TRANSMITTAL NOTICE **Date: March 1992**

Publication Number: CDM-1114-0A1 **Publication Title: DS-40/41 Disk Subsystem Diagnostic Reference Manual Change Packet**

Remove	Insert	Page Numbers	# of Sheets	General contents of manual described and changes (if any) listed
★		iii through xv. Part 1: 1-1, all of Section 3, 4-7, 4-17, 4-19, 5-1, 5-3, 7-1 through 7-5, and 7-15. Part 2: 1-3, 1-5, 3-1, 3-5, and 5-1 through 5-7. Part 3: 1-1 through 1-43.	49	Please remove and shred the listed pages from the *DS-40/41 Disk Subsystem Diagnostic Reference Manual*, publication number CDM-1114-0A0.
	★	iii through xv. Part 1: 1-1, 3-1, 4-7, 4-17 through 4-21, 5-1, 5-3, 7-1 through 7-5, and 7-15. Part 2: 1-3, 1-5, 3-1, 3-5, and 5-1 through 5-7. Part 3: 1-1 through 1-43.	49	The *DS-40/41 Disk Subsystem Diagnostic Reference Manual Change Packet* adds information about the DD-4R and DD-42 disk drives used in the DS-4R and DS-42 disk subsystems. This change packet adds information about using the MDMS diagnostics with the DD-4R and DD-42 disk drives to the following sections in Part 1, "Micro-based Diagnostics": Section 3, "MDMS Installation"; Section 4, "Status Bit Definitions"; Section 5, "MDMS Diagnostics"; and Section 7, "Flaw Management and Surface Analysis Utilities." This change packet adds information about using the DD40 Diagnostics with the DD-4R and DD-42 disk drives to the following sections in Part 2, "IOS Diagnostics": Section 1, "Loading and Running DD40 Diagnostics"; Section 3, "User Parameters"; and Section 5, "Flaw Management Tests." This change packet adds information about the GDTD/GSAD (DD-4R disk drives) and GDTE/GSAE (DD-42 disk drives) foreground diagnostic tests and CD4R and CD42 background diagnostic tests to Part 3, "CRAY-2 Diagnostics Overview." Change bars indicate the updated information. Please insert the pages listed into the *DS-40/41 Disk Subsystem Diagnostic Reference Manual*, publication number CDM-1114-0A0.

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Publication Title: DS-40/41 Disk Subsystem Diagnostic Reference Manual

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★		All	200	Please remove and shred the *DS-40 Disk Subsystem Diagnostic Reference Manual*, publication number CDM-1114-000.
	★	All	210	The *DS-40/41 Disk Subsystem Diagnostic Reference Manual* describes the Cray Research, Inc. (CRI) maintenance control unit (MCU), I/O subsystem (IOS), and CRAY-2 computer system diagnostic software for the DS-40, DS-41, and removable disk system (RDS-5) disk subsystems. The manual describes the micro-based disk maintenance system (MDMS) diagnostic software, the IOS diagnostic test, known as DD40 (previously DDXMD) and DD41; and the CRAY-2 diagnostic tests, known as GDTB, GSAB; GDTC, GSAC, and CD40/41. This revision incorporates information on the DS-41 disk subsystem, and diagnostic and flaw management programs for the DS-41. All previous versions of this manual are obsolete.

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DS-40 and DS-41 Disk Subsystems Diagnostic Reference Manual

CDM-1114-0A0

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Record of Revision

Each time this manual is revised and reprinted, all changes issued against the previous version are incorporated into the new version, and the new version is assigned an alphabetic level which is indicated in the publication number on each page of the manual.

Changes to part of a page are indicated by a change bar in the margin directly opposite the change. A change bar in the footer indicates that most, if not all, of the page is new. If the manual is rewritten, the revision level changes but the manual does not contain change bars.

REVISION	DESCRIPTION
	August 1989 - Original printing.
A	March 1991. Reprint with revision. The manual was revised to include information on the DS-41 disk subsystem, and the DD40 diagnostic package, which replaces the DDXMD diagnostic package. This revision makes all previous printings obsolete.
A1	March 1992. Change packet. This change packet adds information relating to the DD-4R disk drives that are used in the DS-4R disk subsystem and the DD-42 disk drives that are used in the DS-42 disk subsystem. It affects the status bit definitions and menu displays and descriptions in the MDMS sections in Part 1, "Micro-based Diagnostics," and the diagnostic descriptions in the DD40 diagnostics sections in Part 2, "IOS Diagnostics." It adds GDTD/GSAD (DD-4R disk drives) and GDTE/GSAE (DD-42 disk drives) foreground diagnostic test descriptions and CD4R and CD42 background diagnostic test descriptions to the CRAY-2 computer system diagnostics in Part 3, "CRAY-2 Diagnostics Overview."

PREFACE

This manual describes the diagnostic software for the Cray Research, Inc. (CRI) DS-40 disk subsystem, the DS-41 disk subsystem, the DS-4R disk subsystem, the DS-42 disk subsystem, and the removable disk system (RDS-5). The software runs on the input/output subsystem (IOS), the CRAY-2 computer system, and either the maintenance workstation (MWS) or the maintenance control unit (MCU). The three parts of the manual describe the micro-based disk maintenance system diagnostic software, known as MDMS; the IOS diagnostic test, known as DD40 (previously DDXMD); and the CRAY-2 diagnostic tests known as CD40/41/4R/42, GDTB, GSAB, GDTC, GSAC, GDTD, GSAD, GTDE, and GSAE. A glossary of technical terms appears at the end of this manual.

Note: All references in this manual to the DS-40 that contains DD-40 disk drives also apply to the DS-4R that contains DD-4R disk drives and to the DS-42 that contains DD-42 disk drives, unless specifically stated otherwise. All references in this manual to the RDS-5 also apply to the RDS-20, unless specifically stated otherwise. This manual also describes how the MDMS and DD40 diagnostics are used with the RDS-5 disk storage subsystem that uses the DCU-S1 disk controller.

AUDIENCE

This manual is written for CRI field engineers who maintain the DS-40/41/4R/42 disk subsystems. The reader should be familiar with digital computers, Cray Research mainframes, the IOS, and DS-40/41/4R/42 disk subsystems.

ORGANIZATION

PART 1 of this manual describes the MCU- and MWS-based MDMS diagnostics software and includes the following sections:

SECTION 1 - MDMS OVERVIEW provides general information about MDMS commands and the hardware interface.

SECTION 2 - CP/M AND UNIX OPERATING SYSTEMS USER INTERFACES describes the control program/microprocessor (CP/M) and UNIX user interfaces and the most commonly used commands.

SECTION 3 - MDMS INSTALLATION describes how to install the MDMS software.

SECTION 4 - STATUS BIT DEFINITIONS describes the status bits used by the 2XF module and by MDMS.

SECTION 5 - MDMS DIAGNOSTICS describes the DS-40/41 controller and disk drive diagnostic tests.

SECTION 6 - MDMS TROUBLESHOOTING describes the DS-40/41 troubleshooting diagnostic tests.

SECTION 7 - FLAW MANAGEMENT AND SURFACE ANALYSIS UTILITIES describes flaw tables and utilities such as surface analysis.

PART 2 of this manual describes the IOS DD40 diagnostic tests and includes the following sections:

SECTION 1 - LOADING AND RUNNING DD40 DIAGNOSTICS provides general information about the DD40 diagnostic software and the hardware interface.

SECTION 2 - DD40 COMMANDS describes the commands used for initializing and running the DD40 diagnostics.

SECTION 3 - USER PARAMETERS describes the memory-resident parameters used with the DD40 diagnostic command language.

SECTION 4 - DIAGNOSTIC TESTS describes DD40 test sections 0 through 17 and their associated parameters.

SECTION 5 - FLAW MANAGEMENT TESTS describes information about flaw management and surface analysis utilities.

SECTION 6 - STATUS AND ERROR REPORTING describes status information and error messages.

PART 3 of this manual describes the CRAY-2 diagnostic tests and includes the following section:

SECTION 1 - CRAY-2 DIAGNOSTICS OVERVIEW describes the GDTB, GSAB, GDTC, GSAC, GDTD, GSAD, GDTE, GSAE, and CD40/41/4R/42 offline diagnostic tests.

RELATED PUBLICATIONS

Refer to the following CRI publications for more information on CRI equipment and software used with the DD-40/41 disk drives:

- CDM-0003-000 *CRAY-1 Computer Systems Models A, S, and M IOS-based Diagnostic Reference Manual.* This publication contains information about the Cray maintenance operating system (CMOS), which supports the DD40 diagnostic test.

- CDM-0201-0A0 *CRAY-2 Computer Systems Off-line Diagnostic Reference Manual.* This publication describes maintenance control console (MCC) commands and disk I/O diagnostics.

- CDM-0108-000 *CRAY X-MP Computer Systems IOS-based Diagnostic Reference Manual.* This publication contains information about CMOS, which supports the DD40 diagnostic test.

- CDM-1116-0B0 *CRAY Y-MP and CRAY X-MP EA Off-line Diagnostic Reference Manual.* This publication references the CRAY Y-MP and CRAY X-MP EA diagnostic set.

- CMM-1120-0B0 *OWS and MWS Installation and Maintenance Manual.* This publication describes installation and maintenance procedures for the Cray operator workstation (OWS) and maintenance workstation (MWS). System installation procedures, hardware and software procedures, the error logger and VME interface boards, and troubleshooting procedures for the OWS and MWS are described.

- CQM-1105-0A0 *DS-40/DS-41 Quick Reference Manual.* This publication describes the DS-40/41 disk subsystems diagnostic commands that run in an IOS and includes other maintenance information.

- SMM-1011 *CRAY Y-MP, CRAY X-MP EA, CRAY X-MP, and CRAY-1 Computer Systems COS On-line Diagnostic Maintenance Manual.* This publication describes how to run the DONUT online disk utility.

- PRN-0799 *DC-40 Disk Controller/DD-40 Disk Drive Engineering Note.* This publication describes the hardware and software used in the DD-40/DC-40 disk drive.

- PRN-0906 *RDS-5 Removable Disk System Engineering Note.* This publication describes the hardware and software used in the DD-40/DC-40 disk drive.

- DL-DDXMD The DL-DDXMD diagnostic program listing that is available from Technical Operations-Logistics and online on the MWS can be used to determine the code executing when an error occurs. The listing also includes information about the input/output processor (IOP) local memory map for DD40 diagnostic operations. The listing defines the locations of buffers, stored user parameters, and error information.

Refer to the following Control Data Corporation (CDC) publications for additional information on the Expanded Module Drive:

- 01409700 *CDC PA1A7/PA1A9 Expanded Module Drive User's Manual 83327040.* This publication contains general information, and installation and operation procedures for the XMD disk drive.

- 01630800 *CDC PA1A6/PA1A7 Expanded Module Drive Hardware Maintenance Manual, Volume 2 83325460.* This publication contains a theory of operation, maintenance information, troubleshooting information, and repair and replacement procedures for the XMD disk drive.

- 01630900 *CDC PA1A7/PA1A9 Expanded Module Drive, Diagrams 83325470.* This publication contains logic diagrams for the XMD disk drive.

Refer to the following Motorola, Inc. publication for additional information on the UNIX operating system:

- CZM-0937-000 *Motorola System V/68 Release 3 User Reference Manual, Volume 1.* This publication describes the UNIX operating system commands that constitute the basic software running on the MWS.

NOTATIONAL CONVENTIONS

The following conventions are used throughout this manual:

- Numbers appearing in this manual, such as those used to indicate local memory addresses and cylinder, head, and sector values are normally in octal form. When the context is not clear, the number may be designated octal.

- *Italic* font indicates a variable or user-supplied command.

- Screen terms, commands, and key labels appear in bold or terminal-style text, for example **DS** or `DS`.

- A carriage return key is shown by this symbol: ↵.

- Notational conventions that apply to CP/M commands appear in Section 2 of Part 1. Notational conventions that apply to IOS commands are explained in Section 1 of Part 2.

- Parameters in angle brackets < > are mandatory. You must enter the appropriate options from the menu selections. For example, enter the name of your file when <filename> appears in a command. Do not type the angle brackets.

- Parameters in square brackets [ ] are optional. You select the desired parameters only and enter the appropriate information within the brackets. Do not type the square brackets.

- Variable or user-supplied command parameters are in italic unless they are within angle brackets or square brackets.

CONTENTS

1 - CRAY-2 DIAGNOSTICS OVERVIEW (continued)

FIGURES

Part 1 Figures

Part 1 Figures (continued)

TABLES

Part 1 Tables

Part 2 Tables

2 - CP/M AND UNIX OPERATING SYSTEMS USER INTERFACES

MDMS diagnostic software runs under the CP/M and UNIX operating systems.

Note: For information on the UNIX operating system commands used on the MWS, refer to the *Motorola System V/68 Release 3 User's Reference Manual, Volume 1*. The manual is supplied to your site with the maintenance workstation (MWS).

This section primarily describes the CP/M user interface and features that enable you to transfer files from one drive to another, display the contents of drive directories, and erase files from directories. If you need more detailed information about the CP/M instruction language, consult any standard CP/M textbook.

CP/M SCREEN PROMPT

When the CP/M operating system is running, it displays the following screen prompt which identifies the active hard-disk partition:

```
A>
```

The A hard-disk partition contains the CP/M instruction files. Use these files when you enter CP/M instructions.

It is possible to have two 5 ¼-in. disk drives contained in the MCU. The first disk drive is designated with the letter M; the second disk drive is designated with the letter N.

Other hard-disk partitions are labeled consecutively beginning with the B drive. The CP/M operating system recognizes drive designators up to and including the letter P.

CP/M COMMAND ENTRY

To enter a CP/M instruction or the name of a program, type the name of the CP/M instruction or other executable file next to the prompt and add the required parameters. To run the instruction or program, press the **RETURN** key.

If the CP/M operating system displays **?** after you press the **RETURN** key, it usually means the operating system cannot find the file in the active drive's directory. Type **<DRIVE:> <FILE>** and press the **RETURN** key, or transfer the file to the active drive using a **PIP** instruction. The **PIP** instruction is described later in this section.

CP/M FILENAMES

A CP/M filename consists of three parts: filename, extension (EXT), and drive label. In most cases, only the filename and extension are used.

The filename can be a combination of as many as eight numbers and letters. The extension is a string of up to three letters and numbers separated from the filename by a period. The extension is useful if you want to organize files into different categories. The CP/M operating system is able to search through a directory for all files in the category you define with the extension. If the drive label is used, it consists of a letter and a colon. It indicates the flexible disk or hard-disk partition where the file is stored.

The CP/M operating system recognizes the following file specifications:

- `filename.ext` `d:filename`
- `filename` `d:filename.ext`

CP/M OPERATIONS

The following CP/M operations are used most often in a CP/M instruction line:

Operation	Description
*	Designates a wildcard. It is a substitute for all letter and number combinations at or after the wildcard location in filenames or extensions.
=	Assigns a variable or constant on the right side of the operator to a variable on the left side.
[]	Indicates an optional element in a statement.
|	Separates parameters.
?	Designates a wildcard that replaces a single letter or number in a filename or extension.

CP/M NOTATIONAL CONVENTIONS

The following CP/M notational conventions are used in this manual:

Convention	Description
< >	Denotes required parameter(s) in an instruction.
<< >>	Denotes optional parameter(s) in an instruction. If no parameter is entered, either a default parameter is used or none is needed.

COMMONLY USED CP/M COMMANDS

This subsection describes some of the common CP/M commands used with MDMS software.

- DIR
- ERA
- PIP
- STAT
- TYPE

DIR Command

Description: The DIR command displays filename(s) from the selected disk drive's directory.

Note: The descriptions in this manual do not fully describe the CP/M commands listed in this manual or other available CP/M commands. Refer to any standard CP/M manual for more details on the commands.

When to Use:
- To locate a file within the CP/M file structure
- To identify the contents of a particular directory
- To view all files in a particular category found in a disk drive directory

Syntax: `DIR <<DRIVE:>><<FILENAME>>.<<EXT>>`

Parameters:

DRIVE	Denotes a current hard-disk partition or flexible disk drive.
FILENAME	Indicates a label consisting of as many as eight alphanumeric characters.
EXT	Indicates an alphanumeric extension of the filename that contains as many as three characters.

Examples:

`DIR`	Displays the current directory.
`DIR A:`	Displays the A directory.
`DIR *.TXT`	Displays all files in the current directory with TXT extensions.
`DIR JFK*.TXT`	Displays TXT files with a JFK prefix and a TXT extension.

ERA Command

Description: The ERA command erases a file from a disk drive location.

When to Use: To remove a file from your disk drive file structure.

Syntax: `ERA <<DRIVE:>><FILENAME>.<<EXT>>`

Parameters:

DRIVE	Denotes a current hard-disk partition or a flexible disk drive.
FILENAME	Indicates a label consisting of as many as eight alphanumeric characters.
EXT	Indicates an alphanumeric extension of the filename containing as many as three characters.

Examples:

`ERA JFK*.*`	Removes all files with the JFK prefix.
`ERA *.*`	Removes all files from the current directory.
`ERA *.FLW`	Removes all files with the FLW extension.

