc is shown in Figure 4-3. The device characteristics of the T16/4103, 4104, 4105/4106, 4109, 4110/4111, and 4116 disc drives in sector-skipping format are listed in Table 4.1.

In addition to the standard SHADOW error messages, other error messages are displayed at the OSP terminal under the following conditions:

a. The DEX diagnostics append an additional message to the standard SHADOW error message. This additional message, which correlates the error to a specific disc function, is determined by values encoded in specific fields of the IIO cause word. The possible messages, the IIO fields that govern them, and the error conditions they indicate are described in Table 4.2.

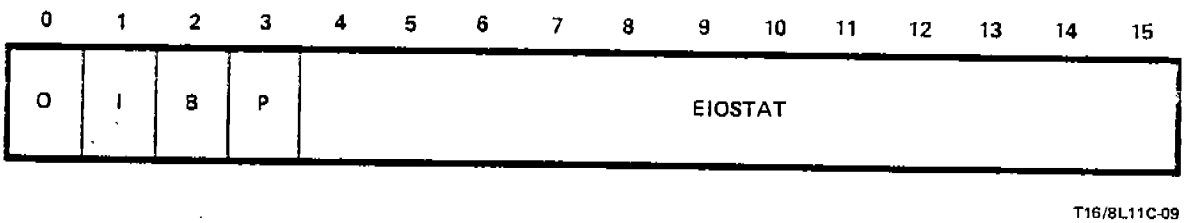
b. Because the DEX diagnostics are interactive programs, certain special error messages can be generated by an operator error during entry of command strings. These operator-entry error messages are described in Table 4.3, under non-command-specific messages.

c. Whenever an error occurs during a seek/read operation and retries are required, a special error message is generated. This message is described in Table 4.3, under non-command-specific messages.

d. Special command-specific error messages can be generated whenever one of the following program-defined commands is executed:

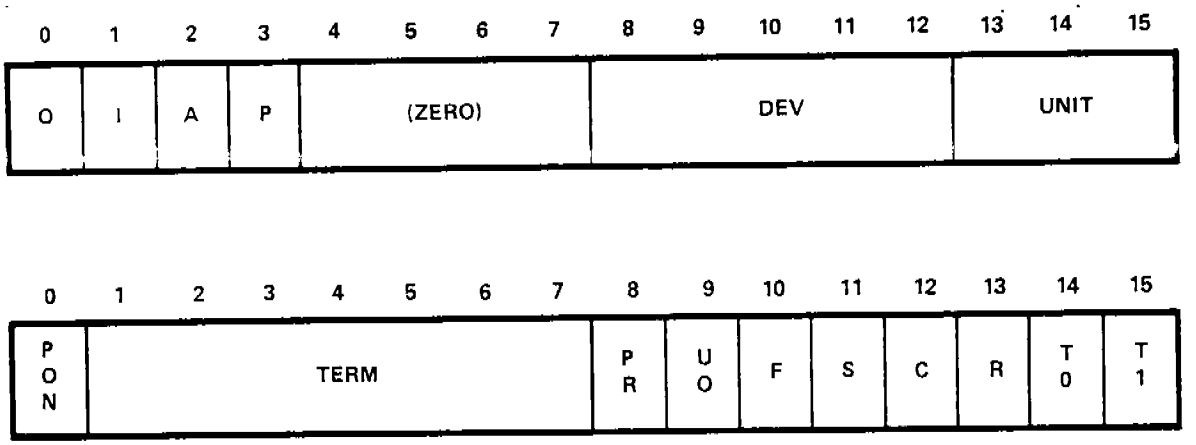
1. CHECK CYLINDER Command
2. FORMAT Command
3. READ BUFFER Command
4. READ MICROCODE VERSION Command
5. WRITE Command
6. WRITE FULL SECTOR Command

These messages are described in Table 4.3, under command-specific error messages.



O - OWNERSHIP ERROR
I - INTERRUPT PENDING
B - CONTROL UNIT BUSY
P - I/O BUS PARITY ERROR ON EIO

Figure 4-1 Format of EIO Status Word



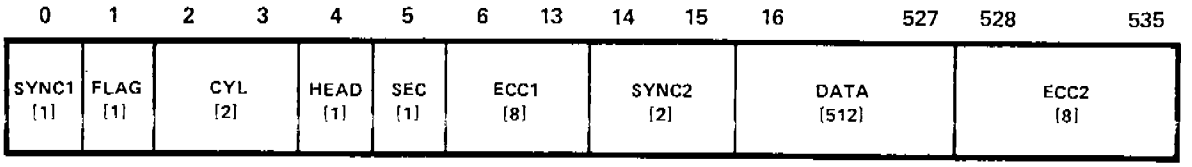
O - OWNERSHIP ERROR
I - INTERRUPT PENDING
A - CHANNEL TRANSFER ABORT
P - PARITY ERROR
DEV - CONTROLLER NUMBER
UNIT - UNIT NUMBER
PON - POWER ON INTERRUPT
PR - UNIT READ ONLY

UO - UNIT OWNERSHIP ERROR
F - UNIT WRITE FAULT
S - UNIT SEEK ERROR
C - UNIT NOT ON CYLINDER
R - UNIT NOT READY
T0 - UNIT TYPE, MSB
T1 - UNIT TYPE, LSB

TERM - ENCODED TERMINATION STATUS (TERMSTAT):

%00 NO ERROR
%01 UNIT ATTENTION
%02 DATA ERROR CORRECTED
%03 ATTEMPT TO WRITE ON PROTECTED UNIT
%04 ILLEGAL ADDRESS
%05 DIRECT ACCESS TO ALTERNATE TRACK
%06 ILLEGAL OPCODE
%07 UNIT STATUS ERROR
%10 BUFFER PARITY ERROR
%11 UNCORRECTABLE DATA ERROR
%12 NO SERVO CLOCKS DURING A WRITE
%13 VERIFY ERROR
%14 HEADER SEARCH FAILED
%15 HEADER ADDRESS MISCOMPARE
%16 ROM PARITY ERROR
%17 UNIT NOT PRESENT
%20 DUPLICATE UNIT NUMBER
%21 UNIT OWNERSHIP ERROR
%22 UNIT NOT READY
%23 READ RETRY SUCCESSFUL WITHOUT OFFSET
%24 READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS
%25 READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS
%26 READ RETRY SUCCESSFUL WITH DATA STROBE LATE
%27 READ RETRY SUCCESSFUL WITH DATA STROBE EARLY
%30 READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS AND DATA STROBE LATE
%31 READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS AND DATA STROBE EARLY
%32 READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS AND DATA STROBE LATE
%33 READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS AND DATA STROBE EARLY
%34 IDLE LOOP DISC CONTROLLER EXERCISER ERROR

Figure 4-2 Format of IIO Status and Cause Words



T16/8L11C-11

SYNC1 = %360 (Good sector - marks the end of the preceding lockup field allowed for read synchronization and signals that address header is to follow)

%377 (Bad sector - all bytes of the entire sector are filled with ones)

FLAG = %350 (Normal sector - CYL/HEAD/SECT contains the current logical address)

%351 (Defective data area)

%352 (Jump-from-extension sector - CYL/HEAD/SECT contains the physical address of return from extension)

%353 (Spare sector)

%354 (Maximum sector on a track)

%355 (Only good sector on a track)

%356 (Jump-to-extension sector - CYL/HEAD/SECT contains the current physical address of extension)

%357 (End of cylinder)

%377 (Defective header)

ECC1 = [0:6] = Error correction code for address header
[7] = Pad byte of zeros

SYNC2 = [0] = %360
[1] = Pad byte of zeros

DATA = 512 bytes of written data

ECC2 = [0:6] = Error correction code for data portion
[7] = Pad byte of zeros

Figure 4-3 Sector-skipping Format for Data on Disc

Table 4.1 Device Characteristics in Sector-skipping Format

DEVICE CHARACTERISTIC	T16/ 4103	T16/ 4104	T16/ 4105/ 4106	T16/ 4109	T16/ 4110/ 4111	T16/ 4116
Device type	3	2	1	1	3	0
Maximum sector (MAXSECT)	19	29	29	29	29	29
Maximum head (MAXHEAD)	18	18	4	4	9	39
Maximum cylinder (MAXCYL)	814	814	822	822	822	842
Defect list cylinder (DLCYL)	813	813	821	821	821	841
First spare cylinder (FSPCYL)	805	803	811	811	811	831
Last spare cylinder (LSPCYL)	812	812	820	820	820	840
First fixed cylinder (FFXCYL)	-	-	-	896	-	-
Last fixed cylinder (LFXCYL)	-	-	-	915	-	-
Last fixed head (LFXHD)	-	-	-	0	-	-
Spare sectors per cylinder (SPSCYL)	2	2	2	2	4	8
Literal PROM ID (LPRID)	%102	%101	%101 %102	%101 %102	%101 -	%101 %102
Volume label sector (CYL/HEAD/SECT)	0/0/2	0/0/2	0/0/2	0/0/2	0/0/2	0/0/2
Spare track table sector (CYL/HEAD/SECT)	0/0/3	0/0/3	0/0/3	0/0/3	0/0/3	0/0/3

PART 1C - DEX4103/DEX4104/DEX4105/DEX4109/DEX4110/DEX4116
ERROR CONDITIONS AND DISPOSITIONS

4.1 ERROR MESSAGES APPENDED TO STANDARD SHADOW MESSAGES

In conjunction with the standard SHADOW error message, the DEX diagnostics typically display one of a number of error messages together with the contents of the controller registers. This error message is decoded from the TERM field of the IIO cause word. (Refer to Figure 4-2.) The form of the error message is as follows:

```
<error message>

CYL xxx HEAD xx SECT xxx FLAGS xxx COUNT xxx ADD xxx
```

The various messages that may appear in the <error message> field are listed and explained in Table 4.2. CYL/HEAD/SECT reflects the disc address of the sector accessed by the command; FLAGS returns the value of the header flag in the accessed sector (refer to Figure 4-3); COUNT reflects the bytecount returned by the operation; and ADD reflects the current address of the controller buffer.

Table 4.2 Error Messages Accompanying Standard SHADOW Messages

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
TIMEOUT ERROR	IIO CAUSE = -1	A timeout occurred on the controller before the current operation could complete.
DEVICE TYPE ERROR	IIO CAUSE bits <14:15>	The accessed unit returned a different device type from that expected by the controller.
NOT READY ERROR	IIO CAUSE bit <13>	One of the following conditions obtains: a. No disc pack is installed. b. Disc spindle motor is not up to speed. c. Read/write heads are not loaded. d. DC voltages of drive are not within margin. e. Terminator is not present or does not have power.
NOT ON CYLINDER ERROR	IIO CAUSE bit <12>	A seek to an illegal address has been received from the channel, i.e., a cylinder, head, or sector address greater than the maximum legal value has been specified (refer to Table 4.1).
SEEK ERROR	IIO CAUSE bit <11>	Drive is unable to seek to specified address.
WRITE FAULT ERROR	IIO CAUSE bit <10>	One of the following conditions obtains: a. More than one write/read head selected b. Read gate and write gate both true c. Read gate and erase gate both true d. Write current but no erase current e. Erase current but no write current f. Write gate or erase gate but not on cylinder g. DC voltages below margin h. Emergency retract condition
OWNERSHIP ERROR	IIO CAUSE bit <9>	Controller is owned by the other port.
WRITE PROTECT ERROR	IIO CAUSE bit <8>	Write operation attempted to disc drive with WRITE PROTECT switch on.

T16/8L11C-12

Table 4.2 Error Messages Accompanying Standard SHADOW Messages (Cont'd)

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
NO TERMSTAT ERROR	TERM = %00	No error.
TERMSTAT ATTENTION ERROR	TERM = %01	One of the following unit attention conditions occurred: a. Selected drive ready (head load sequence) b. I.D. plug changed after drive ready c. Seek complete.
TERMSTAT CORRECTED DATA ERROR	TERM = %02	An error correctable by error correction code (ECC) occurred during a READ operation (≤ 11 bits).
TERMSTAT WRITE ATTEMPT TO PROTECTED UNIT ERROR	TERM = %03	WRITE-type command issued to disc drive with READ ONLY switch enabled.
TERMSTAT ILLEGAL ADDRESS ERROR	TERM = %04	A cylinder address was too large.
TERMSTAT DIRECT ACCESS TO ALT TRACK ERROR	TERM = %05	Not used in sector-skipping format. (In track-sparing, indicates that a READ or WRITE was issued to an alternate track before execution of the routine required to access that track.)
TERMSTAT ILLEGAL OPCODE ERROR	TERM = %06	The controller command in the EIO Address/Command Word is not valid.
TERMSTAT UNIT STATUS ERROR	TERM = %07	One of the following unit status conditions obtains: a. SEEK issued to disc drive with SEEK or NOT ON CYLINDER error b. FAULT or SEEK error occurred during a programmed seek, recalibrate, or head load sequence.
TERMSTAT BUFFER PARITY ERROR	TERM = %10	Incorrect parity in data word read from the controller 4K byte buffer (odd parity maintained).
TERMSTAT UNCORRECTABLE DATA ERROR	TERM = %11	A data record accessed with a READ error burst greater than 11 bits. ECC detected but uncorrectable. Data block could not be recovered with 27 retries using all offset combinations.
TERMSTAT NO SERVO CLOCKS DURING A WRITE	TERM = %12	Record CRC error.

T16/8L11C-13

Table 4.2 Error Messages Accompanying Standard SHADOW Messages (Cont'd)

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
TERMSTAT VERIFY ERROR	TERM = %13	Data read into the buffer does not compare with I/O channel data.
TERMSTAT HEADER SEARCH FAILURE	TERM = %14	One of the following header search conditions occurred: a. No headers on addressed track could be read. b. No sector match among headers on addressed track.
TERMSTAT HEADER ADDRESS MISCOMPARE	TERM = %15	Cylinder address or head address does not compare with the address loaded into the cylinder or head address registers.
TERMSTAT ROM PARITY ERROR	TERM = %16	Incorrect parity in microprogram instruction word read from ROM (odd parity maintained).
TERMSTAT UNIT NOT PRESENT ERROR	TERM = %17	Proper I.D. plug not installed.
TERMSTAT DUPLICATE UNIT NUMBER ERROR	TERM = %20	Plugs with the same I.D. installed in more than one disc drive.
TERMSTAT UNIT OWNERSHIP ERROR	TERM = %21	Disc drive owned by other controller.
TERMSTAT UNIT NOT READY ERROR	TERM = %22	Drive is not up to speed with the heads loaded.

715/8L11C-14

4.2 OTHER ERROR MESSAGES GENERATED BY THE DEX DIAGNOSTICS

In addition to the error messages described in paragraph 4.1, other error messages occur as the commands and command strings entered by the user are executed. These error messages are annotated in Table 4.3. For the purpose of description, they are arranged in the table under two general headings:

a. Non-command-specific messages (including those generated by operator entry error)

b. Command-specific messages.

The messages described under the first heading may occur throughout diagnostic execution, without reference to the command being executed. The messages described under the second heading occur only in the context of a given command; they are, consequently, grouped by command.

Table 4.3 Other Error Messages Generated by the DEX Diagnostics (DEX4103/DEX4104/DEX4105/DEX4109/DEX4110/DEX4116)

SCREEN DISPLAY	EXPLICATION
NON-COMMAND-SPECIFIC MESSAGES	
ILLEGAL SYNTAX	Message displayed if the user enters a command or command string that is syntactically incorrect.
** SOFTWARE ERROR **	Message displayed if a command entered by the user cannot be interpreted, and the error cannot be assigned to any of the standard operator-entry-error types.
-UNIMPLEMENTED COMMAND	Message displayed if the command entered by the user is not among those accepted by the DEX command set.
** PARAMETER NOT ALLOWED **	Message displayed if the user enters a parameter in conjunction with a command that excludes any parameters.
** INVALID PARAMETER %: **	Message displayed if the user enters a parameter outside the legal range for a given command.

T16/8L11C-15

Table 4.3 Other Error Messages Generated by the DEX Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
NON-COMMAND-SPECIFIC MESSAGES	
READ RETRY...CONTROL CODE=% xxx	Message displayed when a seek/read that has initially failed during a COLD LOAD, READ, UNCONDITIONAL READ, or READ WITHOUT TRANSFER operation succeeds on a retry. Up to 27 retries are provided, with different offsets. The octal value displayed in the CONTROL CODE field is the value returned in the TERM field of the IIO cause word. It indicates the particular offset combination that succeeded. The sequence of offsets and corresponding control codes are as follows: a. No offset (%23) b. Servo offset minus (%24) c. Servo offset plus (%25) d. Data strobe late (%26) e. Data strobe early (%27) r. Data strobe late and servo offset minus (%30) g. Data strobe early and servo offset minus (%31) f. Data strobe late and servo offset plus (%32) i. Data strobe early and servo offset plus (%33).
COMMAND-SPECIFIC MESSAGES	
CHECK CYLINDER (CC)	
** SEEK ERROR, EFXSK: xx **	Message displayed if a seek error occurs during the initial SEEK operation. The command is aborted, and the program prompts for a new command input.

T16/8L11C-16

Table 4.3 Other Error Messages Generated by the DEX Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
COMMAND-SPECIFIC MESSAGES	
FORMAT (FM)	
SOLID TRACK OF HEADER ERRORS. CYL = xxx HEAD = xx PACK CANNOT BE FORMATTED	Message displayed if a solid track of header errors is encountered during the basic formatting loop.
** ERROR: ATTEMPT TO FORMAT DLCYL **	Message displayed if the program attempts to format the defect list cylinder (DLCYL). The program then suspends execution.
CYLINDER IS INCREMENTED, SET BREAK POINT TO FIND OUT WHY START ADDR (C/H/S): xxx/xx/xx CNTLR ADDR (C/H/S): xxx/xx/xx SECTORCOUNT: xxxx	Message displayed if a discrepancy occurs between the controller address and the starting address. The program then suspends execution.
SOFTWARE ERROR IN DEF: PRINTDEFECT	Message displayed if one of the patterns used in the formatting loop results in a software error in the PRINTDEFECT statement. The pattern is repeated until no new errors are reported.
DEFECT-HEADER CHECKSUM, CYL/HEAD/SECT: xxx/xx/xx	Message displayed if one of the patterns used in the formatting loop produces a HEADER CHECKSUM error. The pattern is repeated until no new errors are reported.
DEFECT-UNCORRECTABLE DATA ERROR, CYL/HEAD/SECT: xxx/xx/xx BURST LENGTH = xx	Message displayed if one of the patterns used in the formatting loop produces an UNCORRECTABLE DATA error. The pattern is repeated until no new errors are reported.
DEFECT-CORRECTABLE DATA ERROR, CYL/HEAD/SECT: xxx/xx/xx BURST LENGTH = xx	Message displayed if one of the patterns used in the formatting loop produces a CORRECTABLE DATA error. The pattern is repeated until no new errors are reported.

T16/8L11C-17

Table 4.3 Other Error Messages Generated by the DEX Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
COMMAND-SPECIFIC MESSAGES	
FORMAT (Cont'd)	
DEFECT-READFULLS, CYL/HEAD/SECT: xxx/xx/xx	Message displayed if one of the patterns used in the formatting loop produces a READ FULL SECTOR error. The pattern is repeated until no new errors are reported.
DEFECT -> TERMSTAT = % xx CYL = xxx HEAD = xx SECTOR = xx	Message displayed if one of the patterns used in the formatting loop produces a TERMSTAT error. The pattern is repeated until no new errors are reported.
# DEFECTS EXCEEDS # SPARES, NO EXTENSION PERFORMED # SPARES = xx # DEFECTS = xx	Message displayed when format of the cylinder is complete if the number of defects on the cylinder exceeds the number of spare sectors.
READ BUFFER (RB)	
** READBUF ERROR, RIC: %xxx **	Message displayed if an error occurs during execution of the READ BUFFER command. The program then prompts for the next command input.
READ MICROCODE VERSION (VM)	
DEFECT-SKIPPING MICROCODE NOT INSTALLED	Message displayed if the device under test does not have sector-skipping microcode.
WRITE (WT)	
** ERROR: ATTEMPT TO WRITE ON DEFECT LIST CYL **	Message displayed if a WRITE command is issued to the defect list cylinder (DLCYL). The program is then suspended.
WRITE FULL SECTOR (WF)	
** ERROR: WRITING ON DLCYL **	Message displayed if a WRITE FULL SECTOR command is issued to the defect list cylinder (DLCYL). The program is then suspended.

T16/8L11C-18

PART 1C - DEX4103/DEX4104/DEX4105/DEX4109/DEX4110/DEX4116
ERROR CONDITIONS AND DISPOSITIONS

SECTION 5
RUN PROCEDURES

5.0 RUN PROCEDURES

> CAUTION
>
> Many of the commands available in the DEX diagnostics perform WRITE operations to the disc volumes under test. If these commands are executed with the user volumes in place, user and system data are destroyed. Extreme care must therefore be taken. If the disc drive under test houses removable media, a scratch pack can be installed. In the case of nonremovable media, unless the disc volume is configured as part of a mirrored pair or a backup of the data exists on tape, the test may have to be restricted to the exercising of read-only functions.

A sample successful run of a DEX diagnostic is illustrated in Figure 5-1. The test case uses a 128-MB disc drive (T16/4110), configured as drive number %2 on controller number %1, volume name $DISC6. The illustration assumes SHADOW loaded and bits <3>, <4>, and <5> of the Switch Register in the OFF position. (Refer to Table 5.2 for the definition of all applicable switch settings.)

For the user unfamiliar with SHADOW in general or with the DEX diagnostics in particular, the system preparations necessary for running diagnostics are described in paragraph 5.1; a step-by-step run procedure follows in paragraph 5.2.

```
T9404D00.SHADOW  01APR81  00:00
>RUN DEX4110 <cr>

CONTROL PROGRAM FOR 4110 DISK DRIVES
T9472A02.DEX4110 (A02) 01APR82
(ONE 3106 CONTROLLER AND ONE DRIVE)

INPUT PRIMARY CONTROLLER NUMBER
? %1 <cr>
INPUT DRIVE NUMBER
? %2 <cr>

** INPUT COMMAND STRING **
? TT <cr>
** INPUT COMMAND STRING **
? CN16,CN2,CN64 <cr>
** INPUT COMMAND STRING **
? SK,RF,DP,CP,LL10,SM <cr>
** INPUT COMMAND STRING **
? CY10,FM <cr>
DO YOU REALLY WANT TO INVALIDATE HEADERS ON CYL 10
? Y <cr>
USE DEFECTS FROM 'CHECK CYLINDER'?
? Y <CR>
** INPUT COMMAND STRING **
? RT <cr>
ILLEGAL SYNTAX
** INPUT COMMAND STRING **
? RR <cr>
CONTENTS OF CONTROLLER REGISTERS
CYL =   10   HEAD =   9   SECT =  29
FLAGS =  % 0 000 000 000 000 000
SECTOR COUNT =  0
BUFADD = 2301
** INPUT COMMAND STRING **
? EM <cr>
** INPUT COMMAND STRING **
? VM <cr>
MICROCODE VERSION ID = %103
** INPUT COMMAND STRING **
? <escape>


!!!!!!!!!!   E N D   OF   D E X 4 1 1 0   !!!!!!!!!!
```

Note: 128-Mb disc drive (T16/4110), drive number %2, controller number %1. SHADOW loaded and panel switches <3>, <4>, and <5> switched off.

T16/8L11C-19

Figure 5-1 Sample Successful Run of DEX4110

5.1 PREPARATIONS FOR RUNNING THE DEX DIAGNOSTICS

Before any diagnostic is run, certain steps must be taken to allocate the system resources necessary for SHADOW and to ensure that the diagnostic run has minimum impact on system performance. The necessary procedures are ordinarily performed by the local system manager, or at least with the concurrence of the system manager. They include:

a. Obtaining access to the OSP subsystem

b. Transferring to another processor all user processes currently running in the processor to be taken off line

c. Transferring to another processor the path preference of all controllers with preferred paths currently assigned to the processor to be taken off line

d. Taking whatever precautions are indicated to protect the data stored on the disc volume to be tested

e. Taking off line the processor to be loaded with SHADOW

f. Taking off line the disc subsystem (controller and drive) to be tested.

> CAUTION
>
> If a T16/4109 disc drive is to be tested, both the moving and fixed-head portions of the disc (each assigned a different physical unit number) must be taken off line. Since the drives are dual ported, both paths to both portions of the disc must be off line.

These steps are described in detail elsewhere in the NonStop II Diagnostic Operating Procedures, Part Number 82803; those that deal with preparing the system in general for SHADOW, in Volume 1, Chapter 2, Parts 1 and 2; and those that deal with preparing the disc subystem in particular, in Volume 3B, Chapter 1, Part 1.

A checklist of the requirements for the DEX diagnostics, both those that must be available on the system and those that must be supplied by the customer engineer, is given in Table 5.1.

Table 5.1 Checklist for the DEX Diagnostics

REQUIREMENTS	SOURCE
A functioning OSP subsystem and terminal.	On site.
A processor that can be taken off line and dedicated to SHADOW.	On site.
A tape drive unit (if SHADOW is to be loaded from tape).	On site.
a. The tape drive must be physically connected to the test processor if SHADOW is I/O loaded from tape. b. The tape drive must be physically connected to the processor that is to read the tape if SHADOW is bus loaded through an offline processor. c. The tape drive must be physically connected to a processor running GUARDIAN (TM) if SHADOW is bus loaded through an online processor.	
Scratch pack or packs to substitute for the user packs during diagnostic execution (if removable media are to be tested).	On site.
SHADOW operating system. *	Either on site, in disc storage, or supplied by C.E. on cold load tape.
The appropriate DEX diagnostic program for the disc drive type under test (refer to Table 1.1).	Either on site, in disc storage, or supplied by C.E. on cold load tape.

* There are two distinct versions of the SHADOW operating system, one for the NonStop system (usually denoted as ZZDIAG1.SHADOW) and the other for the NonStop II system (usually denoted as ZZDIAG2.SHADOW). If loading from tape, ensure that the correct version is present on the tape and specify it during the load procedure.

5.2 RUN PROCEDURE FOR THE DEX DIAGNOSTICS

> CAUTION
>
> It is possible to run SHADOW diagnostics from the OSP in two or more processors concurrently. However, only one test process can communicate with the OSP at a time. For this reason, no more than one diagnostic process is ordinarily run on a system at any given time.

To run one of the DEX diagnostics, first ensure that the preparations listed in paragraph 5.1 are taken and then proceed as follows:

a. Load SHADOW into the test processor.

> CAUTION
>
> There are two distinct versions of the SHADOW operating system, one for the NonStop system (usually denoted as ZZDIAG1.SHADOW) and the other for the NonStop II system (usually denoted as ZZDIAG2.SHADOW). If loading from tape, ensure that the correct version is present on the tape and specify it during the load procedure. There are three methods for loading SHADOW: I/O cold load from tape, bus cold load from tape, and online load from tape or disc. They are described in detail in the NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 1.

b. Set desired Switch Register options in the operator control panel of the test processor. (Refer to Table 5.2 for a list of panel switches defined for the DEX diagnostics.)

c. At the SHADOW prompt (>) on the OSP screen, enter the command:

RUN <filename>

where <filename> is DEX4103, DEX4104, DEX4105, DEX4109, DEX4110, or DEX4116. (Refer to Figure 5-1 for further illustration.)

Table 5.2 Switch Register Options Available for the DEX Diagnostics *

SWITCH	FUNCTION
<0>	(Standard SHADOW function) If toggled on and off, generates a user break request and returns the SHADOW interpreter to conversational mode, where it waits for further instruction.
<3>	(Standard SHADOW function) If placed in the ON position, suppresses error printout and enables setting of the special numerics ERROR# and COMPERR#. Refer to the Diagnostic Languages Manual, Part Number 82848, for a description of the special numerics ERROR# and COMPERR#.
<4>	(Standard SHADOW function) If placed in the ON position, suppresses error printout, disables setting of the special numerics ERROR# and COMPERR#, and disables ERROR limit decrement. SWITCH BIT <4> MUST NOT BE USED WITH THE DEX DIAGNOSTICS.
<5>	(Standard SHADOW function) If placed in the ON position, causes a program halt on I/O error.
<6>	(DEX-specific function) When switched to the ON position, causes program to loop on the previously entered command string. Program continues looping until switch is returned to the OFF position.

* Switches <1>, <2>, and <7> are not defined for the DEX diagnostics, and switches <8> through <15> reflect the I/O address.

NOTE

Execution of the RUN command causes the program to initialize and the program name to be displayed at the OSP terminal. Several requests for user input follow. Actual program execution commences only when the last request is honored.

d. When the following request is displayed at the OSP terminal, respond as indicated:

```
INPUT PRIMARY CONTROLLER NUMBER
?
```

1. Enter at the prompt the physical unit number (in octal) of the disc controller to be tested.

2. Depress carriage return.

e. When the following request is displayed at the OSP terminal, respond as indicated:

```
INPUT DRIVE NUMBER
?
```

1. Enter at the prompt the physical unit number (in octal) of the disc drive to be tested.

2. Depress carriage return.

NOTE

The disc drive indicated must be connected to the controller specified in step e. The DEX diagnostics test one controller and one drive at a time.

> The T16/4109 drive requires two I/O addresses (one for the moving heads and one for the fixed heads). So that DEX4109 can test both parts of the disc, the valid range of drive numbers for DEX4109 is limited to [0,3] instead of the customary range [0,7]. The upper half of the range [4,7] is reserved for identifying internally the fixed-head portions of the disc drives specified by the lower half (i.e., drive number 4 is the fixed-head portion of drive number 0, and so on).

f. When the following request is displayed at the OSP terminal, respond as indicated:

```
** INPUT COMMAND STRING **
?
```

1. Enter the following command at the OSP terminal:

   TT

2. Depress carriage return.

g. When the TAKE OWNERSHIP is accomplished and the following request for command string input is again displayed at the OSP terminal, respond as indicated:

```
** INPUT COMMAND STRING **
?
```

1. Enter at the prompt any legal command or series of commands, using a comma to separate each command from the command following it (but not a command from its parameter).

2. Depress carriage return.

NOTE

When this command or command string is executed, and as each subsequent command or command string is executed, the program prompts as before for another command string input. To exit exerciser mode and reinitialize the DEX diagnostic for test of another device, the EXIT command (EX) must be entered. To terminate the diagnostic, either the ESCAPE key must be depressed at the OSP terminal, or switch <0> of the control panel toggled on and off; SHADOW then returns to conversational mode. Table 5.3 describes a possible opening series of commands. Refer to Section 3 for a description of all available commands and of the operations they perform.

h. Analyze any errors generated. (Refer to Section 4 for a description of possible error conditions.)

i. If the problem can be isolated to a faulty cable or to the drive as a unit, replace the faulty part. (Refer to the appropriate maintenance manual for a description of replacement procedures.)

j. If the results of the DEX diagnostic are inconclusive, try to isolate the problem further by running another of the diagnostics for sector-skipping format. (Refer to Table 1.1.)

Table 5.3 Possible Opening Series of Commands *

COMMAND	OPERATION
TT <cr>	Performs a TAKE OWNERSHIP.
CN16 <cr>	Performs a PRIORITY SELECT.
CN2 <cr>	Performs a UNIT CLEAR.
CN64 <cr>	Performs a RECALIBRATE.
CY0 <cr>	Sets current cylinder address to 0.
HD0 <cr>	Sets current head address to 0.
SC0 <cr>	Sets current sector address to 0.
SK <cr>	Performs a SEEK to address 0,0,0.
RF <cr>	Performs a READ FULL SECTOR at address 0,0,0.
DR <cr>	Performs a DUMP READ$, displaying the contents read at address 0,0,0.

* This series of commands could also be entered as a single command string, each command separated from the others by a comma, with a single carriage return at the end. The success of this series of commands is a fair indication that the controller and cables are properly installed and functioning.

** To access the fixed-head portion of a T16/4109 disc drive, CY must be set in the range [896,915]; HD in the range [0,4]; and SC in the range [0,29]. Zero (0) is the only valid head setting for cylinder 915.

CAUTION

The DEX diagnostics can invalidate the format of a disc pack. When testing with a DEX diagnostic is complete, it is necessary to run the appropriate disc pack formatter to restore valid sector-skipping format to the disc pack. Either the PUP FORMAT facility or the appropriate SHADOW formatter (FMT) may be used for this purpose. In cases where the contents of DLCYL have been lost, the PUP FORMAT facility must be used. To provide for adequate restoration of DLCYL in such cases, it is essential that a tape or hard copy of the vendor defect list information stored on DLCYL when first formatted by Tandem manufacturing be available. If a tape copy exists, it can be loaded directly onto the reformatted disc. If only a hard copy exists, the defects must be entered one by one, using the appropriate SHADOW defect-logging utility program (DUT). The PUP FORMAT procedure is described in the NonStop II System Operations Manual, Part Number 82075. The FMT programs are described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 3B, Chapter 1, Part 1F; the DUT programs, in Part 1D.

k. When diagnostic testing is complete, perform the following:

1. Notify the system manager that the serviced disc volume is now ready to be returned to system use.

NOTE

The facility for bringing disc volumes on line is provided by the PUP commands UP and REVIVE. The UP command is used to bring on line a volume that is not part of a mirrored pair. Any volumes configured to operate as part of a mirrored pair must be brought on line with the REVIVE command. The PUP commands UP and REVIVE are described in the NonStop II System Operations Manual, Part Number 82075.

2. Assist the customer in verifying the integrity of any disc volumes that have been serviced and in restoring the system to normal performance.

NOTE

The procedure for reloading a processor that is off line is described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 3.

PART 1D

DUT 4103, DUT 4104, DUT 4105
DUT 4109, DUT 4110, DUT 4116

SECOND LEVEL MANUAL

DIAGNOSTIC OPERATING PROCEDURES

NonStop II (TM) Systems

VOLUME 3B, CHAPTER 1, PART 1D

DUT4103, DUT4104, DUT4105, DUT4109, DUT4110,
AND DUT4116 DISC DIAGNOSTICS

Copyright © 1982

TANDEM COMPUTERS INCORPORATED
2450 Walsh Avenue
Santa Clara, California 95050

Tandem Part Number 82803

October 1982
Printed in U.S.A.

This document contains information that is protected by copyright. No part of this document may be photocopied, reproduced or translated to another program or system without the prior written consent of Tandem Computers Incorporated.

The following are trademarks of Tandem Computers Incorporated:
Tandem, NonStop, NonStop II, AXCESS, DYNABUS, ENCOMPASS, ENFORM, ENSCRIBE, ENVOY, EXCHANGE, EXPAND, GUARDIAN, TGAL, PATHWAY, XRAY.

VOLUME 3B, CHAPTER 1, PART 1D

TABLE OF CONTENTS

Par.No. | Title | Page No.

SECTION 1
INTRODUCTION

1.0 INTRODUCTION.....1-1

SECTION 2
OVERVIEW

2.0 OVERVIEW.....2-1
2.1 PROGRAM SELECTION AND EXECUTION.....2-2

SECTION 3
COMMANDS

3.0 COMMANDS.....3-1
3.1 COMMAND SET FOR THE DUT DIAGNOSTICS.....3-1
3.1.1 CC - CHECK CYLINDER Command.....3-4
3.1.2 CN - SEND CONTROL Command.....3-5
3.1.3 CY - SET CYLINDER Command.....3-6
3.1.4 DD - DISPLAY DEFECT LIST Command.....3-7
3.1.5 EM - EXECUTE MEMORY Command.....3-8
3.1.6 EX - EXIT Command.....3-9
3.1.7 HD - SET HEAD Command.....3-10
3.1.8 HP - HELP Command.....3-11
3.1.9 IC - INCREMENTAL SEEK Command.....3-12
3.1.10 LH - LIST HEADERS Command.....3-13
3.1.11 LL - LOOP Command.....3-14
3.1.12 LT - READ LITERAL PROM Command.....3-15
3.1.13 MD - MODIFY DEFECT LIST Command.....3-16
3.1.14 RR - READ REGISTERS Command.....3-20
3.1.15 SC - SET SECTOR Command.....3-21
3.1.16 SK - SEEK Command.....3-22
3.1.17 SM - STORE MEMORY Command.....3-23
3.1.18 TT - TAKE OWNERSHIP Command.....3-24

TABLE OF CONTENTS (Cont'd)

Par.No.	Title	Page No.
3.1.19	VL - VENDOR DEFECT LIST Command	3-25
3.1.20	VM - READ MICROCODE VERSION Command	3-28
3.1.21	WD - WRITE DEFECT LIST Command	3-29

SECTION 4
ERROR CONDITIONS AND DISPOSITIONS

4.0 ERROR CONDITIONS AND DISPOSITIONS.....4-1
4.1 ERROR INFORMATION APPENDED TO SHADOW ERROR MESSAGES.....4-6
4.2 OTHER ERROR MESSAGES RETURNED BY THE DUT DIAGNOSTICS....4-10

SECTION 5
RUN PROCEDURES

5.0 RUN PROCEDURES.....5-1
5.1 PREPARATIONS FOR RUNNING THE DUT DIAGNOSTICS.....5-1
5.2 RUN PROCEDURE FOR THE DUT DIAGNOSTICS.....5-6

LIST OF ILLUSTRATIONS

Fig.No.	Title	Page No.
4-1	Format of EIO Status Word	4-2
4-2	Format of IIO Status and Cause Words	4-3
4-3	Sector-skipping Format for Data on Disc	4-4
5-1	Sample Successful Run of DUT4110	5-2

TABLE OF CONTENTS (Cont'd)

LIST OF TABLES

Table No.	Title	Page No.
1.1	Disc Subsystem Diagnostics for the NonStop II System	1-2
3.1	Command Set for the Defect-logging Utility Programs	3-2
3.2	Function Requests Recognized by SEND CONTROL Command	3-5
3.3	Messages Displayed during Execution of DISPLAY DEFECT LIST	3-7
3.4	Messages Displayed during Execution of HELP Command	3-11
3.5	Messages Displayed during Execution of INCREMENTAL SEEK Command	3-12
3.6	Messages Displayed during Execution of MODIFY DEFECT LIST Command	3-17
3.7	Messages Displayed during Execution of VENDOR DEFECT LIST Command	3-26
3.8	Messages Displayed during Execution of WRITE DEFECT LIST Command	3-29
4.1	Device Characteristics in Sector-skipping Format	4-5
4.2	Error Messages Accompanying Standard SHADOW Messages	4-7
4.3	Other Error Messages Generated by the DUT Diagnostics	4-10
5.1	Checklist for the DUT Diagnostics	5-5
5.2	Switch Register Options Available for the DUT Diagnostics	5-7
5.3	Possible Series of Commands in DUT Diagnostics	5-10

PART 1D - DUT4103/DUT4104/DUT4105/DUT4109/DUT4110/DUT4116
TABLE OF CONTENTS

PART 1D - DUT4103/DUT4104/DUT4105/DUT4109/DUT4110/DUT4116
TABLE OF CONTENTS

SECTION 1
INTRODUCTION

1.0 INTRODUCTION

This chapter describes six SHADOW diagnostics, DUT4103, DUT4104, DUT4105, DUT4109, DUT4110, and DUT4116. These diagnostics are designed as defect-logging utility programs (DUT) and can be used, respectively, to test a T16/4103, 4104, 4105/4106, 4109, 4110/4111, or 4116 disc drive on a Tandem NonStop II (TM) system. To accept these programs, the drive should be formatted for sector skipping and configured with a T16/3106 disc controller.

Used primarily in the corrective maintenance process, the DUT diagnostics can be run to determine the types of errors being produced and to help isolate the probable area of failure. After the suspected area of failure is corrected, these programs can be run again as end tests to ensure that the errors are eliminated.

The DUT diagnostics are one of seven sets of SHADOW diagnostic programs provided for the NonStop II disc subsystems. Refer to Table 1.1 for a list of the other available diagnostics.

The DUT diagnostics are written for SHADOW Rev level D00 and are compatible with all Rev levels of the disc controller and disc drives.

Table 1.1 Disc Subsystem Diagnostics for the NonStop II System *

SUBSYSTEM	DIAGNOSTIC	MANUAL REF. **
T16/4103 drive - T16/3106 ctrl	FAST4103	Part 1A
	DISC4103	Part 1B
	DEX4103	Part 1C
	DUT4103	Part 1D
	EDT4103	Part 1E
	FMT4103	Part 1F
	REX4103	Part 1G
T16/4104 drive - T16/3106 ctrl	FAST4104	Part 1A
	DISC4104	Part 1B
	DEX4104	Part 1C
	DUT4104	Part 1D
	EDT4104	Part 1E
	FMT4104	Part 1F
	REX4104	Part 1G
T16/4105 drive - T16/3106 ctrl ***	FAST4105	Part 1A
T16/4106 drive - T16/3106 ctrl	DISC4105	Part 1B
	DEX4105	Part 1C
	DUT4105	Part 1D
	EDT4105	Part 1E
	FMT4105	Part 1F
	REX4105	Part 1G
T16/4109 drive - T16/3106 ctrl	FAST4109	Part 1A
	DISC4109	Part 1B
	DEX4109	Part 1C
	DUT4109	Part 1D
	EDT4109	Part 1E
	FMT4109	Part 1F
	REX4109	Part 1G
	FHD4109	Part 1H
T16/4110 drive - T16/3106 ctrl ***	FAST4110	Part 1A
T16/4111 drive - T16/3106 ctrl	DISC4110	Part 1B
	DEX4110	Part 1C
	DUT4110	Part 1D
	EDT4110	Part 1E
	FMT4110	Part 1F
	REX4110	Part 1G
T16/4116 drive - T16/3106 ctrl ***	FAST4116	Part 1A
	DISC4116	Part 1B
	DEX4116	Part 1C
	DUT4116	Part 1D
	EDT4116	Part 1E
	FMT4116	Part 1F
	REX4116	Part 1G

* A somewhat different subset of disc subsystems is supported on the NonStop (TM) system, some in sector-skipping format and some in track-sparing format. For a complete list of the disc subsystems supported on the NonStop system and of the applicable diagnostics, refer to NonStop Diagnostic Operating Procedures, Part Number 82802, Volume 3B, Chapter 1, Part 1.

** In all cases, the general manual reference is to Volume 3B, Chapter 1, of NonStop II Diagnostic Operating Procedures, Part Number 82803.

*** The T16/4105 and 4106 disc drives are identical devices, as are the T16/4110 and 4111, except that in each case the first is free standing in the cabinet and the second is drawer mounted.

T16/8L11D-01

SECTION 2
OVERVIEW

2.0 OVERVIEW

The DUT diagnostics define a set of commands that the user can invoke singly or in sequences to perform various defect-logging utility functions. These programs are interactive; the user inputs a command, and the program performs the indicated operation and reports error status. With these programs, the user can compose and run complete diagnostic tests of a disc subsystem tailored to the needs of a given situation.

The command set for the DUT diagnostics consists of a series of two-letter mnemonics, in some cases followed by an optional parameter. Commands can be combined into a command string, comprised of two or more commands separated by commas. A command string is executed, function by function, until either the end of the string or a syntax or parameter error is detected. If a parameter is specified for any command, it is entered directly after the command, without intervening space or punctuation. The maximum legal parameter value is 4095. For a description of the command set for the DUT diagnostics, refer to Section 3.

The DUT diagnostics are run from the OSP terminal. Before any of them can be run, the following system resources must be taken off line and dedicated exclusively to the SHADOW program:

a. The disc drive to be tested and the associated controller

b. The processor into which SHADOW is to be loaded (the procedure for taking processor modules off line is described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 2)

SHADOW is then loaded into the test processor by one of the three customary methods, and the desired Switch Register options may be set in the operator control panel of the test processor. Refer to Table 5.3 for a description of the Switch Register options for the DUT diagnostics. The SHADOW load procedure is described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 1.

2.1 PROGRAM SELECTION AND EXECUTION

After SHADOW is loaded, the appropriate defect-logging utility program for the particular subsystem under test can be loaded and run. The typical SHADOW requests for input are displayed at the OSP terminal as the program initializes. Initialization cannot complete without appropriate responses from the operator. Proper program execution requires that the first response to the request for command string input be a TAKE OWNERSHIP command. Thereafter, the program continues to prompt for command string input after each command string is executed. A possible opening command string is as follows:

TT,CN16,CN2,CN64

This command string accomplishes the following operations:

a. Take ownership

b. Priority select

c. Unit clear

d. Recalibrate.

All of the programs report the SHADOW error messages appropriate to the conditions detected (unless error printout is suppressed in the panel switches). Execution of many of the commands results in the display of additional specific error information or requests for further input. Refer to Section 3 for a description of the prompts displayed by certain commands, and to Section 4 for a description of all error messages that may be displayed at the OSP terminal.

An error summary is printed when the diagnostic completes execution. Invoking the EXIT command (EX) does not terminate the diagnostic or return the terminal to SHADOW conversational mode; it merely causes processing to stop for the device under test and the DUT program to reinitialize. To terminate the diagnostic and return to SHADOW conversational mode, either bit <0> of the Switch Register must be toggled on and off or the ESCAPE key depressed at the OSP terminal.

Because the DUT diagnostics are interactive programs, run times vary widely, depending on such factors as the number of commands invoked, the number of options exercised, and so on. The settings of the panel switches can also affect the course of any given run of the diagnostic. Most individual commands take less than 30 seconds to execute. Factors to be considered when estimating down time include not only the run times for the diagnostics to be used, but also the time which may be required for reformatting and reviving the discs after the diagnostics are completed. The times required for these procedures vary from an hour or less to as long as overnight, depending on such factors as system load and disc pack size.

SECTION 3
COMMANDS

3.0 COMMANDS

The DUT diagnostics contain a program-defined command set for interactive use during execution. The command names for this command set consist of two-letter mnemonics, in some instances accompanied by an optional parameter. With them, the program user can compose and run tests of a disc subsystem tailored to the needs of a given situation. The command set for the DUT diagnostics is described in paragraph 3.1.

In addition, the DUT diagnostics require the SHADOW RUN command for program execution. If the user wishes to implement the NOSTRIP option, the SHADOW OPTION command must also be invoked. (SHADOW defaults to option STRIP.)

3.1 COMMAND SET FOR THE DUT DIAGNOSTICS

The command set for the DUT diagnostics is summarized in Table 3.1. Descriptions of the individual commands follow in paragraphs 3.1.1 through 3.1.21. Each description consists of a metalinguistic definition of the command, using the Backus-Naur/Normal Form (BNF), followed by discussion and examples.

NOTE

A metalanguage is a set of symbols and associated conventions for defining exhaustively the syntax of another language. BNF notation is a metalanguage devised and commonly in use for the description of programming languages. For that reason, it is employed here. The conventions observed by BNF notation are further explained in the NonStop II Diagnostic Operating Procedures, Part Number 82803, Appendix A.

Table 3.1 Command Set for the Defect-logging Utility Programs (DUT4103, DUT4104, DUT4105, DUT4109, DUT4110, and DUT4116)

COMMAND	FUNCTION	PARAMETER	DEFAULT
CC	Run CHECK command for whole cylinder	cylinder number	current
CN	Issue control request to disc	function	0
CY	Set current disc cylinder address (no EIO issued)	cylinder number	0
DD	Display the defect list cylinder (DLCYL)	N/A	N/A
EM	Execute stored command string	N/A	N/A
EX	Exit exerciser	N/A	N/A
HD	Set current disc head address (no EIO issued)	head number	0
HP	HELP	N/A	N/A
IC	Incremental seek	N/A	N/A
LH	List headers for whole cylinder	N/A	N/A
LL	Loop command sequence	number of times	1
LT	Read and dump Literal Prom ID	N/A	N/A
MD	Modify/display defect List in memory	N/A	N/A
RR	Read/print current controller registers	N/A	N/A
SC	Set current disc sector address (no EIO issued)	sector number	0
SK	Seek to current disc address	N/A	N/A
SM	Store last command string	N/A	N/A

Table 3.1 Command Set for the Defect-logging Utility Programs (Cont'd)

COMMAND	FUNCTION	PARAMETER	DEFAULT
TT	Take ownership	N/A	N/A
VL	Enter vendor defect list	N/A	N/A
VM	Read and dump microcode version number	N/A	N/A
WD	Write defect list on DLCYL	N/A	N/A

3.1.1 CC - CHECK CYLINDER Command

The form of the CHECK CYLINDER command is as follows:

```
check_cylinder_command  ::=  CC [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to MAXCYL
  MAXCYL  ::=  { 814 | 822 | 842 }
```

Execution of the CHECK CYLINDER command (CC) causes the controller to scan all sectors on the cylinder indicated in the parameter, looking for header and data errors. The results are reported in the READ$ buffer, and defects are displayed at the OSP terminal. (Refer to Table 4.3 for the special error message generated if a seek error occurs during command execution.)

If no cylinder number is specified, the parameter defaults to the current cylinder. The legal range for the parameter is [0,MAXCYL]. (Refer to Table 4.1 for the possible values of MAXCYL.)

The format of the defect display is as follows:

```
                    DEFECTS FOR CYLINDER xxx

                TERM (%B)                HEAD   SECTOR
        %Bx xxx xxx xxx xxx xxx           xx      xx
        %Bx xxx xxx xxx xxx xxx           xx      xx
           .    .    .    .    .    .    .    .
        %Bx xxx xxx xxx xxx xxx           xx      xx
```

NOTE

The relevant error codes (in octal) returned in column TERM are: %02 - correctable data error; %11 - uncorrectable data error; %14 - header search failure.

Examples:

```
  CY25,CC              ! defaults to cylinder 25 (the previously
                       ! designated current cylinder) and causes all
                       ! sectors on cylinder 25 to be scanned for
                       ! header and data errors
                       !
  CC351                ! causes all sectors on cylinder 351 to be
                       ! scanned for header and data errors
```

3.1.2 CN - SEND CONTROL Command

The form of the SEND CONTROL command is as follows:

send_control_command ::= CN [parameter]

parameter ::= integer_constant
integer_constant ::= { 0 | 1 | 2 | 4 | 8 | 16 | 32 | 64 | 128 }

Execution of the SEND CONTROL command (CN) causes the function request indicated in the parameter to be sent to the controller. If no function is specified, the parameter defaults to zero (0). The valid function requests are listed in Table 3.2.

Example:

CN64 ! issues a RECALIBRATE to the controller

Table 3.2 Function Requests Recognized by SEND CONTROL Command

PARAMETER	BIT	OCTAL EQUIVALENT	FUNCTION
128	8	%200	Data Strobe Early
64	9	%100	Recalibrate
32	10	%40	Unit Release
16	11	%20	Priority Select
8	12	%10	Servo Offset Minus
4	13	%4	Servo Offset Plus
2	14	%2	Unit Clear
1	15	%1	Data Strobe Late
0	-	0	No operation

3.1.3 CY - SET CYLINDER Command

The form of the SET CYLINDER command is as follows:

```
set_cylinder_command  ::=  CY [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to MAXCYL
  MAXCYL  ::=  { 814 | 822 | 842 }
```

Execution of the SET CYLINDER command (CY) causes the address of the current cylinder to be set to the number specified in the parameter. If no cylinder number is specified, the parameter defaults to zero (0). The legal range of values for the parameter is [0,MAXCYL]. (Refer to Table 4.1 for the possible values of MAXCYL.)

Examples:

```
CY                  ! sets the current cylinder address to 0
                    !
CY101               ! sets the current cylinder address to 101
```

3.1.4 DD - DISPLAY DEFECT LIST Command

The form of the DISPLAY DEFECT LIST command is as follows:

display_defect_list_command ::= DD

Execution of the DISPLAY DEFECT LIST command (DD) causes the defects stored on the defect list cylinder (DLCYL) to be displayed at the test terminal, 16 defects at a time. Refer to Table 3.3 for a description of the screen displays that occur during normal command execution, and to Table 4.3 for a description of the error messages that may be generated.

Example:

```
DD                    ! displays the contents of DLCYL
```

Table 3.3 Messages Displayed during Execution of the DISPLAY DEFECT LIST Command

SCREEN DISPLAY	EXPLICATION
*** DISPLAYING DEFECTS ON DLCYL: xxx ***	Message displayed when the command is acknowledged.
DLCYL/HEAD/SECT2- xxx / xx / xx # CYL HEAD SECT 1 xxx xx xx 2 xxx xx xx 3 xxx xx xx . . . . 16 xxx xx xx RETURN TO CONTINUE, ANY CHAR TO STOP	Format for the display of the defect list. When the first head/sector of DLCYL is accessed, the first sixteen entries in the defect list are displayed. The last line of the display is a prompt for a user decision to continue or to terminate the display. If the user elects to continue, the program displays the next sixteen entries and again invites the user to continue or to stop. This procedure continues until the user elects to stop or until the end of the defect list is reached. If the user elects to stop at any point, the program prompts for the next command input.
** ALTERNATE DEFECT LIST **	Message displayed if, in the course of the display of DLCYL, the address of the alternate defect list is reached.

T16/8L11D-02

3.1.5 EM - EXECUTE MEMORY Command

The form of the EXECUTE MEMORY command is as follows:

execute_memory_command ::= EM

Execution of the EXECUTE MEMORY command (EM) causes the last command string saved in memory by the SM command (refer to paragraph 3.1.17) to be displayed and reexecuted. If no string is currently stored when the command is executed, the following message is displayed:

** NO STRING STORED **

Example:

```
CY10,SK,SM,EM          ! reexecutes the command string "CY10,SK"
                       ! stored in memory by the preceding STORE
                       ! MEMORY command
```

3.1.6 EX - EXIT Command

The form of the EXIT command is as follows:

exit_command ::= EX

Execution of the EXIT command (EX) causes exerciser mode to terminate and the program to reinitialize, allowing a new controller and disc number to be specified for testing.

Example:

```
EX                    ! terminates exerciser mode for the device
                      ! under test and returns to program
                      ! initialization for selection of another
                      ! device for testing
```

3.1.7 HD - SET HEAD Command

The form of the SET HEAD command (HD) is as follows:

```
set_head_command  ::=  HD [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to MAXHEAD
  MAXHEAD  ::=  { 4 | 9 | 18 | 39 }
```

Execution of the SET HEAD command (HD) causes the address of the current head to be set to the number specified in the parameter. If no number is specified, the parameter defaults to head number zero (0). The legal range of values for parameter is [0,MAXHEAD]. (Refer to Table 4.1 for the possible values of MAXHEAD.)

Examples:

```
HD                  ! sets the current head address to 0
                    !
HD1                 ! sets the current head address to 1
```

3.1.8 HP - HELP Command

The form of the HELP command is as follows:

help_command ::= HP

Execution of the HELP command (HP) causes a brief description of the available commands to be displayed at the OSP terminal. Refer to Table 3.4 for a description of the screen displays that occur during command execution.

Example:

```
HP                    ! displays a description of available commands
```

Table 3.4 Messages Displayed during Execution of the HELP Command

SCREEN DISPLAY	EXPLICATION
*** AVAILABLE COMMANDS *** CMD PARAMETER DESCRIPTION CC --------- CHECK CYLINDER CN FUNCTION CONTROL FUNCTION CY 0/xxx SET CYLINDER DD --------- DISPLAY DLCYL EM --------- EXECUTE LAST CMD STRING EX --------- EXIT HD 0/xx SET HEAD HP --------- HELP (LIST COMMANDS) IC --------- INCREMENTAL SEEK LH --------- LIST HEADERS <RETURN> TO CONTINUE, ANY OTHER CHAR TO STOP	Partial list of available commands, displayed when the command is first executed. The last line of the display is a prompt requesting that the user indicate whether to display the list of remaining commands.
CMD PARAMETER DESCRIPTION LL 0/4095 LOOP LT --------- READ LITERAL PROM ID MD --------- MODIFY/DISPLAY DL IN MEMORY RR --------- READ CNTR REGISTERS SC 0/xx SET SECTOR SK --------- SEEK SM --------- STORE LAST COMMAND STRING TT --------- TAKE OWNERSHIP VL --------- ENTER VENDOR DEFECT LIST VM --------- READ MICROCODE VERSION # WD --------- WRITE DL ON DLCYL	List of remaining commands, displayed if the user elects to continue after the initial list is displayed.

T16/8L11D-03

3.1.9 IC - INCREMENTAL SEEK Command

The form of the INCREMENTAL SEEK command is as follows:

incremental_seek_command ::= IC

Execution of the INCREMENTAL SEEK command (IC) causes an incrementing or a decrementing seek to be performed, depending on the starting and ending cylinders specified by the operator in response to program prompts for input. Refer to Table 3.5 for a description of the messages displayed during command execution.

Example:

```
IC                    ! performs an incrementing or decrementing seek
```

Table 3.5 Messages Displayed during Execution of the INCREMENTAL SEEK Command

SCREEN DISPLAY	EXPLICATION
*** INCREMENTAL SEEK, PUN %: xxx ***	Message displayed when the command is acknowledged.
FIRST CYLINDER:	Prompt requesting that the user indicate the cylinder address at which to begin the incremental seek. The range of legal cylinder values for the first cylinder is [0,MAXCYL].
LAST CYLINDER:	Prompt, after receipt of first input, for the cylinder address at which to conclude the incremental seek. The range of legal cylinder values for the last cylinder is [0,MAXCYL]. If the first cylinder is higher than the last cylinder, the program performs a decremental seek.

T16/8L11D-04

3.1.10 LH - LIST HEADERS Command

The form of the LIST HEADERS command is as follows:

list_headers_command ::= LH

Execution of the LIST HEADERS command (LH) causes the headers for a whole cylinder to be listed. The command defaults to the current cylinder set in the control program. When the command is executed, information for the first twenty headers is listed in the following format:

PHEAD	PSECT	SYNC%	FLAG%	CYL	HEAD	SECT
xx	xx	xxx	xxx	xxx	xx	xx
xx	xx	xxx	xxx	xxx	xx	xx
.	.	.	.	.	.	.
xx	xx	xxx	xxx	xxx	xx	xx

<RETURN> TO CONTINUE DUMP OR ANY CHAR. TO STOP

If the user elects to continue with the listing of headers, the information for the next twenty headers is displayed in the same format. This procedure continues for each set of twenty headers until all headers are displayed or until the user terminates command execution. Refer to Table 4.3 for a description of the error message displayed if a SEEK error occurs during command execution.

Example:

```
CY10,LH              ! causes the headers for cylinder 10 to be
                     ! listed
```

3.1.11 LL - LOOP Command

The form of the LOOP command is as follows:

```
loop_command  ::=  LL [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to 4095
```

Execution of the LOOP command (LL) causes the sequence of commands bounded by the start of the command string (or by a previous LOOP command in the string) to be repeated. The number of times the command string is to be repeated is specified in the parameter. If no number of repetitions is specified, the parameter defaults to 1. The legal range for the parameter is [0,4095].

Examples:

```
CY10,SK,LL          ! loops the preceding sequence of commands one
                    ! time
CY10,SK,LL10        ! loops the preceding sequence of commands 10
                    ! times
```

3.1.12 LT - READ LITERAL PROM Command

The form of the READ LITERAL PROM command is as follows:

read_literal_PROM_command ::= LT

Execution of the READ LITERAL PROM command (LT) causes the literal PROM ID to be read and displayed at the OSP terminal. The form of the display is as follows:

```
** LITERAL PROM ID %: xxx
```

Example:

```
LT                    ! displays the literal PROM ID
```

3.1.13 MD - MODIFY DEFECT LIST Command

The form of the MODIFY DEFECT LIST command is as follows:

modify_defect_list_command ::= MD

Execution of the MODIFY DEFECT LIST command (MD) enables the operator to display, add, and delete defects in the defect list. A copy is updated in memory that can then be used to overwrite the copy on DLCYL. Refer to Table 3.6 for a description of the messages displayed during normal command execution, and to Table 4.3 for a description of the error messages that may be generated.

Example:

```
MD                    ! initiates defect-list modification
```

Table 3.6 Messages Displayed during Execution of the MODIFY DEFECT LIST Command

SCREEN DISPLAY	EXPLICATION
********** *** WARNING: ONLY THE MEMORY DEFECT LIST IS UPDATED! *** *** AFTER MODIFICATIONS, USE (WD) COMMAND TO WRITE *** *** NEW MEMORY DEFECT LIST ONTO DLCYL *** **********	Message displayed, when the command is acknowledged, reminding the user that the command accesses only the memory defect list not DLCYL.
NEW COPY FROM DLCYL (Y/N) ?	Prompt requesting that the user indicate whether the command is to be executed on the defect list currently in memory or whether that defect list should first be replaced by a new copy of the contents of DLCYL. If the user response is Y, the program obtains a new copy of the defect list from DLCYL.
DISPLAY MEMORY DEFECT LIST (Y/N) ?	Prompt, if the user does not elect to obtain a new copy of the defect list from DLCYL, requesting a user decision whether to display the current memory defect list.
DEFECT CYL HEAD SECTOR 1 xxx xx xx 2 xxx xx xx . . . . 10 xxx xx xx <RETURN> TO CONTINUE, ANY CHAR TO STOP	Format of the display if the user elects to display the memory defect list. The first ten defects listed in the memory defect list are followed by a prompt for user decision to continue or to terminate the display. If the user elects to continue, the program displays the next ten defects and again invites the user to continue or to stop. This procedure continues until the end of the list is reached or, until the user elects to stop.
ADD A DEFECT (Y/N) ?	Prompt, if the user elects not to display the memory defect list (or after the list has been displayed), requesting that the user indicate whether he wishes to add a defect to the memory defect list.
NOTE: ONLY THE DEFECT LIST IN MEMORY IS UPDATED	Message displayed if the user elects to add a defect to the defect list in memory.
CYLINDER:	Prompt for the cylinder address of the sector to be added to the defect list.

T16/8L11D-05

Table 3.6 Messages Displayed during Execution of the MODIFY DEFECT LIST Command (Cont'd)

SCREEN DISPLAY	EXPLICATION
HEAD:	Prompt for the head address of the sector to be added to the defect list.
SECTOR:	Prompt for the sector address of the sector to be added to the defect list.
<RETURN> TO ADD, ANY CHAR TO REPEAT	Prompt, when all three address inputs are received, allowing the user a final chance to change the address specified. If the user elects to repeat (in order to change the address to be added), the program redisplays the three requests for address input. On carriage return alone, the program adds the indicated address to the defect list and then prompts, as initially, for the next defect to be added. This process continues until the user has added all the defects he wisnes or until the space allocated for the memory defect list overflows.
DELETE A DEFECT (Y/N) ?	Prompt requesting that the user indicate whether he wishes to delete a defect from the memory defect list. This prompt occurs after all additions to the defect list have been honored (or immediately if the user elected not to add any defects to the list).
DEFECT CYL HEAD SECTOR 1 xxx xx xx 2 xxx xx xx . . . . 10 xxx xx xx ALTER (Y/N) ?	Format of the display if the user elects to delete a defect from the defect list in memory. The first ten defects in the list are displayed along with a request that the user indicate whether the defect to be deleted is among those listed.
ENTER DEFECT #	Prompt for the number of the defect to be deleted from among the ten currently displayed.

T16/8L11D-06

Table 3.6 Messages Displayed during Execution of the MODIFY DEFECT LIST Command (Cont'd)

SCREEN DISPLAY	EXPLICATION
DEFECT CYL HEAD SECTOR x xxx xx xx <RETURN> TO CONTINUE, ANY CHAR TO IGNORE	Message redisplaying the defect to be deleted. This message, which occurs when the number of the defect to be deleted is received, allows the user a final chance to countermand his decision to delete the specified sector. If the user elects at this point not to delete the defect he has singled out, the program simply ignores the previous deletion request. Otherwise, the defect is deleted. In either event, the program then prompts, as initially, allowing for another defect from among the first ten in the list to be singled out.
<RETURN> TO CONTINUE, ANY CHAR TO STOP	Prompt if the user does not elect to delete one of the ten defects first displayed. If the user then elects to continue, the program displays the next ten defects in the list for possible deletion. This process continues until the entire defect list in memory has been displayed for possible deletion, or until the user elects to stop.
QUIT (Y/N) ?	Prompt if the user elects to stop at some point during the defect deletion process. If the user response is Y, the program prompts for the next command input. If the user response is N, the program displays the initial request for input generated by the MODIFY DEFECT LIST command and the entire procedure begins again.

T16/8L11D-07

3.1.14 RR - READ REGISTERS Command

The form of the READ REGISTERS command is as follows:

read_registers_command ::= RR

Execution of the READ REGISTERS command (RR) causes the current contents of the controller registers to be displayed at the OSP terminal. The format of the display is as follows:

```
CONTENTS OF CONTROLLER REGISTERS
CYL =  xxx   HEAD =  xx   SECT =  xx
FLAGS =  % x xxx xxx xxx xxx xxx
SECTCOR COUNT =  xxx
BUFADD =  xxxx
```

CYL/HEAD/SECT reflects the disc address of the most recently accessed sector; FLAGS returns the value of the header flag in the accessed sector (refer to Figure 4-3); COUNT reflects the bytecount returned by the operation; and ADD reflects the current address of the controller buffer.

Example:

```
RR                    ! displays the contents of the controller
                      ! registers
```

3.1.15 SC - SET SECTOR Command

The form of the SET SECTOR command is as follows:

```
set_sector_command  ::=  SC [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to MAXSECT
  MAXSECT  ::=  { 19 | 29 }
```

Execution of the SET SECTOR command (SC) causes the address of the current sector to be set to the number specified in the parameter. If no number is specified, the parameter defaults to sector number zero (0). The legal range of values for parameter is [0,MAXSECT]. (Refer to Table 4.1 for the possible values of MAXSECT.)

Examples:

```
SC                  ! sets the current sector address to 0
                    !
SC10                ! sets the current sector address to 10
```

3.1.16 SK - SEEK Command

The form of the SEEK command is as follows:

seek_command ::= SK

Execution of the SEEK command (SK) causes a seek operation to be performed to the current disc address. (Refer to Table 4.3 for a description of the error message displayed if a seek error occurs during command execution.)

Example:

```
CY,HD,SC,SK          ! seeks to address 0,0,0
```

3.1.17 SM - STORE MEMORY Command

The form of the STORE MEMORY command is as follows:

store_memory_command ::= SM

Execution of the STORE MEMORY command (SM) causes the last command string without syntactical errors to be saved for possible later reexecution. Commands that require operator interaction or that contain parameters may be included. Only one command string may be in memory at any given time.

Example:

```
CY10,SK,SM          ! saves the command string "CY10,SK" for later
                    ! reexecution
```

3.1.18 TT - TAKE OWNERSHIP Command

The form of the TAKE OWNERSHIP command is as follows:

take_ownership_command ::= TT

Execution of the TAKE OWNERSHIP command (TT) causes the diagnostic to take ownership of the device under test.

Example:

```
TT                    ! takes ownership of the device under test
```

3.1.19 VL - VENDOR DEFECT LIST Command

The form of the VENDOR DEFECT LIST command is as follows:

vendor_defect_list_command ::= VL

Execution of the VENDOR DEFECT LIST command (VL) enables the operator to enter vendor-identified defects into a list held in memory. These defects can be obtained from hardcopy data supplied by the vendor. This list can then be copied onto DLCYL with a WRITE DEFECT LIST (WD) command, and in turn read with a DISPLAY DEFECT LIST (DD) command. Refer to Table 3.7 for a description of the messages displayed during normal command execution, and to Table 4.3 for a description of the error messages that may be generated.

Example:

```
VL                    ! enters routine for entry of vendor-identified
                      ! defects into memory defect list
```

Table 3.7 Messages Displayed during Execution of the VENDOR DEFECT LIST Command

SCREEN DISPLAY	EXPLICATION
*** VENDOR DEFECT LIST ** ********** *** WARNING: ONLY THE MEMORY DEFECT LIST IS UPDATED! *** *** AFTER MODIFICATIONS, USE (WD) COMMAND TO WRITE *** *** NEW MEMORY DEFECT LIST ONTO DLCYL *** ********** IS DEFECT LIST ON DLCYL VALID?	Message displayed, when the command is acknowledged, announcing the command and reminding the user that the command accesses only the memory defect list, not DLCYL. The last line of the display prompts for the user to indicate whether DLCYL is valid. If DLCYL is indicated as valid, the program first builds the memory defect list from DLCYL, before entering the routine for adding vendor-identified defects to the memory defect list. If DLCYL is indicated as invalid, the program proceeds directly to the routine for entering vendor-identified defects.
ENTERING A BAD TRACK (Y/N) ?	Prompt when the routine for entering vendor-identified defects is entered, requesting that the user indicate whether he wishes to enter an entire track listed by the vendor as defective.
CYLINDER:	Prompt for cylinder address of defective track. This prompt occurs only if the user elects to enter an entire track listed by the vendor as defective.
HEAD:	Prompt for head address of defective track. This prompt occurs only if the user elects to enter an entire track listed by the vendor as defective. When both cylinder and head of the defective track are received, the program enters into the memory defect list all sectors of the specified track and prompts, as initially, for the next entire track to be entered in the list. This procedure continues until all specified tracks are entered.
<RETURN> TO CONTINUE, ANY CHAR TO STOP	Prompt for user input if the user elects not to enter any entire tracks, or when all specified tracks are entered. If the user elects to stop, the program prompts for the next command input.

T16/8L11D-08

Table 3.7 Messages Displayed during Execution of the VENDOR DEFECT LIST Command (Cont'd)

SCREEN DISPLAY	EXPLICATION
CYLINDER:	Prompt for the cylinder address of a vendor-identified defect that occupies less than a full track. The legal range for this input is [0,MAXCYL]. This prompt occurs only if the user has responded to the preceding prompt with a decision to continue.
HEAD:	Prompt for the head address of a vendor-identified defect that occupies less than a full track. The legal range for this input is [0,MAXHEAD].
BYTE POSITION:	Prompt for the byte position of a vendor-identified defect that occupies less than a full track. The legal range for this input is [0,32700].
ERROR LENGTH:	Prompt for the error length of a vendor-identified defect that occupies less than a full track. The legal range for this input is [0,32700]. When all four inputs are received, the specified defect is added and the program prompts, as before, for a user decision to continue or to stop. This procedure continues until the user has added all the vendor-identified defects, or until the space allocated for the defect list in memory overflows.

T16/8L11D-09

3.1.20 VM - READ MICROCODE VERSION Command

The form of the READ MICROCODE VERSION command is as follows:

read_microcode_version_command ::= VM

Execution of the READ MICROCODE VERSION command (VM) causes the current version of the microcode to be displayed at the OSP terminal. The form of this display is as follows:

MICROCODE VERSION ID = % xxx

Refer to Table 4.3 for a description of the error message generated if the device under test does not have defect-skipping microcode.

Example:

```
VM                    ! displays the current version of the microcode
```

3.1.21 WD - WRITE DEFECT LIST Command

The form of the WRITE DEFECT LIST command is as follows:

write_defect_list_command ::= WD

Execution of the WRITE DEFECT LIST command (WD) causes the defect list held in memory to be copied onto DLCYL. Refer to Table 3.8 for a description of the messages displayed during normal command execution, and to Table 4.3 for a description of the error messages that may be generated.

Example:

```
WD                    ! writes memory defect list into DLCYL
```

Table 3.8 Messages Displayed during Execution of the WRITE DEFECT LIST Command

SCREEN DISPLAY	EXPLICATION
*** TRANSFERRING DL TO DLCYL, COPY #1 ***	Message displayed when the command is acknowledged.
-DLCYL/HEAD/SECT: xxx/xx/xx PUN %: xxx.	Message displayed when all defects are successfully transcribed onto Copy #1 of DLCYL.
*** TRANSFERRING DL TO DLCYL, COPY #2 ***	Message displayed as the memory defect list is transcribed on Copy #2 of DLCYL. The messages that can occur during the transfer to Copy #2 are the same as those that can occur during the transfer to Copy #2 (see descriptions of preceding messages). When the transfer is complete, the program prompts for the next command input.

T16/8L11D-10

SECTION 4
ERROR CONDITIONS AND DISPOSITIONS

4.0 ERROR CONDITIONS AND DISPOSITIONS

The DUT diagnostics utilize the SHADOW error message facility and return the typical SHADOW messages generated by compare errors, EIO status errors, interrupt status errors, and unexpected non-I/O interrupt errors.

When a SHADOW error message is returned, the sequence of events producing the error can be determined by cross-referencing the error message with the program listing of the currently executing diagnostic. The formats for the return of EIO status and IIO status are given in Figures 4-1 and 4-2, respectively. The format of data on the disc is shown in Figure 4-3. The device characteristics of the T16/4103, 4104, 4105/4106, 4109, 4110/4111, and 4116 in sector-skipping format are listed in Table 4.1.

In addition to the standard SHADOW error messages, other error messages are displayed at the Diag Link terminal under the following conditions:

a. The DUT diagnostics append an additional message to the standard SHADOW error message. This additional message, which correlates the error to a specific disc function, is determined by values encoded in specific fields of the IIO cause word. The possible messages, the IIO fields that govern them, and the error conditions they indicate are described in Table 4.2.

b. Because the DUT diagnostics are interactive programs, certain special error messages can be generated by an operator error during entry of command strings. These operator-entry error messages are described in Table 4.3, under non-command-specific messages.

c. Whenever an error occurs during a seek/read operation and retries are required, a special error message is generated. This message is described in Table 4.3, under non-command-specific messages.

d. When program execution completes, an error summary is generated. This summary is described in Table 4.3, under non-command-specific messages.

e. Special command-specific error messages can be generated whenever one of the following program-defined commands is executed:

1. CHECK CYLINDER Command
2. DISPLAY DEFECT LIST Command
3. LIST HEADERS Command
4. MODIFY DEFECT LIST Command
5. READ MICROCODE VERSION Command
6. SEEK Command
7. VENDOR DEFECT LIST Command
8. WRITE DEFECT LIST Command

These messages are described in Table 4.3, under command-specific error messages.

T16/8L11D-11

O - OWNERSHIP ERROR
I - INTERRUPT PENDING
B - CONTROL UNIT BUSY
P - I/O BUS PARITY ERROR ON EIO

Figure 4-1 Format of EIO Status Word

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
O	I	A	P	(ZERO)				DEV					UNIT		

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PON	TERM							PR	UO	F	S	C	R	T0	T1

T16/8L11D-12

O - OWNERSHIP ERROR
I - INTERRUPT PENDING
A - CHANNEL TRANSFER ABORT
P - PARITY ERROR
DEV - CONTROLLER NUMBER
UNIT - UNIT NUMBER
PON - POWER ON INTERRUPT
PR - UNIT READ ONLY

UO - UNIT OWNERSHIP ERROR
F - UNIT WRITE FAULT
S - UNIT SEEK ERROR
C - UNIT NOT ON CYLINDER
R - UNIT NOT READY
T0 - UNIT TYPE, MSB
T1 - UNIT TYPE, LSB

TERM - ENCODED TERMINATION STATUS (TERMSTAT):

%00 NO ERROR
%01 UNIT ATTENTION
%02 DATA ERROR CORRECTED
%03 ATTEMPT TO WRITE ON PROTECTED UNIT
%04 ILLEGAL ADDRESS
%05 DIRECT ACCESS TO ALTERNATE TRACK
%06 ILLEGAL OPCODE
%07 UNIT STATUS ERROR
%10 BUFFER PARITY ERROR
%11 UNCORRECTABLE DATA ERROR
%12 NO SERVO CLOCKS DURING A WRITE
%13 VERIFY ERROR
%14 HEADER SEARCH FAILED
%15 HEADER ADDRESS MISCOMPARE
%16 ROM PARITY ERROR
%17 UNIT NOT PRESENT
%20 DUPLICATE UNIT NUMBER
%21 UNIT OWNERSHIP ERROR
%22 UNIT NOT READY
%23 READ RETRY SUCCESSFUL WITHOUT OFFSET
%24 READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS
%25 READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS
%26 READ RETRY SUCCESSFUL WITH DATA STROBE LATE
%27 READ RETRY SUCCESSFUL WITH DATA STROBE EARLY
%30 READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS AND DATA STROBE LATE
%31 READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS AND DATA STROBE EARLY
%32 READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS AND DATA STROBE LATE
%33 READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS AND DATA STROBE EARLY
%34 IDLE LOOP DISC CONTROLLER EXERCISER ERROR

Figure 4-2 Format of IIO Status and Cause Words

0	1	2 3	4	5	6 13	14 15	16 527	528 535
SYNC1 [1]	FLAG [1]	CYL [2]	HEAD [1]	SEC [1]	ECC1 [8]	SYNC2 [2]	DATA [512]	ECC2 [8]

T16/8L11D-13

SYNC1 = %360 (Good sector - marks the end of the preceding lockup field allowed for read synchronization and signals that address header is to follow)

%377 (Bad sector - all bytes of the entire sector are filled with ones)

FLAG = %350 (Normal sector - CYL/HEAD/SECT contains the current logical address)

%351 (Defective data area)

%352 (Jump-from-extension sector - CYL/HEAD/SECT contains the physical address of return from extension)

%353 (Spare sector)

%354 (Maximum sector on a track)

%355 (Only good sector on a track)

%356 (Jump-to-extension sector - CYL/HEAD/SECT contains the current physical address of extension)

%357 (End of cylinder)

%377 (Defective header)

ECC1 = [0:6] = Error correction code for address header
[7] = Pad byte of zeros

SYNC2 = [0] = %360
[1] = Pad byte of zeros

DATA = 512 bytes of written data

ECC2 = [0:6] = Error correction code for data portion
[7] = Pad byte of zeros

Figure 4-3 Sector-skipping Format for Data on Disc

Table 4.1 Device Characteristics in Sector-skipping Format

DEVICE CHARACTERISTIC	T16/ 4103	T16/ 4104	T16/ 4105/ 4106	T16/ 4109	T16/ 4110/ 4111	T16/ 4116
Device type	3	2	1	1	3	0
Maximum sector (MAXSECT)	19	29	29	29	29	29
Maximum head (MAXHEAD)	18	18	4	4	9	39
Maximum cylinder (MAXCYL)	814	814	822	822	822	842
Defect list cylinder (DLCYL)	813	813	821	821	821	841
First spare cylinder (FSPCYL)	805	803	811	811	811	831
Last spare cylinder (LSPCYL)	812	812	820	820	820	840
First fixed cylinder (FFXCYL)	-	-	-	896	-	-
Last fixed cylinder (LFXCYL)	-	-	-	915	-	-
Last fixed head (LFXHD)	-	-	-	0	-	-
Spare sectors per cylinder (SPSCYL)	2	2	2	2	4	8
Literal PROM ID (LPRID)	%102	%101	%101 %102	%101 %102	%101 -	%101 %102
Volume label sector (CYL/HEAD/SECT)	0/0/2	0/0/2	0/0/2	0/0/2	0/0/2	0/0/2
Spare track table sector (CYL/HEAD/SECT)	0/0/3	0/0/3	0/0/3	0/0/3	0/0/3	0/0/3

PART 1D - DUT4103/DUT4104/DUT4105/DUT4109/DUT4110/DUT4116
ERROR CONDITIONS AND DISPOSITIONS

4.1 ERROR INFORMATION APPENDED TO SHADOW ERROR MESSAGES

In conjunction with the standard SHADOW error message, the defect-logging utility programs typically display one of a number of error messages together with the contents of the controller registers. This error message is determined by IIO status. The form of the error message is as follows:

```
<error message>

CYL xxx HEAD xx SECT xxx FLAGS xxx COUNT xxx ADD xxx
```

The various messages that may appear in the <error message> field are listed and explained in Table 4.2. CYL/HEAD/SECT reflects the disc address of the sector accessed by the command; FLAGS returns the value of the header flag in the accessed sector (refer to Figure 4-3); COUNT reflects the bytecount returned by the operation; and ADD reflects the current address of the controller buffer.

Table 4.2 Error Messages Accompanying Standard SHADOW Messages

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
TIMEOUT ERROR	IIO CAUSE = -1	A timeout occurred on the controller before the current operation could complete.
DEVICE TYPE ERROR	IIO CAUSE bits <14:15>	The accessed unit returned a different device type from that expected by the controller.
NOT READY ERROR	IIO CAUSE bit <13>	One of the following conditions obtains: a. No disc pack is installed. b. Disc spindle motor is not up to speed. c. Read/write heads are not loaded. d. DC voltages of drive are not within margin. e. Terminator is not present or does not have power.
NOT ON CYLINDER ERROR	IIO CAUSE bit <12>	A seek to an illegal address has been received from the channel, i.e., a cylinder, head, or sector address greater than the maximum legal value has been specified (refer to Table 4.1).
SEEK ERROR	IIO CAUSE bit <11>	Drive is unable to seek to specified address.
WRITE FAULT ERROR	IIO CAUSE bit <10>	One of the following conditions obtains: a. More than one write/read head selected b. Read gate and write gate both true c. Read gate and erase gate both true d. Write current but no erase current e. Erase current but no write current f. Write gate or erase gate but not on cylinder g. DC voltages below margin h. Emergency retract condition
OWNERSHIP ERROR	IIO CAUSE bit <9>	Controller is owned by the other port.
WRITE PROTECT ERROR	IIO CAUSE bit <8>	Write operation attempted to disc drive with WRITE PROTECT switch on.

T16/8L11D-14

Table 4.2 Error Messages Accompanying Standard SHADOW Messages (Cont'd)

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
NO TERMSTAT ERROR	TERM = %00	No error.
TERMSTAT ATTENTION ERROR	TERM = %01	One of the following unit attention conditions occurred: a. Selected drive ready (head load sequence) b. I.D. plug changed after drive ready c. Seek complete.
TERMSTAT CORRECTED DATA ERROR	TERM = %02	An error correctable by error correction code (ECC) occurred during a READ operation (≤ 11 bits).
TERMSTAT WRITE ATTEMPT TO PROTECTED UNIT ERROR	TERM = %03	WRITE-type command issued to disc drive with READ ONLY switch enabled.
TERMSTAT ILLEGAL ADDRESS ERROR	TERM = %04	A cylinder address was too large.
TERMSTAT DIRECT ACCESS TO ALT TRACK ERROR	TERM = %05	Not used in sector-skipping format. (In track-sparing, indicates that a READ or WRITE was issued to an alternate track before execution of the routine required to access that track.)
TERMSTAT ILLEGAL OPCODE ERROR	TERM = %06	The controller command in the EIO Address/Command Word is not valid.
TERMSTAT UNIT STATUS ERROR	TERM = %07	One of the following unit status conditions obtains: a. SEEK issued to disc drive with SEEK or NOT ON CYLINDER error b. FAULT or SEEK error occurred during a programmed seek, recalibrate, or head load sequence.
TERMSTAT BUFFER PARITY ERROR	TERM = %10	Incorrect parity in data word read from the controller 4K byte buffer (odd parity maintained).
TERMSTAT UNCORRECTABLE DATA ERROR	TERM = %11	A data record accessed with a READ error burst greater than 11 bits. ECC detected but uncorrectable. Data block could not be recovered with 27 retries using all offset combinations.
TERMSTAT NO SERVO CLOCKS DURING A WRITE	TERM = %12	Record CRC error.