PIP Command

Description: The PIP command copies, transfers, or appends files from one CP/M logical device to another. It also enables the user to duplicate a file on the active drive or rename a file.

When to Use:

- To copy a file from one disk to another
- To duplicate and then rename a file
- To duplicate more than one file
- To combine files
- To copy a file from one of several CP/M logical devices to another

Syntax: `PIP <DESTINATION>=<SOURCE><OPTION>`

Parameters:

DESTINATION	Indicates the name of a file or logical device that data is sent to.
SOURCE	Indicates the name of a file or logical device that data is sent from.
OPTION	Enables one of 19 different options for the file transfer. Refer to a CP/M manual for a description of the options.

Examples:

`PIP A:=B:JFKFILE.TXT`	Copies file from the B drive to the A drive.

`PIP JFKNEW.TXT=JFKOLD.TXT`	Duplicates and renames a file or files.
`PIP E:=M:*.*`	Copies all files from the flexible disk to the E hard-disk partition.
`PIP M:=E:*.FLW`	Copies all flaw files from the E hard-disk partition to the flexible disk drive.

STAT Command

Description: The STAT command displays information about disk drives, files, and other CP/M logical devices connected to the MCU.

When to Use:
- To find out how much free space is on a drive
- To learn the size of a file

Syntax: `STAT <<DRIVE:>> <<FILENAME>>`

Parameters:

DRIVE	Identifies the disk drive status.
FILENAME	Identifies the file status.

Examples:

`STAT`	Displays the active drive's free disk space and drive attributes.
`STAT *.FLW`	Displays .FLW file sizes and remaining free disk space on the active drive.

TYPE Command

Description: The TYPE command displays the contents of an ASCII file at the MCU console. Press any key while the TYPE command is displaying a file to stop the display of the file. The TYPE command does not accept wildcard parameters.

Entering **<Cntl>P** before issuing a TYPE command causes the file to be sent to the printer. Enter **<Cntl>P** again to prevent other TYPE commands from sending output to the printer.

When to Use: To view the contents of a file

Syntax: `TYPE <<DRIVE:>> <FILENAME>.<<EXT>>`

Parameters:

DRIVE	Designates the drive where the file is stored. This drive can be either a hard-disk partition or a disk drive.
FILENAME	Indicates a label consisting of as many as three alphanumeric characters.

EXT	Indicates the filename extension consisting of as many as three alphanumeric characters. The extension entry is separated from the filename by a period. The extension can be used to define file categories.

Examples:

`TYPE A:ANYFILE.TXT`	Displays a file stored on the A drive.
`TYPE SETFMT`	Displays the file on the current drive.

3 - MDMS INSTALLATION

For MDMS installation information, refer to the Site Installation Bulletin (SIB) for your current diagnostic configuration.

4 - STATUS BIT DEFINITIONS

This section describes status bits used by the MDMS software and 2XF module. Status bits are used to troubleshoot the DS-40/41 and determine its operating status.

Table 4-1 describes the tester status parcel bits the MCU and MWS read from the 2XF module in the offline channel disk tester. Table 4-2 describes the 2XF module's status buffer 0 bit assignments. Tables 4-3 through 4-8 show the status bit assignments in status buffer 1.

All commands issued to the 2XF module return tester status parcels to the MCU and MWS for error checking. Commands that run in the DC-40/41 disk controller unit return status buffer 0 bits with the tester status parcels. Some of these commands also send MCU and MWS echo data or general status from status buffer 1 for error checking.

Table 4-1. Tester Status Parcel Bits

Bit	Description
0	Data checker enabled
1	Random data enabled
2	Data generator enabled
3	Continuous generation enabled
4	Short transfer mode enabled
5	Global error flag (bits 8 through 10 and/or 11 set)
6	2IE data done
7	2IE done
8	2IE error
9	Data miscompare in data checker
10	Data buffer parity error
11	LOSP channel parity error
12	LOSP channel parity error (bits 0 through 3)
13	LOSP channel parity error (bits 4 through 7)
14	LOSP channel parity error (bits 8 through 11)
15	LOSP channel parity error (bits 12 through 15)

Table 4-2. 2XF Module Status Buffer 0 Bit Assignments †

Bit	Description
0	Drive ready
1	Drive status available
2	Drive busy or invalid drive command
3	Drive error
4	Status parity error
5	Bus-in parity error
6	Read data parity error
7	Error flag
8	Parameter register 2^0
9	Parameter register 2^1
10	Parameter register 2^2
11	Parameter register 2^3
12	Parameter register 2^4
13	Parameter register 2^5
14	Parameter register 2^6
15	Parameter register 2^7

† This status simulates DCU-5 status 0 in an IOP.

Table 4-3. General Status

Bit(s)	Status Names	Description
2^0 - 2^3	Sector number	Indicates the last sector in error or the last sector read.
2^4 - 2^5	Drive number	Indicates the drive with the last sector in error or the last sector read.
2^6	Channel error	Indicates a new function was received when a function was in progress. The signal is also issued if a function 12 is decoded. A function 12 is not used in the DC-40/41 or if a parity error occurs.
2^7	Buffer error	Indicates a single- or double-bit error. All single-bit errors are corrected by single-error correction/double-error detection (SECDED).
2^8	Unit ready	Indicates all spindles are up to speed, the heads are loaded, and there are no faults in the spindle.
2^9	On-cylinder	Indicates the servo positioned the heads over the desired track without error on all spindles.
2^{10}	Seek error	Indicates one of the following conditions: • Any spindle took too long to complete a seek • Any head position is outside the data area • Any spindle attempted a seek past the highest-numbered cylinder When a seek error goes active, the MPU stops all servo commands. This keeps the heads at their present position. The seek error can only be cleared by a return-to-zero (RTZ). Refer to the "Theory of Operations" section of Control Data Corporation (CDC) manual 83325460 for more information on seek errors.
2^{11}	Drive fault	Indicates that one or more of the following faults occurred: • Ready and write • Write or read while off-cylinder • First seek • Write and write protected • Head select • Voltage (Refer to Table 4-6 for a description of the drive faults.)

Table 4-3. General Status (continued)

Bit(s)	Status Names	Description
2^{12}	Error-correction code (ECC) error	Indicates that the data read from the sector did not match the data written to the sector.
2^{13}	ID error	Indicates the sector did not match the ID stored in the registers of the 2EJ module.
2^{14}	Sync timeout	Indicates the sync byte was not found in the allotted amount of time.
2^{15}	Defect parity error	Indicates the parity and defect bits revealed that a defect field error was read from the disk.

Table 4-4. DC-40/41 Controller (Buffer) Status Format

Status Register 1 Bit	Name	Description
2^0	Sector number	Bit 2^0 of the sector address number
2^1	Sector number	Bit 2^1 of the sector address number
2^2	Sector number	Bit 2^2 of the sector address number
2^3	Sector number	Bit 2^3 of the sector address number
2^4 2^5	Spindle number	Bit 2^4 is least significant bit 00 = A, 01 = B, 10 = C, 11 = D
2^6	Uncorrectable buffer error	This bit is set if two or more bits in a full-track buffer parcel are in error
2^7	Buffer error	This bit is set if one or more bits in a full-track buffer parcel are in error
2^8	Unit ready	This bit is set when the selected drive (all spindles) is ready
2^9	On-cylinder	This bit is set when the heads of the selected drive (all spindles) are positioned at the requested cylinder
2^{10}	Seek error	This bit is set if the selected drive fails to complete a seek operation
2^{11}	Drive fault	This bit is set if a fault condition exists on the selected drive (any of the spindles)
2^{12} †	Error correction code error (ECC error)	This bit is set if the data read does not match the data written to a selected sector
2^{13} †	ID not found	This bit is set if a sector ID field is not found within a specified time
2^{14} †	Sync timeout	This bit is set if a sync byte is not found in the sector ID or data field within a specified time
2^{15} †	Defect parameter parity error	This bit is set if a parity error is found in the defect parameter address of a sector

† Refer to bits 2^0 through 2^5 for indication of the actual sector flagging these error conditions.

Table 4-5. DD-40/41 Disk Storage Device - Drive Status

Bit(s)	Status Names	Description
2^0 - 2^3	Sector number	Indicates the last sector in error or the last sector read.
2^4 - 2^5	Drive number	Indicates the drive with the last sector in error or the last sector read.
2^6	Command error	Sets if a new function is received with a function in progress. Also sets if a function 12 is decoded because a function 12 is not used in the DC-40/41.
2^7	Channel diagnostic mode	Sets when only the port is selected. The port is selected without a drive when a unit select function is issued with the lower 3 bits set. This condition is held until another unit select function is sent with bits 2^{20} through 2^{22} cleared to select the primary drive or set to select the shadow drive. (Push the RESET button to clear the bit.) **Note:** Bits 2^0 through 2^7 are common to all DD-40/41 status parcels.
2^8	Unit ready	All spindles are up to speed, the heads are loaded, and there are no faults in the spindle.
2^9	On-cylinder	Indicates the servo positioned the heads over the desired track without error on all spindles.
2^{10}	Seek error	Indicates that the drive took too long to complete a seek, that the head positioner has moved outside the recording field, or that the drive attempted to seek beyond cylinder 2613 (DD-40) or 3142 (DD-41). The seek error can be cleared by an RTZ command.
2^{11}	Drive fault	Indicates that one or more of the following faults occurred: • Ready and write • Write or read while off-cylinder • First seek • Write and write protected • Head select • Voltage (Refer to Table 4-6 for a description of the drive faults.)
2^{12}	Write protect	Indicates that the drive write circuits are disabled. The write protect mode is enabled by a jumper plug on the control board, by a switch on the operator panel, by a fault condition, or by a loss of motor speed. Attempting to write while the write protect mode is active results in a fault condition.

Table 4-5. DD-40/41 Disk Storage Device - Drive Status (continued)

Bit(s)	Status Names	Description
2^{13}	Address mark	Indicates the address mark has been found during an address mark search operation (refer to the Tag 3 description in the "Theory of Operations" section of CDC manual 83325460 for more information on address mark status).
2^{14}	Index mark	Indicates the index mark has been found. The Index Mark signal, which occurs once per revolution of the disk, is obtained from the servo tracks. The Index Mark signal's leading edge is the leading edge of sector 0. The Index Mark signal is disabled by a switch on the I/O board.
2^{15}	Sector mark	Indicates the sector mark has been found. The number of Sector Mark signals that occur for each revolution of the disk is selected by switches on the drive control board. The Sector Mark signal is disabled by a switch on the I/O board.

Table 4-6. DD-40/41 Disk Storage Device - Fault Status

Bit	Status Names	Description
2^0 - 2^2	Sector number	Indicates the last sector in error or the last sector read.
2^3 - 2^5	Spindle number	Indicates the spindle with the last sector in error or the last sector read.
2^6	Command error	Indicates an invalid function was issued.
2^7	Diagnostic mode	Indicates the selected drive is in diagnostic mode.
2^8	Read and write	Indicates read and write operations were attempted at the same time.
2^9	Read or write and off-cylinder	Indicates the spindle is not on-cylinder when it receives a read or write function.
2^{10}	First seek error	Indicates an error during the initial powering on of the drive, spinning up of the spindle, or loading of the heads to cylinder 0. (Refer to CDC manual 83325460 for more information on first seek error.)
2^{11}	Write fault	Indicates a write fault occurred because of one of the following conditions: • Write gate with write protect • Write gate with no write clock • Write gate without write data • Open head • Write enable without arm enable
2^{12}	Write and write-protected fault	Indicates a write is attempted when the write protect function is enabled.
2^{13}	Head select fault	Indicates that more than one head is selected.
2^{14}	Voltage fault	Indicates a voltage fault when the +15-V, -15-V, +5-V, or -5-V voltage levels are too low. Most of the logic needed to access the drive is disabled, and the heads are unloaded. (Refer to CDC manual 83325460 for more information on voltage faults.)
2^{15}	Valid status available	Indicates the status information is valid.

Table 4-7. DD-40 Operating Status Format

Status Parcel (Octal)	Status Byte (Octal)	Spindle Display Code (Hex)	Description
			Motor Start/Stop Status
100000	200	00	Drive is on-cylinder and ready
100400	201	01	Unloading heads
101000	202	02	Stopping or braking motor
101400	203	03	Motor stopped normally
103400	207	07	Spindle motor is starting
100400	210	08	Spindle motor is starting with jog
104400	211	09	Motor up to speed prematurely
105000	212	0A	Motor not up to full speed within required time; retry after stop
106000	214	0C	Excessive start failures, no more attempts
107000	216	0E	Excessive motor speed
107400	217	0F	Insufficient motor speed
110000	220	10	Speed-loss recovery with seek error
			Recovering From Speed Loss
110400	221	11	Heads unloading
111000	222	12	Motor stopping
114000	230	18	Spindle motor is starting with jog
114400	231	19	Up to speed prematurely, motor stopped
115000	232	1A	Motor not up to full speed within required time; motor stopped
116000	234	1C	Excessive start failures, no more attempts
117000	236	1E	Excessive motor speed
117400	237	1F	Insufficient motor speed

Table 4-7. DD-40 Operating Status Format (continued)

Status Parcel (Octal)	Status Byte (Octal)	Spindle Display Code (Hex)	Description
			Load
120400	241	21	Heads loaded before load begins
121000	242	22	Fault occurred after power amplifier driver was enabled
122400	245	25	Demodulator Active signal timeout during load
123000	246	26	Cylinder counter timeout during load
123400	247	27	Fault set after load complete
124000	250	28	Code 22 and excessive attempts
125400	253	2B	Code 25 and excessive attempts
126000	254	2C	Code 26 and excessive attempts
126400	255	2D	Code 27 and excessive attempts
127000	256	2E	Sequence power delay
127400	257	2F	Backup into outer guard band, fault before seek error
			Return To Zero (RTZ)
130000	260	30	Move from outer guard band inward not permitted
130400	261	31	Demodulator Active signal lost
131400	263	33	Timeout
132000	264	34	Detected outer guard band during backup
132400	265	35	Turnaround
133000	266	36	Out of guard band prematurely
133400	267	37	Cylinder pulse at track - 1 not detected
134000	270	38	Fine Enable signal not found
134400	271	39	Settle in on track 0

Table 4-7. DD-40 Operating Status Format (continued)

Status Parcel (Octal)	Status Byte (Octal)	Spindle Display Code (Hex)	Description
			Guard Bands
140000	300	40	Detected inner guard band during seek
140400	301	41	Detected inner guard band during on-cylinder routine
141000	302	42	Detected inner guard band while on track
141400	303	43	Detected outer guard band during seek
142000	304	44	Detected outer guard band during on-cylinder routine
142400	305	45	Detected outer guard band while on cylinder
			Seek
143000	306	46	Seek time too long
			Failure to Stop On Track During On-cylinder Routine
143400	307	47	Excessive time elapsed after on-cylinder sense active
144000	310	48	Lost Demodulator Active signal
144400	311	49	Excessive cylinder pulses while settling in
145000	312	4A	Excessive on-cylinder sense dropouts
			On Cylinder
145400	313	4B	On-cylinder signal lost
146000	314	4C	Demodulator Active signal lost while on cylinder
146400	315	4D	Cylinder address out of range
147000	316	4E	Voltage fault while on cylinder

Table 4-7. DD-40 Operating Status Format (continued)

Status Parcel (Octal)	Status Byte (Octal)	Spindle Display Code (Hex)	Description
			Microprocessor Unit (MPU) Errors
150000	320	50	Recovering from low-voltage (Vcc) reset
150400	321	51	MPU reset due to hang condition
151000	322	52	Recovered from low voltage (Vcc) reset and speed loss
151400	323	53	Recovered from MPU hang reset and loss of speed
154000	330	58	Nonmaskable interrupt
154400	331	59	Software interrupt
155000	332	5A	Programmable timer interrupt
156000	334	5C	Temperature too high fault
156400	335	5D	Seek error during scan
157400	337	5F	Peripheral Interface Adapter (PIA) test failure
			Servo and Motor Tests
160000	340	60	Failed servo test during RTZ
160400	341	61	Failed servo test during recalibrate
16100	342	62	Failed servo test during on-cylinder seek
161400	343	63	Maximum length seek test failed
162000	344	64	Failed recalibrate test; no comparison between servo gain numbers
162400	345	65	Excessive single-track seek time
163000	346	66	Insufficient single-track seek time
163400	347	67	Excessive maximum-track seek time
164000	350	68	Insufficient maximum-track seek time
164400	351	69	Incorrect pre-seek status

Table 4-7. DD-40 Operating Status Format (continued)

Status Parcel (Octal)	Status Byte (Octal)	Spindle Display Code (Hex)	Description
			Servo and Motor Tests (continued)
165000	352	6A	No Speed signal during seek test
165400	353	6B	Bus changes during diagnostic test
166000	354	6C	Tag 5 missing at end of diagnostic
166400	355	6D	Scan active
167400	357	6F	Sector number out of range
170000	360	70	Self-test complete
170400	361	71	Not over-temperature condition
171000	362	72	Execute switch not released
176000	374	7C	Missing On-cylinder signal in I/O
102000	204	80	Fault set before move
102400	205	90	Recovered from loss of speed
			Load and Fault Set Before Seek Error
103000	206	A1	Unable to unload heads before load
111400	223	A2	Fault after enabling power amplifier driver
112000	224	A5	Demodulator Active signal late
112400	225	A6	Cylinder counter timeout
113000	226	A7	Fault after load complete
113400	227	A8	Code 22 and excessive attempts
120000	240	AB	Code 25 and excessive attempts
121400	243	AC	Code 26 and excessive attempts
122000	244	AD	Code 27 and excessive attempts

Table 4-7. DD-40 Operating Status Format (continued)

Status Parcel (Octal)	Status Byte (Octal)	Spindle Display Code (Hex)	Description
			RTZ and Fault Set Before Seek Error
124400	251	B0	Move in from outer guard band not permitted
125000	252	B1	Demodulator Active signal lost
177000	376	B3	Timeout during return to zero
131000	262	B5	Timeout during turnaround
135000	272	B6	Out of guard band prematurely
135400	273	B7	Cylinder pulse on track 1 not found
136000	274	B8	Fine Enable signal not found
136400	275	B9	Settle in on track 0
			Guard Band and Fault Set Before Seek Error
137000	276	C0	Detected inner guard band during seek
137400	277	C1	Detected inner guard band during on-cylinder routine
147400	317	C2	Detected inner guard band while on cylinder
152000	324	C3	Detected outer guard band during seek
152400	325	C4	Detected outer guard band during on-cylinder routine
153000	326	C5	Detected outer guard band while on cylinder
			Seek Timeout and Fault Set Before Seek Error
153400	327	C6	Seek time too long

Table 4-7. DD-40 Operating Status Format (continued)

Status Parcel (Octal)	Status Byte (Octal)	Spindle Display Code (Hex)	Description
			Can't Stop On Cylinder During On-cylinder Routine and Fault Set Before Seek Error
157000	336	C7	Excessive time elapsed before On-cylinder Sense signal active, fault set
171400	363	C8	Demodulator Active signal lost
172000	364	C9	Excessive cylinder pulses
172400	365	CA	Excessive cylinder sense dropouts
			On Cylinder and Fault Set Before Seek Error
173000	366	CB	Lost On-cylinder sense signal
173400	367	CC	Lost Demodulator Active signal
174000	370	CD	Cylinder address out of range
174400	371	CE	Voltage fault
			Reset Dummy RTZ Mode Active
175000	372	D0	Recovering from Vcc reset
175400	373	D1	Recovering from microprocessor unit (MPU) hang reset

Table 4-8. DD-41 Operating Status Format

Status Parcel (Octal)	Status Byte (Octal)	Spindle Display Code (Hex)	Description
			Motor Start Stop Status
100000	200	00	Drive is on-cylinder and ready
100400	202	02	Stopping or braking motor
101400	203	03	Motor stopped normally
102000	204	04	Servo calibration and first load
102400	205	05	Power sequence delay in progress
103000	206	06	Waiting to start power sequence
103400	207	07	Spindle motor is starting
104000	210	08	Spindle motor reached full speed
			Status for Seek Error
143000	306	46	Seek time too long
145400	313	4B	On-cylinder signal lost
146400	315	4D	Cylinder address out of range
147400	317	4F	Seek error while settling in on the destination cylinder
			Status for First Seek Fault
152000	324	54	Fault on retract portion of first seek
152400	325	55	Heads failed to load on first seek
153000	326	56	Return to zero failed on first seek
153400	327	57	Velocity calibration failed on first seek

Table 4-8. DD-41 Operating Status Format (continued)

Status Parcel (Octal)	Status Byte (Octal)	Spindle Display Code (Hex)	Description
			Status for Error Condition
154000	330	58	Loss of speed
154400	331	59	Motor control circuitry cannot start motor
155000	332	5A	Emergency heads retract
			Errors for Motor and Servo MPU
160000	340	60	Failed motor MPU
160400	341	61	Failed servo MPU

Table 4-9. DD-4R and DD-42 Operating Status Format

Status Parcel (Octal)	Status Byte (Octal)	Spindle Display Code (Hex)	Description
100000	200	00	Spindle is ready and on cylinder
101000	202	02	Spindle motor is stopping
101400	203	03	Spindle motor stopped
102000	204	04	Performing first load and calibration
102400	205	05	Performing sequence delay
103000	206	06	Waiting for power sequence signals after the start switch was pressed
103400	207	07	Spindle motor is starting
104000	210	08	Spindle motor is at the correct speed
105000	212	0A	Spindle is in sweep segment
105400	213	0B	Heads are located on last cylinder of sweep
110000	220	10	Spindle is ready and synchronized
112000	224	14	Performing first load and calibration and spindle synchronization
114000	230	18	Spindle motor is at the correct speed and the spindle is synchronized
115000	232	1A	Sweep segment is in progress and spindle is synchronizing
115400	233	1B	Heads are located on last cylinder of sweep and the spindle is synchronized
143000	306	46	Timed out during a seek routine
145000	312	4A	Failed move due to demodulator check
145400	313	4B	Heads were off-track during a seek routine
146000	314	4C	Seek error due to the actuator being locked or an inactive demodulator
146400	315	4D	Cylinder address out of range
147000	316	4E	A fault occurred during a seek routine
147400	317	4F	A seek error occurred during settle-in
150000	320	50	Low-voltage recovery

Table 4-9. DD-4R and DD-42 Operating Status Format (continued)

Status Parcel (Octal)	Status Byte (Octal)	Spindle Display Code (Hex)	Description
150400	321	51	Control microprocessor unit (MPU) hang recovery
151000	322	52	Spindle motor is stopped and braking loop failed
151400	323	53	Initial seek fault and spindle motor is below speed
152000	324	54	Initial seek fault and the Data Pulse 1 signal was not received
152400	325	55	Initial seek fault and the Data Pulse 2 signal was not received
153000	326	56	Initial seek fault and the Demod Active signal was not received
153400	327	57	Initial seek fault and the Index signal was not received
154000	330	58	Spindle motor lost speed
154400	331	59	The rotor is locked
155400	333	5B	Spindle motor is stopping and the braking loop failed
156400	335	5D	The flying speed check failed
157000	336	5E	Spindle motor failed the up-to-speed check
157400	337	5F	Spindle motor failed the RPM control
160400	341	61	The servo MPU communication check failed
162000	344	64	Initial seek fault and seek error
164400	351	69	Restart due to the spindle motor losing speed

A status select operation for a field-replaceable unit (FRU) code sends the DD-40/41 field-replaceable unit status to status register 1. Table 4-10 shows the DD-40/41 and DD-4R/42 field-replaceable unit status in parcel and byte format (used in error reports) and spindle display code formats (used on XMD and Sabre LED/LCD displays).

Table 4-10. DD-40/41 and DD-4R/42 Field-replaceable Unit Status

FRU Status Parcel (Octal)	FRU Status Byte (Octal)	Spindle Display Code (Hex)	DD-40 Field-replaceable Unit Most Likely to Fail	DD-41 Field-replaceable Unit Most Likely to Fail	DD-4R/DD-42 Field-replaceable Unit Most Likely to Fail
100000	200	00	FRU log clear	FRU log clear	Not used
100400	201	01	Power supply	Control board	Control and read/write board
101000	202	02	Control board	Module	Module (HDA)
101400	203	03	Power amplifier	Power supply	Power supply
102000	204	04	Drive motor	I/O board	I/O board
102400	205	05	Read/write board	Control board	Not used
103000	206	06	Module	Module	Not used
103400	207	07	Cooling fan	Not used	Not used
104000	210	08	I/O board	Not used	Not used
104400	211	09	Operator panel	Not used	Not used
105000	212	0A	Motherboard	Not used	Not used
105400	213	0B	Actuator unlocking solenoid	Not used	Not used
106000	214	0C	Belt	Not used	Not used
106400	215	0D	Diagnostic display	Not used	Not used
107000	216	0E	Head and disk assembly (HDA) interface board	Not used	Not used
107400	217	0F	Air filter	Not used	Not used

A status select operation for diagnostic execute status sends the DD-40/41 diagnostic execute status to status register 1. Table 4-11 shows the format for DD-40/41 diagnostic execute status.

Table 4-11. DD-40/41 Diagnostic Execute Status Format

Status Register 1 Bit	Name	Description
2^0	Sector number	Bit 2^0 of the sector number
2^1	Sector number	Bit 2^1 of the sector number
2^2	Sector number	Bit 2^2 of the sector number
2^3	Sector number	Bit 2^3 of the sector number
2^4 2^5	Spindle number	Bit 2^4 is least significant bit 00 = A, 01 = B, 10 = C, 11 = D
2^6	Command error	This bit is set if an invalid function is issued
2^7	Diagnostic mode	This bit is set when the selected drive is in diagnostic mode
2^8	Logical zero	This bit is set to a logical 0
2^9	Logical zero	This bit is set to a logical 0
2^{10}	Logical zero	This bit is set to a logical 0
2^{11}	Logical zero	This bit is set to a logical 0
2^{12}	Logical zero	This bit is set to a logical 0
2^{13}	Logical zero	This bit is set to a logical 0
2^{14}	Logical zero	This bit is set to a logical 0
2^{15}	Servo test	This bit is set when the following servo tests are started: • Return to zero (RTZ) • Single-track seek • Servo recalibrate • Maximum seek Do not interrupt the series; it stops when an error is detected or when the tests are complete

5 - MDMS DIAGNOSTICS

The MDMS diagnostic program tests the operation of a DS-40/41 using comprehensive controller and disk drive diagnostic tests. Either the maintenance control unit (MCU) or the maintenance workstation (MWS) works with the 2XF and 2IE modules in the offline channel disk tester to control program execution. The DC-40/41 and DD-40/41 units can be tested without interrupting IOP operations.

MDMS COMPREHENSIVE DIAGNOSTICS

MDMS is booted into the computer system as a stand-alone disk testing package. The advantage of a stand-alone diagnostic program like MDMS is that it is no longer necessary to use the entire Cray Research system to test a disk drive. The diagnostic program is written in the C programming language to provide portability (an advantage that allows software to be adapted from one computer architecture to another).

The MDMS program runs at a practical speed. When run from an MCU, MDMS runs at approximately 60% of the speed of an IOS when MDMS is doing surface analysis. For disk formatting and verification, the speed is approximately 50% of the speed of an IOS. When run from an MWS, MDMS is approximately equal in speed to the IOS and CRAY-2 computer systems for all disk maintenance and testing operations.

MDMS is a menu-driven, interactive diagnostic package for testing DS-40/41 disk subsystems. The MDMS 2.1 diagnostic release performs surface analysis and flaw management, and provides a comprehensive diagnostic test section used to test all logic from the 2XF tester module up to and including the disk drive.

The MDMS diagnostic section menu allows users to select a specific diagnostic section, all sections, or any combination of sections. The following diagnostic tests are available.

- Controller diagnostics, including 2XF and 2IE module tests, the diagnostic echo test, parity errors test, and full-track buffer testing of the data bus, SECDED test, data test, and addressing logic

- Drive diagnostics, including tests of basic drive functions, head select, cylinder select, seek timing, single sector write/read, continuous write with and without data compare, error correction, and defect pad location

DIAGNOSTICS HARDWARE INTERFACE

MDMS runs on either the MWS or the MCU. The MCU is a CP/M-based microcomputer system with a 5-Mbyte or 15-Mbyte hard disk drive installed. It has a single $5\frac{1}{4}$-in. flexible disk drive; a second drive is optional. MDMS diagnostic software is distributed to the field on $5\frac{1}{4}$-in. diskettes for the MCU or on streaming tape for the MWS.

The MWS is a VERSAbus modular eurocard (VME) bus-based workstation. UNIX System V operating system software is used. The MWS consists of the following peripheral equipment:

- 2 console terminals
- 182-Mbyte disk drive
- Graphics display monitor
- 60-Mbyte data-streaming tape drive

The disk drive and the data-streaming tape drive described in the previous list are installed in the VME chassis.

There is an MCU and/or an MWS at every customer site. The MCU and MWS send disk functions to an offline channel disk tester in the DCC-2 disk controller cabinet. The tester consists of two modules: the 2XF and the 2IE. The 2XF module emulates the DCU-5 disk controller, which is the hardware interface between one of the system's IOPs and the disk storage subsystem. The 2IE module links the 2XF module to the disk storage subsystem for diagnostic testing.

The 2XF module runs some of the functions it receives from the MWS or MCU. It sends other functions through the 2IE module to the 2EI channel adapter module in the DC-40/41 disk controller unit. The DC-40/41 runs these functions to test the operation of a DD-40/41 disk storage device and the DC-40/41.

The MCU and MWS can be connected to one DC-40/41 disk controller at a time. As many as two DD-40/41 disk storage devices, with four spindles each, can be connected to one DC-40/41 disk controller unit.

MDMS MENUS

The MDMS program provides the following series of menus that are used to select the various diagnostic tests for the DS-40/41 controller and disk drive. After the diagnostic test sections are selected, it is possible to select data patterns and specific heads, cylinders, and sectors on the disk drive. Use the **ESC** key to return to the previous menu.

The first menu in Figure 5-1 provides the drive type selection. Enter a **1** for a DS-40 disk subsystem. Enter a **2** for a DS-41 subsystem, and so on.

After selecting a drive, you are presented with the menu in Figure 5-2. Enter a **D** to select DS-40 controller and disk drive diagnostics.

```
MDMS Micro-based Disk Maintenance System - Revision MDMS1.1
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                  Drive Type Selection
                  --------------------


              1 - DD40
              2 - DD41
              3 - DD4R
              4 - DD42
              5 - RDS5
              6 - RDS20
              7 - DCUS1/DD40
              8 - DCUS1/DD4R
              9 - DCUS1/DD42
              Q - Quit

              Command>
```

Figure 5-1. MDMS Drive Type Menu

```
MDMS Function Selection
-----------------------

D - Diagnostics
T - Trouble Shoot
S - Surface Analysis
F - Flaw Management
R - Redefine Disk Type
Q - Quit

Command>
```

Figure 5-2. MDMS Function Menu

The next menu to appear (refer to Figure 5-3) enables you to select individual controller diagnostic tests. It is possible to select all test sections, not select any test sections, or select individual sections. After controller tests have been selected, enter a **C** to continue.

```
Controller Diagnostic Selection
-------------------------------

C - Continue as is
A - All Sections Selected
N - No Sections Selected
0 - 2XF Register Test
1 - 2XF Data Buffer Test
2 - 2IE Done Test
3 - 2IE Buffer Echo Test
4 - Diagnostic Echo Test
5 - Parity Errors Test
6 - Full-Track Buffer Data Bus Test
7 - Full-Track Buffer SECDED Test
8 - Full-Track Buffer Data Generator Test
9 - Full-Track Buffer Write/Read Test
M - Main Menu

Command> C


Sections Selected: 0 1 2 3 4 5 6   8 9
```

Figure 5-3. Controller Diagnostic Menu

The next menu, shown in Figure 5-4, enables you to select a drive diagnostic. Select the desired test section by entering the appropriate test section letter or number. Enter **A** to select all test sections. First enter **N** to disable all test sections; then select individual sections. Enter **C** to continue. Figure 5-4 shows all sections selected, which is the default.

```
Drive Diagnostic Selection
--------------------------

C - Continue as is
A - All Sections Selected
N - No Sections Selected
0 - Basic Drive Functions Test
1 - Head Select Test
2 - Cylinder Select Test
3 - Seek Timing Test
4 - CE Cylinder Data Generator Test
5 - CE Cylinder Write/Read Test
6 - CE Cylinder Data Chaining Test
7 - Error Correction Test
8 - Defect Pad Location Test
M - Main Menu

Command> C

Sections Selected:  0 1 2 3 4 5 6 7 8
```

Figure 5-4. Drive Diagnostic Menu

The next menu, shown in Figure 5-5, shows the data pattern selection menu. Enter **C** to obtain the default pattern selections. These patterns include all selections except **8** and **9**. Selection **8** is not a default pattern because the 2XF data generator and data checker cannot be used. Without the data generator and data checker, the diagnostic test takes considerably longer to run. Selection **9** is not used as a default pattern because the user must enter the pattern.

```
          Data Pattern Selection
          ------------------------

          C - Continue as is
          A - All Patterns Selected
          N - No Patterns Selected
          1 - 000000
          2 - 177777
          3 - 125252
          4 - 052525
          5 - Random Pattern
          6 - Sector Addressing Pattern
          7 - Continuous Random Pattern
          8 - Parcel Addressing Pattern
          9 - User Defined Pattern
          M - Main Menu

          Command> C


     Patterns Selected:  1 2 3 4 5 6 7
```

Figure 5-5. Data Pattern Selection

If **9** is selected, you must enter an octal parcel value. Up to three parcel values can be entered, as shown in Figure 5-6. This causes a test data pattern to be written to the disk drive and disk controller.

```
                    Data Pattern Selection
                    ----------------------

                    C - Continue as is
                    A - All Patterns Selected
                    N - No Patterns Selected
                    1 - 000000
                    2 - 177777
                    3 - 125252
                    4 - 052525
                    5 - Random Pattern
                    6 - Sector Addressing Pattern
                    7 - Continuous Random Pattern
                    8 - Parcel Addressing Pattern
                    9 - 125252 010101 125252
                    M - Main Menu

                    Command>


          Enter an octal parcel value or RETURN to quit:

          Patterns Selected:              9
```

Figure 5-6. User-defined Test Data Pattern

The next display, shown in Figure 5-7, enables you to select spindles for multiple spindle drives. To select a specific spindle, enter its number. To deselect a specific spindle, enter its number again. The currently selected spindles are shown at the bottom of the display. Select **U** to switch to primary or secondary drive. Enter **C** to continue.