T16/8L11D-15

Table 4.2 Error Messages Accompanying Standard SHADOW Messages (Cont'd)

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
TERMSTAT VERIFY ERROR	TERM = %13	Data read into the buffer does not compare with I/O channel data.
TERMSTAT HEADER SEARCH FAILURE	TERM = %14	One of the following header search conditions occurred: a. No headers on addressed track could be read. b. No sector match among headers on addressed track.
TERMSTAT HEADER ADDRESS MISCOMPARE	TERM = %15	Cylinder address or head address does not compare with the address loaded into the cylinder or head address registers.
TERMSTAT ROM PARITY ERROR	TERM = %16	Incorrect parity in microprogram instruction word read from ROM (odd parity maintained).
TERMSTAT UNIT NOT PRESENT ERROR	TERM = %17	Proper I.D. plug not installed.
TERMSTAT DUPLICATE UNIT NUMBER ERROR	TERM = %20	Plugs with the same I.D. installed in more than one disc drive.
TERMSTAT UNIT OWNERSHIP ERROR	TERM = %21	Disc drive owned by other controller.
TERMSTAT UNIT NOT READY ERROR	TERM = %22	Drive is not up to speed with the heads loaded.

T16/8L11D-16

4.2 OTHER ERROR MESSAGES RETURNED BY THE DUT DIAGNOSTICS

In addition to the error messages described in paragraph 4.1, certain error messages may occur as the commands and command strings entered by the user are executed. These messages are annotated in Table 4.3. For the purpose of description, these messages have been arranged in the table under two general headings: a) non-command-specific messages, and b) command-specific messages. The messages described under the first heading may occur throughout diagnostic execution, without reference to the command being executed. The messages described under the second heading occur only in the context of a given command; they are, consequently, grouped by command.

Table 4.3 Other Error Messages Generated by the DUT Diagnostics (DUT4103/DUT4104/DUT4105/DUT4109/DUT4110/DUT4116)

SCREEN DISPLAY	EXPLICATION
NON-COMMAND-SPECIFIC MESSAGES	
ILLEGAL SYNTAX	Message displayed if the user enters a command or command string that is syntactically incorrect.
** SOFTWARE ERROR **	Message displayed if a command entered by the user cannot be interpreted, and the error cannot be assigned to any of the standard operator-entry-error types.
-UNIMPLEMENTED COMMAND	Message displayed if the command entered by the user is not among those accepted by the DUT command set.
** INVALID CYLINDER PARAMETER **	Message displayed if the user specifies an illegal cylinder number in a command entry that requires a cylinder number in the parameter field.
** PARAMETER NOT ALLOWED **	Message displayed if the user enters a parameter in conjunction with a command that excludes any parameters.
** MISSING PARAMETER **	Message displayed if the user omits the parameter when entering a command that requires a parameter.

T16/8L11D-17

Table 4.3 Other Error Messages Generated by the DUT Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
NON-COMMAND-SPECIFIC MESSAGES	
** INVALID PARAMETER %: **	Message displayed if the user enters a parameter outside the legal range for a given command.
READ RETRY...CONTROL CODE=% xxx	Message displayed when a seek/read that has initially failed during a COLD LOAD, READ, UNCONDITIONAL READ, or READ WITHOUT TRANSFER operation succeeds on a retry. Up to 27 retries are provided, with different offsets. The octal value displayed in the CONTROL CODE field is the value returned in the TERM field of the IIO cause word. It indicates the particular offset combination that succeeded. The sequence of offsets and corresponding control codes are as follows: a. No offset (%23) b. Servo offset minus (%24) c. Servo offset plus (%25) d. Data strobe late (%26) e. Data strobe early (%27) r. Data strobe late and servo offset minus (%30) g. Data strobe early and servo offset minus (%31) f. Data strobe late and servo offset plus (%32) i. Data strobe early and servo offset plus (%33).
* ERROR SUMMARY DURING DUT41xx * TIMEOUTS xxxxxxx NOT ON CYLINDERS xxxxxxx SEEK ERRORS xxxxxxx DATA ERRORS CORRECTED xxxxxxx ILLEGAL ADDRESSES xxxxxxx DATA UNCORRECTABLES xxxxxxx HEADER SEARCH FAILS xxxxxxx	Error summary displayed when program execution completes.

T16/8L11D-18

Table 4.3 Other Error Messages Generated by the DUT Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
COMMAND-SPECIFIC MESSAGES	
CHECK CYLINDER (CC)	
** SEEK ERROR, EFXSK: xx **	Message displayed if a seek error occurs during the SEEK operation. The command is aborted, and the program prompts for a new command input.
DISPLAY DEFECT LIST (DD)	
** DLCYL ACCESS ERROR, CYL/HEAD/SECT: xxx / xx / xx ** RETURN TO CONTINUE	Message displayed if an error occurs during cylinder access. The program suspends execution until the user responds with a carriage return. The program then attempts to address the next sector and to proceed with the defect list display.
LIST HEADERS (LH)	
** SEEK ERROR, EFXSK: xx **	Message displayed if a seek error occurs during the initial SEEK operation. The command is aborted, and the program prompts for a new command input.
MODIFY DEFECT LIST (MD) and VENDOR DEFECT LIST (VL)	
** ERROR READING DEFECT LIST-RETRYING **	Message displayed if an error occurs during the initial attempt to access a given sector of DLCYL. The access is then attempted a second and, if necessary, a third time. The message is redisplayed before each repeat.
-RETRY RUNOUT, SKIPPING SECTOR	Message displayed if the final attempt to access the sector also fails. The program then proceeds to the next sector.

T16/8L11D-19

Table 4.3 Other Error Messages Generated by the DUT Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
COMMAND-SPECIFIC MESSAGES	
MODIFY DEFECT LIST (MD) and VENDOR DEFECT LIST (VL)	
PAUSE-BAD CYL IN DL, CYL/MAXCYL: xxx / xxx	Message displayed if a cylinder greater than the maximum allowable is encountered during the sector-by-sector read of DLCYL. The program then suspends execution. When the user responds with a carriage return, the program attempts to access the next sector. For the possible values of MAXCYL, refer to Table 4.1.
PAUSE-BAD HEAD IN DL, HEAD/MAXHEAD: xx / xx	Message displayed if a head greater than the maximum allowable is encountered during the sector-by-sector read of DLCYL. The program then suspends execution. When the user responds with a carriage return, the program attempts to access the next sector. For the possible values of MAXHEAD, refer to Table 4.1.
PAUSE-BAD SECT IN DL, SECT/MAXSECT: xx / xx	Message displayed if a sector greater than the maximum allowable is encountered during the sector-by-sector read of DLCYL. The program then suspends execution. When the user responds with a carriage return, the program attempts to access the next sector. For the possible values of MAXSECT, refer to Table 4.1.
*** TOO MANY DEFECTS, BLIP FULL - PAUSE ***	Message displayed if the space allocated for the memory defect list overflows. The program then suspends execution.
READ MICROCODE VERSION (VM)	
DEFECT-SKIPPING MICROCODE NOT INSTALLED	Message displayed if the device under test does not have sector-skipping microcode.

T16/8L11D-20

Table 4.3 Other Error Messages Generated by the DUT Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
COMMAND-SPECIFIC MESSAGES	
SEEK (SK)	
** SEEK ERROR, CYL/HEAD/SECT: xxx / xx / xx **	Message displayed if an error occurs during the seek operation. The seek is aborted, and the program prompts for the next command input.
WRITE DEFECT LIST (WD)	
DL WRITE ERROR <RETURN> TO CONTINUE	Message displayed if a write error occurs during the transcribing of defects onto DLCYL. The program then suspends execution. The last line of the display is a prompt for user decision to continue.

T16/8L11D-21

SECTION 5
RUN PROCEDURES

5.0 RUN PROCEDURES

> CAUTION
>
> The WRITE DEFECT LIST (WD) performs WRITE operations to the defect list cylinder (DLCYL) of the disc volume under test. Extreme care should therefore be taken when executing this command.

A sample successful run of a DUT diagnostic is illustrated in Figure 5-1. The test case uses a 128-MB disc drive (T16/4110), configured as drive number %2 on controller number %1. The illustration assumes SHADOW loaded and bits <3>, <4>, and <5> of the Switch Register in the OFF position. (Refer to Table 5.2 for the definition of all applicable switch settings.)

For the user unfamiliar with SHADOW in general or with the DUT diagnostics in particular, the system preparations necessary for running diagnostics are described in paragraph 5.1; a step-by-step run procedure follows in paragraph 5.2.

5.1 PREPARATIONS FOR RUNNING THE DUT DIAGNOSTICS

Before any diagnostic is run, certain steps must be taken to allocate the system resources necessary for SHADOW and to ensure that the diagnostic run has minimum impact on system performance. The necessary procedures are ordinarily performed by the local system manager, or at least with the concurrence of the system manager. They include:

a. Obtaining access to the OSP subsystem

b. Transferring to another processor all user processes currently running in the processor to be taken off line

c. Transferring to another processor the path preference of all controllers with preferred paths currently assigned to the processor to be taken off line

```
T9404D00.SHADOW  01APR81  00:00
>RUN DUT4110 <cr>

DEFECT LOGGING UTILITY PROGRAM FOR 4110 DISKS
T9472A02.DUT4110 (A02) 01APR82
ONE 3106 CONTROLLER AND ONE DRIVE

INPUT PRIMARY CONTROLLER NUMBER
? %1 <cr>
INPUT DRIVE NUMBER
? %2 <cr>

** INPUT COMMAND STRING **
? TT <cr>
** INPUT COMMAND STRING **
? CN16,CN2,CN64 <cr>
** INPUT COMMAND STRING **
? DD <cr>
*** DISPLAYING DEFECTS ON DLCYL: 821  ***
   DLCYL/HEAD/SECT 821/0/0
   #      CYL     HEAD     SECT
   1      101       1        0
   2      337       1        1
   3      693       1       29
   4      791       5        5
   5      793       2       26
   6      805       1       29
   7       -1     255      255
   8       -1     255      255
   9       -1     255      255
  10       -1     255      255
  11       -1     255      255
  12       -1     255      255
  13       -1     255      255
  14       -1     255      255
  15       -1     255      255
  16       -1     255      255
RETURN TO CONTINUE, ANY CHAR TO STOP
? n <cr>
** INPUT COMMAND STRING **
?  MD <cr>

*********************************************************
***  WARNING: ONLY THE MEMORY DEFECT LIST IS UPDATED!  ***
***   AFTER MODIFICATIONS, USE (WD) COMMAND TO WRITE   ***
***         NEW MEMORY DEFECT LIST ONTO DLCYL          ***
*********************************************************

NEW COPY FROM DLCYL (Y/N) ?
? y <cr>
DISPLAY MEMORY DEFECT LIST (Y/N) ?
? n <cr>
ADD A DEFECT (Y/N) ?
? y <cr>
NOTE: ONLY THE DEFECT LIST IN MEMORY IS UPDATED
CYLINDER:
? 0 <cr>
HEAD:
? 1 <cr>
SECTOR:
? 5 <cr>
<RETURN> TO ADD, ANY CHAR TO REPEAT
? <cr>
ADD A DEFECT (Y/N) ?
? n <cr>
```

T16/8L11D-22

Figure 5-1 Sample Successful Run of DUT4110

```
DELETE A DEFECT (Y/N) ?
? y <cr>
DEFECT       CYL     HEAD  SECTOR
   1         101        1       0
   2         337        1       1
   3         693        1      29
   4         791        5       5
   5         793        2      26
   6         805        1      29
   7           0        1       5
   8          -1      255     255
   9          -1      255     255
  10          -1      255     255
ALTER (Y/N) ?
? y <cr>
ENTER DEFECT #
? 7 <cr>
DEFECT CYL HEAD SECTOR
  7      0    1      5
<RETURN> TO CONTINUE, ANY CHAR TO IGNORE
? <cr>
DELETE A DEFECT (Y/N) ?
? y <cr>
<RETURN> TO CONTINUE, ANY CHAR TO STOP
? n <cr>
QUIT (Y/N) ?
? y <cr>
** INPUT COMMAND STRING **
? WD <cr>
*** TRANSFERRING DL TO DLCYL, COPY #1 ***
-DLCYL/HEAD/SECT: 821  0  0  PUN %: 12
*** TRANSFERRING DL TO DLCYL, COPY #2 ***
-DLCYL/HEAD/SECT: 821  0  0  PUN %: 12
** INPUT COMMAND STRING **
? <escape>

*  ERROR SUMMARY DURING DUT4110   *

   TIMEOUTS                      0
   NOT ON CYLINDERS              0
   SEEK ERRORS                   0
   DATA ERRORS CORRECTED         0
   ILLEGAL ADDRESSES             0
   DATA UNCORRECTABLES           0
   HEADER SEARCH FAILS           0

!!!!!!!!!!   E N D   OF   D U T 4 1 1 0   !!!!!!!!!!
```

Note: 128-Mb disc drive (T16/4110), drive number %2, controller number %1. SHADOW loaded and panel switches <3>, <4>, and <5> switched off.

T16/8L11D-23

Figure 5-1 Sample Successful Run of DUT4110 (Cont'd)

d. Taking whatever precautions are indicated to protect the data stored on the disc volume to be tested

e. Taking off line the processor to be loaded with SHADOW

f. Taking off line the disc subsystem (controller and drive) to be tested.

> CAUTION
>
> If a T16/4109 disc drive is to be tested, both the moving and fixed-head portions of the disc (each assigned a different physical unit number) must be taken off line. Since the drives are dual ported, both paths to both portions of the disc must be off line.

These steps are described in detail elsewhere in the NonStop II Diagnostic Operating Procedures, Part Number 82803; those that deal with preparing the system in general for SHADOW, in Volume 1, Chapter 2, Parts 1 and 2; and those that deal with preparing the disc subystem in particular, in Volume 3B, Chapter 1, Part 1.

A checklist of the requirements for the DUT diagnostics, both those that must be available on the system and those that must be supplied by the customer engineer, is given in Table 5.1.

> CAUTION
>
> It is possible to run SHADOW diagnostics from the OSP in two or more processors concurrently. However, only one test process can communicate with the OSP at a time. For this reason, no more than one diagnostic process is ordinarily run on a system at any given time.

Table 5.1 Checklist for the DUT Diagnostics

REQUIREMENTS	SOURCE
A functioning OSP subsystem and terminal.	On site.
A processor that can be taken off line and dedicated to SHADOW.	On site.
A tape drive unit (if SHADOW is to be loaded from tape). a. The tape drive must be physically connected to the test processor if SHADOW is I/O loaded from tape. b. The tape drive must be physically connected to the processor that is to read the tape if SHADOW is bus loaded through an offline processor. c. The tape drive must be physically connected to a processor running GUARDIAN (TM) if SHADOW is bus loaded through an online processor.	On site.
Scratch pack or packs to substitute for the user packs during diagnostic execution (if removable media are to be tested).	On site.
SHADOW operating system. *	Either on site, in disc storage, or supplied by C.E. on cold load tape.
The appropriate DUT diagnostic program for the disc drive type under test (refer to Table 1.1).	Either on site, in disc storage, or supplied by C.E. on cold load tape.

* There are two distinct versions of the SHADOW operating system, one for the NonStop system (usually denoted as ZZDIAG1.SHADOW) and the other for the NonStop II system (usually denoted as ZZDIAG2.SHADOW). If loading from tape, ensure that the correct version is present on the tape and specify it during the load procedure.

5.2 RUN PROCEDURE FOR THE DUT DIAGNOSTICS

To run one of the DUT diagnostics, first ensure that the preparations listed in paragraph 5.1 are taken and then proceed as follows:

a. Load SHADOW into the test processor.

> CAUTION
>
> There are two distinct versions of the SHADOW operating system, one for the NonStop system (usually denoted as ZZDIAG1.SHADOW) and the other for the NonStop II system (usually denoted as ZZDIAG2.SHADOW). If loading from tape, ensure that the correct version is present on the tape and specify it during the load procedure. There are three methods for loading SHADOW: I/O cold load from tape, bus cold load from tape, and online load from tape or disc. They are described in detail in the NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 1.

b. Set desired Switch Register options in the operator control panel of the test processor. (Refer to Table 5.2 for a list of panel switches defined for the DUT diagnostics.)

c. At the SHADOW prompt on the OSP screen, enter the command:

RUN <filename>

where <filename> is DUT4103, DUT4104, DUT4105, DUT4109, DUT4110, or DUT4116. (Refer to Figure 5-1 for further illustration.)

> NOTE
>
> Execution of the RUN command causes the program to initialize and the program name to be displayed at the OSP terminal. Several requests for user input follow. Actual program execution commences only when the last request is honored.

Table 5.2 Switch Register Options Available for the DUT Diagnostics *

SWITCH	FUNCTION
<0>	(Standard SHADOW function) If toggled on and off, generates a user break request and returns the SHADOW interpreter to conversational mode, where it waits for further instruction.
<3>	(Standard SHADOW function) If placed in the ON position, suppresses error printout and enables setting of the special numerics ERROR# and COMPERR#. Refer to the Diagnostic Languages Manual, Part Number 82848, for a description of the special numerics ERROR# and COMPERR#.
<4>	(Standard SHADOW function) If placed in the ON position, suppresses error printout, disables setting of the special numerics ERROR# and COMPERR#, and disables ERROR limit decrement. SWITCH BIT <4> MUST NOT BE USED WITH THE DUT DIAGNOSTICS.
<5>	(Standard SHADOW function) If placed in the ON position, causes a program halt on I/O error.
<6>	(DUT-specific function) When switched to the ON position, causes program to loop on the previously entered command string. Program continues looping until switch is returned to the OFF position.

* Switches <1>, <2>, and <7> are not defined for the DUT diagnostics, and switches <8> through <15> reflect the I/O address.

d. When the following request is displayed at the OSP terminal, respond as indicated:

```
INPUT PRIMARY CONTROLLER NUMBER
?
```

1. Enter at the prompt the physical unit number (in octal) of the disc controller to be tested.

2. Depress carriage return.

e. When the following request is displayed at the OSP terminal, respond as indicated:

```
INPUT DRIVE NUMBER
?
```

1. Enter the physical unit number (in octal) of the first disc drive to be tested.

2. Depress carriage return.

NOTE

The disc drive indicated must be connected to the controller specified in step e. The DUT diagnostics test one controller and one drive at a time.

The T16/4109 drive requires two I/O addresses (one for the moving heads and one for the fixed heads). So that DUT4109 can test both parts of the disc, the valid range of drive numbers for DUT4109 is limited to [0,3] instead of the customary range [0,7]. The upper half of the range [4,7] is reserved for identifying internally the fixed-head portions of the disc drives specified by the lower half (i.e., drive number 4 is the fixed-head portion of drive number 0, and so on).

f. When the following request is displayed at the OSP terminal, respond as indicated:

```
** INPUT COMMAND STRING **
?
```

1. Enter the following command at the OSP terminal:

TT

2. Depress carriage return.

g. When the TAKE OWNERSHIP command is accomplished and the following request for command string input is again displayed at the OSP terminal, respond as indicated:

```
** INPUT COMMAND STRING **
?
```

1. Enter at the prompt any legal command or series of commands, using a comma to separate each command from the command following it (but not a command from its parameter).

2. Depress carriage return.

NOTE

When this command or command string is executed (and as each subsequent command or command string is executed), the program prompts as before for another command string input. To exit exerciser mode and reinitialize the DUT diagnostic for test of another device, the EXIT command (EX) must be entered. To terminate the diagnostic, either the ESCAPE key must be depressed at the OSP terminal, or switch <0> of the control panel toggled on and off; SHADOW then returns to conversational mode. Table 5.3 describes a possible series of commands. Refer to Section 3 for a description of all available commands and of the operations they perform.

Table 5.3 Possible Series of Commands in DUT Diagnostics *

COMMAND	OPERATION
TT <cr>	Performs a TAKE OWNERSHIP.
CN16 <cr>	Performs a PRIORITY SELECT.
CN2 <cr>	Performs a UNIT CLEAR.
CN64 <cr>	Performs a RECALIBRATE.
CY0 <cr>	Sets current cylinder address to 0.
HD0 <cr>	Sets current head address to 0.
SC0 <cr>	Sets current sector address to 0.
DD <cr>	Displays the contents of the defect list cylinder (DLCYL).
MD <cr>	Allows the user to modify/display defect list in memory.
WD <cr>	Allows the user to write the current contents of the memory defect list onto DLCYL.

* This series of commands could also be entered as a single command string, each command separated from the others by a comma, with a single carriage return at the end.

** To access the fixed-head portion of a T16/4109 disc drive, CY must be set in the range [896,915]; HD in the range [0,4]; and SC in the range [0,29]. Zero (0) is the only valid head setting for cylinder 915.

h. Analyze any errors generated. (Refer to Section 4 for a description of possible error conditions.)

i. If the problem can be isolated to a faulty cable or to the drive as a unit, replace the faulty part. (Refer to the appropriate maintenance manual for a description of replacement procedures.)

j. If the results of the DUT diagnostic are inconclusive, try to isolate the problem further by running another of the diagnostics for sector-skipping format. (Refer to Table 1.1.)

CAUTION

In cases where DLCYL has been invalidated, it is essential that a tape or hard copy of the vendor defect list information stored on DLCYL when first formatted by Tandem manufacturing be available. If a tape copy exists, it can be loaded directly onto the disc after reformatting with the PUP FORMAT facility. If only a hard copy exists, the defects must be entered one by one, using the appropriate SHADOW defect-logging utility program (DUT). The PUP FORMAT procedure is described in the NonStop II System Operations Manual, Part Number 82075. The FMT programs are described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 3B, Chapter 1, Part 1F; the DUT programs, in Part 1D.

k. When diagnostic testing is complete, perform the following:

1. Notify the system manager that the serviced disc volume is now ready to be returned to system use.

NOTE

The facility for bringing disc volumes on line is provided by the PUP commands UP and REVIVE. The UP command is used to bring on line a volume that is not part of a mirrored pair. Any volumes configured to operate as part of a mirrored pair must be brought on line with the REVIVE command. The PUP commands UP and REVIVE are described in the NonStop II System Operations Manual, Part Number 82075.

2. Assist the customer in verifying the integrity of any disc volumes that have been serviced and in restoring the system to normal performance.

NOTE

The procedure for reloading a processor that is off line is described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 3.

PART 1E

EDT 4103, EDT 4104, EDT 4105
EDT 4109, EDT 4110, EDT 4116

SECOND LEVEL MANUAL

DIAGNOSTIC OPERATING PROCEDURES

NonStop II (TM) Systems

VOLUME 3B, CHAPTER 1, PART 1E

EDT4103, EDT4104, EDT4105, EDT4109, EDT4110,
AND EDT4116 DISC DIAGNOSTICS

Copyright © 1982

TANDEM COMPUTERS INCORPORATED
2450 Walsh Avenue
Santa Clara, California 95050

Tandem Part Number 82803

October 1982
Printed in U.S.A.

This document contains information that is protected by copyright. No part of this document may be photocopied, reproduced or translated to another program or system without the prior written consent of Tandem Computers Incorporated.

The following are trademarks of Tandem Computers Incorporated:
Tandem, NonStop, NonStop II, AXCESS, DYNABUS, ENCOMPASS, ENFORM, ENSCRIBE, ENVOY, EXCHANGE, EXPAND, GUARDIAN, TGAL, PATHWAY, XRAY.

VOLUME 3B, CHAPTER 1, PART 1E

TABLE OF CONTENTS

Par.No.	Title	Page No.
	SECTION 1 INTRODUCTION	
1.0	INTRODUCTION	1-1
	SECTION 2 OVERVIEW	
2.0	OVERVIEW	2-1
2.1	PROGRAM SELECTION AND EXECUTION	2-1
	SECTION 3 COMMANDS	
3.0	COMMANDS	3-1
	SECTION 4 ERROR CONDITIONS AND DISPOSITIONS	
4.0	ERROR CONDITIONS AND DISPOSITIONS	4-1
4.1	ERROR INFORMATION APPENDED TO SHADOW ERROR MESSAGES	4-6
4.2	OTHER ERROR MESSAGES RETURNED BY THE EDT DIAGNOSTICS	4-10
	SECTION 5 RUN PROCEDURES	
5.0	RUN PROCEDURES	5-1
5.1	PREPARATIONS FOR RUNNING THE EDT DIAGNOSTICS	5-4
5.2	RUN PROCEDURE FOR THE EDT DIAGNOSTICS	5-6

TABLE OF CONTENTS (Cont'd)

LIST OF ILLUSTRATIONS

Fig.No.	Title	Page No.
4-1	Format of EIO Status Word	4-2
4-2	Format of IIO Status and Cause Words	4-3
4-3	Sector-skipping Format for Data on Disc	4-4
5-1	Sample Successful Run of EDT4110	5-2

LIST OF TABLES

Table No.	Title	Page No.
1.1	Disc Subsystem Diagnostics for the NonStop II System	1-2
2.1	Tests Performed by the Extended Data Tests	2-4
2.2	Messages Accompanying Normal Program Execution	2-5
4.1	Device Characteristics in Sector-skipping Format	4-5
4.2	Error Messages Accompanying Standard SHADOW Messages	4-7
4.3	Other Error Messages Generated by the Extended Data Tests	4-11
5.1	Checklist for the EDT Diagnostics	5-5
5.2	Switch Register Options Available for the EDT Diagnostics	5-7

PART 1E - EDT4103/EDT4104/EDT4105/EDT4109/EDT4110/EDT4116
TABLE OF CONTENTS

SECTION 1
INTRODUCTION

1.0 INTRODUCTION

This chapter describes six SHADOW diagnostics, EDT4103, EDT4104, EDT4105, EDT4109, EDT4110, and EDT4116. These diagnostics are extended data tests (EDT) designed for testing disc media with multiple patterns both incrementally and randomly. They can be used, respectively, to test a T16/4103, 4104, 4105/4106, 4109, 4110/4111, or 4116 disc drive on a Tandem NonStop II (TM) system. To accept these programs, the drive must be formatted for sector skipping and configured with a T16/3106 disc controller.

Used primarily in the corrective maintenance process, the EDT diagnostics can be run to determine the types of errors being produced and to help isolate the probable area of failure. After the suspected area of failure is corrected, these programs can be run again as end tests to ensure that the errors are eliminated.

The EDT diagnostics are one of seven sets of SHADOW diagnostic programs provided for the NonStop II disc subsystems. Refer to Table 1.1 for a list of the other available diagnostics.

The EDT diagnostics are written for SHADOW Rev level D00 and are compatible with all Rev levels of the disc controller and disc drives.

Table 1.1 Disc Subsystem Diagnostics for the NonStop II System *

SUBSYSTEM	DIAGNOSTIC	MANUAL REF. **
T16/4103 drive - T16/3106 ctrl	FAST4103	Part 1A
	DISC4103	Part 1B
	DEX4103	Part 1C
	DUT4103	Part 1D
	EDT4103	Part 1E
	FMT4103	Part 1F
	REX4103	Part 1G
T16/4104 drive - T16/3106 ctrl	FAST4104	Part 1A
	DISC4104	Part 1B
	DEX4104	Part 1C
	DUT4104	Part 1D
	EDT4104	Part 1E
	FMT4104	Part 1F
	REX4104	Part 1G
T16/4105 drive - T16/3106 ctrl ***	FAST4105	Part 1A
T16/4106 drive - T16/3106 ctrl	DISC4105	Part 1B
	DEX4105	Part 1C
	DUT4105	Part 1D
	EDT4105	Part 1E
	FMT4105	Part 1F
	REX4105	Part 1G
T16/4109 drive - T16/3106 ctrl	FAST4109	Part 1A
	DISC4109	Part 1B
	DEX4109	Part 1C
	DUT4109	Part 1D
	EDT4109	Part 1E
	FMT4109	Part 1F
	REX4109	Part 1G
	FHD4109	Part 1H
T16/4110 drive - T16/3106 ctrl ***	FAST4110	Part 1A
T16/4111 drive - T16/3106 ctrl	DISC4110	Part 1B
	DEX4110	Part 1C
	DUT4110	Part 1D
	EDT4110	Part 1E
	FMT4110	Part 1F
	REX4110	Part 1G
T16/4116 drive - T16/3106 ctrl ***	FAST4116	Part 1A
	DISC4116	Part 1B
	DEX4116	Part 1C
	DUT4116	Part 1D
	EDT4116	Part 1E
	FMT4116	Part 1F
	REX4116	Part 1G

* A somewhat different subset of disc subsystems is supported on the NonStop (TM) system, some in sector-skipping format and some in track-sparing format. For a complete list of the disc subsystems supported on the NonStop system and of the applicable diagnostics, refer to NonStop Diagnostic Operating Procedures, Part Number 82802, Volume 3B, Chapter 1, Part 1.

** In all cases, the general manual reference is to Volume 3B, Chapter 1, of NonStop II Diagnostic Operating Procedures, Part Number 82803.

*** The T16/4105 and 4106 disc drives are identical devices, as are the T16/4110 and 4111, except that in each case the first is free standing in the cabinet and the second is drawer mounted.

T16/8L11E-01

SECTION 2
OVERVIEW

2.0 OVERVIEW

The EDT diagnostics permit the thorough testing of one controller and up to eight drives. If the disc drive under test houses removable media (T16/4103, 4104, or 4105), a scratch pack with valid sector-skipping format is normally used because the programs destroy data stored on the media. The EDT diagnostics recognize the defects previously stored in the defect log; they also allow defects detected during testing to be added to the log. The contents of the defect log may be viewed both before and after media testing.

The EDT diagnostics are run from the OSP terminal. Before any of them can be run, the following system resources must be taken off line and dedicated to the SHADOW program:

a. The disc drive to be tested and the associated controller

b. The processor into which SHADOW is to be loaded (the procedure for taking processor modules off line is described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 2).

SHADOW is then loaded into the test processor by one of the three customary methods, and the desired Switch Register options may be set in the operator control panel of the test processor. Refer to Table 5.2 for a description of the Switch Register options. The SHADOW load procedure is described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 1.

2.1 PROGRAM SELECTION AND EXECUTION

After SHADOW is loaded, the appropriate EDT diagnostic for the particular subsystem under test can be loaded and run. The typical SHADOW requests for input are displayed at the OSP terminal as the program initializes. Initialization cannot complete without appropriate responses from the operator. At certain points throughout program execution, further interaction with the operator is required.

All of the programs report the SHADOW error messages appropriate to the conditions detected (unless error printout is suppressed in the panel switches). Additional information relating the error to a specific disc function typically accompanies the standard SHADOW message. Refer to Section 4 for a description of all error messages displayed at the OSP terminal.

PART 1E - EDT4103/EDT4104/EDT4105/EDT4109/EDT4110/EDT4116
OVERVIEW

The functions tested by the EDT diagnostics are listed in sequence in Table 2.1. (The tests are numbered in Table 2.1 strictly as an aid to sequential presentation; they do not exist in the program as independently numbered entities). For the purpose of description, execution of the EDT diagnostics can be divided into the following sequence of operations:

a. Basic controller checks

b. Address rollover test

c. Media test

   1. Manipulation of DLCYL

   2. Cylinder-by-cylinder write/read/verify test

   3. Random positioning/data verification test.

The screen displays that each of these operations generates during a normal, error-free run of the diagnostic are described in Table 2.2.

The address rollover test is a cylinder rollover applied to all cylinders except the defect list cylinder (DLCYL) and the last moving-head cylinder. The program attempts to read two sectors, the first being the last logical sector of the current cylinder. When both sectors are successfully retrieved, the program verifies the cylinder, head, and sector addresses of both sectors. If errors are detected, the program displays an appropriate message and offers the user the option of continuing or aborting the test.

The media tests are performed on a cylinder-by-cylinder basis first, starting with cylinder 0 and proceeding to DLCYL-1. The program writes a pattern on each logical sector of the current cylinder and overwrites the last four bytes of the sector with the current disc address. Each sector, unless previously labeled bad, is then read and verified against a known data pattern. If an error is detected during the read operation, the program attempts to recalibrate and labels the sector bad. The sector is also declared bad if data errors are detected. This write/read/verify test is performed with three data patterns over the range of specified cylinders.

When the cylinder-by-cylinder tests are complete, the program performs a random positioning/data verification test. This test uses the data written on the media during the cylinder-by-cylinder test. It randomly positions the moving heads, reads a sector, and verifies the retrieved data, including the disc address previously written in the last four bytes. If errors are detected, the sector is declared bad.

Run times for the EDT diagnostics vary, depending on such factors as the number of options exercised, the storage capacity of the disc drive under test, and so on. The settings of the panel switches can also affect the course of any given run of the diagnostic. EDT4110, for example, can take six hours or more. Factors to be considered when estimating down time include not only the run times for the diagnostics to be used, but also the time which may be required for reformatting and reviving the discs after the diagnostics are completed. The times required for these procedures vary from an hour or less to as long as overnight, depending on such factors as system load and disc pack size.

Table 2.1 Tests Performed by the Extended Data Tests (EDT4103, EDT4104, EDT4105, EDT4109, EDT4110, and EDT4116)

TEST NUMBER	DESCRIPTION
1	Checks for correct PROM ID.
2	Tests ability to set and clear PROM parity error.
3	Performs Set Cylinder and Set Head/Sector commands 10,000 times. Then reads and verifies the cylinder, head, and sector registers.
4	Writes 18 test patterns to the buffer, then reads and compares the data written.
5	Fills the buffer with random data patterns, then reads and compares the data written.
6	Performs Seek commands at head 0, sector 0 of all cylinders, incrementing from 0:MAXCYL and then decrementing from MAXCYL:0.
7	Performs disc address rollover tests for all cylinders, heads, and sectors.
8	Performs media tests on all cylinders, heads, and sectors except DLCYL. a. Adds current DLCYL to memory defect list. b. Updates memory defect list as desired by user. c. Scans the media for bad headers and merges them into memory defect list if desired. d. Tests each cylinder by writing data patterns on media, reading, and verifying. e. Performs random positioning/data verification test

Table 2.2 Messages Accompanying Normal Program Execution

SCREEN DISPLAY	EXPLICATION
BASIC CONTROLLER CHECKS	
*** PERFORMING CONTROLLER ADDRESSING TEST, PUN % xxx	Message displayed when the controller addressing tests begin.
*** DATA TEST ON PHYSICAL UNIT %: xxx *** HEAD POSITIONING CHECK -- SEEK TO ALL CYLINDERS ***	Message displayed when the head positioning check begins.
CAN THE DATA BE OVERWRITTEN ON PHYSICAL UNIT %xxx (Y/N)?	Prompt requesting the user to indicate whether the current data on the disc can be written over (i.e., destroyed).
ABORTING THIS UNIT	Message displayed if the user indicates that the data must not be overwritten. The program proceeds to the next unit under test.
DISPLAY ALL HEADER DATA (Y/N) ?	Prompt requesting the user to indicate whether all header data is to be displayed. User response sets a program flag that governs the display of header data during the cylinder-by-cylinder write/read/verify test.
ADDRESS ROLLOVER TEST	
*** ADDRESS ROLLOVER TEST ***	Message displayed when the address rollover test commences.
MEDIA TESTS	
*** BEGIN MEDIA TESTING ***	Message displayed when the media tests begin.
MANIPULATION OF DLCYL	
<RETURN> TO ADD DLCYL TO DEFECT LIST, ANY OTHER CHAR - NO	Prompt allowing for the addition of the contents of the defect list cylinder (DLCYL) to the defect list in memory.
BUILDING DL IN MEMORY	Message displayed if user elects to add the contents of DLCYL to memory defect list.

T16/8L11E-02

Table 2.2 Messages Accompanying Normal Program Execution (Cont'd)

SCREEN DISPLAY	EXPLICATION
MANIPULATION OF DLCYL	
MODIFY/DISPLAY DEFECT LIST IN MEMORY (Y/N) ?	Prompt allowing the user the option of displaying or modifying the defect list. This prompt occurs after the contents of DLCYL have been added to the defect list in memory.
DISPLAY MEMORY DEFECT LIST (Y/N) ?	Prompt requesting that the user indicate whether he wishes to display the memory defect list. This prompt occurs only if the user has responded positively to the preceding prompt.
DEFECT CYL HEAD SECTOR 1 xxx xx xx 2 xxx xx xx . . . . 10 xxx xx xx <RETURN> TO CONTINUE, ANY CHAR TO STOP	Format of defect list display. If the user elects to display the memory defect list, the first ten defects are displayed, followed by a prompt for user decision to continue or to terminate. If the user elects to continue, the program displays the next ten defects in the defect list and again invites the user to continue or to stop. This procedure continues until the end of the list is reached or until the user elects to stop.
ADD A DEFECT (Y/N) ?	Prompt requesting that the user indicate whether he wishes to add a defect to the memory defect list. This prompt occurs after the memory defect list has been displayed (or immediately if the user elected not to display the list).
NOTE THAT ONLY THE MEMORY DEFECT LIST WILL BE UPDATED	Message displayed if the user elects to add a defect to the memory defect list.
CYLINDER:	Prompt for the cylinder address of the defect to be added to the memory defect list.
HEAD:	Prompt for the head address of the defect to be added to the memory defect list.
SECTOR:	Prompt for the sector address of the defect to be added to the memory defect list.

T16/8L11E-03

Table 2.2 Messages Accompanying Normal Program Execution (Cont'd)

SCREEN DISPLAY	EXPLICATION
MANIPULATION OF DLCYL	
<RETURN> TO ADD, ANY CHAR TO REPEAT	Prompt, when all three address inputs have been received, allowing the user a final chance to change the address he has specified. If the user elects to repeat (in order to change the address before adding it to the defect list), the program redisplays the three successive requests for address input. When a carriage return alone is received, the program adds the indicated address to the defect list and then prompts, as initially, for the next defect to be added. This process continues until the user has added all the defects he wishes or until the space allocated for the defect list in memory overflows.
QUIT (Y/N) ?	Prompt for a user decision to continue or to terminate the modification/display of the memory defect list. This prompt occurs after all desired defects have been added to the memory defect list (or immediately if the user elected not to add any defects to the list). If the user elects not to quit, the program repeats the entire display/modify procedure. If the user elects to quit, the program proceeds to the next stage of defect list manipulation, resetting cylinder 0, heads 0 and 1.
ADD ALL SECTORS WITH BAD HEADERS TO DEFECT LIST ?	Prompt allowing the user the option of adding all sectors with bad headers to the memory defect list. This prompt occurs when the reset of cylinder 0, heads 0 and 1, is complete. If the user elects not to add the sectors with bad headers to the memory defect list, the program advances immediately to the cylinder-by-cylinder write/read/verify test.
*** LISTING HEADERS & BUILDING DL ***	Message displayed if the user elects to add the sectors with bad headers to the memory defect list.

T16/8L11E-04

Table 2.2 Messages Accompanying Normal Program Execution (Cont'd)

SCREEN DISPLAY	EXPLICATION
MANIPULATION OF DLCYL	
*** COMPLETED CYL: xxx PUN % xxx ***	Message displayed after the headers for a given cylinder have been scanned and the defective sectors added to the defect list. The message is repeated as each cylinder is completed.
<RETURN> TO CONTINUE, ANY OTHER CHAR TO CREATE NEW DLCYL	Prompt, when all sectors with bad headers have been added to the memory defect list, allowing the user the option of updating the defect list cylinder (DLCYL) with the newly obtained information.
*** WRITING NEW DLCYL, PUN %: xxx ***	Message displayed if the user elects to update DLCYL. When the updated version of DLCYL is written, the program again offers the user the option of displaying or modifying the memory defect list. If the user elects not to update DLCYL, or when the updating procedure is complete the program advances to the cylinder-by-cylinder write/read/verify test.
CYLINDER-BY-CYLINDER WRITE/READ/VERIFY TEST	
*** CYL-BY-CYL WRITE/READ VERIFY TEST ***	Message displayed when the cylinder-by-cylinder write/read/verify test begins.
*** COMPLETED CYL: xxx PUN %: xxx ***	Message displayed when the write/read/verify test is completed on a given cylinder. The message occurs for each cylinder from 0 to DLCYL-1, signalling that the program is advancing to the next cylinder to be tested. This message is displayed even if an error condition has actually prevented the normal completion of all parts of the write/read/verify test. In such instances it merely indicates that the program is advancing to the next cylinder to be tested.

T16/8L11E-05

Table 2.2 Messages Accompanying Normal Program Execution (Cont'd)

SCREEN DISPLAY	EXPLICATION
RANDOM POSITIONING/DATA VERIFICATION TEST	
*** RANDOM POSITIONING/DATA VERIFICATION TEST ***	Message displayed when the random positioning/data verification test begins.

T16/8L11E-06

SECTION 3
COMMANDS

3.0 COMMANDS

The EDT diagnostics contain no program-defined or program-specific commands. They require the SHADOW RUN command for program execution. If the user wishes to implement the NOSTRIP option, the SHADOW OPTION command must also be invoked. (SHADOW defaults to option STRIP.)

SECTION 4
ERROR CONDITIONS AND DISPOSITIONS

4.0 ERROR CONDITIONS AND DISPOSITIONS

The EDT diagnostics utilize the SHADOW error message facility and return the typical SHADOW messages generated by compare errors, EIO status errors, interrupt status errors, and unexpected non-I/O interrupt errors. These messages include the program step number at which failure occurred, the logical unit number of the device under test, and the EIO and IIO status and cause words.

When a SHADOW error message is returned, the sequence of events producing the error can be determined by cross-referencing the error message with the program listing of the currently executing diagnostic. The formats for the return of EIO status and IIO status are given in Figures 4-1 and 4-2, respectively. The format of data on the disc is shown in Figure 4-3. The device characteristics of the T16/4103, 4104, 4105/4106, 4109, 4110/4111, and 4116 disc drives in sector-skipping format are listed in Table 4.1.

The EDT diagnostics append an additional error message to the standard SHADOW error message. This additional message, which correlates the error to a specific disc function, is determined by values encoded in certain fields of the IIO cause word. The possible messages, the IIO fields that govern them, and the error conditions they indicate are described in Table 4.2.

Other error messages are displayed at the the OSP terminal as certain portions of the diagnostic run or when certain conditions are encountered. When program execution completes, an error summary is generated. These error messages are described in Table 4.3.