Note: The remaining menus, except those used to set the loop count and turn the printer on and off, do not appear when only controller diagnostic test sections 0 through 5 are selected.

```
Spindle Selection
-----------------

C - Continue as is
A - All Spindles Selected
N - No Spindles Selected
0 - Spindle 0
1 - Spindle 1
2 - Spindle 2
3 - Spindle 3
U - Select Other Unit
M - Main Menu


Command> C

Spindles Selected: 0 1 2 3

Unit Selected:  0 (primary)
```

Figure 5-7. Spindle Selection

Figure 5-8 shows the next menu which includes options that enable you to select cylinders, heads, and sectors for performing drive and controller diagnostics. By default, all heads and sectors of all data cylinders are selected. The values shown at the bottom of the menu are the default values of the cylinder, head, and sector limits for the DS-40/41 and the RDS-5 systems. Select **CY**, **H**, or **S** from the menu to perform tests with user-specified limits. Selecting option **CE** automatically selects the CE cylinder. Enter a **C** to continue.

```
                    Select Limits
                    -------------

                    C  - Continue as is
                    D  - Default Limits
                    CY - Redefine Seek Test Cylinder Limits
                    H  - Redefine Head Limits
                    S  - Redefine Sector Limits
                    CE - Write/Read CE Cylinder
                    DC - Write/Read Data Cylinder
                    M  - Main Menu

                         Command> C

Current Settings:
Beginning Seek Cylinder:  0   Ending Seek Cylinder:   2611
Beginning Head:           0   Ending Head:              22
Beginning Sector:         0   Ending Sector:            13
Write/Read Cylinder:    2613
```

Figure 5-8. Select Limits

Figure 5-9 shows the next menu, which includes options to enable the printer and redefine the test loop count. The printer is off by default; enter a **P** to turn it on and off. If possible, turn on the printer to provide a hard copy of any error information. Enter an **L** to redefine the test loop count. Valid loop counts are between 1 and 65,535. Enter a **C** to continue.

```
                    Other Settings
                    --------------

                C - Continue as is
                P - Toggle Printer On/Off
                L - Redefine Loop Count
                M - Main Menu

                Command> C


             Current Settings:
             Printer:  OFF
             Loop Count:  1
```

Figure 5-9. Other Settings

Figure 5-10 shows the display of the MDMS controller diagnostics with test sections 0 through 9 selected. The display shows a test section 0 time-out error. The display shows pass counts of the tests and 2XF tester status. Press the **ESC** key on the MWS or MCU workstation to return to the main menu. Enter **B** to bypass the present test section and go to the next selected section. Enter **L** to loop the test; a passcount is given when the test runs. Enter **R** to retry the test section.

```
MDMS Controller Diagnostics                                          Pass Count: 0

Current Section: 0 - 2XF Register Test

Error Counts by Section:
0: 00001        1: 00000        2: 00000        3: 00000        4: 00000
5: 00000        6: 00000        7: 00000        8: 00000        9: 00000

Error setting 2XF tester mode to 370 octal.


2XF Tester Status: TIME OUT




Commands:  ESC - Exit   B - Bypass Section   L - Scope Loop   R - Retry
```

Figure 5-10. MDMS Controller Diagnostics

MDMS CONTROLLER TEST SECTIONS

This subsection describes the test sections in the MDMS controller diagnostic program. Ten tests, labeled test sections 0 through 9, are used for the controller diagnostic (refer to Figure 5-3). For RDS-5 systems, only test sections 0 through 2 are available.

Section 0 - 2XF Register Test

This test section tests four of the status registers in the 2XF tester module. The following sequence describes what occurs in this test section; use it for troubleshooting purposes.

1. The low-speed (LOSP) channel is initialized.

2. The following sequence occurs for 2XF tester modes 37 to 0:

a. The 2XF tester mode is selected using the 2XF command 5.

b. The lower 5 bits of the 2XF tester status are checked to ensure they are equal to the tester mode number.

3. The following sequence occurs for each of the test section 0 data patterns:

   a. Status register 0 is written with the data pattern.

   b. Status register 0 is read and the data is compared to the original pattern.

4. The following sequence occurs for each of the test section 0 data patterns:

   a. Status register 1 is written with the data pattern.

   b. Status register 1 is read and the data is compared to the original pattern.

5. The following sequence occurs for each of the test section 0 data patterns:

   a. The data generator seed is written with the data pattern.

   b. The data generator seed is read and the data is compared to the original pattern.

The following sequence of data patterns is used for test section 0:

1. 000000
2. 177777
3. 125252
4. 052525
5. Walking 1's (16 patterns)
6. Walking 0's (16 patterns)
7. 000000

Section 1 - 2XF Data Buffer Test

This section tests the data buffer in the 2XF tester module. It tests short transfers (16 parcels) first and then long transfers (2,048 parcels). The following sequence describes what occurs for short transfers in this test section; use it for troubleshooting purposes:

1. The LOSP channel is initialized.

2. The 2XF tester is set to short transfer mode.

3. The following sequence occurs for each user-selected data pattern, except the sector addressing pattern:

   a. The MWS or MCU output buffer is loaded with the pattern.

   b. The pattern is written to the 2XF data buffer.

   c. The pattern is read back to the input buffer.

d. The first 16 parcels of the input and output buffers are compared.

The following sequence describes what occurs for long transfers (2,048 parcels) in this test section:

1. The LOSP channel is initialized.
2. The 2XF tester is set to long transfer mode.
3. The following sequence occurs for each user-selected data pattern, except the sector addressing pattern:
   a. The MWS or MCU output buffer is loaded with the pattern.
   b. The pattern is written to the 2XF data buffer.
   c. The pattern is read back to the MWS or MCU input buffer.
   d. The input and output buffers are compared.

Section 2 - 2IE Done Test

This test section tests setting and clearing of the 2IE done bit in the 2XF tester status register. The following sequence describes what occurs in this test section; use it for troubleshooting purposes:

1. The LOSP channel is initialized.
2. The 2XF tester mode is cleared.
3. The channel is cleared.
4. A DIA : 17 select special controller mode/status command is issued with a parameter of 0.
5. The following results are checked:
   a. 2XF tester status equals 200 (2IE done).
   b. Status register 0 equals 1 (drive ready).
   c. Status register 1 equals 0.
6. The channel is cleared.
7. The 2XF tester status is checked to ensure it equals 0 (2IE done bit clears).

Section 3 - 2IE Buffer Echo Test

This section tests the data buffers in the 2IE module. To do this, it uses the buffer echo mode of the DIA : 17 select special controller mode/status command. This test section uses a special compare routine because the 2IE module buffers only 1,024 parcels (the 2IE module has two 512-parcel buffers that get read or written twice on a single read or write operation). The following sequence describes what occurs in this test section; use it for troubleshooting purposes:

1. The LOSP channel is initialized.

2. The 2XF tester mode is cleared.

3. The following sequence occurs for each user-selected data pattern except the sector addressing pattern:

    a. The MWS or MCU output buffer is loaded with the pattern.

    b. The channel is cleared.

    c. Buffer echo mode is set up (DIA : 17 with a parameter of 2).

    d. The pattern is written to the 2IE module data buffer (mode 0 write).

    e. The channel is cleared.

    f. Buffer echo mode is set up as previously described.

    g. The pattern is read back to the MWS or MCU input buffer (mode 0 read).

    h. The input and output buffers are compared using the following routine:

        1) Input buffer parcels 0 through 777 are compared to output buffer parcels 2000 through 2077 (These parcels originate from the first reading of the 2IE module's A data buffer.)

        2) Input buffer parcels 1000 through 1777 are compared to output buffer parcels 3000 through 3777 (These parcels originate from the first reading of the 2IE module's B data buffer.)

        3) Input buffer parcels 2000 through 2777 are compared to output buffer parcels 2000 through 2777 (These parcels originate from the second reading of the 2IE module's A data buffer.)

        4) Input buffer parcels 3000 through 3777 are compared to output buffer parcels 3000 through 3777 (These parcels originate from the second reading of the 2IE module's B data buffer.)

Section 4 - Diagnostic Echo Test

This section uses the DIA : 4 diagnostic echo command to test the path to and from the 2EI module of the DC-40/41 controller. The following sequence describes what occurs in this test section; use it for troubleshooting purposes:

1. The LOSP channel is initialized.

2. The 2XF tester mode is cleared.

3. The channel is cleared.

4. Unit 7 is selected (diagnostic loopback).

5. A clear faults command is issued.

6. The following sequence occurs for each of the test section's data patterns:

   a. A DIA : 4 diagnostic echo command is issued with the data pattern as a parameter.

   b. The 2XF tester status is checked to ensure it indicates 2IE done.

   c. Status register 0 is checked to ensure it indicates the drive is ready.

   d. Status register 1 is compared to the data pattern.

The following sequence of data patterns is used for test section 4:

1. 000000
2. 177777
3. 125252
4. 052525
5. Walking 1's (16 patterns)
6. Walking 0's (16 patterns)
7. 000000

Section 5 - Parity Errors Test

This section uses the DIA : 1 diagnostic select command to force a bus-in parity error and a status parity error. The following sequence describes what occurs in the test section program to force a bus-in parity error; use it for troubleshooting purposes:

1. The LOSP channel is initialized.

2. The 2XF tester mode is cleared.

3. The channel is cleared.

4. Unit 7 is selected (diagnostic loopback).

5. A clear faults command is issued.

6. A DIA : 1 diagnostic select command is issued with a parameter of 1 (force bus-in parity error).

7. The following results are checked:

    a. 2XF tester status equals 640 (global error flag, 2IE done, 2IE error).

    b. Status register 0 equals 241 (drive ready, bus-in parity error, and error flag).

    c. Status register 1 equals 1 (echo of the diagnostic select parameter).

The following sequence describes what occurs in this test section program to force a status parity error:

1. The LOSP channel is initialized.

2. The 2XF tester mode is cleared.

3. The channel is cleared.

4. Unit 7 is selected (diagnostic loopback).

5. A clear faults command is issued.

6. A DIA : 1 diagnostic select command is issued with a parameter of 2 (force status parity error).

7. The following results are checked:

    a. 2XF tester status equals 640 (global error flag, 2IE done, 2IE error).

    b. Status register 0 equals 221 (drive ready, status parity error, and error flag).

    c. Status register 1 equals 2 (echo of diagnostic select parameter).

Section 6 - Full-track Buffer Data Bus Test

This section uses 16-parcel track buffer write and read operations to test the data path to and from the full-track buffer in the DC-40/41 controller (2EB module). It writes to and reads from the first user-selected sector of the first user-selected spindle in the full-track buffer. The following sequence describes what occurs in this test section; use it for troubleshooting purposes:

1. The LOSP channel is initialized.

2. The 2XF tester is set to short transfer mode.

3. The channel is cleared.

    Note: A drive must be connected and operating to perform the next step.

4. The unit is selected (primary or secondary).

5. A clear faults command is issued.

6. The following sequence occurs for each user-selected data pattern, except the sector addressing pattern:

    a. The MWS or MCU output buffer is loaded with the pattern.

    b. Sixteen parcels are written to the full-track buffer (mode 3 write).

    c. Sixteen parcels are read from the full-track buffer (mode 3 read).

    d. The first 16 parcels of the input and output buffers are compared.

7. A release command is issued.

Section 7 - Full-track Buffer SECDED Test

This section tests the ability of the DC-40/41 single-error correction/double-error detection (SECDED) logic to correct single-bit errors.

Note: Place the SECDED TEST/NORM switch on the DC-40/41 control panel in the TEST position before running this section. Return the switch to the NORM position when this section is done.

The test writes 16 parcels of a data pattern to the full-track buffer with a single bit in each parcel set to a 1. The test then reads the 16 parcels back and determines whether a buffer error was reported. The test also checks whether the data read is all 0's, which verifies that the error-correction circuitry operated correctly. (When the SECDED TEST/NORM switch is in the TEST position, the SECDED check bits are set to all 0's on a write.)

The 1 bit is shifted across all 16 bits of the test pattern (patterns 000001 to 100000). The test writes to and reads from the first user-selected sector of the first user-selected spindle of the full-track buffer. The following sequence describes what occurs in this test section; use it for troubleshooting purposes:

1. The user is prompted to place the SECDED TEST/NORM switch in the TEST position.

2. The LOSP is initialized.

3. The 2XF tester is set to short transfer mode.

4. The channel is cleared.

    Note: A drive must be connected and operating to perform the following step.

5. The unit is selected (primary or secondary).

6. A clear faults command is issued.

7. The following sequence occurs for each of the 16 data patterns (000001 to 100000):

    a. The MWS or MCU output buffer is loaded with the pattern.

b. Sixteen parcels are written to the full-track buffer (mode 3 write).

c. Sixteen parcels are read from the full-track buffer (mode 3 read).

d. The following results are checked:

1) 2XF tester status equals 740 (global error flag, 2IE data done, 2IE done, 2IE error).

2) Status register 0 equals 211 (drive ready, drive error, error flag).

3) General status and DC-40/41 controller status equal 200 (buffer error).

e. The channel is cleared.

f. A clear faults command is issued.

g. The first 16 parcels of the input buffer are verified to be 0's.

8. A release command is issued.

9. The user is prompted to place the SECDED TEST/NORM switch in the NORM position.

Section 8 - Full-track Buffer Data Generator Test

This section uses track buffer write and read operations of 2,048 parcels to test the 2XF module data generator and data checker. The test writes to and reads from the first user-selected sector of the first user-selected spindle in the full-track buffer. First, the test writes a data pattern generated on the MWS or MCU to the full-track buffer. Then it reads the data back and compares data on the MWS or MCU. Next the test reads the data again using the 2XF module data checker.

The test then writes the same pattern to the full-track buffer using the 2XF module data generator. Finally, the test reads the data two more times, first comparing data on the MWS or MCU and then using the 2XF data checker to compare data. The following sequence describes what occurs in this test section; use it for troubleshooting purposes:

1. The LOSP channel is initialized.

2. The 2XF tester mode is cleared.

3. The channel is cleared.

Note: A drive must be connected and operating to perform the following step.

4. The unit is selected (primary or secondary).

5. A clear faults command is issued.

6. The following sequence occurs for each user-selected data pattern that can use the 2XF data generator:

   a. The MWS or MCU output buffer is loaded with the pattern.

   b. The 2XF tester mode is cleared.

   c. 2,048 parcels are written to the full-track buffer through the 2XF data buffer (mode 14 write).

   d. 2,048 parcels are read back from the full-track buffer to the input buffer (mode 12 read).

   e. The input and output buffers are compared.

   f. The 2XF data generator and data checker are enabled.

   g. The 2XF data generator seed register is loaded with the pattern.

   h. 2,048 parcels are read back from the full-track buffer using the 2XF data checker (mode 12 read).

   i. The 2XF data generator is enabled.

   j. The 2XF data generator seed register is loaded with the pattern.

   k. 2,048 parcels are written to the full-track buffer using the 2XF data generator (mode 14 write).

   l. The 2XF tester mode is cleared.

   m. 2,048 parcels are read back from the full-track buffer to the input buffer (mode 12 read).

   n. Steps e through h are repeated.

7. A release command is issued.

Section 9 - Full-track Buffer Write/Read Test

This section uses track buffer write and read operations of 2,048 parcels to test all user-selected sectors of all user-selected spindles in the full-track buffer (2EB module). The test uses the 2XF module data generator and data checker on all data patterns possible. The following sequence describes what occurs in this test section; use it for troubleshooting purposes:

1. The LOSP channel is initialized.

2. The 2XF tester mode is cleared.

3. The channel is cleared.

Note: A drive must be connected and operating to perform the following step.

4. The unit is selected (primary or secondary).

5. A clear faults command is issued.

6. The following sequence occurs for each user-selected data pattern:

   a. The 2XF data generator is loaded with the pattern, if possible. (If it is not possible to load the data generator, the pattern is loaded in the MWS or MCU output buffer and into the 2XF data buffer.)

   b. The following sequence occurs for each user-selected sector:

      1) The 2XF data generator seed register is loaded with the sector address if the current pattern is the sector addressing pattern.

      2) 2,048 parcels are written to the full-track buffer (mode 14 write).

   c. The 2XF data generator and data checker are enabled if the data generator was used for write operations.

   d. The following sequence occurs for each user-selected sector:

      1) The 2XF data generator register is loaded with the sector address if the current pattern is the sector addressing pattern.