O - OWNERSHIP ERROR
I - INTERRUPT PENDING
B - CONTROL UNIT BUSY
P - I/O BUS PARITY ERROR ON EIO

Figure 4-1 Format of EIO Status Word

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
O	I	A	P	(ZERO)				DEV					UNIT		

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PON	TERM							PR	UO	F	S	C	R	T0	T1

T16/8L11E-08

O - OWNERSHIP ERROR
I - INTERRUPT PENDING
A - CHANNEL TRANSFER ABORT
P - PARITY ERROR
DEV - CONTROLLER NUMBER
UNIT - UNIT NUMBER
PON - POWER ON INTERRUPT
PR - UNIT READ ONLY
UO - UNIT OWNERSHIP ERROR
F - UNIT WRITE FAULT
S - UNIT SEEK ERROR
C - UNIT NOT ON CYLINDER
R - UNIT NOT READY
T0 - UNIT TYPE, MSB
T1 - UNIT TYPE, LSB

TERM - ENCODED TERMINATION STATUS (TERMSTAT):

%00 NO ERROR
%01 UNIT ATTENTION
%02 DATA ERROR CORRECTED
%03 ATTEMPT TO WRITE ON PROTECTED UNIT
%04 ILLEGAL ADDRESS
%05 DIRECT ACCESS TO ALTERNATE TRACK
%06 ILLEGAL OPCODE
%07 UNIT STATUS ERROR
%10 BUFFER PARITY ERROR
%11 UNCORRECTABLE DATA ERROR
%12 NO SERVO CLOCKS DURING A WRITE
%13 VERIFY ERROR
%14 HEADER SEARCH FAILED
%15 HEADER ADDRESS MISCOMPARE
%16 ROM PARITY ERROR
%17 UNIT NOT PRESENT
%20 DUPLICATE UNIT NUMBER
%21 UNIT OWNERSHIP ERROR
%22 UNIT NOT READY
%23 READ RETRY SUCCESSFUL WITHOUT OFFSET
%24 READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS
%25 READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS
%26 READ RETRY SUCCESSFUL WITH DATA STROBE LATE
%27 READ RETRY SUCCESSFUL WITH DATA STROBE EARLY
%30 READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS AND DATA STROBE LATE
%31 READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS AND DATA STROBE EARLY
%32 READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS AND DATA STROBE LATE
%33 READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS AND DATA STROBE EARLY
%34 IDLE LOOP DISC CONTROLLER EXERCISER ERROR

Figure 4-2 Format of IIO Status and Cause Words

0	1	2 3	4	5	6 13	14 15	16 527	528 535
SYNC1 [1]	FLAG [1]	CYL [2]	HEAD [1]	SEC [1]	ECC1 [8]	SYNC2 [2]	DATA [512]	ECC2 [8]

T16/8L11E-09

SYNC1 = %360 (Good sector - marks the end of the preceding lockup field allowed for read synchronization and signals that address header is to follow)

%377 (Bad sector - all bytes of the entire sector are filled with ones)

FLAG = %350 (Normal sector - CYL/HEAD/SECT contains the current logical address)

%351 (Defective data area)

%352 (Jump-from-extension sector - CYL/HEAD/SECT contains the physical address of return from extension)

%353 (Spare sector)

%354 (Maximum sector on a track)

%355 (Only good sector on a track)

%356 (Jump-to-extension sector - CYL/HEAD/SECT contains the current physical address of extension)

%357 (End of cylinder)

%377 (Defective header)

ECC1 = [0:6] = Error correction code for address header
[7] = Pad byte of zeros

SYNC2 = [0] = %360
[1] = Pad byte of zeros

DATA = 512 bytes of written data

ECC2 = [0:6] = Error correction code for data portion
[7] = Pad byte of zeros

Figure 4-3 Sector-skipping Format for Data on Disc

Table 4.1 Device Characteristics in Sector-skipping Format

DEVICE CHARACTERISTIC	T16/ 4103	T16/ 4104	T16/ 4105/ 4106	T16/ 4109	T16/ 4110/ 4111	T16/ 4116
Device type	3	2	1	1	3	0
Maximum sector (MAXSECT)	19	29	29	29	29	29
Maximum head (MAXHEAD)	18	18	4	4	9	39
Maximum cylinder (MAXCYL)	814	814	822	822	822	842
Defect list cylinder (DLCYL)	813	813	821	821	821	841
First spare cylinder (FSPCYL)	805	803	811	811	811	831
Last spare cylinder (LSPCYL)	812	812	820	820	820	840
First fixed cylinder (FFXCYL)	-	-	-	896	-	-
Last fixed cylinder (LFXCYL)	-	-	-	915	-	-
Last fixed head (LFXHD)	-	-	-	0	-	-
Spare sectors per cylinder (SPSCYL)	2	2	2	2	4	8
Literal PROM ID (LPRID)	%102	%101	%101 %102	%101 %102	%101 -	%101 %102
Volume label sector (CYL/HEAD/SECT)	0/0/2	0/0/2	0/0/2	0/0/2	0/0/2	0/0/2
Spare track table sector (CYL/HEAD/SECT)	0/0/3	0/0/3	0/0/3	0/0/3	0/0/3	0/0/3

4.1 ERROR INFORMATION APPENDED TO SHADOW ERROR MESSAGES

In conjunction with the standard SHADOW error message, the EDT diagnostics typically display one of a number of error messages together with the contents of the controller registers. This error message is determined by IIO status. The form of the error message is as follows:

```
<error message>

CYL xxx HEAD xx SECT xxx FLAGS xxx COUNT xxx ADD xxx
```

If bit <2> of the Switch Register is in the ON position, the following message is then displayed, and the program suspends execution until bit <2> is placed in the OFF position:

```
PROCESSING STOPPED - SWITCH # 2 IS UP
```

The various messages that may appear in the <error message> field are listed in Table 4.2. CYL/HEAD/SECT reflects the disc address of the sector accessed by the command; FLAGS returns the value of the header flag in the accessed sector (refer to Figure 4-3); COUNT reflects the bytecount returned by the operation; and ADD reflects the current address of the controller buffer.

Table 4.2 Error Messages Accompanying Standard SHADOW Messages

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
TIMEOUT ERROR	IIO CAUSE = -1	A timeout occurred on the controller before the current operation could complete.
DEVICE TYPE ERROR	IIO CAUSE bits <14:15>	The accessed unit returned a different device type from that expected by the controller.
NOT READY ERROR	IIO CAUSE bit <13>	One of the following conditions obtains: a. No disc pack is installed. b. Disc spindle motor is not up to speed. c. Read/write heads are not loaded. d. DC voltages of drive are not within margin. e. Terminator is not present or does not have power.
NOT ON CYLINDER ERROR	IIO CAUSE bit <12>	A seek to an illegal address has been received from the channel, i.e., a cylinder, head, or sector address greater than the maximum legal value has been specified (refer to Table 4.1).
SEEK ERROR	IIO CAUSE bit <11>	Drive is unable to seek to specified address.
WRITE FAULT ERROR	IIO CAUSE bit <10>	One of the following conditions obtains: a. More than one write/read head selected b. Read gate and write gate both true c. Read gate and erase gate both true d. Write current but no erase current e. Erase current but no write current f. Write gate or erase gate but not on cylinder g. DC voltages below margin h. Emergency retract condition
OWNERSHIP ERROR	IIO CAUSE bit <9>	Controller is owned by the other port.
WRITE PROTECT ERROR	IIO CAUSE bit <8>	Write operation attempted to disc drive with WRITE PROTECT switch on.

T16/8L11E-10

Table 4.2 Error Messages Accompanying Standard SHADOW Messages (Cont'd)

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
NO TERMSTAT ERROR	TERM = %00	No error.
TERMSTAT ATTENTION ERROR	TERM = %01	One of the following unit attention conditions occurred: a. Selected drive ready (head load sequence) b. I.D. plug changed after drive ready c. Seek complete.
TERMSTAT CORRECTED DATA ERROR	TERM = %02	An error correctable by error correction code (ECC) occurred during a READ operation (≤ 11 bits).
TERMSTAT WRITE ATTEMPT TO PROTECTED UNIT ERROR	TERM = %03	WRITE-type command issued to disc drive with READ ONLY switch enabled.
TERMSTAT ILLEGAL ADDRESS ERROR	TERM = %04	A cylinder address was too large.
TERMSTAT DIRECT ACCESS TO ALT TRACK ERROR	TERM = %05	Not used in sector-skipping format. (In track-sparing, indicates that a READ or WRITE was issued to an alternate track before execution of the routine required to access that track.)
TERMSTAT ILLEGAL OPCODE ERROR	TERM = %06	The controller command in the EIO Address/Command Word is not valid.
TERMSTAT UNIT STATUS ERROR	TERM = %07	One of the following unit status conditions obtains: a. SEEK issued to disc drive with SEEK or NOT ON CYLINDER error b. FAULT or SEEK error occurred during a programmed seek, recalibrate, or head load sequence.
TERMSTAT BUFFER PARITY ERROR	TERM = %10	Incorrect parity in data word read from the controller 4K byte buffer (odd parity maintained).
TERMSTAT UNCORRECTABLE DATA ERROR	TERM = %11	A data record accessed with a READ error burst greater than 11 bits. ECC detected but uncorrectable. Data block could not be recovered with 27 retries using all offset combinations.
TERMSTAT NO SERVO CLOCKS DURING A WRITE	TERM = %12	Record CRC error.

T16/8L11E-11

Table 4.2 Error Messages Accompanying Standard SHADOW Messages (Cont'd)

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
TERMSTAT VERIFY ERROR	TERM = %13	Data read into the buffer does not compare with I/O channel data.
TERMSTAT HEADER SEARCH FAILURE	TERM = %14	One of the following header search conditions occurred: a. No headers on addressed track could be read. b. No sector match among headers on addressed track.
TERMSTAT HEADER ADDRESS MISCOMPARE	TERM = %15	Cylinder address or head address does not compare with the address loaded into the cylinder or head address registers.
TERMSTAT ROM PARITY ERROR	TERM = %16	Incorrect parity in microprogram instruction word read from ROM (odd parity maintained).
TERMSTAT UNIT NOT PRESENT ERROR	TERM = %17	Proper I.D. plug not installed.
TERMSTAT DUPLICATE UNIT NUMBER ERROR	TERM = %20	Plugs with the same I.D. installed in more than one disc drive.
TERMSTAT UNIT OWNERSHIP ERROR	TERM = %21	Disc drive owned by other controller.
TERMSTAT UNIT NOT READY ERROR	TERM = %22	Drive is not up to speed with the heads loaded.

T16/8L11E-12

4.2 OTHER ERROR MESSAGES RETURNED BY THE EDT DIAGNOSTICS

In addition to the error messages described in paragraph 4.1, special messages are displayed as certain portions of the diagnostic execute. For the purpose of description, execution of the extended data tests can be divided into the following sequence of operations:

a. Basic controller checks

b. Address rollover test

c. Media test

   1. Manipulation of DLCYL

   2. Cylinder-by-cylinder write/read/verify test

   3. Random positioning/data verification test.

The special error messages relative to each of these operations are described in Table 4.3.

Table 4.3 Other Error Messages Generated by the Extended Data Tests (EDT4103, EDT4104, EDT4105, EDT4109, EDT4110, EDT4116)

SCREEN DISPLAY	EXPLICATION
BASIC CONTROLLER CHECKS	
** ABORT: OWNERSHIP ERROR **	Message displayed if the take ownership operation attempted at the beginning of the basic controller checks fails. In this event the diagnostic aborts to program end.
** ERROR: BAD LITERAL PROM ID, EXP %: xxx OBS %: xxx CONTINUE?	Message displayed if program does not encounter the expected value when checking the literal PROM ID of the controller under test. If user elects to continue, the program proceeds with the next controller check. If user elects to stop, the program proceeds to the next unit to be tested.
** ABORT: CAN'T SET PROM PARITY **	Message displayed if program is unable to set a PROM parity error. In this event, the diagnostic terminates.
ABORT 12	Message displayed if program, having set a PROM parity error, is unable to clear it properly. In this event, the diagnostic terminates.
CYLINDER REGISTER ERROR, OBS: x xxx xxx xxx EXP: x xxx xxx xxx	Message displayed during controller addressing tests if a pattern read back from the cylinder register differs from the test pattern loaded into that register by the LOAD CYLINDER statement. (Register values are displayed in binary.)
HEAD REGISTER ERROR, OBS: x xxx xxx xxx EXP: x xxx xxx xxx	Message displayed during controller addressing tests if a pattern read back from the head register differs from the test pattern loaded into that register by the LOAD HEAD statement. (Register values are displayed in binary.)
SECTOR REGISTER ERROR, OBS: x xxx xxx xxx EXP: x xxx xxx xxx	Message displayed during controller addressing tests if a pattern read back from the sector register differs from the test pattern loaded into that register by the LOAD SECTOR statement. (Register values are displayed in binary.)

T16/8L11E-13

Table 4.3 Other Error Messages Generated by the Extended Data Tests (Cont'd)

SCREEN DISPLAY	EXPLICATION
ADDRESS ROLLOVER TEST	
ROLLOVER ERROR @ CYL/HEAD/SECT: xxx / xx / xx	Message displayed if an error occurs during the address rollover test.
** SW1 UP - RETURN TO CONTINUE, ANY OTHER CHAR TO STOP **	Message displayed in conjunction with the error message if bit 1 of the switch register is in the ON position when a rollover error occurs. The program halts and awaits user decision. If the user elects to continue, the program proceeds with the rollover test. If the user elects to stop, the program commences the media tests.
MEDIA TESTS	
** BAD DISC ADDR INPUT TO DLCYL-SOFTWARE ERROR ** CYL/HEAD/SECT: xxx / xx / xx	Message displayed if, at any time during the media tests, the program encounters an invalid disc address (one with a cylinder, head, or sector greater than the maximum or less than the minimum allowable for the device under test) when attempting to add a sector to the defect list. In this event, the program suspends execution.
NO ROOM LEFT IN DEFECT TABLE, RETURN TO CONTINUE	Message displayed if at any time during the media tests the space allocated for the defect list in memory overflows.
* EDT41xx ERROR SUMMARY * TIMEOUTS xxxxxxx NOT ON CYLINDERS xxxxxxx SEEK ERRORS xxxxxxx DATA ERRORS CORRECTED xxxxxxx ILLEGAL ADDRESSES xxxxxxx DATA UNCORRECTABLES xxxxxxx HEADER SEARCH FAILS xxxxxxx PASS COUNT xxxxxxx	Error summary displayed when the program completes execution.

T16/8L11E-14

Table 4.3 Other Error Messages Generated by the Extended Data Tests (Cont'd)

SCREEN DISPLAY	EXPLICATION
MANIPULATION OF DLCYL	
** ERROR READING DEFECT LIST-RETRYING **	Message displayed if an error occurs during an attempt to read a sector of the defect list. The program retries the read up to three times, displaying the message with each retry.
-RETRY RUNOUT, SKIP SECTOR	Message displayed if the read fails the last retry. In this event, the program skips the unreadable sector.
** BAD CYL IN DL, CYL/MAXCYL: xxx / xxx **	Message displayed if a cylinder address greater than the maximum allowable cylinder is encountered in reading the defect list. If bit <1> of the Switch Register is in the ON position, duplication of the defect list in memory terminates and program proceeds to the next stage of the media tests. Otherwise the duplication of the defect list continues.
** BAD HEAD IN DL, HEAD/MAXHEAD: xx / xx **	Message displayed if a head address greater than the maximum allowable head is encountered in reading the defect list. If bit <1> of the Switch Register is in the ON position, duplication of the defect list in memory terminates and program proceeds to the next stage of the media tests. Otherwise the duplication of the defect list continues.
** BAD SECT IN DL, SECT/MAXSECT: xx / xx **	Message displayed if a sector address greater than the maximum allowable sector is encountered in reading the defect list. If bit <1> of the Switch Register is in the ON position, duplication of the defect list in memory terminates and program proceeds to the next stage of the media tests. Otherwise the duplication of the defect list continues.

T16/8L11E-15

Table 4.3 Other Error Messages Generated by the Extended Data Tests (Cont'd)

SCREEN DISPLAY	EXPLICATION
MANIPULATION OF DLCYL	
ERROR: PACK BAD, CAN'T CORRECTLY WRITE ON CYL 0, HEADS 0&1 CYL/HEAD/SECT: xxx / xx / xx RETURN TO CONTINUE	Message displayed if an error occurs during the resetting of cylinder 0, heads 0 and 1. The program then suspends until the user responds with carriage return.
CYLINDER-BY-CYLINDER WRITE/READ VERIFY TEST	
*** HEADER HAS BEEN DECLARED BAD *** EXP CYL/HEAD/SECT: xxx / xx / xx OBS CYL/HEAD/SECT: xxx / xx / xx SYNC %: xxx FLAG %: xxx	Message displayed during the HEADER CHECK portion of the cylinder-by-cylinder test if an incorrect header is encountered during a header check.
*** BAD SYNC DATA *** EXP CYL/HEAD/SECT: xxx / xx / xx OBS CYL/HEAD/SECT: xxx / xx / xx SYNC %: xxx FLAG %: xxx	Message displayed during the HEADER CHECK portion of the cylinder-by-cylinder test if an incorrect sync byte is encountered during a header check.
*** BAD FLAG *** EXP CYL/HEAD/SECT: xxx / xx / xx OBS CYL/HEAD/SECT: xxx / xx / xx SYNC %: xxx FLAG %: xxx	Message displayed during the HEADER CHECK portion of the cylinder-by-cylinder test if the flag byte is incorrect.
*** SPARE OR SKIP SECTOR *** EXP CYL/HEAD/SECT: xxx / xx / xx OBS CYL/HEAD/SECT: xxx / xx / xx SYNC %: xxx FLAG %: xxx	Message displayed during the HEADER CHECK portion of the cylinder-by-cylinder test if the flag byte contains the value %351, %353, or %356.
*** END-OF-TRACK *** EXP CYL/HEAD/SECT: xxx / xx / xx OBS CYL/HEAD/SECT: xxx / xx / xx SYNC %: xxx FLAG %: xxx	Message displayed during the HEADER CHECK portion of the cylinder-by-cylinder test if the flag byte contains the value %354.
*** END-OF-CYLINDER *** EXP CYL/HEAD/SECT: xxx / xx / xx OBS CYL/HEAD/SECT: xxx / xx / xx SYNC %: xxx FLAG %: xxx	Message displayed during the HEADER CHECK portion of the cylinder-by-cylinder test if the flag byte contains the value %357.
*** HEADER DISC ADDRESS MISMATCH *** EXP CYL/HEAD/SECT: xxx / xx / xx OBS CYL/HEAD/SECT: xxx / xx / xx SYNC %: xxx FLAG %: xxx	Message displayed during the HEADER CHECK portion of the cylinder-by-cylinder test if a discrepancy is encountered between the header and disc address.

T16/8L11E-16

Table 4.3 Other Error Messages Generated by the Extended Data Tests (Cont'd)

SCREEN DISPLAY	EXPLICATION
CYLINDER-BY-CYLINDER WRITE/READ VERIFY TEST	
<RETURN> TO CONTINUE, ANY CHAR TO STOP	Prompt, in cases where bad sync data or a bad flag byte are detected, allowing the user the option of continuing or terminating the test. If the user elects to stop, the cylinder-by-cylinder test is discontinued, and the program advances directly to the random positioning/data verification test.
** SW1 UP - <RETURN> TO CONTINUE, ANY CHAR TO STOP	Prompt if bit <1> of the Switch Register is in the ON position and an error is detected during the HEADER CHECK portion of the cylinder-by-cylinder test. User has option to continue or terminate test. If user elects to stop, the cylinder-by-cylinder test is discontinued, and the program advances to the random positioning/data verification test.
*** MATCH - SECTOR IN DL (DTBL) ***	Prompt displayed in cases where all of the following are true: a. A bad header, a bad sync, or a bad flag has been detected b. The program has been instructed to continue c. The detected defect is already logged in the memory defect list.
SECTOR NOT IN DEFECT LIST, MAY CAUSE ERRORS UNLESS ENTERED <RETURN> TO CONTINUE, ANY CHAR TO ENTER	Prompt displayed in cases where all of the following are true: a. A bad header, a bad sync, or a bad flag has been detected b. The program has been instructed to continue c. The detected defect is not yet logged in the memory defect list d. Bit <6> of the Switch Register is in the OFF position. The user has the option of entering the defect or not. (If the defect is not yet logged and if bit <6> of the Switch Register is in the ON position, allowing automatic logging of newly detected defects, the program simply adds the defect to the list.)

T16/8L11E-17

Table 4.3 Other Error Messages Generated by the Extended Data Tests (Cont'd)

SCREEN DISPLAY	EXPLICATION
CYLINDER-BY-CYLINDER WRITE/READ VERIFY TEST	
*** COMPLETED CYL: xxx PUN: xxx ***	Message displayed if any error has occurred during the checking of headers for a given cylinder and bit <7> of the Switch Register is in the OFF position, disabling the automatic termination of the diagnostic after the testing of one cylinder. In this event, the program automatically advances to the next cylinder to be tested and begins the HEADER CHECK portion of the write/read/verify test for that cylinder.
*** COMPLETED CYL: xxx PUN: xxx *** <RETURN> TO CONTINUE, ANY CHAR TO STOP THIS TEST	Prompt displayed if any error has occurred during the checking of headers for a given cylinder and bit <7> of the Switch Register is in the ON position, enabling the automatic termination of the diagnostic after the testing of one cylinder. The user has the option of continuing or of terminating the diagnostic. If the user elects to continue, the program advances to the next cylinder to be tested and begins the HEADER CHECK portion of the write/read/verify test for that cylinder. If the user elects to stop, the diagnostic terminates, and SHADOW returns to conversational mode where it waits for user instruction.
-MISSING LOGICAL DISK ADDRESS ON CYL: xxx LOGICAL HEAD/SECT: xx/xx	Message displayed if a logical disc address is detected as missing during the check for all logical disc addresses on the cylinder under test. (The check for logical disc addresses on a given cylinder takes place only if the checking of headers has completed without error.)
-CYLINDER HAS BEEN EXTENDED	Message displayed when a logical disc address is detected as missing and the header of the immediately preceding address contains an extension flag (%356), indicating a jump-to-extension sector.

T16/8L11E-18

Table 4.3 Other Error Messages Generated by the Extended Data Tests (Cont'd)

SCREEN DISPLAY	EXPLICATION
CYLINDER-BY-CYLINDER WRITE/READ/VERIFY TEST	
** ERROR: CYL NOT EXTENDED ** -LAST HEADER: SYNC/FLAG/CYL/HEAD/SECT: %xxx,%xxx,xxx,xx,xx - CYL REQUIRES FORMATTING, NO TEST PERFORMED <RETURN> TO CONTINUE	Message displayed when a logical disc address is detected as missing and no jump-to-extension is detected at the immediately preceding address. In this event, the program suspends execution until the user enters carriage return.
*** UNRECOGNIZABLE PATTERN # ***	Message displayed during the WRITE portion of the cylinder-by-cylinder test if a data pattern is generated that differs from the three implemented by the program (%252, %307/%017, and %377/%177). (The WRITE portion of the cylinder-by-cylinder test takes place for a given cylinder only if the HEADER CHECK portion has completed without error.)
-WRITE ERROR AT CYL/HEAD/SECT: xxx/xx/xx RECALIBRATING	Message displayed during the WRITE portion of the cylinder-by-cylinder test if a WRITE error occurs.
*** TOO MANY BAD DISK ADDRESSES ON WRITE, TABLE FULL *** BAD DISK ADDRESSES HAVE BEEN SAVED IN DEFECT LIST CONTINUE AFTER CLEARING TABLE ?	Message displayed during the WRITE portion of the cylinder-by-cylinder test if the number of bad disc addresses detected exceeds the limit imposed by the program. The user has the option of continuing or terminating the diagnostic. If the user elects to continue, the program clears the memory defect list and proceeds as before.
-READ ERROR AT CYL/HEAD/SECT: xxx/xx/xx RECALIBRATING	Message displayed during the READ/VERIFY portion of the cylinder-by-cylinder test if a READ error occurs.

T16/8L11E-19

Table 4.3 Other Error Messages Generated by the Extended Data Tests (Cont'd)

SCREEN DISPLAY	EXPLICATION
CYLINDER-BY-CYLINDER WRITE/READ VERIFY TEST	
*** TOO MANY BAD DISK ADDRESSES ON READ *** BAD DISK ADDRESSES HAVE BEEN SAVED IN DEFECT LIST CONTINUE AFTER CLEARING TABLE ?	Message displayed during the READ/VERIFY portion of the cylinder-by-cylinder test if the number of bad disc addresses encountered during the READ operation exceeds the limit imposed by the program. The user has the option of continuing or terminating the diagnostic. If the user elects to continue, the program clears the memory defect list and proceeds as before.
*** TOO MANY DATA COMPARE ERRORS *** BAD DISK ADDRESSES HAVE BEEN SAVED IN DEFECT LIST CONTINUE AFTER CLEARING TABLE ?	Message displayed during the READ/VERIFY portion of the cylinder-by-cylinder test if the number of bad disc addresses encountered during the COMPARE operation exceeds the limit imposed by the program. The user has the option of continuing or terminating the diagnostic. If the user elects to continue, the program clears the memory defect list and proceeds as before.
PROCESSING STOPPED	Message displayed during either the WRITE or the READ/VERIFY portion of the cylinder-by-cylinder test if the user elects to stop when the number of bad disc addresses detected has exceeded the limit imposed by the program. The error summary is displayed, and diagnostic execution terminates.
CYL/HEAD/SECT: xxx / xx / xx	Message displayed during the READ/VERIFY portion of the cylinder-by-cylinder test if a data compare error occurs.

T16/8L11E-20

Table 4.3 Other Error Messages Generated by the Extended Data Tests (Cont'd)

SCREEN DISPLAY	EXPLICATION
RANDOM POSITIONING/DATA VERIFICATION TEST	
*** TOO MANY BAD DISK ADDRESSES ON RANDOM READS *** BAD DISK ADDRESSES HAVE BEEN SAVED IN DEFECT LIST CONTINUE AFTER CLEARING TABLE ?	Message displayed during the random positioning/data verification test if the number of bad disc addresses encountered during the SEEK/READ operation exceeds the limit imposed by the program. The user has the option of continuing or terminating the diagnostic. If the user elects to continue, the program clears the memory defect list and proceeds as before.
PROCESSING STOPPED	Message displayed during the random positioning/data verification test if the user elects to stop when the number of bad disc addresses detected has exceeded the limit imposed by the program. The error summary is displayed, and diagnostic execution terminates.
CYL/HEAD/SECT: xxx / xx / xx	Message displayed during the random positioning/data verification test if a data compare error occurs.

T16/8L11E-21

SECTION 5
RUN PROCEDURES

5.0 RUN PROCEDURES

> CAUTION
>
> Many of the procedures provided in the EDT diagnostics perform WRITE operations to the disc volumes under test. If these procedures are executed with the user volumes in place, user and system data are destroyed. Extreme care must therefore be taken. If the disc drive under test houses removable media, a scratch pack can be installed. In the case of nonremovable media, unless the disc volume is configured as part of a mirrored pair or a backup of the data exists on tape, the test may have to be restricted to the exercising of read-only functions.

A sample successful run of an EDT diagnostic is illustrated in Figure 5-1. The test case uses a 128-MB disc drive (T16/4110), configured as drive number %2 on controller number %1. The illustration assumes SHADOW loaded and bits <3>, <4>, and <5> of the Switch Register in the OFF position. (Refer to Table 5.2 for the definition of all applicable switch settings.)

For the user unfamiliar with SHADOW in general or with the EDT diagnostics in particular, the system preparations necessary for running diagnostics are described in paragraph 5.1; a step-by-step run procedure follows in paragraph 5.2.

```
T9404D00.SHADOW  01APR81  00:00
>RUN EDT4110 <cr>

EXTENDED DATA TEST WITH DEFECT LOGGING
T9472A02.DISC4110 (A02) 01APR82
ONE 3106 CONTROLLER AND UP TO EIGHT DRIVES

SWITCH OPTIONS:

1  SUBTEST STOP ON ERROR
2  STOP AFTER LOW-LEVEL ERROR REPORT
6  IF UP, PUT SECTORS WITH BAD HEADERS IN DEFECT LIST
7  STOP AFTER TESTING A CYLINDER

INPUT PRIMARY CONTROLLER NUMBER
? %1 <cr>
INPUT DRIVE NUMBER
? %2 <cr>
INPUT DRIVE NUMBER
? <cr>

*** PERFORMING CONTROLLER ADDRESSING TEST, PUN % 12

*** DATA TEST ON PHYSICAL UNIT %: 12

*** HEAD POSITIONING CHECK -- SEEK TO ALL CYLINDERS ***

CAN THE DATA BE OVERWRITTEN ON PHYSICAL UNIT %12  (Y/N)?
? y <cr>

DISPLAY ALL HEADER DATA (Y/N) ?
? n <cr>

*** ADDRESS ROLLOVER TEST ***

*** BEGIN MEDIA TESTING ***

<RETURN> TO ADD DLCYL TO DEFECT LIST, ANY OTHER CHAR - NO
? n <cr>

ADD ALL SECTORS WITH BAD HEADERS TO DEFECT LIST ?
? n <cr>

*** CYL-BY-CYL WRITE/READ/VERIFY TEST ***

*** COMPLETED CYL:   0   PUN %: 12   ***

<RETURN> TO CONTINUE, ANY CHAR TO STOP THIS TEST
? k <cr>

<RETURN> TO CONTINUE, ANY OTHER CHAR MAKES NEW DLCYL
? <cr>

MODIFY/DISPLAY DEFECT LIST IN MEMORY?
? n <cr>

<RETURN> TO CONTINUE, ANY CHAR CREATES NEW DLCYL
? k <cr>

***  WRITING NEW DLCYL, PUN %: 12   ***
```

T16/BL11E-22

Figure 5-1 Sample Successful Run of EDT4110

```
*  EDT4110 ERROR SUMMARY          *
   TIMEOUTS                     0
   NOT ON CYLINDERS             0
   SEEK ERRORS                  0
   DATA ERRORS CORRECTED        0
   ILLEGAL ADDRESSES            0
   DATA UNCORRECTABLES          0
   HEADER SEARCH FAILS          0
   PASS COUNT                   1

!!!!!!!!!!!   E N D   OF   E D T 4 1 1 0   !!!!!!!!!!
```

Note: 128-Mb disc drive (T16/4110), drive number %2, controller number %1. SHADOW loaded and panel switches <3>, <4>, and <5> switched off; panel switch <7> switched on.

T16/8L11E-23

Figure 5-1 Sample Successful Run of EDT4110 (Cont'd)

5.1 PREPARATIONS FOR RUNNING THE EDT DIAGNOSTICS

Before any diagnostic is run, certain steps must be taken to allocate the system resources necessary for SHADOW and to ensure that the diagnostic run has minimum impact on system performance. The necessary procedures are ordinarily performed by the local system manager, or at least with the concurrence of the system manager. They include:

a. Obtaining access to the OSP subsystem

b. Transferring to another processor all user processes currently running in the processor to be taken off line

c. Transferring to another processor the path preference of all controllers with preferred paths currently assigned to the processor to be taken off line

d. Taking whatever precautions are indicated to protect the data stored on the disc volume to be tested

e. Taking off line the processor to be loaded with SHADOW

f. Taking off line the disc subsystem (controller and drive) to be tested.

> CAUTION
>
> If a T16/4109 disc drive is to be tested, both the moving and fixed-head portions of the disc (each assigned a different physical unit number) must be taken off line. Since the drives are dual ported, both paths to both portions of the disc must be off line.

These steps are described in detail elsewhere in the NonStop Diagnostic Operating Procedures, Part Number 82802; those that deal with preparing the system in general for SHADOW, in Volume 1, Chapter 2, Parts 1 and 2; and those that deal with preparing the disc subystem in particular, in Volume 3B, Chapter 1, Part 1.

A checklist of the requirements for the EDT diagnostics, both those that must be available on the system and those that must be supplied by the customer engineer, is given in Table 5.1.

Table 5.1 Checklist for the EDT Diagnostics

REQUIREMENTS	SOURCE
A functioning OSP subsystem and terminal.	On site.
A processor that can be taken off line and dedicated to SHADOW.	On site.
A tape drive unit (if SHADOW is to be loaded from tape). a. The tape drive must be physically connected to the test processor if SHADOW is I/O loaded from tape. b. The tape drive must be physically connected to the processor that is to read the tape if SHADOW is bus loaded through an offline processor. c. The tape drive must be physically connected to a processor running GUARDIAN (TM) if SHADOW is bus loaded through an online processor.	On site.
Scratch pack or packs to substitute for the user packs during diagnostic execution (if removable media are to be tested).	On site.
SHADOW operating system. *	Either on site, in disc storage, or supplied by C.E. on cold load tape.
The appropriate EDT diagnostic program for the disc drive type under test (refer to Table 1.1).	Either on site, in disc storage, or supplied by C.E. on cold load tape.

* There are two distinct versions of the SHADOW operating system, one for the NonStop system (usually denoted as ZZDIAG1.SHADOW) and the other for the NonStop II system (usually denoted as ZZDIAG2.SHADOW). If loading from tape, ensure that the correct version is present on the tape and specify it during the load procedure.

5.2 RUN PROCEDURE FOR THE EDT DIAGNOSTICS

> CAUTION
>
> It is possible to run SHADOW diagnostics from the OSP in two or more processors concurrently. However, only one test process can communicate with the OSP at a time. For this reason, no more than one diagnostic process is ordinarily run on a system at any given time.

To run one of the EDT diagnostics, first ensure that the preparations listed in paragraph 5.1 are taken and then proceed as follows:

a. Load SHADOW into the test processor.

> CAUTION
>
> There are two distinct versions of the SHADOW operating system, one for the NonStop system (usually denoted as ZZDIAG1.SHADOW) and the other for the NonStop II system (usually denoted as ZZDIAG2.SHADOW). If loading from tape, ensure that the correct version is present on the tape and specify it during the load procedure. There are three methods for loading SHADOW: I/O cold load from tape, bus cold load from tape, and online load from tape or disc. They are described in detail in the NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 1.

b. Set desired Switch Register options in the operator control panel of the test processor. (Refer to Table 5.2 for a list of panel switches defined for the EDT diagnostics.)

c. At the SHADOW prompt (>) on the OSP screen, enter the command:

```
RUN <filename>
```

where <filename> is EDT4103, EDT4104, EDT4105, EDT4109, EDT4110, or EDT4116. (Refer to Figure 5-1 for further illustration.)

Table 5.2 Switch Register Options Available for the EDT Diagnostics *

SWITCH	FUNCTION
<0>	(Standard SHADOW function) If toggled on and off, generates a user break request and returns the SHADOW interpreter to conversational mode, where it waits for further instruction.
<1>	(EDT-specific function) If placed in the ON position, causes the program to stop when an error is encountered, either in reading data from the defect list cylinder (DLCYL) or in media testing.
<2>	(EDT-specific function) If placed in the ON position, causes the program to stop further processing when issuance of an EIO results in errors.
<3>	(Standard SHADOW function) If placed in the ON position, suppresses error printout and enables setting of the special numerics ERROR# and COMPERR#. Refer to the SHADOW Diagnostic Language Manual, Part Number 82848, for a description of the special numerics ERROR# and COMPERR#.
<4>	(Standard SHADOW function) If placed in the ON position, suppresses error printout, disables setting of the special numerics ERROR# and CGMPERR#, and dasables ERROR limit decrement.
<5>	(Standard SHADOW function) If placed in the ON position, causes a program halt on I/O error.
<6>	(EDT-specific function) If placed in the ON position, causes any bad sectors located by the program to be added automatically to the defect list.
<7>	(EDT-specific function) If placed in the ON position, causes the diagnostic to stop at the end of the current cylinder.

* Switches <8> through <15> reflect the I/O address.

T16/8L11E-24

NOTE

The program is now initializing. The program name is displayed at the OSP terminal, together with the following list of special Switch Register options:

```
SWITCH OPTIONS:

1  SUBTEST STOP ON ERROR
2  STOP AFTER LOW-LEVEL ERROR REPORT
6  IF UP, PUT SECTORS WITH BAD HEADERS
     IN DEFECT LIST
7  STOP AFTER TESTING A CYLINDER
```

This display is then followed by several requests for input. Actual program execution commences only when the last request is honored.

d. When the following request is displayed at the OSP terminal, respond as indicated:

```
INPUT PRIMARY CONTROLLER NUMBER
?
```

1. Enter the physical unit number (in octal) of the disc controller to be tested.

2. Depress carriage return.

e. When the following request is displayed at the OSP terminal, respond as indicated:

```
INPUT DRIVE NUMBER
?
```

1. Enter the physical unit number (in octal) of the first disc drive to be tested.

2. Depress carriage return.

NOTE

This request for input is repeated up to eight times, as long as an acceptable drive number is received after each display of the request. Receipt of carriage return alone terminates the input and causes the program to begin execution of the basic controller checks. The T16/4109 drive requires two I/O addresses for complete identification (one for the moving heads and one for the fixed heads). So that EDT4109 can test both parts of the disc, the valid range of drive numbers for EDT4109 is limited to [0,3] instead of the customary range [0,7]. The upper half of the range [4,7] is reserved for identifying internally the fixed-head portions of the disc drives specified by the lower half (i.e., drive number 4 is the fixed-head portion of drive number 0, and so on).

f. When the following request is displayed at the end of basic controller checks, make one of two responses, as appropriate:

```
*** DATA TEST ON PHYSICAL UNIT %: xxx

*** HEAD POSITIONING CHECK - SEEK TO ALL CYLINDERS ***

CAN THE DATA BE OVERWRITTEN ON PHYSICAL UNIT #: %xxx  (Y/N) ?
?
```

1. Enter Y at the prompt and depress carriage return if a scratch pack is in place or if the data subject to destruction is not vital.

2. Enter N at the prompt and depress carriage return if the data on the disc pack should not be destroyed.

NOTE

If the user response is N, the program displays the following message:

```
** ABORTING THIS UNIT **
```

and proceeds to the next unit under test.

g. When the following request is displayed at the OSP terminal, make one of two responses, as appropriate:

```
DISPLAY ALL HEADER DATA (Y/N) ?
?
```

1. Enter **Y** at the prompt and depress carriage return if the display of header data is required.

2. Enter **N** at the prompt and depress carriage return if the display of header data is not required.

NOTE

When this input is received, initialization is complete. The program begins execution of the address rollover test and then proceeds to the media tests. Further requests for operator input occur at various points throughout the program execution. (Refer to Table 2.2.)

h. Analyze any errors generated. (Refer to Section 4 for a description of possible error conditions.)

i. If the problem can be isolated to a faulty cable or to the drive as a unit, replace the faulty part. (Refer to the appropriate maintenance manual for a description of replacement procedures.)

j. If the results of the EDT diagnostic are inconclusive, try to isolate the problem further by running another of the diagnostics for sector-skipping format. (Refer to Table 1.1.)

CAUTION

The EDT diagnostics can invalidate the format of a disc pack. When testing with a EDT diagnostic is complete, it is necessary to run the appropriate disc pack formatter to restore valid sector-skipping format to the disc pack. Either the PUP FORMAT facility or the appropriate SHADOW formatter (FMT) may be used for this purpose. In cases where the contents of DLCYL have been lost, the PUP FORMAT facility must be used. To provide for adequate restoration of DLCYL in such cases, it is essential that a tape or hard copy of the vendor defect list information stored on DLCYL when first formatted by Tandem manufacturing be available. If a tape copy exists, it can be loaded directly onto the reformatted disc. If only a hard copy exists, the defects must be entered one by one, using the appropriate SHADOW defect-logging utility program (DUT). The PUP FORMAT procedure is described in the NonStop II System Operations Manual, Part Number 82075. The FMT programs are described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 3B, Chapter 1, Part 1F; the DUT programs, in Part 1D.

k. When diagnostic testing is complete, perform the following:

1. Notify the system manager that the serviced disc volume is now ready to be returned to system use.

NOTE

The facility for bringing disc volumes on line is provided by the PUP commands UP and REVIVE. The UP command is used to bring on line a volume that is not part of a mirrored pair. Any volumes configured to operate as part of a mirrored pair must be brought on line with the REVIVE command. The PUP commands UP and REVIVE are described in the NonStop II System Operations Manual, Part Number 82075.

2. Assist the customer in verifying the integrity of any disc volumes that have been serviced and in restoring the system to normal performance.

NOTE

The procedure for reloading a processor that is off line is described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 3.

PART 1F

FMT 4103, FMT 4104, FMT 4105
FMT 4109, FMT 4110, FMT 4116

SECOND LEVEL MANUAL

DIAGNOSTIC OPERATING PROCEDURES

NonStop II (TM) Systems

VOLUME 3B, CHAPTER 1, PART 1F

FMT4103, FMT4104, FMT4105, FMT4109, FMT4110,
AND FMT4116 DISC DIAGNOSTICS

Copyright © 1982

TANDEM COMPUTERS INCORPORATED
2450 Walsh Avenue
Santa Clara, California 95050

Tandem Part Number 82803

October 1982
Printed in U.S.A.

This document contains information that is protected by copyright. No part of this document may be photocopied, reproduced or translated to another program or system without the prior written consent of Tandem Computers Incorporated.

The following are trademarks of Tandem Computers Incorporated:
Tandem, NonStop, NonStop II, AXCESS, DYNABUS, ENCOMPASS, ENFORM, ENSCRIBE, ENVOY, EXCHANGE, EXPAND, GUARDIAN, TGAL, PATHWAY, XRAY.