      2) 2,048 parcels are read from the full-track buffer (mode 12 read).

      3) The input and output buffers are compared if the 2XF data checker is not being used.

7. A release command is issued.

MDMS DRIVE TEST SECTIONS

This subsection describes the test sections in the MDMS drive diagnostic test. Nine tests, labeled test sections 0 through 8, are used for the drive diagnostic test (refer to Figure 5-4).

Section 0 - Basic Drive Functions Test

This section tests drive control functions. The test issues the functions and determines whether correct status is returned. The following sequence describes what occurs in this test section; use it for troubleshooting purposes:

1. The LOSP channel is initialized.

2. The 2XF tester mode is cleared.

3. The channel is cleared.

   Note: A drive must be connected and operating to perform the following step.

4. The unit is selected (primary or secondary).
5. A clear faults command is issued.
6. A return-to-zero command is issued.
7. A reset command is issued.
8. The general status is read.
9. The DC-40/41 controller (buffer) status is read for each selected sector.
10. The following sequence occurs for each user-selected spindle:
    a. The current sector count is read.
    b. The fault status is read.
    c. The operating status is read.
    d. The field-replaceable unit code is read.
11. A release command is issued.

Section 1 - Head Select Test

This section uses head select and sector ID read operations to test whether all of the user-selected heads can be addressed. The following sequence describes what occurs in this test section; use it for troubleshooting purposes:

1. The LOSP channel is initialized.
2. The 2XF tester mode is cleared.
3. The channel is cleared.
4. The unit is selected (primary or secondary).
5. A reset command is issued.
6. The CE cylinder is selected.
7. The 2XF tester is set to short transfer mode.
8. The following sequence occurs for each user-selected spindle:

Note: The following sequence is repeated for each user-selected head as each user-selected spindle is being tested:

a. The head is selected.

b. The current sector status is read.

c. The sector ID is read two sector locations past the current sector.

d. If the sector ID is valid, the cylinder, head, and sector fields of the ID are checked to ensure they match the sector that the ID was read from in step 8.c. If the ID is invalid, the next sector is read.

9. A return-to-zero command is issued.

10. A release command is issued.

Section 2 - Cylinder Select Test

This section uses cylinder select and sector ID read operations to test whether all of the user-selected cylinders can be selected. Sequential cylinder selects are tested first, and then random cylinder selects. The following sequence describes what occurs in the sequential cylinder select test; use it for troubleshooting purposes:

1. The LOSP channel is initialized.

2. The 2XF tester mode is cleared.

3. The channel is cleared.

Note: A drive must be connected and operating to perform the following step.

4. The unit is selected (primary or secondary).

5. A reset command is issued.

6. The 2XF tester is set to short transfer mode.

7. The following sequence occurs for each user-selected cylinder:

   a. The cylinder is selected.

   b. The following sequence occurs for each user-selected spindle:

      1) The current sector status is read.

      2) The sector ID is read two sector locations past the current sector and on the first user-selected head.

      3) If the sector ID is valid, the cylinder, head, and sector fields of the ID are checked to ensure they match the sector that the ID was read from in step 7. b.2. If the ID is invalid, the next sector is read.

c. A return-to-zero command is issued.

d. A release command is issued.

The following sequence describes what occurs in the random cylinder select test program:

1. The LOSP channel is initialized.

2. The 2XF tester mode is cleared.

3. The channel is cleared.

Note: A drive must be connected and operating to perform the following step.

4. The unit is selected (primary or secondary).

5. A reset command is issued.

6. The 2XF tester is set to short transfer mode.

7. The following sequence occurs for 1,000 cylinder select operations:

   a. A random cylinder value is generated.

   b. A random head value is generated.

   c. The cylinder is selected.

   d. The following sequence occurs for each user-selected spindle:

      1) The current sector status is read.

      2) The sector ID is read two sector locations past the current sector and on the random head.

      3) If the sector ID is valid, the cylinder, head, and sector fields of the ID are checked to ensure they match the sector that the ID was read from in step 7. d. 2. If the ID is invalid, the next sector is read.

   e. A return-to-zero command is issued.

   f. A release command is issued.

Section 3 - Seek Timing Test

This section times cylinder select operations to determine whether the seek operation meets factory specifications. First, the seek timing test times one-track seek operations in ascending and descending cylinder order. It then tests full-stroke seek operations in ascending and descending cylinder order. Finally, the test performs random seek operations to test average seek timing. The following sequence describes what occurs in the one-track seek timing test; use it for troubleshooting purposes:

1. The LOSP channel is initialized.

2. The 2XF tester mode is cleared.

3. The channel is cleared.

   Note: A drive must be connected and operating to perform the following step.

4. The unit is selected (primary or secondary).

5. A reset command is issued.

6. Cylinder 0 is selected.

7. The following sequence occurs for cylinder 1-to-maximum cylinder seeks:

   a. The seek is delayed one-half revolution before beginning.

   b. The cylinder is selected.

   c. The 2XF function timer is checked to see if the seek time met specifications (7 ms).

8. The following sequence occurs for maximum cylinder (minus 1)-to-cylinder 0 seeks:

   a. The seek is delayed one-half revolution before beginning.

   b. The cylinder is selected.

   c. The 2XF function timer register is checked to determine whether the seek time met specifications (7 ms).

9. A return-to-zero command is issued.

10. A release command is issued.

The following sequence describes what occurs in the full-stroke seek timing test program:

1. The LOSP channel is initialized.

2. The 2XF tester mode is cleared.

3. The channel is cleared.

   Note: A drive must be connected and operating to perform the following step.

4. The unit is selected (primary or secondary).

5. A reset command is issued.

6. Cylinder 0 is selected.

7. The following sequence occurs for 200 seek operations:

a. The seek is delayed one-half revolution before beginning.

b. The maximum cylinder is selected.

c. The 2XF function timer is checked to determine whether the seek time met specifications (30 ms).

d. The seek is delayed one-half revolution before beginning.

e. Cylinder 0 is selected.

f. The 2XF function timer register is checked to determine if the seek time was within specifications (30 ms).

8. A return-to-zero command is issued.

9. A release command is issued.

The following sequence describes what occurs in the average seek timing test program:

1. The LOSP channel is initialized.
2. The 2XF tester mode is cleared.
3. The channel is cleared.

   Note: A drive must be connected and operating to perform the following step.

4. The unit is selected (primary or secondary).
5. A reset command issued.
6. Cylinder 0 is selected.
7. The following sequence occurs for 2,000 seek operations:

   a. The seek is delayed one-half cylinder revolution before beginning.

   b. A random cylinder value is generated.

   c. The cylinder is selected.

   d. The 2XF function timer register is checked and its value added to the total seek time.

8. The average seek time is computed to determine whether it meets specifications (16.5 ms) using the following formula: average seek time = total seek time/2,000.
9. A return-to-zero command is issued.
10. A release command is issued.

Section 4 - CE Cylinder Data Generator Test

This section writes to and reads from the first unflawed sector on the disk within user-selected limits in order to test the 2XF data generator and data checker. To do this, the test first writes a data pattern generated on the MWS or MCU to the disk. It then reads the data back and compares data on the MWS or MCU. Then the test reads the data again using the 2XF data checker and writes the same pattern to the disk using the 2XF data generator. The test then reads the data two more times; first comparing data on the MWS or MCU, and then using the 2XF data checker to compare data. The following sequence describes what occurs in this test section; use it for troubleshooting purposes:

1. The LOSP channel is initialized.
2. The 2XF tester mode is cleared.
3. The channel is cleared.

   Note: A drive must be connected and operating to perform the following step.

4. The unit is selected (primary or secondary).
5. A reset command is issued.
6. Select the CE cylinder.
7. The following sequence occurs for each user-selected data pattern that can use the 2XF data generator:

   a. The MWS or MCU output buffer is loaded with the pattern.

   b. The 2XF tester mode is cleared.

   c. The pattern is written to the disk through the 2XF data buffer (mode 10 write operation on the DS-40/41).

   d. The pattern is read back from the disk into the MWS or MCU input buffer (mode 10 read on the DS-40/41).

   e. The input and output buffers are enabled.

   f. The 2XF data generator and data checker are enabled.

   g. The 2XF data generator seed register is loaded with the pattern.

   h. The pattern is read back from the disk using the 2XF data checker (mode 10 read on the DS-40/41).

   i. The 2XF data generator is enabled.

   j. The 2XF data generator seed register is loaded with the pattern.

   k. The pattern is written to the disk using the 2XF data generator (mode 10 write on the DS-40/41).

l. The 2XF tester mode is cleared.

m. The pattern is read back from the disk into the MWS or MCU input buffer (mode 10 read on the DS-40/41).

n. Steps f through h are repeated.

8. A return-to-zero command is issued.

9. A release command is issued.

Section 5 - CE Cylinder Write/Read Test

This section writes and reads all user-selected sectors of the CE cylinder that do not have unhideable flaws. It uses the 2XF data generator and data checker on all data patterns possible. On the DS-40/41 systems, this section tests all combinations of mode 0 and mode 10 write and read operations. The following sequence describes what occurs in the DS-40/41 test program; use it for troubleshooting purposes:

1. The LOSP channel is initialized.
2. The 2XF tester mode is cleared.
3. The channel is cleared.
4. The unit is selected (primary or secondary).
5. A reset command is issued.
6. The CE cylinder is selected.
7. The following sequence occurs for each user-selected data pattern:

   a. The 2XF data generator is loaded with the pattern, if possible. (If the data generator cannot be loaded, the pattern is loaded into the MWS or MCU output buffer and into the 2XF data buffer.)

   b. The following sequence occurs for each user-selected sector:

      1) The 2XF data generator seed register is loaded with the sector address if the current pattern is the sector addressing pattern.

      2) The sector is written without the write behind enabled (mode 10 write).

   c. The 2XF data generator and data checker are enabled if the data generator was used for write operations.

   d. The following sequence occurs for each user-selected sector:

      1) The 2XF data generator seed register is loaded with the sector address if the current pattern is the sector addressing pattern.

2) The sector is read without read ahead enabled (mode 10 read).

3) The input and output buffers are compared if the 2XF data checker is not being used.

e. The following sequence occurs for each user-selected sector:

1) The 2XF data generator seed register is loaded with the sector address if the current pattern is the sector addressing pattern.

2) The sector is read with read ahead enabled (mode 0 read).

3) The input and output buffers are compared if the 2XF data checker is not being used.

f. The 2XF data generator is loaded with the pattern, if possible. (If the 2XF data generator cannot be loaded, the pattern is loaded into the MWS or MCU output buffer and into the 2XF data buffer.)

g. The following sequence occurs for each user-selected sector:

1) The 2XF data generator seed register is loaded with the sector address if the current pattern is the sector addressing pattern.

2) The sector is written with write behind enabled (mode 0 write).

h. The 2XF data generator and data checker are enabled if the data generator was used for write operations.

i. The following sequence occurs for each user-selected sector:

1) The 2XF data generator seed register is loaded with the sector address if the current pattern is the sector addressing pattern.

2) The sector is read without read ahead enabled (mode 10 read).

3) The input and output buffers are compared if the 2XF data checker is not being used.

j. The following sequence occurs for each user-selected sector:

1) The 2XF data generator seed register is loaded with the sector address if the current pattern is the sector addressing pattern.

2) The sector is read with read ahead enabled (mode 0 read).

3) The input and output buffers are compared if the 2XF data checker is not being used.

8. A return-to-zero command is issued.

9. A release command is issued.

The following sequence describes what occurs in the CE cylinder write/read test for the RDS-5 test program:

1. The LOSP channel is initialized.
2. The 2XF tester mode is cleared.
3. The channel is cleared.
4. The unit is selected.
5. A reset command is issued.
6. The CE cylinder is selected.
7. The following sequence occurs for each user-selected data pattern:
   a. The 2XF data generator is loaded with the pattern, if possible. (If the data generator cannot be loaded, the pattern is loaded into the MWS or MCU output buffer and the 2XF data buffer.)
   b. The following sequence occurs for each user-selected sector:
      1) The 2XF data generator seed register is loaded with the sector address if the current pattern is the sector addressing pattern.
      2) The sector is written (mode 0 write).
   c. The 2XF data generator and data checker are enabled if the data generator was used for write operations.
   d. The following sequence occurs for each user-selected sector:
      1) The 2XF data generator is loaded with the sector address if the current pattern is the sector addressing pattern.
      2) The sector is read (mode 0 read).
      3) The input and output buffers are compared if the 2XF data checker is not being used.
8. A return-to-zero command is issued.
9. A release command is issued.

Section 6 - CE Cylinder Data Chaining Test

This section tests the data chaining feature of the controller during write and read operations. The test writes to and reads from all user-selected sectors of the CE cylinder that do not have unhideable flaws. Only data patterns that can use the 2XF data generator and data checker are used. In addition, the sector addressing pattern is not used for timing reasons.

The test first writes to all sectors using data chaining. It then reads all sectors without data chaining to test the write operation. Finally, the test reads all sectors using data chaining. The following sequence describes what occurs in this test section; use it for troubleshooting purposes:

1. The LOSP channel is initialized.

2. The 2XF tester mode is cleared.

3. The channel is cleared.

   Note: A drive must be connected and operating to perform the following step.

4. The unit is selected (primary or secondary).

5. A reset command is issued.

6. The CE cylinder is selected.

7. The following sequence occurs for each user-selected data pattern:

   a. The 2XF data generator is loaded with the data pattern.

   b. Each user-selected sector is written with data chaining according to the following sequence:

      1) The initial sector is written using the DIA : 3 mode 0 write command.

      2) The following sequence occurs in all remaining sectors:

         a) The sector is written using the DIA : 16 mode 0 write command.

         b) If the done bit sets, there is a return to step 7. b. 1 and the write command is reissued for the current sector.

   c. The 2XF data generator and data checker are enabled.

   d. Each user-selected sector is read without data chaining (mode 0 read).

   e. Each user-selected sector is read with data chaining using the following sequence:

      1) The initial sector is read using the DIA : 2 mode 0 read command.

      2) The following sequence occurs for all remaining sectors:

         a) The sector is read using the DIA : 16 mode 0 read command.

         b) If the done bit sets, there is a return to step 7. e. 1 and the read command is reissued for the current sector.

8. A return-to-zero command is issued.

9. A release command is issued.

Section 7 - Error Correction Test

This section tests the ability of the ECC circuitry in the controller to detect and correct errors in data read from the disk. The test uses the first nonflawed sector within user-defined limits on each user-selected spindle of the CE cylinder. The test uses the write zero ECC function to force ECC errors.

Three different error patterns are used in test section 7. The first pattern is a single bit in error. The second pattern is 8 consecutive bits in error (the maximum correctable error). The third pattern is 9 consecutive bits in error in the sector and is used to test the ability of the ECC circuitry to detect an uncorrectable error. All three patterns are used once in each parcel of the sector.

The following sequence of data patterns is used for test section 7:

1. 000001 (single-bit error)
2. 000377 (8-bit error - maximum correctable)
3. 000777 (9-bit error - uncorrectable)

The following sequence describes what occurs in this test section; use it for troubleshooting purposes:

1. The LOSP channel is initialized.
2. The 2XF tester mode is cleared.
3. The channel is cleared.

   Note: A drive must be connected and operating to perform the following step.

4. The unit is selected (primary or secondary).
5. A reset command is issued.
6. The CE cylinder is selected.
7. The following sequence occurs for each user-selected spindle:

   a. The MWS or MCU output buffer is set to all 0's.

   b. The following sequence occurs for each test pattern:

      Note: The following sequence is repeated in every parcel in the sector as each test pattern is being tested:

      1) The test pattern is loaded in the current parcel of the output buffer.

      2) The sector data field is written using the write zero ECC function (mode 4 write).

3) The sector data field is read back to the MWS or MCU input buffer (mode 10 read on the DS-40/41).

4) An ECC error is verified.

5) The input and output buffers are compared.

6) The 2XF tester is set to short transfer mode.

7) The error correction vectors are read (read mode 5).

8) The error correction mask and offset from the error correction vectors are checked to ensure they are correct for the current pattern.

9) A clear faults command is issued.

10) The 2XF tester mode is cleared.

11) The current parcel of the output buffer is reset to 0.

c. The sector data field is written with the correct ECC (mode 10 write on the DS-40/41).

8. A return-to-zero command is issued.

9. A release command is issued.

Section 8 - Defect Pad Address Test

This section tests the controller's ability to write a defect pad to any of the possible pad addresses. It uses the first nonflawed sector within the user-defined limits on each user-selected spindle of the CE cylinder. The test first writes the sector ID field with the address of the defect pad being tested. It then reads the sector ID back and ensures that it was written correctly. Next, all 1's are written to the sector data field. The sector data field is then read back and verified to be all 1's. Finally, an absolute read of the sector data field is done in order to determine if the defect pad is written with 0's. The following sequence describes what occurs in this test section; use it for troubleshooting purposes:

1. The LOSP channel is initialized.
2. The 2XF tester mode is cleared.
3. The channel is cleared.
4. The unit is selected (primary or secondary).
5. A reset command is issued.
6. The CE cylinder is selected.
7. The following sequence occurs for each user-selected spindle:

Note: The following sequence is repeated for every possible defect pad address as each user-selected spindle is being tested:

a. The 2XF tester is set to short transfer mode.

b. The output buffer is loaded with the sector ID defect pad address.

c. The sector ID is written to disk.

d. The sector ID is read back to the input buffer.

e. The input and output buffers are compared.

f. The 2XF data generator is enabled in long transfer mode.

g. All 1's are written to the sector data field (mode 10 write on the DS-40/41).

h. The 2XF data generator and data checker are enabled.

i. The sector data field is read to verify whether it is all 1's (mode 10 read on the DS-40/41).

j. The 2XF tester mode is cleared.

k. The defect pad register is loaded using a DIA : 4 command.

l. The sector data field is read back to the MWS or MCU input buffer using an absolute read (mode 2 read).

m. The defect pad area is verified whether or not it is filled with 0's.

8. A return-to-zero command is issued.

9. A release command is issued.

6 - MDMS TROUBLESHOOTING

This section describes how to troubleshoot the DS-40/41 disk subsystems and the RDS-5 using the MDMS drive troubleshooting diagnostic. A 2XF troubleshooting diagnostic is also described in this section. Both diagnostics are menu driven to provide more simplified and fail-safe troubleshooting.

MDMS TROUBLESHOOTING DIAGNOSTIC

The MDMS troubleshooting diagnostic is menu driven to allow for data handling and more easily issued drive functions. An example of the drive troubleshooting menu for DS-40/41 disk subsystems and the RDS-5 appears in Figure 6-1.

```
                          MDMS DRIVE TROUBLE SHOOTING

Last Function:          R 0 0 0 0               Unit:          0
2XF Status:             000300                  Cylinder:      2613
DCU-5 Status 0:         000001                  Spindle:       1
DCU-5 Status 1:         001400                  Head:          0
2XF Function Timer:     004215 (3.502 msec)     Sector:        0

CC - Clear Channel        RZ - Return To Zero      C - Compare Buffers
US - Unit Select          RO - Release Opposite    I - Input Buffer Display
H  - Head Select          RU - Release Unit        O - Output Buffer Display
SS - Status Select        R  - Read                D - Display All Statuses
G  - General Status       W  - Write               L - Loop On Last Function
DS - Diagnostic Select    DE - Diagnostic Echo     T - Initialize 2XF Tester
RT - Reset                S  - Select Cylinder     X - 2XF Trouble Shooting
CF - Clear Faults         SP - Select Special      M - Main MDMS Menu

 Command>
```

Figure 6-1. MDMS Drive Troubleshooting Menu

The following command descriptions are used when troubleshooting the drive. Comparable IOS and DCU-5 diagnostic commands are also provided when these commands are available. The diagnostic program requests any parameters necessary to issue a given function. However, these parameters can be previously supplied by stacking the appropriate responses for the desired spindle, head, sector, etc. (Refer to the *DC-40 Disk Controller/DD-40 Disk Drive Engineering Note*, PRN-0799 for more information on IOP commands.)

Command:	CC - Clear channel
IOP command:	DIA : 0 clear channel controller
DCU-5 command:	None
Additional parameters needed:	None
Comments:	None

Command:	US - Unit select
IOP command:	Unit select under DIA : 1 drive control functions
DCU-5 command:	SU - Select unit
Additional parameters needed:	Unit number (0 or 1 for DS-40/41, 0 for DCU-S1)
Comments:	None

Command:	H - Head select
IOP command:	Head select under DIA : 1 drive control functions
DCU-5 command:	H or SH - Select head
Additional parameters needed:	Head number
Comments:	None

Command:	SS - Status select
IOP command:	Status select under DIA : 1 drive control functions
DCU-5 command:	SS - Status select
Additional parameters needed:	Status type, spindle (for DS-40/41 or RDS-5), and sector
Comments:	None

Command:	G - General status
IOP command:	General status under DIA : 1 drive control functions
DCU-5 command:	G or GS - General status
Additional parameters needed:	None
Comments:	None

Command:	DS - Diagnostic select
IOP command:	Diagnostic select under DIA : 1 drive control functions
DCU-5 command:	SD - Select diagnostic
Additional parameters needed:	Parity error to force (force bus-in parity error or force status parity error).
Comments:	None

Command:	RT - Reset
IOP command:	Reset under DIA : 1 drive control functions
DCU-5 command:	RT - Reset
Additional parameters needed:	None
Comments:	None

Command:	CF - Clear faults
IOP command:	Clear faults under DIA : 1 drive control functions
DCU-5 command:	CF - Clear faults
Additional parameters needed:	None
Comments:	None
Command:	RZ - Return to zero
IOP command:	Return to zero under DIA : 1 drive control functions
DCU-5 command:	RZ - Return to zero
Additional parameters needed:	None
Comments:	None
Command:	RO - Release opposite
IOP command:	Release opposite channel under DIA : 1 drive control functions
DCU-5 command:	RO - Release opposite and select
Additional parameters needed:	Unit to select
Comments:	None
Command:	RU - Release unit
IOP command:	Release under DIA : 1 drive control functions
DCU-5 command:	RU - Release unit
Additional parameters needed:	Unit to release
Comments:	None
Command:	R - Read
IOP command:	DIA : 2 request read
DCU-5 command:	R or RD - Read
Additional parameters needed:	Read option and the desired head, spindle, and sector.
Comments:	None
Command:	W - Write
IOP command:	DIA : 3 request write
DCU-5 command:	W or WT - Write
Additional parameters needed:	Write option and desired head, spindle, and sector.
Comments:	None
Command:	DE - Diagnostic echo
IOP command:	DIA : 4 Diagnostic echo
DCU-5 command:	ED - Echo data
Additional parameters needed:	Data to be echoed
Comments:	None
Command:	S - Select cylinder
IOP command:	DIA : 5 select cylinder
DCU-5 command:	S or SC - Select cylinder
Additional parameters needed:	Cylinder to be selected
Comments:	None

Command:	SP - Select special
IOP command:	DIA : 17 select special controller mode/status
DCU-5 command:	None
Additional parameters needed:	Mode to select
Comments:	None

Command:	C - Compare data buffers
IOP command:	None
DCU-5 command:	VD - View data
Additional parameters needed:	None
Comments:	Compares the input and output data buffers on the MWS or MCU.

Command:	I - Input buffer display
IOP command:	None
DCU-5 command:	BD - Build data
Additional parameters needed:	None
Comments:	Allows displaying and editing the input data buffer on the MWS or MCU.

Command:	O - Output buffer display
IOP command:	None
DCU-5 command:	BD - Build data
Additional parameters needed:	None
Comments:	Allows displaying and editing the output data buffer on the MWS or MCU.

Command:	D - Display all statuses
IOP command:	None
DCU-5 command:	None
Additional parameters needed:	None
Comments:	Displays all the controller and drive statuses. Uses the cylinder, head, spindle, and sector of the most recently executed drive command.

Command:	I - Initialize 2XF tester
IOP command:	None
DCU-5 command:	None
Additional parameters needed:	None
Comments:	None

Command:	L - Loop on last function
IOP command:	Same as last function
DCU-5 command:	L - Loop on last function
Additional parameters needed:	Same as last function
Comments:	None

Command:	M - Main MDMS menu
IOP command:	None
DCU-5 command:	None
Additional parameters needed:	None
Comments:	This command returns you to the main MDMS menu.

Command: X - 2XF troubleshooting
IOP command: None
DCU-5 command: None
Additional parameters needed: None
Comments: This command displays the 2XF troubleshooting menu.

2XF TROUBLESHOOTING DIAGNOSTIC

The 2XF troubleshooting diagnostic tests the 2XF module in the tester interface when a failure in the module is suspected. The menu appears in Figure 6-2.

```
                          MDMS 2XF TROUBLE SHOOTING

Last Function:          RGS                         Data Checker:             OFF
2XF Status:             000300                      Random Data:              OFF
DCU-5 Status 0:         000001                      Data Generator:           OFF
DCU-5 Status 1:         001400                      Continuous Generation:    0
2XF Function Timer:     004215 (3.502 msec)         Transfer Length:          LONG
Data Generator Seed:    123456

Last Command:

 WS0 - Write DCU-5 Status 0                   W - Write 2XF Data Buffer
 WS1 - Write DCU-5 Status 1                   R - Read  2XF Data Buffer
 WGS - Write Data Generator Seed              C - Compare Buffers
 RTS - Read 2XF Tester Status                 I - Input Buffer Display
 RS0 - Read  DCU-5 Status 0                   O - Output Buffer Display
 RS1 - Read  DCU-5 Status 1                   L - Loop on Last Function
 RFT - Read 2XF Function Timer                T - Initialize 2XF Tester
 RGS - Read Data Generator Seed               D - Drive Trouble Shooting
 TDC - Toggle Data checker On/Off             M - Main MDMS Menu
 TRD - Toggle Random Data On/Off
 TDG - Toggle Data Generator On/Off
 TCG - Toggle Continuous Generaton On/Off
 TTL - Toggle Transfer Length Short/Long

 Command>
```

Figure 6-2. 2XF Troubleshooting Menu

The 2XF troubleshooting menu uses the following command descriptions. Comparable IOS and DCU-5 diagnostic commands are also provided when these commands are available.

Command:	WS0 - Write DCU-5 status 0
2XF command:	Write status buffer command 0
Additional parameters needed:	Value to write
Comments:	None

Command:	WS1 - Write DCU-5 status 1
2XF command:	Write status buffer command 0
Additional parameters needed:	Value to write
Comments:	None

Command:	WGS - Write data generator seed
2XF command:	Write status buffer command 0
Additional parameters needed:	Value to write
Comments:	None

Command:	RTS - Read 2XF tester status
2XF command:	Read status buffer command 4
Additional parameters needed:	None
Comments:	None

Command:	RS0 - Read DCU-5 status 0
2XF command:	Read status buffer command 4
Additional parameters needed:	None
Comments:	None

Command:	RS1 - Read DCU-5 status 1
2XF command:	Read status buffer command 4
Additional parameters needed:	None
Comments:	None

Command:	RFT - Read 2XF function timer
2XF command:	Read status buffer command 4
Additional parameters needed:	None
Comments:	None

Command:	RGS - Read data generator seed
2XF command:	Read status buffer command 4
Additional parameters needed:	None
Comments:	None

Command:	TDC - Toggle data checker ON/OFF
2XF command:	Tester mode select command 2
Additional parameters needed:	None
Comments:	None

Command:	TRD - Toggle random data ON/OFF
2XF command:	Tester mode select command 2
Additional parameters needed:	None
Comments:	None

Command:	TCG - Toggle continuous generation ON/OFF
2XF command:	Tester mode select command 2
Additional parameters needed:	None
Comments:	None

Command:	TTL - Toggle transfer length SHORT/LONG
2XF command:	Tester mode select command 2
Additional parameters needed:	None
Comments:	None

Command:	W - Write 2XF data buffer
2XF command:	Write data buffer command 1
Additional parameters needed:	None
Comments:	After master clearing the 2XF, the data buffer must be written, read, written, read, etc. A time-out error results if the data buffer is written two times in a row without being read. Do not loop on this function.

Command:	R - Read 2XF data buffer
2XF command:	Read data buffer command 2
Additional parameters needed:	None
Comments:	After master clearing the 2XF, the data buffer must be written, read, written, read, etc. A time-out error results if the data buffer is read two times in a row without being read. Do not loop on this function.

Command:	C - Compare data buffers
2XF Command:	None
Additional parameters needed:	None
Comments:	Compares the input and output data buffers on the MWS or MCU.

Command:	I - Input buffer display
2XF command:	None
Additional parameters needed:	None
Comments:	Allows displaying and editing the input data buffer on the MWS or MCU.

Command:	O - Output buffer display
2XF command:	None
Additional parameters needed:	None
Comments:	Allows displaying and editing the output data buffer on the MWS or MCU.

Command:	L - Loop on last function
2XF command:	Same as last function
Additional parameters needed:	Same as used in last function
Comments:	None

Command: T - Initialize 2XF tester
2XF command: None
Additional parameters needed: None
Comments: None

Command: D - Drive troubleshooting
2XF command: None
Additional parameters needed: None
Comments: This command redisplays the drive troubleshooting menu.

Command: M - Main MDMS menu
2XF command: None
Additional parameters needed: None
Comments: This command redisplays the main MDMS menu. The **ESC** key performs the same function.

DISPLAY DATA BUFFER COMMANDS

Display data buffer commands are available in MDMS diagnostics as a troubleshooting aid. These commands are a subset of the commands available under the IOS maintenance system (IMS). Refer to the *CRAY Y-MP and CRAY X-MP EA Off-line Diagnostic Reference Manual*, CDM-1116-0B0, for a description of the IMS commands.

Display Address Commands

Display address commands may be entered in upper- or lower-case letters. Case is significant only for filenames. Table 6-1 lists the display address commands. There is no specific entry sequence or hierarchy among these commands.

Table 6-1. Display Address Commands

Command	Display Format
d *addr*	Sets the buffer address of the entire display to the specified address
d *leftaddr rightaddr*	Sets the buffer address on the left and right sides of the display to the specified left and right addresses, respectively
dl *addr*	Sets the buffer address on the left side of the display to the specified address
dr *addr*	Sets the buffer address on the right side of the display to the specified address
dll *addr*	Sets the buffer address on the lower left quadrant of the display to the specified address
dlu *addr*	Sets the buffer address on the upper left quadrant of the display to the specified address
drl *addr*	Sets the buffer address on the lower right quadrant of the display to the specified address
dru *addr*	Sets the buffer address on the upper right quadrant of the display to the specified address

Display Roll Commands

The display roll commands scroll the displayed memory forward or backward. Table 6-2 lists the display roll commands.

Table 6-2. Display Roll Commands

Command	Description
db	Rolls all quadrants on the display backward
df	Rolls all quadrants on the display forward
dlf	Rolls the left side of the display forward
dlb	Rolls the left side of the display backward
drf	Rolls the right side of the display forward
drb	Rolls the right side of the display backward

Mode Select Commands

The mode select commands change the display format to the specified mode. Table 6-3 lists the mode select commands. The italicized letter *m* in the command is a variable to be replaced with one of the following letters: w for word, a for address, p for parcel, b for byte, h for hexadecimal, or t for text.

Table 6-3. Mode Select Commands

Command	Description
M*m*	Changes the entire display to the given format
M*w*	Changes the entire display to word format (64 bits)
M*a*	Changes the entire display to address format (32 bits)
M*p*	Changes the entire display to parcel format (default) (16 bits)
M*b*	Changes the entire display to byte format (8 bits)
M*h*	Changes the entire display to hexadecimal format (8 bits)
M*t*	Changes the entire display to text format (8 bits)

Store Buffer Commands

The store buffer commands change the contents of the buffer. Table 6-4 lists the store commands.

Table 6-4. Store Buffer Commands

Command	Description
s *addr data*	Stores *data* at the given address.
s *addr data0-data3*	Stores *data0* through *data3* at the given address. (If less than 4 parcels of data are specified, only the specified number of parcels will be stored.)
s+*addr data*	Stores *data* at the given address and increments the pointer to the next address.
s+*addr data0-data3*	Stores *data0* through *data3* at the given address and increments the pointer to the next address.

Set Commands

The set commands set the buffer. Table 6-5 lists the set commands.

Table 6-5. Set Commands

Command	Description
/00 *fpa lpa*	This command sets to 0's that portion of the buffer specified by the first parcel address and the last parcel address. The default *fpa* is 0, and the default *lpa* is 03777; the defaults indicate the size of a sector.
/11 *fpa lpa*	This command sets to 1's that portion of the buffer specified by the first parcel address and the last parcel address. The default *fpa* is 0, and the default *lpa* is 03777; the defaults indicate the size of a sector.
/A	This command sets each parcel in the buffer to its address.
/I	This command sets the buffer being displayed to the value of the input buffer.
/O	This command sets the buffer being displayed to the value of the output buffer.

COMPARE DATA BUFFER COMMANDS

Compare data buffer commands are available in MDMS diagnostics as a troubleshooting aid. These commands are a subset of the commands available under IMS. Refer to the *CRAY Y-MP and CRAY X-MP EA Off-line Diagnostic Reference Manual*, CDM-1116-0B0, for a description of the IMS commands.

Display Address Command

The display address command (Table 6-1) may be entered in upper- or lower-case letters. Case is significant only for filenames.

1 - MDMS OVERVIEW

The Cray Research, Inc. micro-based disk maintenance system (MDMS) diagnostic program tests the operation of a DS-40, DS-41, DS-4R, or DS-42 disk subsystem without the use of a CRI mainframe. DS-40s contain a DC-40 disk controller and DD-40 disk drives. DS-41s contain a DC-41 disk controller and DD-41 disk drives. DS-4Rs contain a DC-40 disk controller and DD-4R disk drives. DS-42s contain a DC-40 disk controller and DD-42 disk drives.

Note: All references to a DS-40 that contains DD-40 disk drives also apply to a DS-4R that contains DD-4R disk drives and a DS-42 that contains DD-42 disk drives, unless specifically noted otherwise.