VOLUME 3B, CHAPTER 1, PART 1F

TABLE OF CONTENTS

Par.No.	Title	Page No.
	SECTION 1 INTRODUCTION	
1.0	INTRODUCTION	1-1
	SECTION 2 OVERVIEW	
2.0	OVERVIEW	2-1
2.1	PROGRAM SELECTION AND EXECUTION	2-1
	SECTION 3 COMMANDS	
3.0	COMMANDS	3-1
	SECTION 4 ERROR CONDITIONS AND DISPOSITIONS	
4.0	ERROR CONDITIONS AND DISPOSITIONS	4-1
4.1	ERROR INFORMATION APPENDED TO SHADOW ERROR MESSAGES	4-6
4.2	OTHER ERROR MESSAGES RETURNED BY THE FMT DIAGNOSTICS	4-10
	SECTION 5 RUN PROCEDURES	
5.0	RUN PROCEDURES	5-1
5.1	PREPARATIONS FOR RUNNING THE FMT DIAGNOSTICS	5-4
5.2	RUN PROCEDURE FOR the FMT DIAGNOSTICS	5-6

TABLE OF CONTENTS (Cont'd)

LIST OF ILLUSTRATIONS

Fig.No.	Title	Page No.
4-1	Format of EIO Status Word	4-2
4-2	Format of IIO Status and Cause Words	4-3
4-3	Sector-skipping Format for Data on Disc	4-4
5-1	Sample Successful Run of FMT4110	5-2

LIST OF TABLES

Table No.	Title	Page No.
1.1	Disc Subsystem Diagnostics for the NonStop II System	1-2
2.1	Messages Accompanying Normal Program Execution	2-3
4.1	Device Characteristics in Sector-skipping Format	4-5
4.2	Error Messages Accompanying Standard SHADOW Messages	4-7
4.3	Other Error Messages Generated by the FMT Diagnostics	4-11
5.1	Checklist for the Disc Subsystem Diagnostics	5-5
5.2	Switch Register Options Available in the FMT Diagnostics	5-7

PART 1F - FMT4103/FMT4104/FMT4105/FMT4109/FMT4110/FMT4116
TABLE OF CONTENTS

SECTION 1
INTRODUCTION

1.0 INTRODUCTION

This chapter describes six SHADOW diagnostics, FMT4103, FMT4104, FMT4105, FMT4109, FMT4110, and FMT4116. These diagnostics are designed as disc pack formatters for sector-skipping and can be used, respectively, to format a T16/4103, 4104, 4105/4106, 4109, 4110/4111, or 4116 disc drive configured with a T16/3106 disc controller on a Tandem NonStop (TM) system.

Used primarily in the corrective maintenance process, the FMT diagnostics can be run to determine the types of errors being produced and to help isolate the probable area of failure. After the suspected area of failure is corrected, these programs can be run again as end tests to ensure that the errors are eliminated.

The FMT diagnostics are one of seven sets of SHADOW diagnostic programs provided for the NonStop II disc subsystems. Refer to Table 1.1 for a list of the other available diagnostics.

The FMT diagnostics are written for SHADOW Rev level D00 and are compatible with all Rev levels of the disc controller and disc drives.

Table 1.1 Disc Subsystem Diagnostics for the NonStop II System *

SUBSYSTEM	DIAGNOSTIC	MANUAL REF. **
T16/4103 drive - T16/3106 ctrl	FAST4103	Part 1A
	DISC4103	Part 1B
	DEX4103	Part 1C
	DUT4103	Part 1D
	EDT4103	Part 1E
	FMT4103	Part 1F
	REX4103	Part 1G
T16/4104 drive - T16/3106 ctrl	FAST4104	Part 1A
	DISC4104	Part 1B
	DEX4104	Part 1C
	DUT4104	Part 1D
	EDT4104	Part 1E
	FMT4104	Part 1F
	REX4104	Part 1G
T16/4105 drive - T16/3106 ctrl ***	FAST4105	Part 1A
T16/4106 drive - T16/3106 ctrl	DISC4105	Part 1B
	DEX4105	Part 1C
	DUT4105	Part 1D
	EDT4105	Part 1E
	FMT4105	Part 1F
	REX4105	Part 1G
T16/4109 drive - T16/3106 ctrl	FAST4109	Part 1A
	DISC4109	Part 1B
	DEX4109	Part 1C
	DUT4109	Part 1D
	EDT4109	Part 1E
	FMT4109	Part 1F
	REX4109	Part 1G
	FHD4109	Part 1H
T16/4110 drive - T16/3106 ctrl ***	FAST4110	Part 1A
T16/4111 drive - T16/3106 ctrl	DISC4110	Part 1B
	DEX4110	Part 1C
	DUT4110	Part 1D
	EDT4110	Part 1E
	FMT4110	Part 1F
	REX4110	Part 1G
T16/4116 drive - T16/3106 ctrl ***	FAST4116	Part 1A
	DISC4116	Part 1B
	DEX4116	Part 1C
	DUT4116	Part 1D
	EDT4116	Part 1E
	FMT4116	Part 1F
	REX4116	Part 1G

* A somewhat different subset of disc subsystems is supported on the NonStop (TM) system, some in sector-skipping format and some in track-sparing format. For a complete list of the disc subsystems supported on the NonStop system and of the applicable diagnostics, refer to NonStop Diagnostic Operating Procedures, Part Number 82802, Volume 3B, Chapter 1, Part 1.

** In all cases, the general manual reference is to Volume 3B, Chapter 1, of NonStop II Diagnostic Operating Procedures, Part Number 82803.

*** The T16/4105 and 4106 disc drives are identical devices, as are the T16/4110 and 4111, except that in each case the first is free standing in the cabinet and the second is drawer mounted.

T16/8L11F-01

SECTION 2
OVERVIEW

2.0 OVERVIEW

The FMT diagnostics support defect logging and permit the formatting of one controller and up to eight drives. Tandem- and vendor-identified defects are stored in duplicate on the second-to-last cylinder (defect list cylinder or DLCYL).

The FMT diagnostics are run from the OSP terminal. Before any of them can be run, the following system resources must be taken off line and dedicated to the SHADOW program:

a. The disc drive to be tested and the associated controller

b. The processor into which SHADOW is to be loaded (the procedure for taking processor modules off line is described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 2).

SHADOW is then loaded into the test processor by one of the three customary methods, and the desired Switch Register options may be set in the operator control panel of the test processor. Refer to Table 5.2 for a description of the Switch Register options. The SHADOW load procedure is described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 1.

2.1 PROGRAM SELECTION AND EXECUTION

After SHADOW is loaded, the appropriate FMT diagnostic for the particular subsystem under test can be loaded and run. The typical SHADOW requests for input are displayed at the OSP terminal as the program initializes. Initialization cannot complete without appropriate responses from the operator. At certain points throughout program execution, further interaction with the operator is required.

All of the programs report the SHADOW error messages appropriate to the conditions detected (unless error printout is suppressed in the panel switches). Additional information relating the error to a specific disc function typically accompanies the standard SHADOW message. Refer to Section 4 for a description of all error messages displayed at the OSP terminal.

PART 1F - FMT4103/FMT4104/FMT4105/FMT4109/FMT4110/FMT4116
OVERVIEW

For the purpose of description, execution of the FMT diagnostics can be divided into the following sequence of operations:

a. Take ownership

b. Check for correct PROM ID

c. Check for valid volume ID

d. Formatting of DLCYL and MAXCYL

e. Manipulation of the defect list in memory

f. Formatting of spare cylinders

g. Formatting and sparing of all primary cylinders

h. Display of error summary.

NOTE

> This breakdown of operations is for the purpose of description only. These operations are not all identified as independent entities during program execution. They simply occur sequentially.

The screen displays that each of these operations generates during a normal, error-free run of the diagnostic are described in Table 2.1.

Run times for the FMT diagnostics vary, depending on such factors as the storage capacity of the disc pack being formatted, and so on. The settings of the panel switches can also affect the course of any given run of the diagnostic. FMT4110, for example, typically runs in 35 to 40 minutes. Factors to be considered when estimating down time include not only the run times for the diagnostics to be used, but also the time which may be required for reviving the discs after the diagnostics are completed. The time required for this procedure also varies, depending on such factors as system load and disc pack size.

Table 2.1 Messages Accompanying Normal Program Execution

SCREEN DISPLAY	EXPLICATION
*** CHECKING FOR VALID VOLUME ID, PUN %: xxx ***	Message displayed when the program begins the check for valid volume ID.
VOLUME MOUNTED ON DRIVE % xxx IS VALID VOLUME NAME IS xxxxxxxx <RETURN> TO CONTINUE, ANY CHAR TO STOP	Message displayed if the check for valid volume ID is successful. User has the option to continue or terminate the test. If the user elects to stop, the program proceeds to the next unit under test.
INPUT PATTERN #((DEFAULT IS ALL) 0 -> ALL 1 -> ONLY %353 %155 %266 %333 2 -> ONLY %333 %156	Prompt, if the user elects to continue, requesting that the combination of patterns to be used during the format passes be indicated.
THIS PROGRAM WILL ACCEPT A DEFECT LIST FROM CYL: xxx IF INVALID, IT MUST BE CLEARED BEFORE PROCEEDING IS THIS DEFECT LIST VALID (Y/N) ?	Prompt, when the formatting of the defect list cylinder (DLCYL) and MAXCYL begins, requesting that the user indicate whether DLCYL is currently valid. If the user indicates that the defect list on DLCYL is valid, the program proceeds directly to the formatting of MAXCYL. DLCYL should be declared invalid when the user knows it to have been previously written incorrectly. This is more likely to happen with removable media (T16/4105/4106), which may previously have been formatted for track sparing. (Refer to Chapter 4.8 of this manual for a description of the track-sparing pack formatters.) In the case of nonremovable media (T16/4109, 4110/4111, 4116) DLCYL is ordinarily formatted correctly when the vendor defect list is retrieved during manufacturing test. (The cylinder number specified in this message is the number for DLCYL. To verify the appropriate DLCYL number for the device type under test, refer to Table 4.1.)

T16/8L11F-02

Table 2.1 Messages Accompanying Normal Program Execution (Cont'd)

SCREEN DISPLAY	EXPLICATION
DEFECT LIST WILL BE RESET - PROCEED (Y/N) ?	Prompt, if the user indicates that the defect list on DLCYL is invalid, requesting instruction whether to proceed with the reformatting of DLCYL. If the user elects to proceed, DLCYL is reset (i.e., the current contents of DLCYL are destroyed) and the program attempts to format first DLCYL and then MAXCYL. If the user elects not to proceed, the program redisplays the preceding prompt (effectively suspending on that user indication).
*** COMPLETED CYL: xxx PUN %: xxx ***	Message displayed when DLCYL is successfully formatted, when MAXCYL is formatted, and again for each of the spare cylinders as they are formatted.
*** WRITING DLCYL: xxx PUN %: xxx ***	Message displayed when the current contents of DLCYL are cleared so that it can be rewritten with the contents of the memory defect list. This message occurs when the format of DLCYL and MAXCYL is complete, if DLCYL was indicated as invalid, and again when all primary cylinders have been formatted.
** BAD AREAS ON DLCYL: xxx ** HEAD/SECT: xx / xx HEAD/SECT: xx / xx . . . . HEAD/SECT: xx / xx	Format for display of defects detected on DLCYL when it is being rewritten.
DISPLAY DEFECTS FOUND (Y/N) ?	Prompt, after DLCYL and MAXCYL are formatted, requesting user to indicate whether new defects detected during the formatting of the spare and primary cylinders are to be displayed. User response here sets a flag that governs subsequent defect information display.
*** BUILDING DL IN MEMORY ***	Message displayed when the procedure for building the memory defect list begins.

T16/8L11F-03

Table 2.1 Messages Accompanying Normal Program Execution (Cont'd)

SCREEN DISPLAY	EXPLICATION
ADD SECTORS W/BAD HEADERS TO DEFECT LIST (Y/N) ?	Prompt, requesting the user to indicate whether the disc should be scanned for bad headers and these added to the defect list. This message is displayed when the subroutine for building the memory defect list is entered. (At this point, if DLCYL was declared invalid and then reformatted, the memory defect list already contains the defects detected during the initialization of DLCYL. If DLCYL was declared valid and not reformatted, the memory defect list is empty.) If the user elects not to add the sectors with bad headers, the program proceeds directly to the reading and transfer of data from DLCYL to the memory defect list. If the user elects to add the sectors with bad headers, the program first performs this procedure.
*** SCANNING FOR BAD HEADERS ***	Message displayed when the program enters the subroutine for adding bad headers to the memory defect list.
-READING DEFECT LIST ON CYL: xxx	Message displayed when the program reads and transfers the contents of DLCYL to the memory defect list. The cylinder number returned in this message is the number of DLCYL, which varies with the device under test. For the possible values of DLCYL refer to Table 4.1.
MODIFY/DISPLAY CURRENT DEFECT LIST (Y/N) ?	Prompt allowing the user the option of displaying or modifying the defect list. This prompt occurs after the contents of DLCYL have been added to the defect list in memory.
DISPLAY MEMORY DEFECT LIST (Y/N) ?	Prompt requesting that the user indicate whether he wishes to display the memory defect list. This prompt occurs only if the user has responded positively to the preceding prompt.

T16/8L11F-04

Table 2.1 Messages Accompanying Normal Program Execution (Cont'd)

SCREEN DISPLAY	EXPLICATION
DEFECT CYL HEAD SECTOR 1 xxx xx xx 2 xxx xx xx . 10 xxx xx xx <RETURN> TO CONTINUE, ANY CHAR TO STOP	Format in which first ten defects are displayed if the user elects to display the memory defect list. The last line of the display prompts for user decision to continue or to terminate. If the user elects to continue, the program displays the next ten defects and again invites the user to continue or to stop. This procedure continues until the end of the list is reached or until the user elects to stop.
ADD A DEFECT (Y/N) ?	Prompt, if the user elects not to display the memory defect list (or after it is displayed), requesting that the user indicate whether he wishes to add a defect to the memory defect list.
NOTE: ONLY THE MEMORY DEFECT LIST WILL BE UPDATED	Message displayed if the user elects to add a defect to the memory defect list.
CYLINDER:	Prompt for the cylinder address of the defect to be added to the memory defect list.
HEAD:	Prompt for the head address of the defect to be added to the memory defect list.
SECTOR:	Prompt for the sector address of the defect to be added to the memory defect list.
<RETURN> TO ADD, ANY CHAR TO REPEAT	Prompt, when all three address inputs are received, allowing the user a final chance to change the address he has specified. If the user elects to repeat (in order to change the address to be added), the program redisplays the three successive requests for address input. When a carriage return alone is received, the program adds the indicated address to the defect list and then prompts, as initially, for the next defect to be added. This process continues until the user has added all the defects he wishes or until the space allocated for the defect list in memory overflows.

T16/8L11F-05

Table 2.1 Messages Accompanying Normal Program Execution (Cont'd)

SCREEN DISPLAY	EXPLICATION
QUIT (Y/N) ?	Prompt for a user decision to continue or to terminate the modification/display of the memory defect list. This prompt occurs after all desired defects have been added to the meory defect list (or immediately if the user elected not to add any defects to the list). If the user elects not to quit, the program repeats the entire display/modify procedure. If the user elects to quit, the program proceeds to the formatting of the spare cylinders.
*** FORMATTING SPARE CYLS, PUN %: xxx ***	Message displayed when the formatting of the spare cylinders begins.
*** FORMATTING PRIMARY CYLS, PUN %: xxx ***	Message displayed when the formatting of the primary cylinders begins.
PASS NUMBER x FOR UNIT NUMBER % xxx	Message displayed as each format pass with a different pattern begins. (The number of patterns to be used is an option selected at initialization. If bit <1> of the Switch Register is in the ON position, the program breaks out after the completion of one pattern pass and proceeds directly to the writing of the Spare Tracks Table. Refer to Table 2.1 for a description of the format process.)
*** COMPLETED CYL: xxx PUN %: xxx PASS #: xx ***	Message displayed during the primary format passes as each tenth cylinder is successfully formatted.
-NO CYLINDERS HAVE BEEN EXTENDED	Message displayed when all primary cylinders are formatted if no cylinders have required extension and the Spare Tracks Table (STT) is consequently empty.

T16/8L11F-06

Table 2.1 Messages Accompanying Normal Program Execution (Cont'd)

SCREEN DISPLAY	EXPLICATION
* FMT41xx ERROR SUMMARY * * PUN %: xxx * TIMEOUTS xxxxxxx NOT ON CYLINDERS xxxxxxx SEEK ERRORS xxxxxxx DATA ERRORS CORRECTED xxxxxxx ILLEGAL ADDRESSES xxxxxxx DATA UNCORRECTABLES xxxxxxx HEADER SEARCH FAILS xxxxxxx HEADER CHECKSUM ERRORS xxxxxxx PATTERNS SELECTED %xxx PASS # xxxxxxx # DEFECTS xxxxxxx	Error summary displayed when the program completes execution for each unit under test.
!!!!!!!!!! E N D O F F M T 4 1 x x !!!!!!!!!!	Message displayed when the formatting of all units under test is complete.

T16/8L11F-07

SECTION 3
COMMANDS

3.0 COMMANDS

The FMT diagnostics contain no program-defined or program-specific commands. They require the SHADOW RUN command for program execution. If the user wishes to implement the NOSTRIP option, the SHADOW OPTION command must also be invoked. (SHADOW defaults to option STRIP.)

SECTION 4
ERROR CONDITIONS AND DISPOSITIONS

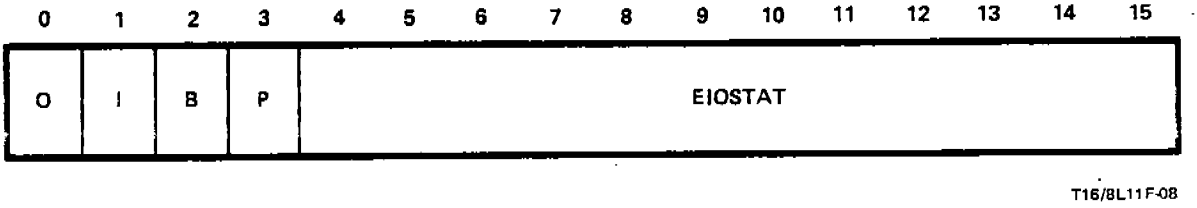
4.0 ERROR CONDITIONS AND DISPOSITIONS

The FMT diagnostics utilize the SHADOW error message facility and return the typical SHADOW messages generated by compare errors, EIO status errors, interrupt status errors, and unexpected non-I/O interrupt errors. These messages include the program step number at which failure occurred, the logical unit number of the device under test, and the EIO and IIO status and cause words.

When a SHADOW error message is returned, the sequence of events producing the error can be determined by cross-referencing the error message with the program listing of the currently executing diagnostic. The formats for the return of EIO status and IIO status are given in Figures 4-1 and 4-2, respectively. The format of data on the disc is shown in Figure 4-3. The device characteristics of the T16/4103, 4104, 4105/4106, 4109, 4110/4111, and 4116 disc drives in sector-skipping format are listed in Table 4.1.

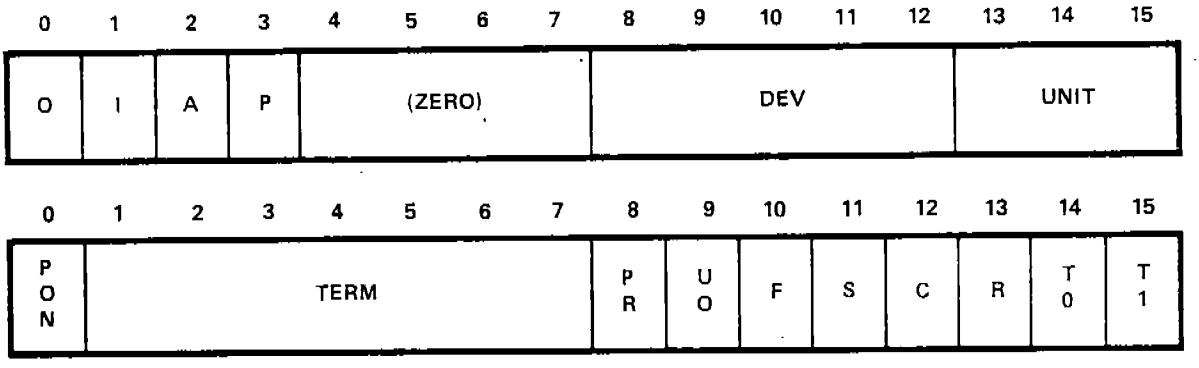
The FMT diagnostics append an additional error message to the standard SHADOW error message. This additional message, which correlates the error to a specific disc function, is determined by values encoded in certain fields of the IIO cause word. The possible messages, the IIO fields that govern them, and the error conditions they indicate are described in Table 4.2.

Other error messages are displayed at the OSP terminal as certain portions of the diagnostic run or when certain conditions are encountered. When program execution completes, an error summary is generated. These error messages are described in Table 4.3.



O - OWNERSHIP ERROR
I - INTERRUPT PENDING
B - CONTROL UNIT BUSY
P - I/O BUS PARITY ERROR ON EIO

Figure 4-1 Format of EIO Status Word



O - OWNERSHIP ERROR
I - INTERRUPT PENDING
A - CHANNEL TRANSFER ABORT
P - PARITY ERROR
DEV - CONTROLLER NUMBER
UNIT - UNIT NUMBER
PON - POWER ON INTERRUPT
PR - UNIT READ ONLY

UO - UNIT OWNERSHIP ERROR
F - UNIT WRITE FAULT
S - UNIT SEEK ERROR
C - UNIT NOT ON CYLINDER
R - UNIT NOT READY
T0 - UNIT TYPE, MSB
T1 - UNIT TYPE, LSB

TERM - ENCODED TERMINATION STATUS (TERMSTAT):

%00 NO ERROR
%01 UNIT ATTENTION
%02 DATA ERROR CORRECTED
%03 ATTEMPT TO WRITE ON PROTECTED UNIT
%04 ILLEGAL ADDRESS
%05 DIRECT ACCESS TO ALTERNATE TRACK
%06 ILLEGAL OPCODE
%07 UNIT STATUS ERROR
%10 BUFFER PARITY ERROR
%11 UNCORRECTABLE DATA ERROR
%12 NO SERVO CLOCKS DURING A WRITE
%13 VERIFY ERROR
%14 HEADER SEARCH FAILED
%15 HEADER ADDRESS MISCOMPARE
%16 ROM PARITY ERROR
%17 UNIT NOT PRESENT
%20 DUPLICATE UNIT NUMBER
%21 UNIT OWNERSHIP ERROR
%22 UNIT NOT READY
%23 READ RETRY SUCCESSFUL WITHOUT OFFSET
%24 READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS
%25 READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS
%26 READ RETRY SUCCESSFUL WITH DATA STROBE LATE
%27 READ RETRY SUCCESSFUL WITH DATA STROBE EARLY
%30 READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS AND DATA STROBE LATE
%31 READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS AND DATA STROBE EARLY
%32 READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS AND DATA STROBE LATE
%33 READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS AND DATA STROBE EARLY
%34 IDLE LOOP DISC CONTROLLER EXERCISER ERROR

Figure 4-2 Format of IIO Status and Cause Words

0	1	2 3	4	5	6 13	14 15	16 527	528 535
SYNC1 [1]	FLAG [1]	CYL [2]	HEAD [1]	SEC [1]	ECC1 [8]	SYNC2 [2]	DATA [512]	ECC2 [8]

T16/8L11F-10

SYNC1 = %360 (Good sector - marks the end of the preceding lockup field allowed for read synchronization and signals that address header is to follow)

%377 (Bad sector - all bytes of the entire sector are filled with ones)

FLAG = %350 (Normal sector - CYL/HEAD/SECT contains the current logical address)

%351 (Defective data area)

%352 (Jump-from-extension sector - CYL/HEAD/SECT contains the physical address of return from extension)

%353 (Spare sector)

%354 (Maximum sector on a track)

%355 (Only good sector on a track)

%356 (Jump-to-extension sector - CYL/HEAD/SECT contains the current physical address of extension)

%357 (End of cylinder)

%377 (Defective header)

ECC1 = [0:6] = Error correction code for address header
[7] = Pad byte of zeros

SYNC2 = [0] = %360
[1] = Pad byte of zeros

DATA = 512 bytes of written data

ECC2 = [0:6] = Error correction code for data portion
[7] = Pad byte of zeros

Figure 4-3 Sector-skipping Format for Data on Disc

Table 4.1 Device Characteristics in Sector-skipping Format

DEVICE CHARACTERISTIC	T16/ 4103	T16/ 4104	T16/ 4105/ 4106	T16/ 4109	T16/ 4110/ 4111	T16/ 4116
Device type	3	2	1	1	3	0
Maximum sector (MAXSECT)	19	29	29	29	29	29
Maximum head (MAXHEAD)	18	18	4	4	9	39
Maximum cylinder (MAXCYL)	814	814	822	822	822	842
Defect list cylinder (DLCYL)	813	813	821	821	821	841
First spare cylinder (FSPCYL)	805	803	811	811	811	831
Last spare cylinder (LSPCYL)	812	812	820	820	820	840
First fixed cylinder (FFXCYL)	-	-	-	896	-	-
Last fixed cylinder (LFXCYL)	-	-	-	915	-	-
Last fixed head (LFXHD)	-	-	-	0	-	-
Spare sectors per cylinder (SPSCYL)	2	2	2	2	4	8
Literal PROM ID (LPRID)	%102	%101	%101 %102	%101 %102	%101 -	%101 %102
Volume label sector (CYL/HEAD/SECT)	0/0/2	0/0/2	0/0/2	0/0/2	0/0/2	0/0/2
Spare track table sector (CYL/HEAD/SECT)	0/0/3	0/0/3	0/0/3	0/0/3	0/0/3	0/0/3

4.1 ERROR INFORMATION APPENDED TO SHADOW ERROR MESSAGES

In conjunction with the standard SHADOW error message, the FMT diagnostics typically display one of a number of error messages together with the contents of the controller registers. This error message is determined by IIO status. The form of the error message is as follows:

```
<error message>

CONTROLLER DATA
CYL xxx HEAD xx SECT xxx FLAGS xxx COUNT xxx ADD xxx.
```

If bit <2> of the Switch Register is in the ON position, the following message is then displayed, and the program suspends execution until bit <2> is placed in the OFF position:

```
PROCESSING STOPPED - SWITCH # 2 IS UP
```

The various messages that may appear in the <error message> field are listed in Table 4.2. CYL/HEAD/SECT reflects the disc address of the sector accessed by the command; FLAGS returns the value of the header flag in the accessed sector (refer to Figure 4-3); COUNT reflects the bytecount returned by the operation; and ADD reflects the current address of the controller buffer.

Table 4.2 Error Messages Accompanying Standard SHADOW Messages

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
TIMEOUT ERROR	IIO CAUSE = -1	A timeout occurred on the controller before the current operation could complete.
DEVICE TYPE ERROR	IIO CAUSE bits <14:15>	The accessed unit returned a different device type from that expected by the controller.
NOT READY ERROR	IIO CAUSE bit <13>	One of the following conditions obtains: a. No disc pack is installed. b. Disc spindle motor is not up to speed. c. Read/write heads are not loaded. d. DC voltages of drive are not within margin. e. Terminator is not present or does not have power.
NOT ON CYLINDER ERROR	IIO CAUSE bit <12>	A seek to an illegal address has been received from the channel, i.e., a cylinder, head, or sector address greater than the maximum legal value has been specified (refer to Table 4.1).
SEEK ERROR	IIO CAUSE bit <11>	Drive is unable to seek to specified address.
WRITE FAULT ERROR	IIO CAUSE bit <10>	One of the following conditions obtains: a. More than one write/read head selected b. Read gate and write gate both true c. Read gate and erase gate both true d. Write current but no erase current e. Erase current but no write current f. Write gate or erase gate but not on cylinder g. DC voltages below margin h. Emergency retract condition
OWNERSHIP ERROR	IIO CAUSE bit <9>	Controller is owned by the other port.
WRITE PROTECT ERROR	IIO CAUSE bit <8>	Write operation attempted to disc drive with WRITE PROTECT switch on.

T16 SL11F 11

Table 4.2 Error Messages Accompanying Standard SHADOW Messages (Cont'd)

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
NO TERMSTAT ERROR	TERM = %00	No error.
TERMSTAT ATTENTION ERROR	TERM = %01	One of the following unit attention conditions occurred: a. Selected drive ready (head load sequence) b. I.D. plug changed after drive ready c. Seek complete.
TERMSTAT CORRECTED DATA ERROR	TERM = %02	An error correctable by error correction code (ECC) occurred during a READ operation (≤ 11 bits).
TERMSTAT WRITE ATTEMPT TO PROTECTED UNIT ERROR	TERM = %03	WRITE-type command issued to disc drive with READ ONLY switch enabled.
TERMSTAT ILLEGAL ADDRESS ERROR	TERM = %04	A cylinder address was too large.
TERMSTAT DIRECT ACCESS TO ALT TRACK ERROR	TERM = %05	Not used in sector-skipping format. (In track-sparing, indicates that a READ or WRITE was issued to an alternate track before execution of the routine required to access that track.)
TERMSTAT ILLEGAL OPCODE ERROR	TERM = %06	The controller command in the EIO Address/Command Word is not valid.
TERMSTAT UNIT STATUS ERROR	TERM = %07	One of the following unit status conditions obtains: a. SEEK issued to disc drive with SEEK or NOT ON CYLINDER error b. FAULT or SEEK error occurred during a programmed seek, recalibrate, or head load sequence.
TERMSTAT BUFFER PARITY ERROR	TERM = %10	Incorrect parity in data word read from the controller 4K byte buffer (odd parity maintained).
TERMSTAT UNCORRECTABLE DATA ERROR	TERM = %11	A data record accessed with a READ error burst greater than 11 bits. ECC detected but uncorrectable. Data block could not be recovered with 27 retries using all offset combinations.
TERMSTAT NO SERVO CLOCKS DURING A WRITE	TERM = %12	Record CRC error.

T16/8L11F-12

Table 4.2 Error Messages Accompanying Standard SHADOW Messages (Cont'd)

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
TERMSTAT VERIFY ERROR	TERM = %13	Data read into the buffer does not compare with I/O channel data.
TERMSTAT HEADER SEARCH FAILURE	TERM = %14	One of the following header search conditions occurred: a. No headers on addressed track could be read. b. No sector match among headers on addressed track.
TERMSTAT HEADER ADDRESS MISCOMPARE	TERM = %15	Cylinder address or head address does not compare with the address loaded into the cylinder or head address registers.
TERMSTAT ROM PARITY ERROR	TERM = %16	Incorrect parity in microprogram instruction word read from ROM (odd parity maintained).
TERMSTAT UNIT NOT PRESENT ERROR	TERM = %17	Proper I.D. plug not installed.
TERMSTAT DUPLICATE UNIT NUMBER ERROR	TERM = %20	Plugs with the same I.D. installed in more than one disc drive.
TERMSTAT UNIT OWNERSHIP ERROR	TERM = %21	Disc drive owned by other controller.
TERMSTAT UNIT NOT READY ERROR	TERM = %22	Drive is not up to speed with the heads loaded.

T16/8L11F-13

4.2 OTHER ERROR MESSAGES RETURNED BY THE FMT DIAGNOSTICS

In addition to the error messages described in paragraph 4.1, certain messages occur as the FMT diagnostics execute. For the purpose of description, execution of the FMT diagnostics can be divided into the following sequence of operations:

a. Take ownership

b. Check for correct PROM ID

c. Check for valid volume ID

d. Formatting of DLCYL and MAXCYL

e. Manipulation of the defect list in memory

f. Formatting of spare cylinders

g. Formatting and sparing of all primary cylinders

h. Display of error summary.

NOTE

This breakdown of operations is for the purpose of description only. These operations are not identified as independent entities during program execution. They simply occur sequentially.

The special messages relative to each of these operations are described in Table 4.3.

Table 4.3 Other Error Messages Generated by the FMT Diagnostics

SCREEN DISPLAY	EXPLICATION
** OWNERSHIP ERROR, PUN %: xxx **	Message displayed if an error occurs when the program takes ownership of the device under test. The program attempts to take ownership again of the same device.
** ERROR COUNT EXCEEDED, PUN % xxx ** <RETURN> TO CONTINUE, ANY CHAR TO STOP	Message displayed if the number of errors detected during the take ownership exceeds the limit established by the program (100). If the user elects to continue, the program attempts to execute the next operation. If the user elects to stop, the program proceeds to the next unit under test.
ERROR: BAD LIT PROM ID, EXP %: xxx xxx OBS %: xxx <RETURN> TO CONTINUE, ANY CHAR TO STOP	Message displayed if an error is detected during the check for correct PROM ID. If the user elects to continue, the program attempts to execute the next operation.
********** ABORTING SECTOR-SKIPPING FORMATTER **********	Message displayed if the user elects to stop after a PROM ID error. The program terminates.
PAUSE-SOLID TRACK OF HEADER ERRORS, CYL/HEAD: xxx/xx DRIVE BAD, PUN %: xxx	Message displayed if a solid track of header errors is detected during one of the following operations: a. Format of DLCYL and MAXCYL b. Format of spare cylinders c. Format of primary cylinders The program then suspends execution until the user responds with carriage return.
** UNABLE TO CREATE FORMAT TABLE, CYL/PUN% xxx/xxx ** <RETURN> TO CONTINUE, ANY CHAR TO STOP	Message displayed if an error occurs during the attempt to create the format table for one of the following operations: a. Format of DLCYL and MAXCYL b. Format of spare cylinders c. Format of primary cylinders The user has the option to continue or terminate the test. If the user elects to continue, the program proceeds with the current formatting operation. If the user elects to stop, the program proceeds to the next unit under test.

T16/8L11F-14

Table 4.3 Other Error Messages Generated by the FMT Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
CYLINDER IS INCREMENTED, SET BREAK POINT TO FIND OUT WHY START CYL: xxx CNTLR ADDR (C/H/S): xxx / xx / xx SECTORCOUNT: xxxx <RETURN> TO CONTINUE	Message displayed if a discrepancy occurs between the controller address and the starting address during one of the following operations: a. Format of DLCYL and MAXCYL b. Format of spare cylinders c. Format of primary cylinders The user has the option to continue or terminate the test. If the user elects to continue, the program performs an error check. If the user elects to stop, the program proceeds to the next unit under test.
START CYL: xxx	Message displayed if an error is detected during the error check referred to in the preceding message description.
*** MATCH FOUND, DEFECT ALREADY PRINTED ***	Message displayed if a defect detected on the cylinder being formatted is already listed in the memory defect list (i.e., has previously been identified as a defective sector). Specifically, this message may occur during the format of DLCYL and MAXCYL, and, if the DISPLAY DEFECTS flag is enabled, during the format of the spare cylinders and of the primary cylinders.
DEFECT-HEADER CHECKSUM, CYL/HEAD/SECT: xxx/xx/xx	Message displayed if a HEADER CHECKSUM error occurs in a sector of the cylinder being formatted and that sector is not already listed in the memory defect list (i.e., has not previously been identified as a defective sector). Specifically, this message may occur during the format of DLCYL and MAXCYL, and, if the DISPLAY DEFECTS flag is enabled, during the format of the spare cylinders and of the primary cylinders.

T16/8L11F-15

Table 4.3 Other Error Messages Generated by the FMT Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
DEFECT-UNCORRECTABLE DATA ERROR, CYL/HEAD/SECT: xxx/xx/xx BURST LENGTH = xx	Message displayed if an UNCORRECTABLE DATA error occurs in a sector of the cylinder being formatted and that sector is not already listed in the memory defect list (i.e., has not previously been identified as a defective sector). Specifically, this message may occur during the format of DLCYL and MAXCYL, and, if the DISPLAY DEFECTS flag is enabled, during the format of the spare cylinders and of the primary cylinders.
DEFECT-CORRECTABLE DATA ERROR, CYL/HEAD/SECT: xxx/xx/xx BURST LENGTH = xx	Message displayed if a CORRECTABLE DATA error occurs in a sector of the cylinder being formatted and that sector is not already listed in the memory defect list (i.e., has not previously been identified as a defective sector). Specifically, this message may occur during the format of DLCYL and MAXCYL, and, if the DISPLAY DEFECTS flag is enabled, during the format of the spare cylinders and of the primary cylinders.
DEFECT-READFULLS, CYL/HEAD/SECT: xxx/xx/xx	Message displayed if a READ FULL SECTOR error occurs in a sector of the cylinder being formatted and that sector is not already listed in the memory defect list (i.e., has not previously been identified as a defective sector). Specifically, this message may occur during the format of DLCYL and MAXCYL, and, if the DISPLAY DEFECTS flag is enabled, during the format of the spare cylinders and of the primary cylinders.
DEFECT -> TERMSTAT = % xx CYL = xxx HEAD = xx SECTOR = xx	Message displayed if a TERMSTAT error occurs in a sector of the cylinder being formatted and that sector is not already listed in the memory defect list (i.e., has not previously been identified as a defective sector). Specifically, this message may occur during the format of DLCYL and MAXCYL, and, if the DISPLAY DEFECTS flag is enabled, during the format of the spare cylinders and of the primary cylinders.

T16/8L11F-16

Table 4.3 Other Error Messages Generated by the FMT Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
SOFTWARE ERROR IN DEF: PRINTDEFECT	Message displayed if the attempt to format a sector of the cylinder under test results in an error that the program cannot otherwise identify. Specifically, this message may occur during the format of DLCYL and MAXCYL, and, if the DISPLAY DEFECTS flag is enabled, during the format of the spare cylinders and of the primary cylinders.
-NEW DEFECTS ON CYL: xxx	Message displayed if any new defects are detected during a format pass on a given cylinder. Format of the cylinder is repeated with the same pattern until no new defects are detected. This message may occur during any of the following operations: a. Format of DLCYL and MAXCYL b. Format of spare cylinders c. Format of primary cylinders
*** TOO MANY DEFECTS, MEMORY DL FULL ***	Message displayed if the space allocated for the memory defect list overflows during one of the following operations: a. Format of DLCYL and MAXCYL b. Format of spare cylinders c. Format of primary cylinders d. Manipulation of memory defect list
-ERROR: OUT OF SPARES	Message displayed if a cylinder extension is required and all spare cylinders are full. This message may occur during any of the following operations: a. Format of DLCYL and MAXCYL b. Format of spare cylinders c. Format of primary cylinders In this event, the program terminates, and SHADOW returns to conversational mode.

T16/8L11F-17

Table 4.3 Other Error Messages Generated by the FMT Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
** HEADER/DATA ECC ERROR ON EXTENSION, PUN %: xxx ** <RETURN> TO RETRY, ANY CHAR TO STOP	Message displayed if a header error occurs during the formatting of an extension. This message may occur during any of the following operations: a. Format of DLCYL and MAXCYL b. Format of spare cylinders c. Format of primary cylinders If the user elects to retry, the program attempts to format the extension again. If the user elects to stop, the program aborts.
-POSSIBLE DEFECT IN HEADER AREA -CYL/HEAD/SECT: xxx,xx,xx -HEADER DATA: -SYNC/FLAG/CYL/HEAD/SECT: %xxx,%xxx,xxx,xx,xx	Message displayed if any anomaly is detected in the header information during the SCRATCH BAD HEADERS subroutine (such as an incorrect sync byte or a cylinder, head, or sector number less than 0 or greater than the maximum allowable value). The memory defect list is then scanned to determine whether the sector in question is listed as defective. This message may occur during any of the following operations: a. Format of DLCYL and MAXCYL b. Format of spare cylinders c. Format of primary cylinders
ERROR: RE-FORMATTING NEEDED ON CYL: xxx	Message displayed if a sector determined defective by the SCRATCH BAD HEADERS subroutine is not found already listed in the memory defect list. The program attempts to reformat the cylinder. This message may occur during any of the following operations: a. Format of DLCYL and MAXCYL b. Format of spare cylinders c. Format of primary cylinders
DL WRITE ERROR, CYL/HEAD/SECT: xxx,xx,xx.	Message displayed if an error occurs when DLCYL is being rewritten.
** BAD HEADER, PUN %: xxx C/H/S: xxx / xx / xx **	Message displayed when a defective header is detected.

T16/8L11F-18

Table 4.3 Other Error Messages Generated by the FMT Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
-ERROR: DLCYL READ	Message displayed if an error occurs during the initial attempt to access a given sector of DLCYL. The access is attempted a second and, if necessary, a third time, and the message is displayed before each repeat.
-RETRY RUNOUT, SKIPPING SECTOR	Message displayed if the third attempt to access the sector also fails. The program then proceeds to the next sector.
CYL HEAD SECT OS UNUSED TERM xxx xx xx xxx xxx xxx -BAD CYL IN DL, CYL/MAXCYL: xxx / xxx <RETURN> TO CONTINUE	Message displayed if a cylinder greater than the maximum allowable is detected during the sector-by-sector read of DLCYL. The program then suspends execution. When the user responds with a carriage return, the program attempts to access the next sector. For the possible values of MAXCYL, refer to Table 4.1.
CYL HEAD SECT OS UNUSED TERM xxx xx xx xxx xxx xxx -BAD HEAD IN DL, HEAD/MAXHEAD: xx / xx <RETURN> TO CONTINUE	Message displayed if a head greater than the maximum allowable is detected during the sector-by-sector read of DLCYL. The program then suspends execution. When the user responds with a carriage return, the program attempts to access the next sector. For the possible values of MAXHEAD, refer to Table 4.1.
CYL HEAD SECT OS UNUSED TERM xxx xx xx xxx xxx xxx -BAD SECT IN DL, SECT/MAXSECT: xx / xx <RETURN> TO CONTINUE	Message displayed if a sector greater than the maximum allowable is detected during the sector-by-sector read of DLCYL. The program then suspends execution. When the user responds with a carriage return, the program attempts to access the next sector. For the possible values of MAXSECT, refer to Table 4.1.
PAUSE-EXCESSIVE DEFECTS, PUN %: xxx	Message displayed if the number of defects detected during the pattern passes exceeds the limit assigned by the program. The program then suspends execution until the user responds with a carriage return. When the user responds with carriage return, the program proceeds directly to the transfer of the memory defect list to DLCYL.