MDMS runs independently of any Cray Research system hardware because the disk drive is cabled directly to the maintenance workstation (MWS) or the maintenance control unit (MCU). A wide range of disk functions can be performed using MDMS diagnostics.

MDMS diagnostic software is menu driven. The MDMS 2.1 software release provides surface analysis, flaw management, and a comprehensive diagnostic test section to test all logic from the 2XF test module up to and including the disk drive.

MDMS DIAGNOSTIC TESTS

The MDMS comprehensive test enables users to select a specific diagnostic section, all sections, or any combination of sections. The following diagnostic tests are available:

- Controller diagnostics, including 2XF and 2IE module tests, diagnostic echo test, parity errors test, and full-track buffer testing of the data bus, single-error correction/double-error detection (SECDED †), data, and addressing logic

- Drive diagnostic tests, including basic drive functions such as head select, cylinder select, seek timing, single sector write/read, continuous write with and without data compare, error correction and defect pad location

MDMS DIAGNOSTICS HARDWARE

MDMS is a program that runs on either the MWS or MCU. The MCU is a CP/M-based microcomputer system with a 5-Mbyte or 15-Mbyte hard disk drive. The MWS is a VERSAbus modular eurocard (VME) bus-based workstation. UNIX System V operating system software is used.

† Hamming, R.W. "Error Detection and Correcting Codes." *Bell System Technical Journal.* 29.2 (1950): 147-160.

There is an MCU or an MWS at every customer site; some sites have both units. The MCU and MWS send MDMS program instructions to an offline channel disk tester in the DCC-2 disk controller cabinet.

The MCU and MWS can be connected to one disk controller at a time. A maximum of two DD-40/41 disk storage devices can be connected to one DC-40/41 disk controller unit. DD-40s have 4 spindles, and DD-41s have 16 spindles.

Figure 1-1 illustrates the DS-40/41 disk subsystem, the MCU, the MWS, and the Cray Research mainframe system.

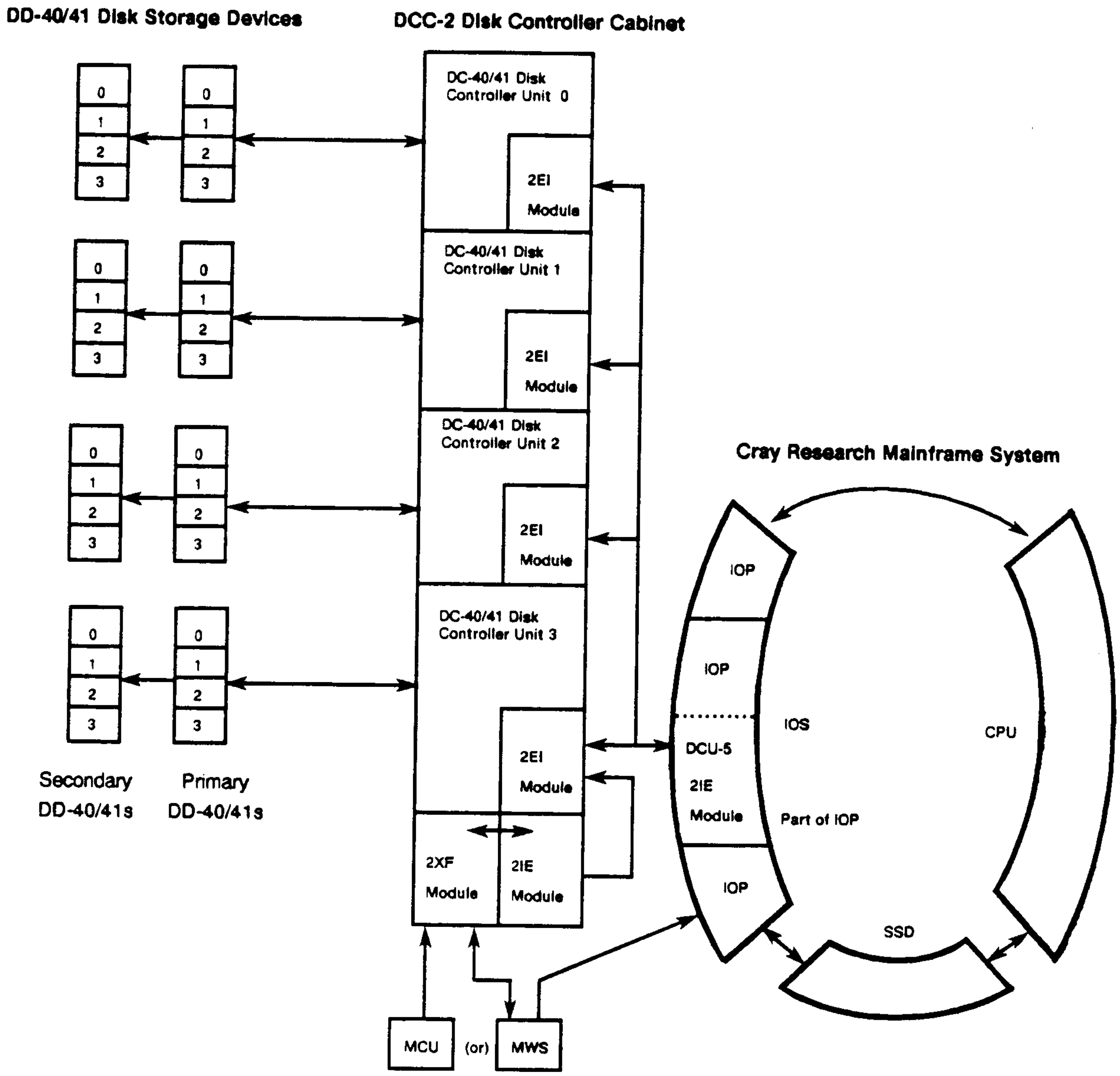


Figure 1-1. DS-40/41 Disk Subsystem

Display Roll Commands

The display roll commands (Table 6-2) scroll the displayed memory forward or backward.

Mode Select Commands

The mode select commands (Table 6-3) change the display format to the specified mode. The italicized letter *m* in the command is a variable to be replaced with one of the following letters: w for word, a for address, p for parcel, b for byte, h for hexadecimal, or t for text.

TROUBLESHOOTING EXAMPLES

The following are some examples on how to use the MDMS drive troubleshooting section. All commands include any needed parameters on the command line. If you do not enter the parameters, you will be prompted for them.

Disk Initialization

Disk initialization should be done before anything else whenever a TIMEOUT occurs. To initialize the controller and disk, enter the following commands and repeat the test until no errors are reported. If an error other than TIMEOUT is reported, continue the test and then repeat the entire test from the beginning. If you are testing the secondary drive, use a 1 instead of a 0 at the US command. If a 2XF Buffer Parity Error is reported, go to the MDMS 2XF Troubleshooting section. Enter an X, then W to write the 2XF data buffer and clear the error. Tables 6-6 through 6-8 show disk initialization for the DS-40, DS-41, and RDS-5 disk drives respectively.

Table 6-6. DS-40 Disk Initialization

Command	Description
T	Initialize 2XF tester
CC	Clear the channel (IOB:0)
US 0	Select unit 0 (IOB:1)
RT	Reset the disk (IOB:1)
DE 0	Load the DS-40 defect pad register (IOB:4)

Table 6-7. DS-41 Disk Initialization

Command	Description
T	Initialize 2XF tester
CC	Clear the channel (IOB:0)
US 0	Select unit 0 (IOB:1)
RT	Reset the disk (IOB:1)
DE 60	Load the DS-41 defect pad register (IOB:4)

Table 6-8. RDS-5 Disk Initialization

Command	Description
T	Initialize 2XF tester
CC	Clear the channel (IOB:0)
US 0	Select unit 0 (IOB:1)
RT	Reset the disk (IOB:1)

CE Cylinder Write/Read

Enter the following commands to write a sector addressing pattern to the drive, read it back, and compare it. The sector to be written and read is spindle 1, head 2, sector 3 of the CE cylinder. Table 6-9 shows a CE cylinder write/read for the DS-40 and DS-41. Table 6-10 shows a CE cylinder write/read for the RDS-5. The RDS-5 has only one spindle, so the spindle parameter is missing.

Table 6-9. DS-40/41 CE Cylinder Write/Read

Command	Description
0	Edit the output buffer
/A	Load a parcel addressing pattern
<ESC>	Exit output buffer display
S 1	Select the CE cylinder (IOB:5)
W 0 1 2 3	Write the sector (IOB:3)
R 0 1 2 3	Read the sector (IOB:2)
C	Compare the input and output buffers

Table 6-10. RDS-5 CE Cylinder Write/Read

Command	Description
0	Edit the output buffer
/A	Load a parcel addressing pattern
<ESC>	Exit output buffer display
S 1	Select the CE cylinder (IOB:5)
W 0 2 3	Write the sector (IOB:3)
R 0 2 3	Read the sector (IOB:2)
C	Compare the input and output buffers

7 - FLAW MANAGEMENT AND SURFACE ANALYSIS UTILITIES

Two flaw management utilities available for the DS-40/41 disk subsystems and the RDS-5 are contained in the micro-based disk maintenance system (MDMS). The DS-40/41 disk subsystem flaw management section, running under the CP/M operating system in the MCU and UNIX operating system in the maintenance workstation (MWS), performs formatting and other flaw management functions. The surface analysis utility examines disk surfaces and compiles flaw information that can be added to the flaw table using the formatter function. The surface analysis utility also runs under the CP/M and UNIX operating systems. Both utilities are described in this section.

DD-40/41 DISK STORAGE DEVICE FLAW MANAGEMENT

The DD-40/41 disk storage device flaw management utility accesses one DD-40/41 logical drive at a time. The flaw management utility uses information from the flaw tables it creates to format disk surfaces. In the process, it masks flaws of hideable length and flags defective sectors. The flaw management utility also prints, backs up, restores, and modifies the contents of a user flaw table.

User Flaw Table

The flaw management utility sends a copy of the user flaw table to every head of the user flaw cylinder. The table entries contain cylinder, head, and sector numbers of flaws along with the media defect address. Defect addresses are obtained from the beginning of the data field to the beginning of the media defect address. User flaw table entries become part of the sector IDs for the flawed sector(s) when the spindle is formatted.

User flaw table entries initially generated from the track headers are referred to as factory flaws. Other flaws recorded in the user flaw table are called Cray added flaws. Cray added flaws are created by the surface analysis utility or are entered manually.

Defect addresses in the sector ID range from 0 to 400 on DD-40s and 0 to 1000 on DD-41s. The address is used to select a 20 (octal)-byte defect pad. When the DC-40/41writes data to a sector with a flaw, it writes the data sequentially until it reaches the defect address. The defect pad, consisting of zero bits, is written at the defect pad address, and then the remaining data is written. If there is more than one defect in the data field, the sector cannot be used. A single flaw in the sector ID or sync bytes also makes the sector unusable. The defective pad address and parity are all 1's if there is no defect in the sector.

The format of a user flaw table entry appears in Figure 7-1. The format is the same as a sector ID except that the Cray added (CA) flaws and unhideable (UH) flaw bits are not used and are set to 0.

	2^{15}	2^{14}	2^{13}	2^{12} – 2^{8}	2^{7} – 2^{0}
Parcel 0	C A	U H	0	Head 2^4 - 2^0 (DD-40) 2^3 - 2^0 (DD-41)	Cylinder Number 2^{11} - 2^4

	2^{15} – 2^{12}	2^{11} – 2^{8}	2^{7} – 2^{0}
Parcel 1	Cylinder Number 2^3 - 2^0	Sector 2^3 - 2^0	0's

	2^{15} – 2^{12}	2^{11} – 2^{3}	2^{2} – 2^{0}
Parcel 2 (DD-40)	0000	Defect Pad Position 2^8 - 2^0	Defect Parity

	2^{15} – 2^{12}	2^{11} – 2^{2}	2^{1} – 2^{0}
Parcel 2 (DD-41)	0000	Defect Pad Position 2^9 - 2^0	Defect Parity

Figure 7-1. User Flaw Table Entry

Operating System Flaw Tables

The flaw management utility can create two different operating system flaw tables: a UNICOS/COS flaw table (system flaw table), and a Cray time sharing system (CTSS) flaw table.

The system flaw table resides on cylinder 0, head 0 beginning on sector 21 (spindle 1, sector 5). The system flaw table has 2 words of header and 1 word of trailer. The first word of header contains the ASCII code $EFT left justified and zero filled as shown in Figure 7-2. The second word of header contains the Cray drive serial number, which is supplied by the user at the time the flaw table is created. The 1 word of trailer consists of all 1's. There is no maximum table length defined by the formatter function for this table. Each entry in the flaw table defines one unhideable flaw (refer to Figure 7-2).

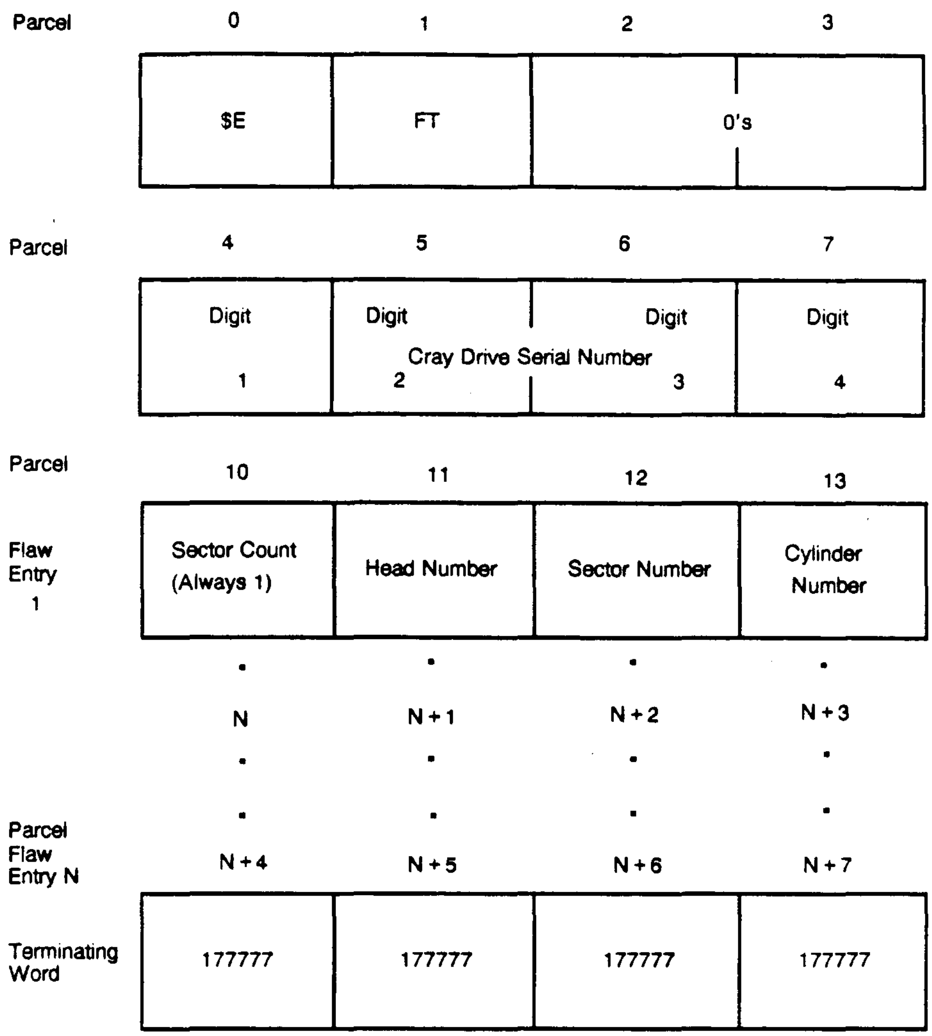


Figure 7-2. System Flaw Table

The CTSS flaw table shown in Figure 7-3 contains the device code specified by the user, the address of the start of the flaw, and the length, which is the number of consecutive defective sectors.

The CTSS flaw table starts at cylinder 0, head 0, sector 0. Each entry is 1 word long; there are no header or trailer words. When all flaws are entered in the table, the remaining words of all sectors (0 through 13) are zero filled. The first entry in the CTSS flaw table flaws out cylinder 0, head 0, and all sectors so that the CTSS operating system does not use this area for data. The device code is user defined at the time the flaw table is created. The disk addresses are counted sequentially with cylinder 0, head 0, sector 0 being address 0; cylinder 0, head 0, sector 1 as address 1; etc. If there are two or more sequential defective sectors, the first address is entered, and the field length is incremented to contain the correct length in sectors of the sequential defective sectors.

	2^{63} — 2^{56}	2^{55} — 2^{28}	2^{27} — 2^{0}
CTSS Flaw Entry 0	Device Number Code (8 bits)	Address (28 bits)	Length (28 bits)

Figure 7-3. CTSS Flaw Table

SURFACE ANALYSIS

The surface analysis utility, like the flaw management utility, is contained in MDMS. Surface analysis checks for disk surface flaws from the MCU or MWS. The surface analysis utility writes a data pattern to the disk and then reads it back looking for error-correction code (ECC) errors. When an error is found, the utility reads the data back to the MCU or MWS from the 2XF data buffer and compares the data with the original write data. From this comparison, the utility defines a Cray flaw consisting of the spindle, cylinder, head, sector, defect address, user-added defect, and defective sector fields.