T16/8L11F-19

SECTION 5
RUN PROCEDURES

5.0 RUN PROCEDURES

CAUTION

The SHADOW FMT programs depend on a valid defect list cylinder (DLCYL). If the contents of DLCYL have been lost, the FMT diagnostics are not usable. The PUP FORMAT facility must be used to restore valid sector-skipping format to the disc pack under test. To provide for adequate restoration of DLCYL in such cases, it is essential that a tape or hard copy of the vendor defect list information stored on DLCYL when first formatted by Tandem manufacturing be available. If a tape copy exists, it can be loaded directly onto the reformatted disc. If only a hard copy exists, the defects must be entered one by one, using the appropriate SHADOW defect-logging utility program (DUT). The PUP FORMAT procedure is described in the NonStop II System Operations Manual, Part Number 82075. The DUT programs are described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 3B, Chapter 1, Part 1D.

A sample successful run of an FMT diagnostic is illustrated in Figure 5-1. The test case uses a 128-MB disc drive, configured as drive number %2 on controller number %1. The illustration assumes SHADOW loaded and bits <3>, <4>, and <5> of the Switch Register in the OFF position. (Refer to Table 5.2 for the definition of all applicable switch settings.)

For the user unfamiliar with SHADOW in general or with the FMT diagnostics in particular, the system preparations necessary for running diagnostics are described in paragraph 5.1; a step-by-step run procedure follows in paragraph 5.2.

```
T9404D00.SHADOW  01APR81  00:00
>RUN FMT4110 <cr>

DEFECT LOGGING FORMATTER
T9472A02.FMT4110 (A02) 01APR82
ONE 3106 CONTROLLER WITH UP TO EIGHT UNITS

INPUT PRIMARY CONTROLLER NUMBER
? %1 <cr>
INPUT DRIVE NUMBER
? %2 <cr>
INPUT DRIVE NUMBER
? <cr>

*** CHECKING FOR VALID VOLUME ID, PUN %: 12  ***

VOLUME MOUNTED ON DRIVE % 12  IS VALID
VOLUME NAME IS [[[[[[[[

<RETURN> TO CONTINUE, ANY CHAR TO STOP
? <cr>

INPUT PATTERN # (DEFAULT IS ALL)
 0 -> ALL
 1 -> ONLY %353 %155 %266 %333
 2 -> ONLY %333 %156
? 0 <cr>

THIS PROGRAM WILL ACCEPT A DEFECT LIST FROM CYL: 821
IF INVALID, IT MUST BE CLEARED BEFORE PROCEEDING

IS THIS DEFECT LIST VALID (Y/N) ?
? y <cr>

*** COMPLETED CYL: 822  PUN %: 12  ***

DISPLAY DEFECTS FOUND (Y/N) ?
? n <cr>

ADD SECTORS W/BAD HEADERS TO DEFECT LIST (Y/N) ?
? n <cr>

MODIFY/DISPLAY CURRENT DEFECT LIST (Y/N) ?
? n <cr>

*** FORMATTING SPARE CYLS, PUN %: 12  ***
*** COMPLETED CYL: 811  PUN %: 12  ***
*** COMPLETED CYL: 812  PUN %: 12  ***
*** COMPLETED CYL: 813  PUN %: 12  ***
*** COMPLETED CYL: 814  PUN %: 12  ***
*** COMPLETED CYL: 815  PUN %: 12  ***
*** COMPLETED CYL: 816  PUN %: 12  ***
*** COMPLETED CYL: 817  PUN %: 12  ***
*** COMPLETED CYL: 818  PUN %: 12  ***
*** COMPLETED CYL: 819  PUN %: 12  ***
*** COMPLETED CYL: 820  PUN %: 12  ***

PASS NUMBER 1  FOR UNIT NUMBER % 12
*** FORMATTING PRIMARY CYLS, PUN %: 12  ***
*** COMPLETED CYL:   0  PUN %: 12   PASS #: 1  ***
*** COMPLETED CYL:  10  PUN %: 12   PASS #: 1  ***
*** COMPLETED CYL:  20  PUN %: 12   PASS #: 1  ***
*** COMPLETED CYL:  30  PUN %: 12   PASS #: 1  ***
     .    .    .    .    .    .    .    .
*** COMPLETED CYL: 780  PUN %: 12   PASS #: 1  ***
*** COMPLETED CYL: 790  PUN %: 12   PASS #: 1  ***
*** COMPLETED CYL: 800  PUN %: 12   PASS #: 1  ***
*** COMPLETED CYL: 810  PUN %: 12   PASS #: 1  ***
```

T16/8L11F-20

Figure 5-1 Sample Successful Run of FMT4110

```
PASS NUMBER 2  FOR UNIT NUMBER % 12
*** FORMATTING PRIMARY CYLS, PUN %: 12  ***
*** COMPLETED CYL:   0  PUN %: 12    PASS #: 2  ***
*** COMPLETED CYL:  10  PUN %: 12    PASS #: 2  ***
*** COMPLETED CYL:  20  PUN %: 12    PASS #: 2  ***
*** COMPLETED CYL:  30  PUN %: 12    PASS #: 2  ***
      .    .    .    .    .    .    .    .
*** COMPLETED CYL: 780  PUN %: 12    PASS #: 2  ***
*** COMPLETED CYL: 790  PUN %: 12    PASS #: 2  ***
*** COMPLETED CYL: 800  PUN %: 12    PASS #: 2  ***
*** COMPLETED CYL: 810  PUN %: 12    PASS #: 2  ***

-NO CYLINDERS HAVE BEEN EXTENDED

*      FMT4110  ERROR SUMMARY      *
*      PUN %:  12                  *
```

TIMEOUTS	0
NOT ON CYLINDERS	0
SEEK ERRORS	0
DATA ERRORS CORRECTED	0
ILLEGAL ADDRESSES	0
DATA UNCORRECTABLES	0
HEADER SEARCH FAILS	0
HEADER CHECKSUM ERRORS	0
PATTERNS SELECTED	0
PASS #	2
# DEFECTS	0

```
!!!!!!!!!!!   E N D   OF   F M T 4 1 1 0   !!!!!!!!!!
```

Note: 128-Mb disc drive (T16/4110), drive number %2, controller number %1. SHADOW loaded and panel switches <3>, <4>, and <5> switched off; panel switch <1> switched on.

T16/8L11F-21

Figure 5-1 Sample Successful Run of FMT4110 (Cont'd)

5.1 PREPARATIONS FOR RUNNING THE FMT DIAGNOSTICS

Before any diagnostic is run, certain steps must be taken to allocate the system resources necessary for SHADOW and to ensure that the diagnostic run has minimum impact on system performance. The necessary procedures are ordinarily performed by the local system manager, or at least with the concurrence of the system manager. They include:

a. Obtaining access to the OSP subsystem

b. Transferring to another processor all user processes currently running in the processor to be taken off line

c. Transferring to another processor the path preference of all controllers with preferred paths currently assigned to the processor to be taken off line

d. Taking whatever precautions are indicated to protect the data stored on the disc volume to be tested

e. Taking off line the processor to be loaded with SHADOW

f. Taking off line the disc subsystem (controller and drive) to be tested.

> CAUTION
>
> If a T16/4109 disc drive is to be tested, both the moving and fixed-head portions of the disc (each assigned a different physical unit number) must be taken off line. Since the drives are dual ported, both paths to both portions of the disc must be off line.

These steps are described in detail elsewhere in the NonStop II Diagnostic Operating Procedures, Part Number 82803; those that deal with preparing the system in general for SHADOW, in Volume 1, Chapter 2, Parts 1 and 2; and those that deal with preparing the disc subystem in particular, in Volume 3B, Chapter 1, Part 1.

A checklist of the requirements for the FMT diagnostics, both those that must be available on the system and those that must be supplied by the customer engineer, is given in Table 5.1.

Table 5.1 Checklist for the FMT Diagnostics

REQUIREMENTS	SOURCE
A functioning OSP subsystem and terminal.	On site.
A processor that can be taken off line and dedicated to SHADOW.	On site.
A tape drive unit (if SHADOW is to be loaded from tape). a. The tape drive must be physically connected to the test processor if SHADOW is I/O loaded from tape. b. The tape drive must be physically connected to the processor that is to read the tape if SHADOW is bus loaded through an offline processor. c. The tape drive must be physically connected to a processor running GUARDIAN (TM) if SHADOW is bus loaded through an online processor.	On site.
Scratch pack or packs to substitute for the user packs during diagnostic execution (if removable media are to be tested).	On site.
SHADOW operating system. *	Either on site, in disc storage, or supplied by C.E. on cold load tape.
The appropriate FMT diagnostic program for the disc drive type under test (refer to Table 1.1).	Either on site, in disc storage, or supplied by C.E. on cold load tape.

* There are two distinct versions of the SHADOW operating system, one for the NonStop system (usually denoted as ZZDIAG1.SHADOW) and the other for the NonStop II system (usually denoted as ZZDIAG2.SHADOW). If loading from tape, ensure that the correct version is present on the tape and specify it during the load procedure.

5.2 RUN PROCEDURE FOR THE FMT DIAGNOSTICS

> CAUTION
>
> It is possible to run SHADOW diagnostics from the OSP in two or more processors concurrently. However, only one test process can communicate with the OSP at a time. For this reason, no more than one diagnostic process is ordinarily run on a system at any given time.

To run one of the FMT diagnostics, first ensure that the preparations listed in paragraph 5.1 are taken and then proceed as follows:

a. Load SHADOW into the test processor.

> CAUTION
>
> There are two distinct versions of the SHADOW operating system, one for the NonStop system (usually denoted as ZZDIAG1.SHADOW) and the other for the NonStop II system (usually denoted as ZZDIAG2.SHADOW). If loading from tape, ensure that the correct version is present on the tape and specify it during the load procedure. There are three methods for loading SHADOW: I/O cold load from tape, bus cold load from tape, and online load from tape or disc. They are described in detail in the NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 1.

b. Set desired Switch Register options in the operator control panel of the test processor. (Refer to Table 5.2 for a list of panel switches defined for the FMT diagnostics.)

c. At the SHADOW prompt (>) on the OSP screen, enter the command:

RUN <filename>

where <filename> is FMT4103, FMT4104, FMT4105, FMT4109, FMT4110, or FMT4116. (Refer to Figure 5-1 for further illustration.)

Table 5.2 Switch Register Options Available for the FMT Diagnostics *

SWITCH	FUNCTION
<0>	(Standard SHADOW function) If toggled on and off, generates a user break request and returns the SHADOW interpreter to conversational mode, where it waits for further instruction.
<1>	(FMT-specific function) If placed in the ON position, causes the program to stop when an error is encountered, either in reading data from the defect list cylinder (DLCYL) or in media testing.
<2>	(FMT-specific function) If placed in the ON position, causes the program to stop further processing when issuance of an EIO results in errors.
<3>	(Standard SHADOW function) If placed in the ON position, suppresses error printout and enables setting of the special numerics ERROR# and COMPERR#. Refer to the Diagnostic Languages Manual, Part Number 82848, for a description of the special numerics ERROR# and COMPERR#.
<4>	(Standard SHADOW function) If placed in the ON position, suppresses error printout, disables setting of the special numerics ERROR# and COMPERR#, and disables ERROR limit decrement.
<5>	(Standard SHADOW function) If placed in the ON position, causes a program halt on I/O error.

* Switches <6> and <7> are not defined for the FMT diagnostics, and switches <8> through <15> reflect the I/O address.

NOTE

The program is now initializing. The program name is displayed at the OSP terminal, followed by several requests for input. Actual program execution commences only when the last request is honored.

d. When the following request is displayed at the OSP terminal, respond as indicated:

```
INPUT PRIMARY CONTROLLER NUMBER
?
```

1. Enter the physical unit number (in octal) of the disc controller to be tested.

2. Depress carriage return.

e. When the following request is displayed at the OSP terminal, respond as indicated:

```
INPUT DRIVE NUMBER
?
```

1. Enter the physical unit number (in octal) of the first disc drive to be tested.

2. Depress carriage return.

NOTE

The disc drive indicated must be connected to the controller specified in step d. This request for input is repeated up to eight times, as long as an acceptable drive number is received after each display of the request. Receipt of carriage return alone terminates the input and causes the next request to be displayed.

> FMT4109 does not format the fixed-head portion of the T16/4109 disc drive. Because the T16/4109 disc drive requires two I/O addresses (one for the moving heads and one for the fixed heads), the acceptable range of drive numbers for FMT4109 is [0,3] instead of the customary range [0,7].

f. When the following request is displayed at the OSP terminal (after the check for valid volume ID), make one of three responses, as appropriate:

```
INPUT PATTERN # (DEFAULT IS ALL)
 0 -> ALL
 1 -> ONLY %353 %155 %266 %333
 2 -> ONLY %333 %156
```

1. If format passes are to be run with all patterns, simply depress carriage return.

2. If format passes with selected patterns are to be run, enter the desired number (1 or 2) and then depress carriage return.

g. Analyze any errors generated. (Refer to Section 4 for a description of possible error conditions.)

h. If the results of the FMT diagnostic are inconclusive, try to isolate the problem further by running another of the diagnostics for sector-skipping format. (Refer to Table 1.1.)

PART 1G

REX 4103, REX 4104, REX 4105
REX 4109, REX 4110, REX 4116

SECOND LEVEL MANUAL

DIAGNOSTIC OPERATING PROCEDURES

NonStop II (TM) Systems

VOLUME 3B, CHAPTER 1, PART 1G

REX4103, REX4104, REX4105, REX4109, REX4110,
AND REX4116 DISC DIAGNOSTICS

Copyright © 1982

TANDEM COMPUTERS INCORPORATED
19333 Vallco Parkway
Cupertino, California 95050

Tandem Part Number 82803

October 1982
Printed in U.S.A.

This document contains information that is protected by copyright. No part of this document may be photocopied, reproduced or translated to another program or system without the prior written consent of Tandem Computers Incorporated.

The following are trademarks of Tandem Computers Incorporated:
Tandem, NonStop, NonStop II, AXCESS, DYNABUS, ENCOMPASS, ENFORM, ENSCRIBE, ENVOY, EXCHANGE, EXPAND, GUARDIAN, TGAL, PATHWAY, XRAY.

VOLUME 3B, CHAPTER 1, PART 1G

TABLE OF CONTENTS

Par.No. | Title | Page No.

SECTION 1
INTRODUCTION

1.0 INTRODUCTION.....1-1

SECTION 2
OVERVIEW

2.0 OVERVIEW.....2-1
2.1 PROGRAM SELECTION AND EXECUTION.....2-2

SECTION 3
COMMANDS

3.0 COMMANDS.....3-1
3.1 COMMAND SET FOR THE REX DIAGNOSTICS.....3-1
3.1.1 AP - ALTER RUN PARAMETERS Command.....3-5
3.1.2 CC - CHECK CYLINDER Command.....3-7
3.1.3 CF - CHECK FLAGS Command.....3-8
3.1.4 CN - SEND CONTROL Command.....3-10
3.1.5 CP - COMPARE BUFFERS Command.....3-11
3.1.6 CS - CHECK SURFACE Command.....3-12
3.1.7 CY - SET CYLINDER Command.....3-13
3.1.8 DL - DEFECT LIST Command.....3-14
3.1.9 DR - DUMP READ$ Command.....3-16
3.1.10 DS - DUMP INTERRUPT STATUS Command.....3-18
3.1.11 DW - DUMP WRITE$ Command.....3-19
3.1.12 EM - EXECUTE MEMORY Command.....3-21
3.1.13 EW - EDIT WRITE$ Command.....3-22
3.1.14 EX - EXIT Command.....3-23
3.1.15 HD - SET HEAD Command.....3-24
3.1.16 HP - HELP Command.....3-25
3.1.17 LH - LIST HEADERS Command.....3-26
3.1.18 LL - LOOP Command.....3-27

TABLE OF CONTENTS (Cont'd)

Par.No.	Title	Page No.
3.1.19	MV - MOVE Command	3-28
3.1.20	PT - INITIALIZE PATTERN Command	3-29
3.1.21	RB - READ BUFFER Command	3-31
3.1.22	RD - READ Command	3-32
3.1.23	RF - READ FULL SECTOR Command	3-33
3.1.24	RR - READ REGISTERS Command	3-34
3.1.25	SC - SET SECTOR Command	3-35
3.1.26	SK - SEEK Command	3-36
3.1.27	SM - STORE MEMORY Command	3-37
3.1.28	TT - TAKE OWNERSHIP Command	3-38
3.1.29	WF - WRITE FULL SECTOR Command	3-39
3.1.30	WS - WRITE SURFACE Command	3-40
3.1.31	WT - WRITE Command	3-41
3.1.32	XA - RANDOM POSITION/READ WITH NO TRANSFER Command	3-42
3.1.33	XB - RANDOM POSITION/READ WITH NO CHECKSUM Command	3-43
3.1.34	XC - RANDOM POSITION/READ WITH NO TRANSFER/VERIFY Command	3-44
3.1.35	XD - RANDOM POSITION/REPOSITION Command	3-45
3.1.36	XE - RANDOM POSITION/READ WITH TRANSFER Command	3-46
3.1.37	XF - RANDOM POSITION/READ WITH TRANSFER/VERIFY CHECKSUM	3-47
3.1.38	YA - MAXCYL RANDOM WRITE/READ/VERIFY Command	3-48
3.1.39	YB - RANDOM WRITE/READ/VERIFY Command	3-49

SECTION 4
ERROR CONDITIONS AND DISPOSITIONS

4.0 ERROR CONDITIONS AND DISPOSITIONS....4-1
4.1 ERROR INFORMATION APPENDED TO SHADOW ERROR MESSAGES....4-6
4.2 OTHER ERROR MESSAGES GENERATED BY THE REX DIAGNOSTICS....4-10

SECTION 5
RUN PROCEDURES

5.0 RUN PROCEDURES....5-1
5.1 PREPARATIONS FOR RUNNING THE REX DIAGNOSTICS....5-4
5.2 RUN PROCEDURE FOR THE REX DIAGNOSTICS....5-6

TABLE OF CONTENTS (Cont'd)

LIST OF ILLUSTRATIONS

Fig.No.	Title	Page No.
4-1	Format of EIO Status Word	4-2
4-2	Format of IIO Status and Cause Words	4-3
4-3	Sector-skipping Format for Data on Disc	4-4
5-1	Sample Successful Run of REX4110	5-2

LIST OF TABLES

Table No.	Title	Page No.
1.1	Disc Subsystem Diagnostics for the NonStop II System	1-2
3.1	Command Set for the REX Diagnostics	3-2
3.2	Prompts Displayed During Execution of the ALTER RUN PARAMETERS Command	3-6
3.3	Prompts Displayed During Execution of the CHECK FLAGS Command	3-9
3.4	Function Requests Recognized by SEND CONTROL Command	3-10
3.5	Prompts Displayed During Execution of the CHECK SURFACE Command	3-12
3.6	Prompts Displayed During Execution of the DEFECT LIST Command	3-15
3.7	Messages Displayed during Execution of the DUMP READ$ Command	3-17
3.8	Messages Displayed during Execution of the DUMP WRITE$ Command	3-20
3.9	Messages Displayed during Execution of the EDIT WRITE$ Command	3-22
3.10	Prompts Displayed during Execution of the MOVE Command	3-28
3.11	Prompts Displayed during Execution of the INITIALIZE PATTERNS Command	3-30
3.12	Prompts Displayed during Execution of the READ BUFFER Command	3-31

TABLE OF CONTENTS (Cont'd)

LIST OF TABLES (Cont'd)

Table No.	Title	Page No.
4.1	Device Characteristics in Sector-skipping Format	4-5
4.2	Error Messages Accompanying Standard SHADOW Messages	4-7
4.3	Non-command-specific Error Messages Generated by the REX Diagnostics	4-11
4.4	Command-specific Error Messages Generated by the REX Diagnostics	4-12
5.1	Checklist for the REX Diagnostics	5-5
5.2	Switch Register Options Available for the REX Diagnostics	5-7
5.3	Possible Opening Series of Commands in REX Diagnostics	5-11

TABLE OF CONTENTS

SECTION 1
INTRODUCTION

1.0 INTRODUCTION

This chapter describes six SHADOW diagnostics, REX4103, REX4104, REX4105, REX4109, REX4110, and REX4116. These diagnostics are designed as random exercisers of disc media and can be used, respectively, to test a T16/4103, 4104, 4105/4106, 4109, 4110/4111, or 4116 disc drive on a Tandem NonStop II (TM) system. To accept these programs, the drive must be formatted for sector skipping and configured with a T16/3106 disc controller.

Used primarily in the corrective maintenance process, the REX diagnostics can be run to determine the types of errors being produced and to help isolate the probable area of failure. After the suspected area of failure is corrected, these programs can be run again as end tests to ensure that the errors are eliminated.

The REX diagnostics are one of seven sets of SHADOW diagnostic programs provided for the Tandem NonStop II disc subsystems. Refer to Table 1.1 for a list of the other available diagnostics.

REX4105, REX4109, and REX4110 are written for SHADOW Rev level D00 and are compatible with all Rev levels of the controller and drives.

NOTE

> The DEX diagnostics, one of these other sets, are very similar to the REX diagnostics. The chief difference is that the REX diagnostics have powerful added capabilities including a number of commands that enable random exercising of the disc pack.

Table 1.1 Disc Subsystem Diagnostics for the NonStop II System *

SUBSYSTEM	DIAGNOSTIC	MANUAL REF. **
T16/4103 drive - T16/3106 ctrl	FAST4103	Part 1A
	DISC4103	Part 1B
	DEX4103	Part 1C
	DUT4103	Part 1D
	EDT4103	Part 1E
	FMT4103	Part 1F
	REX4103	Part 1G
T16/4104 drive - T16/3106 ctrl	FAST4104	Part 1A
	DISC4104	Part 1B
	DEX4104	Part 1C
	DUT4104	Part 1D
	EDT4104	Part 1E
	FMT4104	Part 1F
	REX4104	Part 1G
T16/4105 drive - T16/3106 ctrl ***	FAST4105	Part 1A
T16/4106 drive - T16/3106 ctrl	DISC4105	Part 1B
	DEX4105	Part 1C
	DUT4105	Part 1D
	EDT4105	Part 1E
	FMT4105	Part 1F
	REX4105	Part 1G
T16/4109 drive - T16/3106 ctrl	FAST4109	Part 1A
	DISC4109	Part 1B
	DEX4109	Part 1C
	DUT4109	Part 1D
	EDT4109	Part 1E
	FMT4109	Part 1F
	REX4109	Part 1G
	FHD4109	Part 1H
T16/4110 drive - T16/3106 ctrl ***	FAST4110	Part 1A
T16/4111 drive - T16/3106 ctrl	DISC4110	Part 1B
	DEX4110	Part 1C
	DUT4110	Part 1D
	EDT4110	Part 1E
	FMT4110	Part 1F
	REX4110	Part 1G
T16/4116 drive - T16/3106 ctrl ***	FAST4116	Part 1A
	DISC4116	Part 1B
	DEX4116	Part 1C
	DUT4116	Part 1D
	EDT4116	Part 1E
	FMT4116	Part 1F
	REX4116	Part 1G

* A somewhat different subset of disc subsystems is supported on the NonStop (TM) system, some in sector-skipping format and some in track-sparing format. For a complete list of the disc subsystems supported on the NonStop system and of the applicable diagnostics, refer to NonStop Diagnostic Operating Procedures, Part Number 82802, Volume 3B, Chapter 1, Part 1.

** In all cases, the general manual reference is to Volume 3B, Chapter 1, of NonStop II Diagnostic Operating Procedures, Part Number 82803.

*** The T16/4105 and 4106 disc drives are identical devices, as are the T16/4110 and 4111, except that in each case the first is free standing in the cabinet and the second is drawer mounted.

T16/8L11G-01

SECTION 2
OVERVIEW

2.0 OVERVIEW

The REX diagnostics define a set of commands that the user can invoke singly or in various sequences to test a wide range of disc functions. These programs are interactive; the user inputs a command, and the program performs the indicated operation and reports error status. With these programs, the user can compose and run complete diagnostic tests of a disc subsystem tailored to the needs of a given situation.

The command set for the REX diagnostics consists of a series of two-letter mnemonics, in some cases followed by an optional parameter. Commands can be combined into a command string, comprised of two or more commands separated by commas. A command string is executed, function by function, until either the end of the string or a syntax or parameter error is detected. If a parameter is specified for any command, it is entered directly after the command, without intervening space or punctuation. The maximum legal parameter value is 4095. For a description of the command set for the REX diagnostics, refer to Section 3.

The REX diagnostics are run from the OSP terminal. Before any of them can be run, the following system resources must be taken off line and dedicated exclusively to the SHADOW program:

a. The disc drive to be tested and the associated controller

b. The processor into which SHADOW is to be loaded (the procedure for taking processor modules off line is described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 2).

SHADOW is then loaded into the test processor by one of the three customary methods, and the desired Switch Register options may be set in the operator control panel of the test processor. Refer to Table 5.2 for a description of the Switch Register options for the REX diagnostics. The SHADOW load procedure is described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 1.

2.1 PROGRAM SELECTION AND EXECUTION

After SHADOW is loaded, the appropriate disc control exerciser for the particular subsystem under test can be loaded and run. The typical SHADOW requests for input are displayed at the OSP terminal as the program initializes. Initialization cannot complete without appropriate responses from the operator. Proper program execution requires that the first response to the request for command string input be a TAKE OWNERSHIP command. Thereafter, the program continues to prompt for command string input after each command string is executed. A possible opening command string is as follows:

TT,CN16,CN2,CN64

This command string accomplishes the following operations:

a. Take ownership

b. Priority select

c. Unit clear

d. Recalibrate.

All of the programs report the SHADOW error messages appropriate to the conditions detected (unless error printout is suppressed in the panel switches). Execution of many of the commands results in the display of additional specific error information or requests for further input. Refer to Section 3 for a description of the prompts displayed by certain commands, and to Section 4 for a description of all error messages that may be displayed at the OSP terminal.

An error summary is printed when the diagnostic completes execution. Invoking the EXIT command (EX) does not terminate the diagnostic or return the terminal to SHADOW conversational mode; it merely causes processing to stop for the device under test and the REX program to reinitialize. To terminate the diagnostic and return to SHADOW conversational mode, either bit <0> of the Switch Register must be toggled on and off or the ESCAPE key depressed at the OSP terminal.

Because the REX diagnostics are interactive programs, run times vary widely, depending on such factors as the number of commands invoked, the number of options exercised, the storage capacity of the disc drive under test, and so on. The settings of the panel switches can also affect the course of any given run of the diagnostic. Most individual commands take less than 30 seconds to execute, but certain commands, such as CHECK CYLINDER (CC) and the random exercising commands, can take longer. Factors to be considered when estimating down time include not only the run times for the diagnostics, but also the time which may be required for reformatting and reviving the discs after the diagnostics are completed. The times required for these procedures vary from an hour or less to as long as overnight, depending on such factors as system load and disc pack size.

SECTION 3
COMMANDS

3.0 COMMANDS

The REX diagnostics contain a program-defined command set for interactive use during execution. The command names for this command set consist of two-letter mnemonics, in some instances accompanied by an optional parameter. With them, the program user can compose and run tests of a disc subsystem tailored to the needs of a given situation. The command set for the REX diagnostics is described in paragraph 3.1.

In addition, the REX diagnostics require the SHADOW RUN command for program execution. If the user wishes to implement the NOSTRIP option, the SHADOW OPTION command must also be invoked. (SHADOW defaults to option STRIP.)

3.1 COMMAND SET FOR THE REX DIAGNOSTICS

The command set for the REX diagnostics is summarized in Table 3.1. Descriptions of the individual commands follow in paragraphs 3.1.1 through 3.1.39. Each description consists of a metalinguistic definition of the command, using the Backus-Naur/Normal Form (BNF), followed by discussion and examples.

NOTE

A metalanguage is a set of symbols and associated conventions for defining exhaustively the syntax of another language. BNF notation is a metalanguage devised and commonly in use for the description of programming languages. For that reason, it is employed here. The conventions observed by BNF notation are further explained in the NonStop II Diagnostic Operating Procedures, Part Number 82803, Appendix A.

PART 1G - REX4103/REX4104/REX4105/REX4109/REX4110/REX4116 COMMANDS

Table 3.1 Command Set for the REX Diagnostics (REX4103, REX4104, and REX41105, REX4109, REX4110, and REX4116)

COMMAND	FUNCTION	PARAMETER	DEFAULT
AP	Alter run parameters	N/A	N/A
CC	Run CHECK command for whole cylinder	cylinder number	current
CF	Check flags	N/A	N/A
CN	Issue control request to disc	function	0
CP	Compare READ$ and WRITE$ buffers	number of bytes	512
CS	Check surface	N/A	N/A
CY	Set current disc cylinder address	cylinder number	0
DL	Defect list	N/A	N/A
DR	Dump READ$ buffer to terminal	N/A	N/A
DS	Dump Interrupt Status	N/A	N/A
DW	Dump WRITE$ buffer to terminal	N/A	N/A
EM	Execute stored command string	N/A	N/A
EW	Edit the WRITE$ buffer	first byte number	0
EX	Exit exerciser	N/A	N/A
HD	Set current disc head address	head number	0
* HP	HELP	N/A	N/A

* The HELP command is no longer supported on any of the REX diagnostics due to space limitations. However, the syntax of the HELP command is still recognized as legal in all programs except REX4116. Refer to paragraph 3.1.16 for a description of the message generated by an attempt to execute HELP.

Table 3.1 Command Set for the REX Diagnostics
(Cont'd)

COMMAND	FUNCTION	PARAMETER	DEFAULT
LH	List headers for whole cylinder	N/A	N/A
LL	Loop command sequence	number of times	1
MV	Move data between buffers	N/A	N/A
PT	Initialize patterns in buffers	N/A	N/A
RB	Read buffer	N/A	N/A
RD	Read from current disc address	number of bytes	512
** RF	Read full sector to current address	number of sectors	1
RR	Read/print current controller registers	N/A	N/A
SC	Set current disc sector address	sector number	0
SK	Seek to current disc address	N/A	N/A
SM	Store last command string	N/A	N/A
TT	Take ownership	N/A	N/A
** WF	Write full sector to current address	N/A	N/A
WS	Write surface	flag	-1
WT	Write to current disc address	number of bytes	512

** These commands (RF and WF) assume physical addressing and ignore sector-skipping format.

Table 3.1 Command Set for the REX Diagnostics
(Cont'd)

COMMAND	FUNCTION	PARAMETER	DEFAULT
XA	Random position and read with no transfer	number of times	10,000
XB	Random position and read with no checksum	number of times	10,000
XC	Random position and read with no transfer and verify	number of times	10,000
XD	Random position and reposition	number of times	10,000
XE	Random position and read with transfer	number of times	10,000
XF	Random position and read with transfer and checksum	number of times	10,000
YA	MAXCYL random write/read/verify	number of times	10,000
YB	Random write/read/verify	number of times	10,000

3.1.1 AP - ALTER RUN PARAMETERS Command

The form of the ALTER RUN PARAMETERS command is as follows:

alter_run_parameters_command ::= AP

Execution of the ALTER RUN PARAMETERS command (AP) enables the user to alter the following run parameters:

a. Delay after error: the default setting is bit <0> of special numeric G9# set to 0 (delay disabled). The alternative is bit <0> set to 1 (delay enabled).

b. Stop on error: the default setting is bit <1> of special numeric G9# set to 0 (stop disabled). The alternative is bit <1> set to 1 (stop enabled).

c. Access to defect log: the default setting is bit <2> of special numeric G9# set to 0 (access disabled). The alternative is bit <2> set to 1 (access enabled).

d. Enable/disable write/read/verify testing: the default setting is bit <3> of the special numeric G9# set to 0 (write/read/verify testing disabled). The alternative is bit <3> set to 1 (write/read/verify testing enabled.)

Refer to Table 3.2 for the format of the run parameter display and for a description of the prompts for input displayed during command execution.

Example:

```
AP                    ! enables alteration of run parameters
```

Table 3.2 Prompts Displayed During Execution of the ALTER RUN PARAMETERS Command

SCREEN DISPLAY	EXPLICATION
*** RUN CONTROL PARAMETERS *** -DELAY AFTER ERROR: x -STOP ON ERROR: x -ENABLE DEFECT LOG ACCESS: x RANDOM WRITE/READ/VERIFY ENABLE: x <RETURN> TO CONTINUE, ANY CHAR TO ALTER	List of the current status of the run parameters displayed when the command is first executed. The last line of the display prompts for user input. If the user elects not to alter, no parameters are changed and the program prompts for the next command input. If the user elects to alter, new settings (whether actual changes or not) must be recorded for each parameter. The program then prompts individually for these settings.
-DELAY AFTER ERROR (Y/N) ?	Prompt requesting that the setting for DELAY AFTER ERROR be specified. A user response of Y enables DELAY AFTER ERROR; a user response of N disables DELAY AFTER ERROR.
-STOP ON ERROR (Y/N) ?	Prompt requesting that the setting for STOP ON ERROR be specified. A user response of Y enables STOP ON ERROR; a user response of N disables it.
-ENABLE DEFECT LOG ACCESS (Y/N) ?	Prompt requesting that the setting for ENABLE DEFECT LOG ACCESS be specified. A user response of Y enables DEFECT LOG ACCESS; a user response of N disables it.
-ENABLE RANDOM WRITE/READ/VERIFY (Y/N) ?	Prompt requesting that the setting for ENABLE RANDOM WRITE/READ/VERIFY be specified. A user response of Y enables RANDOM WRITE/READ/VERIFY; a user response of N disables it. When the user specification for this setting is received, the program displays the updated values of the run parameters, in the initial format, again allowing for alteration. If the user elects to alter again, the prompts for the individual parameters are repeated. If the user elects to continue, the program simply prompts for the next command input.

T16/8L11G-02

3.1.2 CC - CHECK CYLINDER Command

The form of the CHECK CYLINDER command is as follows:

```
check_cylinder_command  ::=  CC [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to MAXCYL
  MAXCYL  ::=  { 814 | 822 | 842 }
```

Execution of the CHECK CYLINDER command (CC) causes the controller to scan all sectors on the cylinder indicated in the parameter, looking for header and data errors. The results are reported in the READ$ buffer, and defects are displayed at the OSP terminal. (Refer to Table 4.4 for the special error message generated if a seek error occurs during command execution.)

If no cylinder number is specified, the parameter defaults to the current cylinder (i.e., the cylinder most recently accessed by preceding commands). The legal range for the parameter is [0,MAXCYL]. (Refer to Table 4.1 for the possible values of MAXCYL.)

The format of the defect display is as follows:

```
                    DEFECTS FOR CYLINDER xxx

          TERM (%B)                HEAD   SECTOR
%Bx xxx xxx xxx xxx xxx   xx       xx
%Bx xxx xxx xxx xxx xxx   xx       xx
    .    .    .    .    .    .    .
%Bx xxx xxx xxx xxx xxx   xx       xx
```

NOTE

The relevant error codes (in octal) returned in column TERM are: %02 - correctable data error; %11 - uncorrectable data error; %14 - header search failure.

Examples:

```
CY25,CC          ! defaults to cylinder 25 (the previously
                 ! designated current cylinder) and causes all
                 ! sectors on cylinder 25 to be scanned for
                 ! header and data errors
                 !
CC351            ! causes all sectors on cylinder 351 to be
                 ! scanned for header and data errors
```

3.1.3 CF - CHECK FLAGS Command

The form of the CHECK FLAGS command is as follows:

check_flags_command ::= CF

Execution of the CHECK FLAGS command (CF) causes the controller to scan all headers on the media, validating the header flags. (Note that this flag check is not performed by the CHECK CYLINDER or the CHECK SURFACE command.) Sectors with invalid flags are entered in the copy of the defect list currently assigned for storing run-related defects. The program delays after the display of invalid sector flags for each cylinder (unless the user has disabled DELAY AFTER ERROR with the ALTER RUN PARAMETERS command).

Refer to Table 3.3 for a description of the screen displays that accompany normal command execution. Refer to Table 4.4 for a description of the error messages that may be displayed during command execution.

The following flags are accepted as valid by the program:

a. %350 - valid sector with logical address in header

b. %351 - defective sector with previous logical address

c. %352 - invalid data; return from extension

d. %353 - unused sector with previous logical address

e. %354 - valid sector at end of physical track

f. %355 - defective sector at end of physical track

g. %356 - invalid data; jump per address to extension

h. %357 - last unused sector with previous logical address

Example:

```
CF                    ! scans and validates all header flags
                      ! on the media
```

Table 3.3 Prompts Displayed During Execution of the CHECK FLAGS Command

SCREEN DISPLAY	EXPLICATION
PHEAD PSECT SYNC% FLAG% CYL HEAD SECT xx xx xxx xxx xxx xx xx	Format in which sector information is displayed if an invalid header flag is encountered on any cylinder. The program then checks whether the defective sector is already recorded on DLCYL and, if not, attempts to add it to the copy of the defect list currently assigned for storing run defects. The process of displaying invalid header flags and entering the defective sectors in the defect list is repeated for up to twenty invalid flags.
<RETURN> TO CONTINUE DUMP OR ANY CHAR TO STOP	Prompt displayed if a full twenty invalid flags are encountered, requesting that the user indicate whether to continue or to terminate the display. If the user elects to continue with the listing of invalid header flags, information for as many as twenty more headers is displayed in the same format. This procedure continues for each set of twenty headers until all invalid headers are displayed or until the user terminates command execution.
*** COMPLETED CYL xxx PUN xxx ***	Message displayed as the cylinder-by-cylinder check of header flags completes on every twentieth cylinder.

T16/8L11G-03

3.1.4 CN - SEND CONTROL Command

The form of the SEND CONTROL command is as follows:

```
send_control_command  ::=  CN [parameter]

  parameter  ::=  integer_constant
  integer_constant   ::=  { 0 | 1 | 2 | 4 | 8 | 16 | 32 | 64 | 128 }
```

Execution of the SEND CONTROL command (CN) causes the function request indicated in the parameter to be sent to the controller. If no function is specified, the parameter defaults to zero (0). The valid function requests are listed in Table 3.4.

Example:

```
CN64                    ! issues a RECALIBRATE to the controller
```

Table 3.4 Function Requests Recognized by SEND CONTROL Command

PARAMETER	BIT	OCTAL EQUIVALENT	FUNCTION
128	8	%200	Data Strobe Early
64	9	%100	Recalibrate
32	10	%40	Unit Release
16	11	%20	Priority Select
8	12	%10	Servo Offset Minus
4	13	%4	Servo Offset Plus
2	14	%2	Unit Clear
1	15	%1	Data Strobe Late
0	-	0	No operation

3.1.5 CP - COMPARE BUFFERS Command

The form of the COMPARE BUFFERS command is as follows:

```
compare_buffers_command  ::=  CP [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to 4095
```

Execution of the COMPARE BUFFERS command (CP) causes a standard SHADOW COMPARE statement to be executed on the contents of the READ$ and WRITE$ buffers. The number specified in the parameter determines the number of bytes compared. If no number is specified, the parameter defaults to 512. Only the first ten miscompares are listed. The legal range for the parameter is [0,4095]. For a description of the SHADOW COMPARE statement, refer to the Diagnostic Languages Manual, Part Number 82848.

Examples:

```
WT,RD,CP            ! performs a SHADOW COMPARE operation on 512
                    ! bytes of the READ$ and WRITE$ buffers
                    !
WT100,RD100,CP100   ! performs a SHADOW COMPARE operation on 100
                    ! bytes of the READ$ and WRITE$ buffers
```

3.1.6 CS - CHECK SURFACE Command

The form of the CHECK SURFACE command is as follows:

check_surface_command ::= CS

Execution of the CHECK SURFACE command (CS) causes the controller to scan all sectors on the media for header and data errors. (Note that while this command checks header data, it does not check the header flag. For header flag validation, the CHECK FLAGS command must be used.)

Sectors reporting defects are displayed at the OSP terminal and entered in the memory defect list currently assigned for storing run-related defects. Refer to Table 3.5 for a description of the screen displays that occur during normal command execution, and to Table 4.4 for a description of the special error messages that can be generated.

Example:

```
CS                    ! causes all sectors on the media to be
                      ! scanned for header and data errors
```

Table 3.5 Prompts Displayed During Execution of the CHECK SURFACE Command

SCREEN DISPLAY	EXPLICATION
*** CHECKING SURFACE WITH ´CHECK´ COMMAND ***	Message displayed when the command is first executed.
DEFECTS FOR CYLINDER xxx TERM (%B) HEAD SECTOR %Bx xxx xxx xxx xxx xxx xx xx %Bx xxx xxx xxx xxx xxx xx xx . . . . . . %Bx xxx xxx xxx xxx xxx xx xx	Format in which any defects found on any cylinder are reported. The relevant error codes (in octal) returned in column TERM are: %02 - correctable data error %11 - uncorrectable data error %14 - header search failure.
*** COMPLETED CYL xxx PUN xxx ***	Message displayed when the cylinder-by-cylinder check completes on every twentieth cylinder.

T16/8L11G-04

3.1.7 CY - SET CYLINDER Command

The form of the SET CYLINDER command is as follows:

```
set_cylinder_command  ::=  CY [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to MAXCYL
  MAXCYL  ::=  { 814 | 822 | 842 }
```

Execution of the SET CYLINDER command (CY) causes the address of the current cylinder to be set to the number specified in the parameter. If no cylinder number is specified, the parameter defaults to zero (0). The legal range of values for the parameter is [0,MAXCYL]. (Refer to Table 4.1 for the possible values of MAXCYL.)

Examples:

```
CY                  ! sets the current cylinder address to 0
                    !
CY101               ! sets the current cylinder address to 101
```

3.1.8 DL - DEFECT LIST Command

The form of the DEFECT LIST command is as follows:

defect_list_command ::= DL

Execution of the DEFECT LIST command (DL) enables the user to perform one of the following operations involving the two copies of the defect list maintained on DLCYL:

a. Display copy 1

b. Display copy 2

c. Duplicate copy 1 on copy 2

d. Duplicate copy 2 on copy 1

e. Reset copy 1

f. Reset copy 2

g. Save run data on copy 1

h. Save run data on copy 2

i. Merge copy 1 into copy 2

j. Merge copy 2 into copy 1.

Refer to Table 3.6 for a description of the screen displays that occur during normal command execution. Refer to Table 4.3 for a description of the error messages that may be displayed during command execution.

Example:

```
DL                    ! allows the user to perform certain operations
                      ! involving the memory defect list
```

Table 3.6 Prompts Displayed During Execution of the DEFECT LIST Command

SCREEN DISPLAY	EXPLICATION
WARNING: DL ACCESS NOT ALLOWED	Message displayed when the command is executed if access to the defect list is disabled in the run parameters. The program then prompts for the next command input.
*** DEFECT LIST ACCESS OPTIONS *** # OPTION ---------- 0 DISPLAY COPY #1 1 DISPLAY COPY #2 2 COPY #1 ON #2 3 COPY #2 ON #1 4 RESET COPY #1 5 RESET COPY #2 6 SAVE RUN DATA IN COPY #1 7 SAVE RUN DATA IN COPY #2 8 MERGE COPY #1 INTO COPY #2 9 MERGE COPY #2 INTO COPY #1 ENTER #, <RETURN> TO STOP	Format in which command options are displayed if access to the defect list is enabled. The last line of the display prompts the user to select a procedure. When the selected procedure is completed, list of command options is again displayed and the user invited to select another procedure. This process continues until the user elects to stop. The program then prompts for the next command input.
# CYL HEAD SECT OS - VER 0 xxx xx xx %xxx %xxx 1 xxx xx xx %xxx %xxx . . . . . . 15 xxx xx xx %xxx %xxx <RETURN> TO CONTINUE, ANY CHAR TO STOP	Format in which the contents of DLCYL are displayed if the user elects to display either copy 1 or copy 2. After the first 16 entries in the defect list are displayed, the user is invited to continue or to stop. If the user elects to continue, the program displays the next 16 defects in the same format and again prompts for instruction to continue or to stop. When the user elects to stop the defect display or when all defects are displayed, the program redisplays the original access options, allowing another user selection. If the user elects not to access another option, the program prompts for the next command input.

T16/8L11G-05

3.1.9 DR - DUMP READ$ Command

The form of the DUMP READ$ command is as follows:

dump_read$_command ::= DR

Execution of the DUMP READ$ command (DR) causes the contents of the READ$ buffer to be displayed at the OSP terminal. Execution of the command generates certain requests for input (size of buffer, dump mode). User response determines the format of the display. Refer to Table 3.7 for a description of the screen displays that occur during command execution.

Example:

```
DR                    ! displays the contents of the READ$ buffer
                      ! as specified by user response to the
                      ! requests for input generated by the command
```

Table 3.7 Messages Displayed during Execution of the DUMP READ$ Command

SCREEN DISPLAY	EXPLICATION
SIZE OF BUFFER IN BYTES	Prompt requesting the user to indicate the number of bytes in the buffer. A user input between 1 and 4095 is expected.
INPUT DUMP MODE: A(SCII) OR O(CTAL)	Prompt requesting the user to indicate the mode in which the buffer contents are to be displayed. A user response of A causes the contents of the data buffer to be displayed in ASCII; a user response of O causes the contents of the data buffer to be displayed in octal.
CHECKSUM BUFFER xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx	Format for display of contents of the checksum buffer.
DATA BUFFER %xxxxxxxx : y PRESS RETURN TO CONTINUE DUMP, ANY CHARACTER TO STOP	Format for address-by-address display of contents of the data buffer if the selected dump mode is ASCII. The contents of the data buffer are displayed address by address as long as the user elects to continue or until the entire buffer is displayed. The program then prompts for the next command input.
DATA BUFFER %xxxxxxxx : yyyyyyyy yyyyyyyy yyyyyyyy yyyyyyyy yyyyyyyy yyyyyyyy yyyyyyyy yyyyyyyy PRESS RETURN TO CONTINUE DUMP, ANY CHARACTER TO STOP	Format for address-by-address display of contents of the data buffer if the selected dump mode is octal. The contents of the data buffer are displayed address by address as long as the user elects to continue or until the entire buffer is displayed. The program then prompts for the next command input.

T16/BL11G-06

3.1.10 DS - DUMP INTERRUPT STATUS Command

The form of the DUMP INTERRUPT STATUS command is as follows:

dump_interrupt_status_command ::= DS

Execution of the DUMP INTERRUPT STATUS command (DS) causes the interrupt status to be displayed at the OSP terminal. The format of the display is as follows:

```
INT. STATUS IS:  %B x xxx xxx x
INT. CAUSE  IS:  %B x xxx xxx xxx xxx xxx
```

Example:

```
DS                    ! displays interrupt status
```

3.1.11 DW - DUMP WRITE$ Command

The form of the DUMP WRITE$ command is as follows:

dump_write$_command ::= DW

Execution of the DUMP WRITE$ command (DW) causes the contents of the WRITE$ buffer to be displayed at the OSP terminal. Execution of the command generates certain requests for input (size of buffer, dump mode). User response determines the format of the display. Refer to Table 3.8 for a description of the screen displays that occur during command execution.

Example:

```
DW              !  displays the contents of the WRITE$ buffer
                !  as specified by user response to the
                !  requests for input generated by the command
```

Table 3.8 Messages Displayed during Execution of the DUMP WRITE$ Command

SCREEN DISPLAY	EXPLICATION
SIZE OF BUFFER IN BYTES	Prompt requesting the user to indicate the number of bytes in the buffer. A user input between 1 and 4095 is expected.
INPUT DUMP MODE: A(SCII) OR O(CTAL)	Prompt requesting the user to indicate the mode in which the buffer contents are to be displayed. A user response of A causes the contents of the data buffer to be displayed in ASCII; a user response of O causes the contents of the data buffer to be displayed in octal.
CHECKSUM BUFFER xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx	Format for display of contents of the checksum buffer.
DATA BUFFER %xxxxxxxx : y PRESS RETURN TO CONTINUE DUMP, ANY CHARACTER TO STOP	Format for address-by-address display of contents of the data buffer if the selected dump mode is ASCII. The contents of the data buffer are displayed address by address as long as the user elects to continue or until the entire buffer is displayed. The program then prompts for the next command input.
DATA BUFFER %xxxxxxxx : yyyyyyyy yyyyyyyy yyyyyyyy yyyyyyyy yyyyyyyy yyyyyyyy yyyyyyyy yyyyyyyy PRESS RETURN TO CONTINUE DUMP, ANY CHARACTER TO STOP	Format for address-by-address display of contents of the data buffer if the selected dump mode is octal. The contents of the data buffer are displayed address by address as long as the user elects to continue or until the entire buffer is displayed. The program then prompts for the next command input.

T16/8L11G-07

3.1.12 EM - EXECUTE MEMORY Command

The form of the EXECUTE MEMORY command is as follows:

execute_memory_command ::= EM

Execution of the EXECUTE MEMORY command (EM) causes the last command string saved in memory by the SM command (refer to paragraph 3.1.27) to be displayed and reexecuted. If no string is currently stored when the command is executed, the following message is displayed:

** NO STRING STORED **

Example:

```
CY10,SK,SM,EM          ! reexecutes the command string "CY10,SK"
                       ! stored in memory by the preceding STORE
                       ! MEMORY command
```

3.1.13 EW - EDIT WRITE$ Command

The form of the EDIT WRITE$ command is as follows:

```
edit_write$_command  ::=  EW [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to 4095
```

The EDIT WRITE$ command (EW) allows the operator to edit the WRITE$ buffer starting with the byte number specified in the parameter. If no byte number is specified, the parameter defaults to zero (0). The legal range of values for the parameter is [0,4095]. A new value may be entered for each byte in the specified range; the value for a given byte is left unchanged if an empty response is received (i.e., if a carriage return alone is entered). An entry of negative one (-1) terminates the edit. Refer to Table 3.9 for a description of the screen displays that occur during command execution.

Examples:

```
EW                  ! initiates an edit of the WRITE$ buffer
                    ! starting with byte 0
                    !
EW130               ! initiates an edit of the WRITE$ buffer
                    ! starting with byte 130
```

Table 3.9 Messages Displayed during Execution of the EDIT WRITE$ Command

SCREEN DISPLAY	EXPLICATION
BYTE # xxxx = % yyyyyyyy **INPUT NEG. VALUE TO ESCAPE **	Prompt requesting the user to input a new value for the specified byte. The byte # specified by the prompt is that specified in the EDIT WRITE$ parameter. When the new value is received, the program displays the updated value (see description of next message) and then prompts for a new value for the next byte number in the WRITE$ buffer. This process is repeated for all following bytes in the buffer, or until a negative value is entered to terminate the edit. When the user terminates the edit, the program prompts for the next command input.
NEW VALUE = % xxxxxxxx	Message displayed when the new value for the specified byte is received.

3.1.14 EX - EXIT Command

The form of the EXIT command is as follows:

exit_command ::= EX

Execution of the EXIT command (EX) causes exerciser mode to terminate and the program to reinitialize, allowing a new controller and disc number to be specified for testing.

Example:

```
EX                    ! terminates exerciser mode for the device
                      ! under test and returns to program
                      ! initialization for selection of another
                      ! device for testing
```

3.1.15 HD - SET HEAD Command

The form of the SET HEAD command is as follows:

```
set_head_command  ::=  HD [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to MAXHEAD
  MAXHEAD  ::=  { 4 | 9 | 18 | 39 }
```

Execution of the SET HEAD command (HD) causes the address of the current head to be set to the number specified in the parameter. If no number is specified, the parameter defaults to head number zero (0). The legal range of values for parameter is [0,MAXHEAD]. (Refer to Table 4.1 for the possible values of MAXHEAD.)

Examples:

```
  HD                    ! sets the current head address to 0
                        !
  HD1                   ! sets the current head address to 1
```

3.1.16 HP - HELP Command

The form of the HELP command is as follows:

help_command ::= HP

The HELP command (HP), originally designed to display a brief description of the available commands at the OSP terminal, is not supported due to space limitations. Execution of the HELP command results instead in the display of a brief statement to that effect, followed by display of the current status of the run control parameters. The format of the display is as follows:

```
*** HELP NOT SUPPORTED DUE TO SPACE LIMITATIONS ***

*** RUN CONTROL PARAMETERS ***

-DELAY AFTER ERROR:                x
-STOP ON ERROR:                    x
-ENABLE DEFECT LOG ACCESS:         x
RANDOM WRITE/READ/VERIFY ENABLE:   x
```

> CAUTION
>
> REX4116 does not accept the HELP command as legal syntax. An attempt to execute the HELP command in REX4116 generates an ILLEGAL SYNTAX error.

Example:

```
HP                    ! displays current status of run control
                      ! parameters
```

3.1.17 LH - LIST HEADERS Command

The form of the LIST HEADERS command is as follows:

```
list_headers_command  ::=  LH [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to MAXHEAD
  MAXHEAD  ::=  { 4 | 9 | 18 | 39 }
```

Execution of the LIST HEADERS command (LH) causes the headers for a whole cylinder to be listed. The command defaults to the current cylinder set in the control program. If a parameter is specified, it is interpreted as a starting head address. The legal range of values for parameter is [0,MAXHEAD]. (Refer to Table 4.1 for the possible values of MAXHEAD.) When the command is executed, information for the first twenty headers is listed in the following format:

```
PHEAD   PSECT   SYNC%   FLAG%   CYL   HEAD   SECT
 xx      xx      xxx     xxx    xxx    xx     xx
 xx      xx      xxx     xxx    xxx    xx     xx
  .       .       .       .      .      .      .
 xx      xx      xxx     xxx    xxx    xx     xx

<RETURN> TO CONTINUE DUMP OR ANY CHAR. TO STOP
```

If the user elects to continue with the listing of headers, the information for the next twenty headers is displayed in the same format. This procedure continues for each set of twenty headers until all headers are displayed or until the user terminates command execution.

Examples:

```
CY10,LH          ! causes the headers for cylinder 10 to be
                 ! listed
                 !
CY10,LH4         ! causes the headers for cylinder 10 to be
                 ! listed, starting at head 4.
```

3.1.18 LL - LOOP Command

The form of the LOOP command is as follows:

```
loop_command  ::=  LL [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to 4095
```

Execution of the LOOP command (LL) causes the sequence of commands bounded by the start of the command string (or by a previous LOOP command in the string) to be repeated. The number of times the command string is to be repeated is specified in the parameter. If no number of repetitions is specified, the parameter defaults to 1. The legal range for the parameter is [0,4095].

Examples:

```
CY10,SK,CY20,SK,LL    ! loops the preceding sequence of commands one
                      ! time
                      !
CY10,SK,CY20,SK,LL10  ! loops the preceding sequence of commands 10
                      ! times
```

3.1.19 MV - MOVE Command

The form of the MOVE command is as follows:

move_command ::= MV

Execution of the MOVE command (MV) causes either the contents of the READ$ buffer to be moved to the WRITE$ buffer or the contents of the WRITE$ buffer to be moved to the READ$ buffer. When the command executes, the program prompts for input to determine which buffer is to be moved. Refer to Table 3.10 for a description of the screen displays that accompany command execution.

Example:

```
MV                    ! moves the contents of one buffer to the other
```

Table 3.10 Prompts Displayed during Execution of the MOVE Command

SCREEN DISPLAY	EXPLICATION
ENTER 0 TO MOVE WRITE$ TO READ$; ENTER 1 TO MOVE READ$ TO WRITE$	Initial prompt when command executes, requesting the user to indicate which buffer is to be moved. A user input of 0 causes the contents of WRITE$ to be placed in READ$. A user input of 1 causes the contents of READ$ to be placed in WRITE$.
ENTER BYTECOUNT, 1 TO 4095	Prompt for the number of bytes to be moved. This prompt follows user response to the initial prompt.

T16/8L11G-09

3.1.20 PT - INITIALIZE PATTERN Command

The form of the INITIALIZE PATTERN command is as follows:

initialize_pattern_command ::= PT

Execution of the INITIALIZE PATTERN command (PT) causes a repeating test pattern to be stored in either the READ$ or the WRITE$ buffer. Execution of the command requires user response to several requests for input (buffer to be modified, input mode, pattern). The user must enter from 0 to 16 integers in the range [0,255] or a character string up to 72 ASCII characters in length. Carriage return alone terminates the input. The data entered is repeated as necessary to fill the entire READ$ or WRITE$ buffer. Refer to Table 3.11 for a description of the prompts for input displayed during command execution.

Example:

```
PT                    ! causes a repeating pattern to be stored in
                      ! the buffer as specified by user response
                      ! to certain prompts
```

Table 3.11 Prompts Displayed during Execution of the INITIALIZE PATTERN Command

SCREEN DISPLAY	EXPLICATION
INPUT BUFFER TO MODIFY: R(EAD) OR W(RITE) OR C(HECKSUM)	Prompt requesting that the user indicate the name of the buffer to be modified. The expected user response is R, W, or C.
INPUT MODIFYING MODE: A(SCII) OR O(CTAL)	Prompt requesting that the user indicate the mode by which the specified buffer (see description of preceding message) is to be modified. A user response of A causes the contents of the previously specified buffer to be modified in ASCII; a user response of O causes the contents of the previously specified buffer to be modified in octal.
INPUT ASCII STRING	Prompt, if the specified mode is ASCII, requesting that the user enter the ASCII string with which the buffer is to be modified. When the user response is received, the buffer is modified.
INPUT, IN OCTAL, DATA PATTERNS	Prompt, if the specified mode is octal, requesting that the user enter the data patterns with which the buffer is to be modified. When the user response is received, the buffer is modified.

T16/8L11G-10

3.1.21 RB - READ BUFFER Command

The form of the READ BUFFER command is as follows:

read_buffer_command ::= RB

Execution of the READ BUFFER command (RB) reads the contents of the controller buffer and places it in the READ$ buffer. Refer to Table 3.12 for a description of the prompts for input displayed during command execution.

Example:

```
RB                    ! reads the contents of the controller buffer
                      ! and places it in READ$
```

Table 3.12 Prompts Displayed during Execution of the READ BUFFER Command

SCREEN DISPLAY	EXPLICATION
ENTER FIRST ADDRESS TO READ	Prompt requesting that the user enter the buffer address at which to begin the read operation. An address between 0 and 4095 is expected.
ENTER BYTECOUNT	Prompt requesting that the user enter the number of bytes to be read starting at the specified address. A number between 1 and 4096 is expected.

T16/8L11G-11

3.1.22 RD - READ Command

The form of the READ command is as follows:

```
read_command  ::=  RD [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to 4095
```

Execution of the READ command (RD) causes a read to be performed to the sector addressed by the last SEEK command (SK). The address used for seek operations is that set by one of several possible prior commands (CY, HD, SC, CC, LH, or EM). If a SEEK command has not been performed, the sector or sectors addressed depend on the state of the controller registers. The number of bytes to be read is specified in the parameter. If no number is specified, the parameter defaults to 512. The legal range of values for the parameter is [0,4095].

Examples:

```
CY,HD,SC,SK,RD        ! reads 512 bytes of data starting at address
                      ! 0,0,0
                      !
CY,HD,SC,SK,RD100     ! reads 100 bytes of data starting at address
                      ! 0,0,0
```

3.1.23 RF - READ FULL SECTOR Command

The form of the READ FULL SECTOR command is as follows:

```
read_full_sector_command  ::=  RF [parameter]

 parameter  ::=  integer_constant
 integer_constant  ::=  number within the range 0 to 7
```

Execution of the READ FULL SECTOR command (RF) causes a full-sector READ to be performed at the sector addressed by the last SEEK command (SK). The address used for seek operations is that set by one of several possible prior commands (CY, HD, SC, CC, LH, or EM). If a SEEK command has not been performed, the sector or sectors addressed depend on the state of the controller registers. The number of sectors to be read is specified in the parameter. If no number is specified, the parameter defaults to 1. The legal range of values for the parameter is [0,7]. The READ FULL SECTOR command assumes physical addressing and ignores sector skipping.

Examples:

```
CY,HD,SC,SK,RF        ! reads one full sector starting at address
                      ! 0,0,0
                      !
CY,HD,SC,SK,RF2       ! reads 2 full sectors starting at address
                      ! 0,0,0
```

3.1.24 RR - READ REGISTERS Command

The form of the READ REGISTERS command is as follows:

read_registers_command ::= RR

Execution of the READ REGISTERS command (RR) causes the current contents of the controller registers to be displayed at the OSP terminal. The format of this display is as follows:

```
CONTENTS OF CONTROLLER REGISTERS
CYL =  xxx   HEAD =  xx   SECT =  xx
FLAGS =  % x xxx xxx xxx xxx xxx
SECTOR COUNT =  xxx
BUFADD = xxxx
```

CYL/HEAD/SECT reflects the disc address of the sector accessed by the command; FLAGS returns the value of the header flag in the accessed sector (refer to paragraph 3.1.3); COUNT reflects the bytecount returned by the operation; and BUFADD reflects the current address of the controller buffer.

Example:

```
RR                    ! displays the contents of the controller
                      ! registers
```

3.1.25 SC - SET SECTOR Command

The form of the SET SECTOR command is as follows:

```
set_sector_command  ::=  SC [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to MAXSECT
  MAXSECT  ::=  { 19 | 29 }
```

Execution of the SET SECTOR command (SC) causes the address of the current sector to be set to the number specified in the parameter. If no number is specified, the parameter defaults to sector number zero (0). The legal range of values for parameter is [0,MAXSECT]. (Refer to Table 4.1 for the possible values of MAXSECT.)

Examples:

```
SC                  ! sets the current sector address to 0
                    !
SC10                ! sets the current sector address to 10
```

3.1.26 SK - SEEK Command

The form of the SEEK command is as follows:

seek_command ::= SK

Execution of the SEEK command (SK) causes a seek operation to be performed to the current disc address. This address is established by one of several possible prior commands (CY, HD, SC, CC, LH, or EM).

Example:

```
CY,HD,SC,SK          ! seeks to address 0,0,0
```

3.1.27 SM - STORE MEMORY Command

The form of the STORE MEMORY command is as follows:

store_memory_command ::= SM

Execution of the STORE MEMORY command (SM) causes the last command string without syntactical errors to be saved for possible later reexecution. Commands that require user interaction or that contain parameters may be included. Only one command string may be in memory at any given time.

Example:

```
CY10,SK,SM          ! saves the command string "CY10,SK" for later
                    ! reexecution
```

3.1.28 TT - TAKE OWNERSHIP Command

The form of the TAKE OWNERSHIP command is as follows:

take_ownership_command ::= TT

Execution of the TAKE OWNERSHIP command (TT) causes the diagnostic to take ownership of the device under test.

Example:

```
TT                    ! takes ownership of the device under test
```

3.1.29 WF - WRITE FULL SECTOR Command

The form of the WRITE FULL SECTOR command is as follows:

write_full_sector_command ::= WF

Execution of the WRITE FULL SECTOR command (WF) causes a full-sector write to be performed at the sector addressed by the last SEEK command (SK). The address used for seek operations is that set by one of several possible prior commands (CY, HD, SC, CC, LH, or EM). If a SEEK command has not been performed, the sector or sectors addressed depend on the state of the controller registers. The WRITE FULL SECTOR command assumes physical addressing and ignores sector skipping. (For a description of the special error message generated if command execution results in a WRITE to DLCYL, refer to Table 4.4.)

Examples:

```
CY,HD,SC,WF          ! writes one full sector starting at address
                     ! 0,0,0
                     !
CY,HD,SC,WF2         ! writes 2 full sectors starting at address
                     ! 0,0,0
```

3.1.30 WS - WRITE SURFACE Command

The form of the WRITE SURFACE Command is as follows:

```
write_surface_command  ::=  WS [parameter]

  parameter  ::= integer_constant
  integer_constant  ::=  any positive or negative integer
```

Execution of the WRITE SURFACE command (WS) causes data to be written on all cylinders with proper checksums. The source of the data to be written is determined by the parameter. If no parameter (or a negative integer) is specified, the program uses whatever data currently exist in the WRITE$ buffer. (The WRITE$ buffer may be filled with a specific pattern by a previously executed INITIALIZE PATTERNS command.) If a positive integer is specified, the program generates a random data buffer for use in writing on the media. As the cylinder-by-cylinder check proceeds, the following message is displayed after every twentieth cylinder is checked:

```
*** COMPLETED CYL xxx  PUN xxx  ***
```

(Refer to Table 4.4 for a description of the special error messages that may be displayed during command execution.)

Examples:

```
WS                  ! writes on the media using whatever pattern
                    ! exists in WRITE$
                    !
WS1                 ! writes on the media using a pattern from a
                    ! randomly generated data buffer
```

3.1.31 WT - WRITE Command

The form of the WRITE command is as follows:

```
write_command  ::=  WT [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number in the range 0 to 4095
```

Execution of the WRITE command (WT) causes a write to be performed to the sector addressed by the last SEEK command (SK). The address used for seek operations is that set by one of several possible prior commands (CY, HD, SC, CC, LH, or EM). If a SEEK command has not been performed, the sector or sectors addressed depend on the state of the controller registers. The number of bytes to be written is specified in the parameter. If no number is specified, the parameter defaults to 512. The legal range of values for the parameter is [0,4095]. (For a description of the special error message generated if command execution results in an attempt to write to DLCYL, refer to Table 4.4.)

Examples:

```
CY,HD,SC,WT          ! writes 512 bytes of data starting at address
                     ! 0,0,0
                     !
CY,HD,SC,WT100       ! writes 100 bytes of data starting at address
                     ! 0,0,0
```

3.1.32 XA - RANDOM POSITION/READ WITH NO TRANSFER Command

The form of the RANDOM POSITION/READ WITH NO TRANSFER command is as follows:

```
random_position/read_with_no_transfer_command  ::=  XA [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to 4095
```

Execution of the RANDOM POSITION/READ WITH NO TRANSFER command (XA) causes a random disc address and bytecount to be selected. The disc is then positioned at the selected address and a READ WITH NO TRANSFER command issued for the specified bytecount. If an error is detected, the prior disc address and bytecount are reported along with the bad disc address and bytecount, and the disc is recalibrated. The value specified in the parameter determines the number of times this set of operations is performed. If no value is specified, the parameter defaults to 10,000. The legal range of values for the parameter is [0,4095]. (Refer to Table 4.4 for a description of the error messages that may be displayed during command execution.)

Examples:

```
  XA                  ! performs 10,000 RANDOM POSITION/READ WITH NO
                      ! TRANSFER commands
  XA100               ! performs 100 RANDOM POSITION/READ WITH NO
                      ! TRANSFER commands
```

3.1.33 XB - RANDOM POSITION/READ WITH NO CHECKSUM Command

The form of the RANDOM POSITION/READ WITH NO CHECKSUM command is as follows:

```
random_position/read_with_no_checksum_command  ::=  XB [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to 4095
```

Execution of the RANDOM POSITION/READ WITH NO CHECKSUM command (XB) causes a random disc address and bytecount to be selected. The disc is then positioned at the selected address and a READ WITH NO CHECKSUM command issued for the specified bytecount. If an error is detected, the prior disc address and bytecount are reported along with the bad disc address and bytecount, and the disc is recalibrated. The value specified in the parameter determines the number of times this set of operations is performed. If no value is specified, the parameter defaults to 10,000. The legal range of values for the parameter is [0,4095]. (Refer to Table 4.4 for a description of the error messages that may be displayed during command execution.)

Examples:

```
XB                  ! performs 10,000 RANDOM POSITION/READ WITH NO
                    ! CHECKSUM commands
XB100               ! performs 100 RANDOM POSITION/READ WITH NO
                    ! CHECKSUM commands
```

3.1.34 XC - RANDOM POSITION/READ WITH NO TRANSFER/VERIFY Command

The form of the RANDOM POSITION/READ WITH NO TRANSFER/VERIFY command is as follows:

```
random_position/read_with_no_transfer/verify_command  ::=  XC
                                                           [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to 4095
```

Execution of the RANDOM POSITION/READ WITH NO TRANSFER/VERIFY (XC) command causes a random disc address and bytecount to be selected. The disc is then positioned at the selected address, and a READ WITH NO TRANSFER command, followed by a VERIFY command, is issued for the specified bytecount. If an error is detected, the prior disc address and bytecount are reported along with the bad disc address and bytecount, and the disc is recalibrated. The value specified in the parameter determines the number of times this set of operations is performed. If no value is specified, the parameter defaults to 10,000. The legal range of values for the parameter is [0,4095]. (Refer to Table 4.4 for a description of the error messages that may be displayed during command execution.)

Examples:

```
XC          ! performs 10,000 RANDOM POSITION/READ WITH NO
            ! TRANSFER/VERIFY commands
XC100       ! performs 100 RANDOM POSITION/READ WITH NO
            ! TRANSFER/VERIFY commands
```

3.1.35 XD - RANDOM POSITION/REPOSITION Command

The form of the RANDOM POSITION/REPOSITION command is as follows:

random_position/reposition_command ::= XD [parameter]

parameter ::= integer_constant
integer_constant ::= number within the range 0 to 4095

Execution of the RANDOM POSITION/REPOSITION command (XD) causes the following operations to be performed (in the order listed):

a. A random cylinder, head, and sector address is selected.

b. The data are read from the selected sector and stored in WRITE$.

c. The disc is positioned at cylinder 0, head 0, sector 0.

d. The disc is repositioned at the original random address and the data are read again from that address.

e. The data read the second time are compared with those read initially.

f. The disc is positioned at MAXCYL, head 0, sector 0.

g. The disc is repositioned again at the original random address and the data are read a third time from that address.

h. The data read the third time are compared with those read initially.

If an error is detected, the prior disc address and bytecount are reported along with the bad disc address and bytecount. The value specified in the parameter determines the number of times this set of operations is performed. If no value is specified, the parameter defaults to 10,000. The legal range of values for the parameter is [0,4095]. (Refer to Table 4.4 for a description of the error messages that may be displayed during command execution.)

Examples:

```
XD                  ! performs 10,000 RANDOM POSITION/REPOSITION
                    ! commands
XD100               ! performs 100 RANDOM POSITION/REPOSITION
                    ! commands
```

3.1.36 XE - RANDOM POSITION/READ WITH TRANSFER Command

The form of the RANDOM POSITION/READ WITH TRANSFER command is as follows:

```
random_position/read_with_transfer_command  ::=  XE [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to 4095
```

Execution of the RANDOM POSITION/READ WITH TRANSFER command (XE) causes a random disc address to be selected. The disc is then positioned at the selected address and one sector of data read using a READFULL command. If an error is detected, the prior disc address and bytecount are reported along with the bad disc address and bytecount, and the disc is recalibrated. The value specified in the parameter determines the number of times this set of operations is performed. If no value is specified, the parameter defaults to 10,000. The legal range of values for the parameter is [0,4095]. (Refer to Table 4.4 for a description of the error messages that may be displayed during command execution.)

Examples:

```
XE                  ! performs 10,000 RANDOM POSITION/READ WITH
                    ! TRANSFER commands
XE100               ! performs 100 RANDOM POSITION/READ WITH
                    ! TRANSFER commands
```

3.1.37 XF - RANDOM POSITION/READ WITH TRANSFER/VERIFY CHECKSUM Command

The form of the RANDOM POSITION/READ WITH TRANSFER/VERIFY CHECKSUM command is as follows:

```
random_position/read_with_transfer/verify_checksum_command ::= XF
                                                              [parameter]

  parameter  ::=  integer_constant
  integer_constant  ::=  number within the range 0 to 4095
```

Execution of the RANDOM POSITION/READ WITH TRANSFER/VERIFY CHECKSUM command (XF) causes a random disc address to be selected. The disc is then positioned at the selected address and one sector of data read using a READFULL command. The software checksum is then calculated from the returned data and compared with that stored in the header data. If an error is detected, the prior disc address and bytecount are reported along with the bad disc address and bytecount, and the disc is recalibrated. The value specified in the parameter determines the number of times this set of operations is performed. If no value is specified, the parameter defaults to 10,000. The legal range of values for the parameter is [0,4095]. (Refer to Table 4.4 for a description of the error messages that may be displayed during program execution.)

Examples:

```
XF                  ! performs 10,000 RANDOM POSITION/READ WITH
                    ! TRANSFER/VERIFY CHECKSUM commands
XF100               ! performs 100 RANDOM POSITION/READ WITH
                    ! TRANSFER/VERIFY CHECKSUM commands
```

3.1.38 YA - MAXCYL RANDOM WRITE/READ/VERIFY Command

The form of the MAXCYL RANDOM WRITE/READ/VERIFY command is as follows:

```
MAXCYL_random_write/read/verify_command  ::=  YA [parameter]

  parameter ::=  integer_constant
  integer_constant  ::=  number within the range 0 to 4095
```

Execution of the MAXCYL RANDOM WRITE/READ/VERIFY command (YA) causes a series of write, read, and verify operations to be performed on the last moving-head cylinder (MAXCYL), using data stored in WRITE$. The disc is positioned at MAXCYL, with random head and sector addresses. The bytecount is also random. If an error is detected, the prior disc address and bytecount are reported along with the bad disc address and bytecount, and the disc is recalibrated. The value specified in the parameter determines the number of times this set of operations is performed. If no value is specified, the parameter defaults to 10,000. The legal range of values for the parameter is [0,4095]. The following screen display signals the beginning of command execution:

```
*** MAXCYL WRITE/READ/VERIFY SUBTEST ***
```

Refer to Table 4.4 for a description of the error messages that may be displayed during command execution.

Examples:

```
YA          ! performs 10,000 MAXCYL RANDOM WRITE/READ/
            ! VERIFY commands
YA100       ! performs 100 MAXCYL RANDOM WRITE/READ/VERIFY
            ! commands
```

3.1.39 YB - RANDOM WRITE/READ/VERIFY Command

The form of the RANDOM WRITE/READ/VERIFY command is as follows:

random_write/read/verify_command ::= YB [parameter]

parameter ::= integer_constant
integer_constant ::= number within the range 0 to 4095

Execution of the RANDOM WRITE/READ/VERIFY command (YB) causes a series of write, read, and verify operations to be performed, at random addresses and with random bytecounts, using data stored in WRITE$. If an error is detected, the prior disc address and bytecount are reported along with the bad disc address and the disc is positioned at MAXCYL, with random head and sector addresses. The bytecount is also random. If an error is detected, the prior disc address and bytecount are reported along with the bad disc address and bytecount, and the disc is recalibrated. The value specified in the parameter determines the number of times this set of operations is performed. If no value is specified, the parameter defaults to 10,000. The legal range of values for the parameter is [0,4095]. One of the following two screen displays occurs when command execution is attempted; the first, if RANDOM WRITE/READ/VERIFY is enabled in the run parameters; the second, if it is not:

```
*** RANDOM WRITE/READ/VERIFY SUBTEST ***

-RANDOM WRITE/READ/VERIFY NOT ENABLED
```

(The setting of the run parameters can be altered with the ALTER RUN PARAMETERS command, described in paragraph 3.1.1. Refer to Table 4.4 for a description of the error messages that may be displayed during command execution.)

Examples:

```
YB          ! performs 10,000 RANDOM WRITE/READ/VERIFY
            ! commands
YB100       ! performs 100 RANDOM WRITE/READ/VERIFY
            ! commands
```

SECTION 4
ERROR CONDITIONS AND DISPOSITIONS

4.0 ERROR CONDITIONS AND DISPOSITIONS

The REX diagnostics utilize the SHADOW error message facility and return the typical SHADOW messages generated by compare errors, EIO status errors, interrupt status errors, and unexpected non-I/O interrupt errors. These messages include the program step number at which failure occurred, the logical unit number of the device under test, and the EIO and IIO status and cause words.

When a SHADOW error message is returned, the sequence of events producing the error can be determined by cross-referencing the error message with the program listing of the currently executing diagnostic. The formats for the return of EIO status and IIO status are given in Figures 4-1 and 4-2, respectively. The format of data on the disc is shown in Figure 4-3. The device characteristics of the T16/4103, 4104, 4105/4106, 4109, 4110/4111, and 4116 disc drives in sector-skipping format are listed in Table 4.1.

In addition to the standard SHADOW error messages, other error messages are displayed at the OSP terminal under the following conditions:

a. The REX diagnostics append an additional message to the standard SHADOW error message. This additional message, which correlates the error to a specific disc function, is determined by values encoded in specific fields of the IIO cause word. The possible messages, the IIO fields that govern them, and the error conditions they indicate are described in Table 4.2.

b. Because the REX diagnostics are interactive programs, certain special error messages can be generated by an operator error during entry of command strings. These operator-entry error messages are described in Table 4.3.

c. When program execution completes, an error summary is generated. This summary is described in Table 4.3.

d. Special command-specific error messages can be generated whenever one of the following program-defined commands is executed:

1. CHECK CYLINDER Command
2. CHECK FLAGS Command
3. CHECK SURFACE Command
4. DEFECT LIST Command
5. WRITE Command
6. WRITE FULL SECTOR Command
7. WRITE SURFACE Command
8. RANDOM POSITION/READ WITH NO TRANSFER Command
9. RANDOM POSITION/READ WITH NO CHECKSUM Command
10. RANDOM POSITION/READ WITH NO TRANSFER/VERIFY Command
11. RANDOM POSITION/REPOSITION Command
12. RANDOM POSITION/READ WITH TRANSFER Command
13. RANDOM POSITION/READ WITH TRANSFER/VERIFY CHECKSUM Command
14. MAXCYL RANDOM WRITE/READ/VERIFY Command
15. RANDOM WRITE/READ/VERIFY Command.

These messages are described in Table 4.4.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
O	I	B	P	EIOSTAT											

T16/8L11G-12

O - OWNERSHIP ERROR
I - INTERRUPT PENDING
B - CONTROL UNIT BUSY
P - I/O BUS PARITY ERROR ON EIO

Figure 4-1 Format of EIO Status Word

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
O	I	A	P	(ZERO)				DEV						UNIT	

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PON	TERM							PR	UO	F	S	C	R	T0	T1

T16/8L11G-13

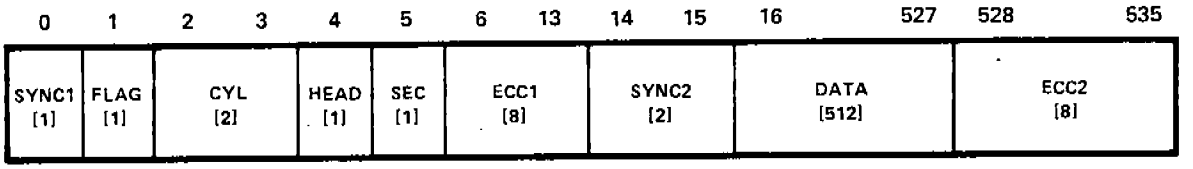
O - OWNERSHIP ERROR
I - INTERRUPT PENDING
A - CHANNEL TRANSFER ABORT
P - PARITY ERROR
DEV - CONTROLLER NUMBER
UNIT - UNIT NUMBER
PON - POWER ON INTERRUPT
PR - UNIT READ ONLY

UO - UNIT OWNERSHIP ERROR
F - UNIT WRITE FAULT
S - UNIT SEEK ERROR
C - UNIT NOT ON CYLINDER
R - UNIT NOT READY
T0 - UNIT TYPE, MSB
T1 - UNIT TYPE, LSB

TERM - ENCODED TERMINATION STATUS (TERMSTAT):

%00 NO ERROR
%01 UNIT ATTENTION
%02 DATA ERROR CORRECTED
%03 ATTEMPT TO WRITE ON PROTECTED UNIT
%04 ILLEGAL ADDRESS
%05 DIRECT ACCESS TO ALTERNATE TRACK
%06 ILLEGAL OPCODE
%07 UNIT STATUS ERROR
%10 BUFFER PARITY ERROR
%11 UNCORRECTABLE DATA ERROR
%12 NO SERVO CLOCKS DURING A WRITE
%13 VERIFY ERROR
%14 HEADER SEARCH FAILED
%15 HEADER ADDRESS MISCOMPARE
%16 ROM PARITY ERROR
%17 UNIT NOT PRESENT
%20 DUPLICATE UNIT NUMBER
%21 UNIT OWNERSHIP ERROR
%22 UNIT NOT READY
%23 READ RETRY SUCCESSFUL WITHOUT OFFSET
%24 READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS
%25 READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS
%26 READ RETRY SUCCESSFUL WITH DATA STROBE LATE
%27 READ RETRY SUCCESSFUL WITH DATA STROBE EARLY
%30 READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS AND DATA STROBE LATE
%31 READ RETRY SUCCESSFUL WITH SERVO OFFSET MINUS AND DATA STROBE EARLY
%32 READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS AND DATA STROBE LATE
%33 READ RETRY SUCCESSFUL WITH SERVO OFFSET PLUS AND DATA STROBE EARLY
%34 IDLE LOOP DISC CONTROLLER EXERCISER ERROR

Figure 4-2 Format of IIO Status and Cause Words



T16/8L11G-14

SYNC1 = %360 (Good sector - marks the end of the preceding lockup field allowed for read synchronization and signals that address header is to follow)

%377 (Bad sector - all bytes of the entire sector are filled with ones)

FLAG = %350 (Normal sector - CYL/HEAD/SECT contains the current logical address)

%351 (Defective data area)

%352 (Jump-from-extension sector - CYL/HEAD/SECT contains the physical address of return from extension)

%353 (Spare sector)

%354 (Maximum sector on a track)

%355 (Only good sector on a track)

%356 (Jump-to-extension sector - CYL/HEAD/SECT contains the current physical address of extension)

%357 (End of cylinder)

%377 (Defective header)

ECC1 = [0:6] = Error correction code for address header
[7] = Pad byte of zeros

SYNC2 = [0] = %360
[1] = Pad byte of zeros

DATA = 512 bytes of written data

ECC2 = [0:6] = Error correction code for data portion
[7] = Pad byte of zeros

Figure 4-3 Sector-skipping Format for Data on Disc

Table 4.1 Device Characteristics in Sector-skipping Format

DEVICE CHARACTERISTIC	T16/ 4103	T16/ 4104	T16/ 4105/ 4106	T16/ 4109	T16/ 4110/ 4111	T16/ 4116
Device type	3	2	1	1	3	0
Maximum sector (MAXSECT)	19	29	29	29	29	29
Maximum head (MAXHEAD)	18	18	4	4	9	39
Maximum cylinder (MAXCYL)	814	814	822	822	822	842
Defect list cylinder (DLCYL)	813	813	821	821	821	841
First spare cylinder (FSPCYL)	805	803	811	811	811	831
Last spare cylinder (LSPCYL)	812	812	820	820	820	840
First fixed cylinder (FFXCYL)	-	-	-	896	-	-
Last fixed cylinder (LFXCYL)	-	-	-	915	-	-
Last fixed head (LFXHD)	-	-	-	0	-	-
Spare sectors per cylinder (SPSCYL)	2	2	2	2	4	8
Literal PROM ID (LPRID)	%102	%101	%101 %102	%101 %102	%101 -	%101 %102
Volume label sector (CYL/HEAD/SECT)	0/0/2	0/0/2	0/0/2	0/0/2	0/0/2	0/0/2
Spare track table sector (CYL/HEAD/SECT)	0/0/3	0/0/3	0/0/3	0/0/3	0/0/3	0/0/3

4.1 ERROR INFORMATION APPENDED TO SHADOW ERROR MESSAGES

In conjunction with the standard SHADOW error message, the REX diagnostics typically display one of a number of error messages together with the contents of the controller registers. This error message is determined by IIO status. The form of the error message is as follows:

```
<error message>

** CONTROLLER REGISTER CONTENTS **
CYL xxx HEAD xx SECT xxx FLAGS xxx COUNT xxx ADD xxx
```

The various messages that may appear in the <error message> field are listed and explained in Table 4.2. CYL/HEAD/SECT reflects the disc address of the sector accessed by the command; FLAGS returns the value of the header flag in the accessed sector (refer to Figure 4-3); COUNT reflects the bytecount returned by the operation; and ADD reflects the current address of the controller buffer.

Table 4.2 Error Messages Accompanying Standard SHADOW Messages

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
TIMEOUT ERROR	IIO CAUSE = -1	A timeout occurred on the controller before the current operation could complete.
DEVICE TYPE ERROR	IIO CAUSE bits <14:15>	The accessed unit returned a different device type from that expected by the controller.
NOT READY ERROR	IIO CAUSE bit <13>	One of the following conditions obtains: a. No disc pack is installed. b. Disc spindle motor is not up to speed. c. Read/write heads are not loaded. d. DC voltages of drive are not within margin. e. Terminator is not present or does not have power.
NOT ON CYLINDER ERROR	IIO CAUSE bit <12>	A seek to an illegal address has been received from the channel, i.e., a cylinder, head, or sector address greater than the maximum legal value has been specified (refer to Table 4.1).
SEEK ERROR	IIO CAUSE bit <11>	Drive is unable to seek to specified address.
WRITE FAULT ERROR	IIO CAUSE bit <10>	One of the following conditions obtains: a. More than one write/read head selected b. Read gate and write gate both true c. Read gate and erase gate both true d. Write current but no erase current e. Erase current but no write current f. Write gate or erase gate but not on cylinder g. DC voltages below margin h. Emergency retract condition
OWNERSHIP ERROR	IIO CAUSE bit <9>	Controller is owned by the other port.
WRITE PROTECT ERROR	IIO CAUSE bit <8>	Write operation attempted to disc drive with WRITE PROTECT switch on.

T16/8L11G-15

Table 4.2 Error Messages Accompanying Standard SHADOW Messages (Cont'd)

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
NO TERMSTAT ERROR	TERM = %00	No error.
TERMSTAT ATTENTION ERROR	TERM = %01	One of the following unit attention conditions occurred: a. Selected drive ready (head load sequence) b. I.D. plug changed after drive ready c. Seek complete.
TERMSTAT CORRECTED DATA ERROR	TERM = %02	An error correctable by error correction code (ECC) occurred during a READ operation (≤ 11 bits).
TERMSTAT WRITE ATTEMPT TO PROTECTED UNIT ERROR	TERM = %03	WRITE-type command issued to disc drive with READ ONLY switch enabled.
TERMSTAT ILLEGAL ADDRESS ERROR	TERM = %04	A cylinder address was too large.
TERMSTAT DIRECT ACCESS TO ALT TRACK ERROR	TERM = %05	Not used in sector-skipping format. (In track-sparing, indicates that a READ or WRITE was issued to an alternate track before execution of the routine required to access that track.)
TERMSTAT ILLEGAL OPCODE ERROR	TERM = %06	The controller command in the EIO Address/Command Word is not valid.
TERMSTAT UNIT STATUS ERROR	TERM = %07	One of the following unit status conditions obtains: a. SEEK issued to disc drive with SEEK or NOT ON CYLINDER error b. FAULT or SEEK error occurred during a programmed seek, recalibrate, or head load sequence.
TERMSTAT BUFFER PARITY ERROR	TERM = %10	Incorrect parity in data word read from the controller 4K byte buffer (odd parity maintained).
TERMSTAT UNCORRECTABLE DATA ERROR	TERM = %11	A data record accessed with a READ error burst greater than 11 bits. ECC detected but uncorrectable. Data block could not be recovered with 27 retries using all offset combinations.
TERMSTAT NO SERVO CLOCKS DURING A WRITE	TERM = %12	Record CRC error.

T16/8L11G-16

Table 4.2 Error Messages Accompanying Standard SHADOW Messages (Cont'd)

ERROR MESSAGE	IIO CAUSE WORD	INDICATED ERROR CONDITION
TERMSTAT VERIFY ERROR	TERM = %13	Data read into the buffer does not compare with I/O channel data.
TERMSTAT HEADER SEARCH FAILURE	TERM = %14	One of the following header search conditions occurred: a. No headers on addressed track could be read. b. No sector match among headers on addressed track.
TERMSTAT HEADER ADDRESS MISCOMPARE	TERM = %15	Cylinder address or head address does not compare with the address loaded into the cylinder or head address registers.
TERMSTAT ROM PARITY ERROR	TERM = %16	Incorrect parity in microprogram instruction word read from ROM (odd parity maintained).
TERMSTAT UNIT NOT PRESENT ERROR	TERM = %17	Proper I.D. plug not installed.
TERMSTAT DUPLICATE UNIT NUMBER ERROR	TERM = %20	Plugs with the same I.D. installed in more than one disc drive.
TERMSTAT UNIT OWNERSHIP ERROR	TERM = %21	Disc drive owned by other controller.
TERMSTAT UNIT NOT READY ERROR	TERM = %22	Drive is not up to speed with the heads loaded.

T16/8L11G-17

4.2 OTHER ERROR MESSAGES GENERATED BY THE REX DIAGNOSTICS

In addition to the error messages described in paragraph 4.1, other error messages occur as the commands and command strings entered by the user are executed. For the purpose of description, these messages have been arranged under two general headings:

a. Non-command-specific messages (including those generated by operator entry error)

b. Command-specific messages.

The messages described under the first heading may occur throughout diagnostic execution, without reference to the command being executed; they are described in Table 4.3. The messages described under the second heading occur only in the context of a given command and are, consequently, grouped by command; they are described in Table 4.4.

Table 4.3 Non-command-specific Error Messages Generated by the REX Diagnostics

SCREEN DISPLAY	EXPLICATION
ILLEGAL SYNTAX	Message displayed if the user enters a command or command string that is syntactically incorrect.
** SOFTWARE ERROR **	Message displayed if a command entered by the user cannot be interpreted, and the error cannot be assigned to any of the standard operator-entry-error types.
-UNIMPLEMENTED COMMAND	Message displayed if the command entered by the user is not among those accepted by the REX command set.
** INVALID CYLINDER PARAMETER **	Message displayed if the user specifies an illegal cylinder number in a command entry that requires a cylinder number in the parameter field.
** PARAMETER NOT ALLOWED **	Message displayed if the user enters a parameter in conjunction with a command that excludes any parameters.
** MISSING PARAMETER **	Message displayed if the user omits the parameter when entering a command that requires a parameter.
** INVALID PARAMETER %: **	Message displayed if the user enters a parameter outside the legal range for a given command.
* ERROR SUMMARY DURING REX41xx * TIMEOUTS xxxxxxx NOT ON CYLINDERS xxxxxxx SEEK ERRORS xxxxxxx DATA ERRORS CORRECTED xxxxxxx ILLEGAL ADDRESSES xxxxxxx DATA UNCORRECTABLES xxxxxxx HEADER SEARCH FAILS xxxxxxx PASS COUNT xxxxxxx	Error summary displayed when program execution completes. The passcount is incremented by one.

T16/8L11G-18

Table 4.4 Command-specific Error Messages Generated by the REX Diagnostics

SCREEN DISPLAY	EXPLICATION
CHECK CYLINDER (CC) and CHECK SURFACE (CS)	
** SEEK ERROR, CHECK CYLINDER ROUTINE, PUN %: xxx **	Message displayed if an error occurs during a SEEK operation to the cylinder under test.
-STOP ON ERROR, ERROR CODE: 40 <RETURN> TO CONTINUE, ANY CHAR TO VOID 'STOP ON ERROR'	Message displayed if a defect is found on the cylinder under test with STOP ON ERROR enabled. The program halts and awaits user input. If the user elects to void STOP ON ERROR, the program automatically alters the setting of the STOP ON ERROR parameter before proceeding. If the user elects simply to continue, the program then checks whether the defective sector is already recorded on DLCYL. If not, the program attempts to add it to the copy of the defect list currently assigned for storing run defects. The error messages that may occur during this procedure are described in this table, under DLCYL-ACCESSING COMMANDS. When this procedure is complete, the program proceeds with the sector-by-sector check of the cylinder.
CHECK FLAGS (CF)	
-STOP ON ERROR, ERROR CODE: 50 <RETURN> TO CONTINUE, ANY CHAR TO VOID 'STOP ON ERROR' -SKIPPING CYL: xxx	Message displayed if an error occurs during the SEEK operation on any cylinder, with STOP ON ERROR enabled. The program halts and awaits user input. If the user elects to void STOP ON ERROR, the program automatically alters the setting of the STOP ON ERROR parameter. When this is done, or if the user elects simply to continue, the program checks whether the defective sector is already recorded on DLCYL. If not, the program attempts to add it to the copy of the defect list currently assigned for storing run defects. The error messages that may occur during this procedure are described in this table, under DLCYL-ACCESSING COMMANDS. When this procedure is complete, the program proceeds to the next cylinder.

T16/BL11G-19

Table 4.4 Command-specific Error Messages Generated by the REX Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
CHECK FLAGS (Cont'd)	
-STOP ON ERROR, ERROR CODE: 60 <RETURN> TO CONTINUE, ANY CHAR TO VOID 'STOP ON ERROR'	Message displayed if an invalid flag is detected with STOP ON ERROR enabled. The program halts and awaits user input. If the user elects to void STOP ON ERROR, the program automatically alters the setting of the STOP ON ERROR parameter. When this is done, or if the user elects simply to continue, the program checks whether the defective sector is already recorded on DLCYL. If not, the program attempts to add it to the copy of the defect list currently assigned for storing run defects. The error messages that may occur during this procedure are described in this table, under DLCYL-ACCESSING COMMANDS. When this procedure is complete, the program proceeds to the next cylinder.
DEFECT LIST (DL)	
-SOURCE ADDRESS BEYOND LIMITS <RETURN> TO CONTINUE, ANY CHAR TO STOP	Message displayed if a source address outside the specified range is detected when the program is attempting to copy the contents of one list over the contents of the other. If the user elects to continue, the program redisplays the defect list access options, allowing another user selection. If the user elects to stop, execution of the DEFECT LIST command terminates, and the program prompts for the next command input. (Other error messages that may occur during execution of the DEFECT LIST command are listed in this table, under DLCYL-ACCESSING COMMANDS.)

T16/8L11G-20

Table 4.4 Command-specific Error Messages Generated by the REX Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
DEFECT LIST (Cont'd)	
-DESTINATION ADDRESS BEYOND LIMITS <RETURN> TO CONTINUE, ANY CHAR TO STOP	Message displayed if a destination address outside the specified range is detected when the program is attempting to copy the contents of one list over the contents of the other. If the user elects to continue, the program redisplays the defect list access options, allowing another user selection. If the user elects to stop, execution of the DEFECT LIST command terminates, and the program prompts for the next command input.
WRITE (WT)	
** ERROR: ATTEMPT TO WRITE ON DEFECT LIST CYL **	Message displayed if a WRITE operation is attempted to DLCYL. The program then suspends execution.
WRITE FULL SECTOR (WF)	
** ERROR: WRITING ON DLCYL **	Message displayed if execution of the WRITE FULL SECTOR command results in a WRITE to DLCYL. The program then suspends execution.
WRITE SURFACE (WS)	
** ERROR: ATTEMPT TO WRITE ON DEFECT LIST CYL **	Message displayed if a WRITE operation is attempted to DLCYL. The program then suspends execution.

T16/8L11G-21

Table 4.4 Command-specific Error Messages Generated by the REX Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
WRITE SURFACE (Cont'd)	
** ERROR: WRITE SURFACE SUBTEST **	Message displayed if an error occurs during an attempt to write to any sector within the valid cylinder range [0,DLCYL-1]. The program then checks whether the defective sector is already recorded on DLCYL. If not, the program attempts to add it to the copy of the defect list currently assigned for storing run defects. The error messages that may occur during this procedure are described in this table, under DLCYL-ACCESSING COMMANDS. When this procedure is complete, the program attempts to write to the next sector.
RANDOM-EXERCISING COMMANDS (XA, XB, XC, XD, XE , XF, YA, YB)	
** SEEK ERROR-RANDOM POSITION & LENGTH TEST (XA) ** ** READ W/NO TRANSFER ERROR-RANDOM POSITION & LENGTH TEST -PRIOR CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx -BAD CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx	Message displayed if a SEEK error occurs during execution of either the RANDOM POSITION/ READ WITH NO TRANSFER (XA) or the RANDOM POSITION/READ WITH NO TRANSFER/VERIFY command (XC). The program then checks whether the defective sector is already recorded on DLCYL. If not, the program attempts to add it to the copy of the defect list currently assigned for storing run defects. The error messages that may occur during this procedure are described in this table, under DLCYL-ACCESSING COMMANDS. When this procedure is complete, the program performs a recalibrate and attempts another random read.

T16/8L11G-22

Table 4.4 Command-specific Error Messages Generated by the REX Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
RANDOM-EXERCISING COMMANDS (Cont'd)	
** READ W/NO TRANSFER ERROR-RANDOM POSITION & LENGTH TEST -PRIOR CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx -BAD CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx	Message displayed if a READ WITH NO TRANSFER error occurs during execution of either the RANDOM POSITION/READ WITH NO TRANSFER (XA) or the RANDOM POSITION/READ WITH NO TRANSFER/ VERIFY command (XC). The program then checks whether the defective sector is already recorded on DLCYL. If not, the program attempts to add it to the copy of the defect list currently assigned for storing run defects. The error messages that may occur during this procedure are described in this table, under DLCYL-ACCESSING COMMANDS. When this procedure is complete, the program performs a recalibrate and attempts another random read.
** SEEK ERROR-RANDOM POSITION & LENGTH TEST (XB) ** ** READ W/NO CHECKSUM ERROR-RANDOM POSITION & LENGTH TEST -PRIOR CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx -BAD CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx	Message displayed if a SEEK error occurs during execution of the RANDOM POSITION/READ WITH NO CHECKSUM command (XB). The program then checks whether the defective sector is already recorded on DLCYL. If not, the program attempts to add it to the copy of the defect list currently assigned for storing run defects. The error messages that may occur during this procedure are described in this table, under DLCYL-ACCESSING COMMANDS. When this procedure is complete, the program performs a recalibrate and attempts another random read.

T16/8L11G-23

Table 4.4 Command-specific Error Messages Generated by the REX Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
RANDOM-EXERCISING COMMANDS (Cont'd)	
** READ W/NO CHECKSUM ERROR-RANDOM POSITION & LENGTH TEST -PRIOR CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx -BAD CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx	Message displayed if a READ WITH NO CHECKSUM error occurs during execution of the RANDOM POSITION/READ WITH NO CHECKSUM command (XB). The program then checks whether the defective sector is already recorded on DLCYL. If not, the program attempts to add it to the copy of the defect list currently assigned for storing run defects. The error messages that may occur during this procedure are described in this table, under DLCYL-ACCESSING COMMANDS. When this procedure is complete, the program performs a recalibrate and attempts another random read.
** VERIFY ERROR - RANDOM POSITION & LENGTH TEST ** ** READ W/NO TRANSFER ERROR - RANDOM POSITION & LENGTH TEST -PRIOR CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx -BAD CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx	Message displayed if a VERIFY error occurs during execution of the RANDOM POSITION/READ WITH NO TRANSFER/VERIFY command (XC). The program then checks whether the defective sector is already recorded on DLCYL. If not, the program attempts to add it to the copy of the defect list currently assigned for storing run defects. The error messages that may occur during this procedure are described in this table, under DLCYL-ACCESSING COMMANDS. When this procedure is complete, the program performs a recalibrate and attempts another random read.
** RANDOM POSITION & RE-POSITION ** -PRIOR CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx -BAD CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx	Message displayed if a READ or COMPARE error occurs during execution of the RANDOM POSITION/REPOSITION command (XD). The program then checks whether the defective sector is already recorded on DLCYL. If not, the program attempts to add it to the copy of the defect list currently assigned for storing run defects. The error messages that may occur during this procedure are described in this table, under DLCYL-ACCESSING COMMANDS. When this procedure is complete, the program performs a recalibrate and attempts another random read.

T16/8L11G-24

Table 4.4 Command-specific Error Messages Generated by the REX Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
RANDOM-EXERCISING COMMANDS (Cont'd)	
-STOP ON ERROR, ERROR CODE: 70 <RETURN> TO CONTINUE, ANY CHAR TO VOID 'STOP ON ERROR'	Message displayed if a defect is detected during execution of the RANDOM POSITION/REPOSITION command (XD) with STOP ON ERROR enabled. The program halts and awaits user input. If the user elects to void STOP ON ERROR, the program automatically alters the setting of the STOP ON ERROR parameter. When this is done, or if the user elects simply to continue, the program proceeds with the execution of the RANDOM POSITION/REPOSITION command.
** READFULL ERROR, PUN #: xxx ** -PRIOR CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx -BAD CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx	Message displayed if a READFULL error occurs during execution of either the RANDOM POSITION/READ WITH TRANSFER command (XE) or the RANDOM POSITION/READ WITH TRANSFER/VERIFY CHECKSUM command (XF). The program then checks whether the defective sector is already recorded on DLCYL. If not, the program attempts to add it to the copy of the defect list currently assigned for storing run defects. The error messages that may occur during this procedure are described in this table, under DLCYL-ACCESSING COMMANDS. When this procedure is complete, the program performs a recalibrate and attempts another random read.
-STOP ON ERROR, ERROR CODE: 80 <RETURN> TO CONTINUE, ANY CHAR TO VOID 'STOP ON ERROR'	Message displayed if a defect is detected during execution of either the RANDOM POSITION/READ WITH TRANSFER command (XE) or the RANDOM POSITION/READ WITH TRANSFER/VERIFY CHECKSUM command (XF) with STOP ON ERROR enabled. The program halts and awaits user input. If the user elects to void STOP ON ERROR, the program automatically alters the setting of the STOP ON ERROR parameter. When this is done, or if the user elects simply to continue, the program proceeds with the execution of the RANDOM POSITION/READ WITH TRANSFER command (XE).

T16/8L11G-25

Table 4.4 Command-specific Error Messages Generated by the REX Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
RANDOM-EXERCISING COMMANDS (Cont'd)	
CHECKSUM ERROR-RANDOM POSITION/CHECKSUM VERIFICATION (XF) -EXP %: xxx -OBS %: xxx -PRIOR CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx -BAD CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx **WARNING: SOFTWARE-CALCULATED CHECKSUM **	Message displayed if a CHECKSUM error occurs during execution of the RANDOM POSITION/READ WITH TRANSFER/VERIFY CHECKSUM command (XF). The program then checks whether the defective sector is already recorded on DLCYL. If not, the program attempts to add it to the copy of the defect list currently assigned for storing run defects. The error messages that may occur during this procedure are described in this table, under DLCYL-ACCESSING COMMANDS. When this procedure is complete, the program performs a recalibrate and attempts another random read.
-WRITE RETRY EXHAUSTED -WRITE/READ/VERIFY TEST -PRIOR CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx -BAD CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx	Message displayed if a WRITE operation fails three successive attempts during execution of either the MAXCYL RANDOM WRITE/READ/VERIFY command (YA) or the RANDOM WRITE/READ/VERIFY command (YB). The program then checks whether the defective sector is already recorded on DLCYL. If not, the program attempts to add it to the copy of the defect list currently assigned for storing run defects. The error messages that may occur during this procedure are described in this table, under DLCYL-ACCESSING COMMANDS. When this procedure is complete, the program performs a recalibrate and attempts another random write/read/verify.
** ERROR: ATTEMPT TO WRITE ON DEFECT LIST CYL **	Message displayed if a WRITE operation is attempted to DLCYL during execution of either the MAXCYL RANDOM WRITE/READ/VERIFY command (YA) or the RANDOM WRITE/READ/VERIFY command (YB).

T16/8L11G-26

Table 4.4 Command-specific Error Messages Generated by the REX Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
RANDOM-EXERCISING COMMANDS (Cont'd)	
-READ RETRY EXHAUSTED -WRITE/READ/VERIFY TEST -PRIOR CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx -BAD CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx	Message displayed if a READ operation fails three successive attempts during execution of either the MAXCYL RANDOM WRITE/READ/VERIFY command (YA) or the RANDOM WRITE/READ/VERIFY command (YB). The program then checks whether the defective sector is already recorded on DLCYL. If not, the program attempts to add it to the copy of the defect list currently assigned for storing run defects. The error messages that may occur during this procedure are described in this table, under DLCYL-ACCESSING COMMANDS. When this procedure is complete, the program performs a recalibrate and attempts another random write/read/verify.
** DATA COMPARE ERRORS ** -EXP: %xxx OBS: %xxx	Message displayed if a VERIFY error occurs during execution of either the MAXCYL RANDOM WRITE/READ/VERIFY command (YA) or the RANDOM WRITE/READ/VERIFY command (YB). The message is displayed for up to four VERIFY errors. The program then checks whether the defective sector is already recorded on DLCYL. If not, the program attempts to add it to the copy of the defect list currently assigned for storing run defects. The error messages that may occur during this procedure are described in this table, under DLCYL-ACCESSING COMMANDS. When this procedure is complete, the program performs a recalibrate and attempts another random write/read/verify.

T16/8L11G-27

Table 4.4 Command-specific Error Messages Generated by the REX Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
RANDOM-EXERCISING COMMANDS (Cont'd)	
** DATA COMPARE ERRORS ** -WRITE/READ/VERIFY TEST -PRIOR CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx -BAD CYL/HEAD/SECT/BC: xxx / xx / xx / xxxx	Message displayed if more than four VERIFY errors occur during execution of either the MAXCYL RANDOM WRITE/READ/VERIFY command (YA) or the RANDOM WRITE/READ/VERIFY command (YB). The program then checks whether the defective sector is already recorded on DLCYL. If not, the program attempts to add it to the copy of the defect list currently assigned for storing run defects. The error messages that may occur during this procedure are described in this table, under DLCYL-ACCESSING COMMANDS. When this procedure is complete, the program performs a recalibrate and attempts another random write/read/verify.
-STOP ON ERROR, ERROR CODE: 90 <RETURN> TO CONTINUE, ANY CHAR TO VOID 'STOP ON ERROR'	Message displayed if a defect is detected during execution of either the MAXCYL RANDOM WRITE/READ/VERIFY command (YA) or the RANDOM WRITE/READ/VERIFY command (YB) with STOP ON ERROR enabled. The program halts and awaits user input. If the user elects to void STOP ON ERROR, the program automatically alters the setting of the STOP ON ERROR parameter. When this is done, or if the user elects simply to continue, the program proceeds with the execution of the command.
** UNABLE TO SUCCESSFULLY RECALIBRATE - PAUSE **	Message displayed if an error occurs during an attempt to recalibrate. The program suspends execution until the user responds with carriage return. This message may occur during execution of any of the following commands: XA, XB, XC, XE, XF, YA, or YB.

T16/8L11G-28

Table 4.4 Command-specific Error Messages Generated by the REX Diagnostics (Cont'd)

SCREEN DISPLAY	EXPLICATION
DLCYL-ACCESSING COMMANDS (CC, CF, CS, DL, WS, XA, XB, XC, XD, XE, XF, YA, YB)	
PROGRAM USES A DL COPY ON THE DISK FOR DEFECT STORAGE -WILL USE COPY # x <RETURN> TO RESET, ANY CHAR TO SAVE	Message displayed if the entry to be made on DLCYL is the first encountered by the program. If the user elects to reset the specified defect list copy, the program attempts a reset before trying to enter the defect. Otherwise, it attempts to add the defect directly to those already in the list. DLCYL contains two copies of the defect list. At initialization, the program is set up to record run defects in copy 2 of the defect list. This setting can be altered with the DEFECT LIST command (refer to paragraph 3.1.8), so that run defects are recorded in copy 1.
WARNING: DL ACCESS NOT ALLOWED	Message displayed when either a reset or an addition to the defect list is attempted with access to the defect list disabled in the run parameters.
ERROR READING FROM DLCYL, <RETURN> TO CONTINUE, ANY CHAR TO STOP	Message displayed if a READ error occurs during the attempt to add a defect to the list. If the user elects to continue even though there is an error, the program proceeds with the current operation. If the user elects to stop, the current operation terminates and the program prompts for the next command input.
ERROR WRITING TO DLCYL, <RETURN> TO CONTINUE, ANY CHAR TO STOP	Message displayed if a WRITE error occurs during the attempt to add a defect to the list. If the user elects to continue even though there is an error, the program proceeds with the current operation. If the user elects to stop, the current operation terminates and the program prompts for the next command input.

T16/8L11G-29

SECTION 5
RUN PROCEDURES

5.0 RUN PROCEDURES

> CAUTION
>
> Many of the commands available in the REX diagnostics perform WRITE operations to the disc volumes under test. If these commands are executed with the user volumes in place, user and system data are destroyed. Extreme care must therefore be taken. If the disc drive under test houses removable media, a scratch pack can be installed. In the case of nonremovable media, unless the disc volume is configured as part of a mirrored pair or a backup of the data exists on tape, the test may have to be restricted to the exercising of read-only functions.

A sample successful run of a REX diagnostic is illustrated in Figure 5-1. The test case uses a 128-MB disc drive (T16/4110), configured as irive number %2 on controller number %1. The illustration assumes SHADOW loaded and bits <3>, <4>, and <5> of the Switch Register in the OFF position. (Refer to Table 5.2 for the definition of all applicable switch settings.)

For the user unfamiliar with SHADOW in general or with the REX diagnostics in particular, the system preparations necessary for running diagnostics are described in paragraph 5.1; a step-by-step run procedure follows in paragraph 5.2.

```
T9404D00.SHADOW  01APR81  00:00
>RUN REX4110 <cr>

RANDOM EXERCISER PROGRAM
T9472A02.REX4110 (A02) 01APR82
ONE 3106 CONTROLLER AND ONE DRIVE

INPUT PRIMARY CONTROLLER NUMBER
? %1 <cr>
INPUT DRIVE NUMBER
? %2 <cr>

*** RUN CONTROL PARAMETERS ***"

-DELAY AFTER ERROR:                 1
-STOP ON ERROR:                     0
-ENABLE DEFECT LOG ACCESS:          0
-RANDOM WRITE/READ/VERIFY ENABLE:   0

** INPUT COMMAND STRING **
? TT,CN16,CN2,CN64 <cr>
** INPUT COMMAND STRING **
? LH <cr>
PHEAD   PSECT  SYNC%  FLAG%   CYL   HEAD   SECT
    0       0    360    350     0      0      0
    0       1    360    350     0      0      1
    0       2    360    350     0      0      2
    0       3    360    350     0      0      3
    0       4    360    350     0      0      4
    0       5    360    350     0      0      5
    0       6    360    350     0      0      6
    0       7    360    350     0      0      7
    0       8    360    350     0      0      8
    0       9    360    350     0      0      9
    0      10    360    350     0      0     10
    0      11    360    350     0      0     11
    0      12    360    350     0      0     12
    0      13    360    350     0      0     13
    0      14    360    350     0      0     14
    0      15    360    350     0      0     15
    0      16    360    350     0      0     16
    0      17    360    350     0      0     17
    0      18    360    350     0      0     18
    0      19    360    350     0      0     19
<RETURN> TO CONTINUE DUMP OR ANY CHAR. TO STOP.
? <cr>
PHEAD   PSECT  SYNC%  FLAG%   CYL   HEAD   SECT
    0      20    360    350     0      0     20
    0      21    360    350     0      0     21
    0      22    360    350     0      0     22
    0      23    360    350     0      0     23
    0      24    360    350     0      0     24
    0      25    360    350     0      0     25
    0      26    360    350     0      0     26
    0      27    360    350     0      0     27
    0      28    360    350     0      0     28
    0      29    360    354     0      0     29
    1       0    360    350     0      0      0
    1       1    360    350     0      0      1
    1       2    360    350     0      0      2
    1       3    360    350     0      0      3
    1       4    360    350     0      0      4
    1       5    360    350     0      0      5
    1       6    360    350     0      0      6
    1       7    360    350     0      0      7
    1       8    360    350     0      0      8
    1       9    360    350     0      0      9
<RETURN> TO CONTINUE DUMP OR ANY CHAR. TO STOP.
? n <cr>
```

T16/8L11G-30

Figure 5-1 Sample Successful Run of REX4110

```
** INPUT COMMAND STRING **
? XA10,XB10,XC10,XD10,XE10,XF10 <cr>
** INPUT COMMAND STRING **
? YB <cr>
*** RANDOM WRITE/READ/VERIFY SUBTEST ***
-RANDOM WRITE/READ/VERIFY NOT ENABLED
** INPUT COMMAND STRING **
? AP <cr>
    *** RUN CONTROL PARAMETERS ***

-DELAY AFTER ERROR:                1
-STOP ON ERROR:                    0
-ENABLE DEFECT LOG ACCESS:         0
RANDOM WRITE/READ/VERIFY ENABLE: 0

<RETURN> TO CONTINUE, ANY CHAR TO ALTER
? k <cr>
-DELAY AFTER ERROR (Y/N) ?
? n <cr>
-STOP ON ERROR (Y/N) ?
? n <cr>
-ENABLE DEFECT LOG ACCESS (Y/N) ?
? n <cr>
-ENABLE RANDOM WRITE/READ/VERIFY (Y/N) ?
? y <cr>
    *** RUN CONTROL PARAMETERS ***

-DELAY AFTER ERROR:                1
-STOP ON ERROR:                    0
-ENABLE DEFECT LOG ACCESS:         0
RANDOM WRITE/READ/VERIFY ENABLE: 1

<RETURN> TO CONTINUE, ANY CHAR TO ALTER
? <cr>
** INPUT COMMAND STRING **
? YB <cr>
** INPUT COMMAND STRING **
? <escape>

*  ERROR SUMMARY DURING REX4110   *

  TIMEOUTS                    0
  NOT ON CYLINDERS            0
  SEEK ERRORS                 0
  DATA ERRORS CORRECTED       0
  ILLEGAL ADDRESSES           0
  DATA UNCORRECTABLES         0
  HEADER SEARCH FAILS         0
  PASS COUNT                  1

!!!!!!!!!!   E N D   OF   R E X 4 1 1 0   !!!!!!!!!!
```

Note: 128-Mb disc drive (T16/4110), drive number %2, controller number %1. SHADOW loaded and panel switches <3>, <4>, and <5> switched off.

T16/8L11G-31

Figure 5-1 Sample Successful Run of REX4110 (Cont'd)

5.1 PREPARATIONS FOR RUNNING THE REX DIAGNOSTICS

Before any diagnostic is run, certain steps must be taken to allocate the system resources necessary for SHADOW and to ensure that the diagnostic run has minimum impact on system performance. The necessary procedures are ordinarily performed by the local system manager, or at least with the concurrence of the system manager. They include:

a. Obtaining access to the OSP subsystem

b. Transferring to another processor all user processes currently running in the processor to be taken off line

c. Transferring to another processor the path preference of all controllers with preferred paths currently assigned to the processor to be taken off line

d. Taking whatever precautions are indicated to protect the data stored on the disc volume to be tested

e. Taking off line the processor to be loaded with SHADOW

f. Taking off line the disc subsystem (controller and drive) to be tested.

> CAUTION
>
> If a T16/4109 disc drive is to be tested, both the moving and fixed-head portions of the disc (each assigned a different physical unit number) must be taken off line. Since the drives are dual ported, both paths to both portions of the disc must be off line.

These steps are described in detail elsewhere in the NonStop II Diagnostic Operating Procedures, Part Number 82803; those that deal with preparing the system in general for SHADOW, in Volume 1, Chapter 2, Parts 1 and 2; and those that deal with preparing the disc subystem in particular, in Volume 3B, Chapter 1, Part 1.

A checklist of the requirements for the REX diagnostics, both those that must be available on the system and those that must be supplied by the customer engineer, is given in Table 5.1.

Table 5.1 Checklist for the REX Diagnostics

REQUIREMENTS	SOURCE
A functioning OSP subsystem and terminal.	On site.
A processor that can be taken off line and dedicated to SHADOW.	On site.
A tape drive unit (if SHADOW is to be loaded from tape). a. The tape drive must be physically connected to the test processor if SHADOW is I/O loaded from tape. b. The tape drive must be physically connected to the processor that is to read the tape if SHADOW is bus loaded through an offline processor. c. The tape drive must be physically connected to a processor running GUARDIAN (TM) if SHADOW is bus loaded through an online processor.	On site.
Scratch pack or packs to substitute for the user packs during diagnostic execution (if removable media are to be tested).	On site.
SHADOW operating system. *	Either on site, in disc storage, or supplied by C.E. on cold load tape.
The appropriate REX diagnostic program for the disc drive type under test (refer to Table 1.1).	Either on site, in disc storage, or supplied by C.E. on cold load tape.

* There are two distinct versions of the SHADOW operating system, one for the NonStop system (usually denoted as ZZDIAG1.SHADOW) and the other for the NonStop II system (usually denoted as ZZDIAG2.SHADOW). If loading from tape, ensure that the correct version is present on the tape and specify it during the load procedure.

5.2 RUN PROCEDURE FOR THE REX DIAGNOSTICS

> CAUTION
>
> It is possible to run SHADOW diagnostics from the OSP in two or more processors concurrently. However, only one test process can communicate with the OSP at a time. For this reason, no more than one diagnostic process is ordinarily run on a system at any given time.

To run one of the REX diagnostics, first ensure that the preparations listed in paragraph 5.1 are taken and then proceed as follows:

a. Load SHADOW into the test processor.

> CAUTION
>
> There are two distinct versions of the SHADOW operating system, one for the NonStop system (usually denoted as ZZDIAG1.SHADOW) and the other for the NonStop II system (usually denoted as ZZDIAG2.SHADOW). If loading from tape, ensure that the correct version is present on the tape and specify it during the load procedure. There are three methods for loading SHADOW: I/O cold load from tape, bus cold load from tape, and online load from tape or disc. They are described in detail in the NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 1.

b. Set desired Switch Register options in the operator control panel of the test processor. (Refer to Table 5.2 for a list of panel switches defined for the REX diagnostics.)

c. At the SHADOW prompt (>) on the OSP screen, enter the command:

```
RUN <filename>
```

where <filename> is REX4103, REX4104, REX4105, REX4109, REX4110, or REX4116. (Refer to Figure 5-1 for further illustration.)

Table 5.2 Switch Register Options Available for the REX Diagnostics *

SWITCH	FUNCTION
<0>	(Standard SHADOW function) If toggled on and off, generates a user break request and returns the SHADOW interpreter to conversational mode, where it waits for further instruction.
<3>	(Standard SHADOW function) If placed in the ON position, suppresses error printout and enables setting of the special numerics ERROR# and COMPERR#. Refer to the Diagnostic Languages Manual, Part Number 82848, for a description of the special numerics ERROR# and COMPERR#.
<4>	(Standard SHADOW function) If placed in the ON position, suppresses error printout, disables setting of the special numerics ERROR# and COMPERR#, and disables ERROR limit decrement. SWITCH BIT <4> MUST NOT BE USED WITH THE REX DIAGNOSTICS.
<5>	(Standard SHADOW function) If placed in the ON position, causes a program halt on I/O error.
<6>	(REX-specific function) When switched to the ON position, causes program to loop on the previously entered command string. Program continues looping until switch is returned to the OFF position.

* Switches <1>, <2>, and <7> are not defined for the REX diagnostics, and switches <8> through <15> reflect the I/O address.

NOTE

Execution of the RUN command causes the program to initialize and the program name to be displayed at the OSP terminal along with the following message:

NOTE: SECTOR-SKIPPING MEDIA ONLY

If the control panel switches are set to anything other than all zeros, the following warning is then displayed:

```
-WARNING: PROCESSOR PANEL SWITCHES SET TO:
          x xxx xxx xxx xxx xxx
```

If any of these settings is other than desired, they can be altered at this time. The program then displays several requests for input. Actual program execution commences only when the last request is honored.

d. When the following request is displayed at the OSP terminal, respond as indicated:

```
INPUT PRIMARY CONTROLLER NUMBER
?
```

1. Enter at the prompt the physical unit number (in octal) of the disc controller to be tested.

2. Depress carriage return.

e. When the following request is displayed at the OSP terminal, respond as indicated:

```
INPUT DRIVE NUMBER
?
```

1. Enter at the prompt the physical unit number (in octal) of the disc drive to be tested.

2. Depress carriage return.

NOTE

The disc drive indicated must be connected to the controller specified in step d. The REX diagnostics test one controller and one drive at a time.

The T16/4109 drive requires two I/O addresses (one for the moving heads and one for the fixed heads). So that REX4109 can test both parts of the disc, the valid range of drive numbers for REX4109 is limited to [0,3] instead of the customary range [0,7]. The upper half of the range [4,7] is reserved for identifying internally the fixed-head portions of the disc drives specified by the lower half (i.e., drive number 4 is the fixed-head portion of drive number 0, and so on).

f. (REX4109 only) When the following request is displayed at the OSP terminal,

```
FIXED HEADS ON THIS UNIT?
?
```

1. Enter **Y** at the prompt.

2. Depress carriage return.

NOTE

If a drive number greater than 3 was entered in step f, the following message is then displayed and the program returns to step e for entry of an acceptable drive number:

```
DRIVE NUMBER MUST BE <= 3
```

g. When the following request is displayed at the OSP terminal, respond as indicated:

```
** INPUT COMMAND STRING **
?
```

1. Enter the following command at the OSP terminal:

TT

2. Depress carriage return.

h. When the TAKE OWNERSHIP is accomplished and the following request for command string input is again displayed at the OSP terminal, respond as indicated:

```
** INPUT COMMAND STRING **
?
```

1. Enter at the prompt any legal command or series of commands, using a comma to separate each command from the command following it (but not a command from its parameter).

2. Depress carriage return.

NOTE

When this command or command string is executed (and as each subsequent command or command string is executed), the program prompts as before for another command string input. To exit exerciser mode and reinitialize the REX diagnostic for test of another device, the EXIT command (EX) must be entered. To terminate the diagnostic, either the ESCAPE key must be depressed at the OSP terminal, or switch <0> of the control panel toggled on and off; SHADOW then returns to conversational mode. Table 5.3 describes a possible opening series of commands. Refer to Section 3 for a description of all available commands and of the operations they perform.

Table 5.3 Possible Opening Series of Commands in REX Diagnostics *

COMMAND	OPERATION
TT <cr>	Performs a TAKE OWNERSHIP.
CN16 <cr>	Performs a PRIORITY SELECT.
CN2 <cr>	Performs a UNIT CLEAR.
CN64 <cr>	Performs a RECALIBRATE.
CY0 <cr>	Sets current cylinder address to 0.
HD0 <cr>	Sets current head address to 0.
SC0 <cr>	Sets current sector address to 0.
SK <cr>	Performs a SEEK to address 0,0,0.
RF <cr>	Performs a READ FULL SECTOR at address 0,0,0.
DR <cr>	Performs a DUMP READ$, displaying the contents read at address 0,0,0.

* This series of commands could also be entered as a single command string, each command separated from the others by a comma, with a single carriage return at the end. The success of this series of commands is a fair indication that the controller and cables are properly installed and functioning.

** To access the fixed-head portion of a T16/4109 disc drive, CY must be set in the range [896,915]; HD in the range [0,4]; and SC in the range [0,29]. Zero (0) is the only valid head setting for cylinder 915.

i. Analyze any errors generated. (Refer to Section 4 for a description of possible error conditions.)

j. If the problem can be isolated to a faulty cable or to the drive as a unit, replace the faulty part. (Refer to the appropriate maintenance manual for a description of replacement procedures.)

k. If the results of the REX diagnostic are inconclusive, try to isolate the problem further by running another of the diagnostics for sector-skipping format. (Refer to Table 1.1.)

CAUTION

The REX diagnostics can invalidate the format of a disc pack. When testing with a REX diagnostic is complete, it is necessary to run the appropriate disc pack formatter to restore valid sector-skipping format to the disc pack. Either the PUP FORMAT facility or the appropriate SHADOW formatter (FMT) may be used for this purpose. In cases where the contents of DLCYL have been lost, the PUP FORMAT facility must be used. To provide for adequate restoration of DLCYL in such cases, it is essential that a tape or hard copy of the vendor defect list information stored on DLCYL when first formatted by Tandem manufacturing be available. If a tape copy exists, it can be loaded directly onto the reformatted disc. If only a hard copy exists, the defects must be entered one by one, using the appropriate SHADOW defect-logging utility program (DUT). The PUP FORMAT procedure is described in the NonStop II System Operations Manual, Part Number 82075. The FMT programs are described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 3B, Chapter 1, Part 1F; the DUT programs, in Part 1D.

1. When diagnostic testing is complete, perform the following:

   1. Notify the system manager that the serviced disc volume is now ready to be returned to system use.

NOTE

The facility for bringing disc volumes on line is provided by the PUP commands UP and REVIVE. The UP command is used to bring on line a volume that is not part of a mirrored pair. Any volumes configured to operate as part of a mirrored pair must be brought on line with the REVIVE command. The PUP commands UP and REVIVE are described in the NonStop II System Operations Manual, Part Number 82075.

   2. Assist the customer in verifying the integrity of any disc volumes that have been serviced and in restoring the system to normal performance.

NOTE

The procedure for reloading a processor that is off line is described in NonStop II Diagnostic Operating Procedures, Part Number 82803, Volume 1, Chapter 2, Part 3.

READER'S COMMENTS

NonStop II Diagnostic Operating Procedures

PN 82803

Tandem welcomes your comments on the quality and usefulness of its publications. Please indicate a specific *section* and *page* number when commenting on any manual. Does this manual have the desired completeness and flow of organization? Are the examples clear and useful? Is it easily understood? Does it have obvious errors? Are helpful additions needed?

FOLD ➤

FOLD ➤

FROM:

Name _____

Company _____

Address _____

City, State _____ Zip _____

A written response is requested: yes no

FOLD

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 482 CUPERTINO, CA USA

POSTAGE WILL BE PAID BY ADDRESSEE

TANDEM
COMPUTERS

C 62

Attn.: CE Hardware Publications
19333 Vallco Parkway
Cupertino, CA U.S.A. 95014

FOLD

STAPLE HERE