After all write and read operations are complete, the flaws found during surface analysis are sorted, and duplicate flaws are combined. The flaws are logged to the spindle's history file and displayed on the console screen. The surface analysis utility then prompts you to add all flaws found two or more times to the user flaw table. If you do, the utility adds those flaws to the user flaw table. The sectors where flaw table entries were changed are then reformatted and verified.

Surface Analysis Menus

The surface analysis utility is menu driven. The following menus are used when doing surface analysis in MDMS.

Figure 7-4 shows the drive type selection menu. Enter a **1** for the DS-40 drive type. Enter a **2** for DS-41 drives, and so on. After a drive is selected, the menu in Figure 7-5 appears.

To select surface analysis, enter an **S**. The next display to appear is the data pattern selection menu, shown in Figure 7-6.

```
MDMS Micro-based Disk Maintenance System - Revision
MDMS1.1
                    COPYRIGHT CRAY RESEARCH, INC.

            UNPUBLISHED -- ALL RIGHTS RESERVED UNDER
            THE COPYRIGHT LAWS OF THE UNITED STATES.

                    Drive Type Selection
                    --------------------

                 1 - DD40
                 2 - DD41
                 3 - DD4R
                 4 - DD42
                 5 - RDS5
                 6 - RDS20
                 7 - DCUS1/DD40
                 8 - DCUS1/DD4R
                 9 - DCUS1/DD42
                 Q - Quit

                 Command>
```

Figure 7-4. MDMS Drive Type Selection Menu

```
                 MDMS Function Selection
                 -----------------------

                 D - Diagnostics
                 T - Trouble Shoot
                 S - Surface Analysis
                 F - Flaw Management
                 R - Redefine Disk Type
                 Q - Quit

                 Command>
```

Figure 7-5. MDMS Function Selection Menu

To select or deselect a data pattern, enter the pattern's number. Patterns displayed on the bottom of the screen are selected. Enter a **C** to continue.

```
Data Pattern Selection
-----------------------

C - Continue as is
A - All Patterns Selected
N - No Patterns Selected
1 - 000000
2 - 177777
3 - 125252
4 - 052525
5 - Random Pattern
6 - Sector Addressing Pattern
7 - Continuous Random Pattern
8 - Parcel Addressing Pattern
9 - User Defined Pattern
M - Main Menu

Command> C


Patterns Selected:  1 2 3 4 5 6 7
```

Figure 7-6. Data Pattern Selection Menu

The next menu, shown in Figure 7-7, enables you to select spindles for multiple-spindle drives. To select a spindle, enter its number. To deselect a spindle, enter its number again. The currently selected spindles are shown at the bottom of the display. Enter a **C** to continue.

The next menu, shown in Figure 7-7, enables you to select spindles for multiple-spindle drives. To select a spindle, enter its number. To deselect a spindle, enter its number again. The currently selected spindles are shown at the bottom of the display. Enter a **C** to continue.

```
Spindle Selection
-----------------

C - Continue as is
A - All Spindles Selected
N - No Spindles Selected
0 - Spindle 0
1 - Spindle 1
2 - Spindle 2
3 - Spindle 3
U - Select Other Unit
M - Main Menu


Command> C

Spindles Selected: 0 1 2 3

Unit Selected:  0 (primary)
```

Figure 7-7. Spindle Selection Menu

Figure 7-8 shows the next menu with options that enable you to select cylinders, heads, and sectors for performing surface analysis. By default, all heads and sectors of all data cylinders are selected. The values shown are the default values for the cylinder, head, and sector limits for the DS-40/41 and the RDS-5. Select **CY**, **H**, or **S** from the menu to perform surface analysis within specific limits. Selecting option **CE** automatically selects the CE cylinder. Enter a **C** to continue.

```
                 Select Limits
                 -------------

                 C  - Continue as is
                 D  - Default Limits
                 CY - Redefine Seek Test Cylinder Limits
                 H  - Redefine Head Limits
                 S  - Redefine Sector Limits
                 CE - Write/Read CE Cylinder
                 DC - Write/Read Data Cylinder
                 M  - Main Menu

                      Command> C

Current Settings:
Beginning Seek Cylinder:  0  Ending Seek Cylinder:    2611
Beginning Head:           0  Ending Head:               22
Beginning Sector:         0  Ending Sector:             13
Write/Read Cylinder:   2613
```

Figure 7-8. Select Limits Display

Enter the HDA serial number for the selected spindle in the next display, shown in Figure 7-9. Remove the cover of the disk drive to obtain the HDA serial number and read it off the HDA. This serial number selects the history file used to record flaws detected during surface analysis.

```
Enter the HDA Serial Number for Spindle 0:
(A RETURN by itself returns you to the Main Menu)
```

Figure 7-9. HDA Serial Number Display

Figure 7-10 shows the next menu, with options to enable the printer, and redefine the loop count. The printer is off by default; entering a **1** toggles it on and off. If possible, enable the printer to print any error information. Enter a **2** to redefine the test loop count. Valid loop counts are between 1 and 65,535. Enter a **C** to continue.

```
                 Other Settings
                 --------------


            C - Continue as is
            P - Toggle Printer On/Off
            L - Redefine Loop Count
            M - Main Menu

            Command>


            Current Settings:
                Printer:  OFF
                Loop Count:  1
```

Figure 7-10. Other Surface Analysis Settings

If any data cylinders are in the range of selected cylinders when surface analysis is performed, the warning shown in Figure 7-11 appears. Enter a **Y** to continue, or an **N** to return to the main menu.

```
                    WARNING
                    -------


            User data will be altered.

            Do you wish to continue (Y/N):
```

Figure 7-11. Data Cylinders Warning

If the user flaw cylinder is in the range of the selected cylinders when surface analysis is performed, the warning shown in Figure 7-12 appears. Enter a **Y** to proceed with surface analysis or an **N** to return to the main menu.

```
                         WARNING
                         -------


                  User data will be altered.

                  Do you wish to continue (Y/N):
```

Figure 7-12. Flaw Cylinder Warning

FLAW MANAGEMENT

The flaw management utility available in MDMS maintains user flaw tables, operating system flaw tables, and sector ID fields. The flaw management utility provides the following functions:

- Format IDs
- Verify IDs
- Backup user flaw table
- Restore user flaw table
- Add flaws to user flaw table
- Delete flaws from user flaw table
- List flaw table
- Convert factory track headers
- Generate system flaw table
- Generate CTSS OS flaw table

All of the previous functions are menu driven and similar in format to the menus presented in the surface analysis section. This subsection describes each of the flaw management functions.

Format IDs

This function reads the user flaw table and writes sector IDs to every selected sector of all selected spindles. Sectors with an unhideable flaw in the user flaw table are formatted as defective sectors. Sectors with a hideable flaw in the user flaw table are formatted with the defect pad in the flaw table. Sectors with no entry in the user flaw table are formatted with no flaws. Perform the format IDs function whenever the user flaw table is altered. (It is only necessary to format the sectors with changed user flaw table entries.) Use the **ESC** key to stop the formatter when it is running. If there is an error in the user flaw table as it is being read, the error is reported and the program stops.

Verify IDs

Initially, this function reads the user flaw table. It then reads and compares all sector IDs (all selected sectors of all selected spindles) to the user flaw table data. Any miscompared data is displayed on the screen and sent to the printer if it is enabled. Use the **ESC** key to terminate the verify ID routine. If there is an error in the user flaw table as the flaw table is being read, an error message is displayed on the MWS or MCU screen and the program stops.

Back Up User Flaw Table

This function reads the user flaw table and writes it to a file on the MWS or MCU hard disk. If the user flaw table is destroyed, it can be restored from the backup copy by using the restore function. Keep a current version of the backed-up user flaw tables on the MCU or MWS hard disk and on the backup media (floppy disks or cartridge tapes). More information on the backed-up user flaw table files can be found in the "Files Maintained by MDMS" subsection in this section. A detailed example of backing up user flaw tables can be found in the "Backing Up DD-40/41 User Flaw Tables" subsection of this section.

Restore User Flaw Table

This function reads a backed-up user flaw table file from the MCU or MWS hard disk and writes it to the user flaw cylinder. The backed-up user flaw table file is used whenever the user flaw table is overwritten. This function formats the IDs on the user flaw and CE cylinders prior to writing the flaw table to the user flaw cylinder. This permits the flaw table to be restored in the event that the IDs become corrupted on the user flaw cylinder. A copy of the user flaw table is written to every head of the user flaw cylinder. The new user flaw table is only as current as the backed-up flaw file. Run the verify IDs function after restoring a flaw table. More information on the backed-up user flaw table files may be found in the "Files Maintained by MDMS" subsection in this section. A detailed example of backing up user flaw tables can be found in the "Backing Up DD-40/41 User Flaw Tables" subsection of this section.

Add Flaws to User Flaw Table

This function enables you to add flaws to the user flaw table. You are prompted for flaws to add to the flaw table. These flaws are then merged into the flaws read from the drive. If a flaw already exists on the same sector as the flaw being added, the sector is made defective. The sectors whose flaw table entries were changed are then reformatted and verified. When a sector is reformatted after adding a flaw from the user flaw table, the data field is written in order to correct the ECC field. This permits you to run the UNICOS surf utility after the format IDs function without reporting flaws just added by MDMS. The updated flaw table is then restored to the flaw cylinder. An account of the flaws that were added are appended to the spindle's history file. For this reason, you are prompted for the HDA serial number. More information on the history file may be found in the "Files Maintained by MDMS" subsection in this section. If there is an error in the user flaw table as it is being read, the error is reported and the program stops.

Delete Flaws From User Flaw Table

This function enables you to delete flaws from the user flaw table. You are prompted for the sectors that should have flaws deleted from the user flaw table. The user flaw table is then read into a temporary file in the MCU or MWS, and all flaws on the sectors supplied by the user are deleted. If the flaw table contains more than one flaw for a sector (an error condition), all flaws on that sector are deleted. When all the user-supplied flaws are deleted, the sectors with changed flaw table entries are reformatted and verified. When a sector is reformatted after deleting a flaw from the user flaw table, the data field is written in order to correct the ECC field. This permits you to run the UNICOS surf utility after the format IDs function without reporting the flaws just deleted by MDMS. The updated flaw table is then restored to the flaw cylinder. An account of the flaws that were deleted is added to the end of the spindle's history file. As a result, you are prompted for the HDA serial number. More information on the history file may be found in the "Files Maintained by MDMS" subsection in this section. The function to delete flaws can be used on flaw tables containing entries in error. Entries in error must be deleted before many of the other MDMS functions work. List the flaw table to determine whether any existing entries are in error.

List Flaw Table

This function enables you to list actual user flaw tables, backed-up user flaw tables, system flaw tables, and CTSS operating system flaw tables. In addition to listing the flaw tables, this function also checks for any possible error in the flaw table. These errors are reported as they occur. Backed-up flaw tables can be listed on the screen and sent to the printer without being connected to the 2XF tester module.

Convert Factory Track Headers

This function enables you to generate a user flaw table from either the actual factory track headers on a new HDA or from a backed-up factory track header file on the MCU or MWS hard disk. If you are converting from track headers on an HDA, the track headers are first read and placed into a backed-up factory track header file on the MCU or MWS hard disk. The rest of the conversion process is the same for either method: first, the factory track headers are converted into a backed-up user flaw table file that is written to the MCU or MWS hard disk; next, the user flaw cylinder and the CE cylinder are formatted the same as the backed-up user flaw table file; and finally, the backed-up user flaw table is restored. More information on the backed-up user flaw table file, and the backed-up factory track header file can be found in the "Files Maintained by MDMS" subsection in this section.

Generate System Flaw Table

Initially, this function reads the defective sector flaws from the user flaw table. It then creates the system flaw table and writes the flaw table to the disk beginning at cylinder 0, head 0, sector 21, octal/17 decimal for DS-40/41 systems. (For RDS-5 systems the system flaw table begins at cylinder 0, head 0, sector 5.) If there is an error in the user flaw table as it is being read, the error is reported and the program stops.

Generate CTSS OS Flaw Table

Initially, this function reads the defective sector flaws from the user flaw table. It then creates the CTSS operating system flaw table and writes the flaw table to the disk beginning at cylinder 0, head 0, sector 0. If there is an error in the user flaw table as it is being read, the error is reported and the program stops.

Backing Up DD-40/41 User Flaw Tables

It is strongly suggested that the user flaw tables be backed up at regular intervals and/or any time significant changes were made to these tables. It is further recommended that a copy of each table be written to a removable storage medium (floppy disk or tape) for additional protection.

Follow these steps to back up the user flaw table on the MCU:

Step	Description
1	Connect the MCU cables to the appropriate connectors on the back of the DCC-2 controller cabinet (labeled "MCU to 2XF").
2	Run a cable pair from the testing interface connectors on the DCC-2 (labeled "2IE to Drive") to the appropriate input port (A or B). Ensure the port used is enabled on the front of the DCC-2.
3	Boot MDMS on the MCU and select the appropriate parameters for the drive type to be accessed.
4	From the MDMS Function Selection menu select Flaw Management, then select Back Up User Flaw Table. The utility will prompt you for the HDA serial number of the spindle(s) selected. Be sure to enter the correct HDA serial number, not the drive serial number. When the program executes, the current user flaw table is read from each selected spindle and is stored on the MCU's hard drive under the filename "F*xxxx*.FLW" (where the *x*'s are the HDA serial number).
5	Repeat Steps 1 through 4 for each DD-40/41 on site.
6	After all the spindle's flaw tables have been transferred to the MCU's hard drive, copy them to a floppy disk using the PIP command. The following example should copy all flaw table files with one command: `PIP M:=C *.FLW ↵`
7	The floppy disk should be labeled and stored in a safe place until the next backup procedure is performed.

Follow these steps to back up the user flaw table on the MWS:

Step	Description
1	Connect the MWS cables to the appropriate connectors on the back of the DCC-2 controller cabinet (labeled "MCU to 2XF"). Use only the INPUT and OUTPUT connectors on the VME, not the CONTROL connector.
2	Run a cable pair from the testing interface connectors on the DCC-2 (labeled "2IE to Drive") to the appropriate input port (A or B). Ensure the port used is enabled on the front of the DCC-2.
3	Boot MDMS on the VME and select the appropriate parameters for the drive type to be accessed.
4	From the MDMS Function Selection menu select Flaw Management, then select Back Up User Flaw Table. The utility will prompt you for the HDA serial number of the spindle(s) selected. Be sure to enter the correct HDA serial number, not the drive serial number. When the program executes, the current user flaw table is read from each selected spindle and is stored on the VME's hard drive under the filename "f*xxxx*.flw" (where the *x*'s are the HDA serial number).
5	Repeat steps 1 through 4 for each DD-40/41 on site.
6	After all the spindle's flaw tables have been transferred to the VME's hard drive, change directories to /u/mws/mdms/flw and execute the command: `ls | cpio -ocBv > /dev/r40a ↵`
7	The streaming tape should be labeled and stored in a safe place until the next backup procedure is performed.

ERROR INFORMATION

When an error occurs, MDMS attempts to read all statuses from the controller and disk drive. MDMS then displays them in the format shown in Figure 7-13.

The status types displayed in the MDMS error report are the same as those in the operating system extract report, which is generated each time a disk error occurs. Controller status in the MDMS error report is the same as the contents of status register 0. Buffer status is the DC-40 controller status referred to in PRN-0799, the *DC-40 Disk Controller/DD-40 Disk Drive Engineering Note*. Only the upper byte of the fault and operating status and the field-replaceable unit code are displayed. For functions that do not access the drive, the various drive-related statuses are not displayed. A description of all statuses in error appears at the bottom of the MDMS error report. These descriptions are read from an error message file on the MCU or MWS hard disk.

```
Error during write.

Spindle:  1          Cylinder:  2613     Head:  22          Sector:  2
2XF Tester Status:  640                  Controller Status: 11611
General Status:  41422                   Buffer Status:  41422
Fault Statuses:
   Spindle 0:  200    Spindle 1:  200    Spindle 2:  200    Spindle 3: 200
Operating Statuses:
   Spindle 0:  200    Spindle 1:  200    Spindle 2:  200    Spindle 3: 200
Field Replaceable Unit Codes:
   Spindle 0:  200    Spindle 1:  200    Spindle 2:  200    Spindle 3: 200

2XF Tester Status Bit 2^8 = 2IE Error
Controller Status Bit 2^3 = Drive Error
General Status    Bit 2^14 = Sync Time Out (sector status of last error)
```

Figure 7-13. MDMS Error Report

FILES MAINTAINED BY MDMS

The MDMS maintains three types of files on the MCU or MWS hard disk: a backed-up user flaw table file, a backed-up factory track header file, and a history file. A fourth hard disk file is a temporary file that stores flaw table information during operation of an MDMS function. The temporary files are erased upon successful completion of the function.

The first three file types are named using the following convention:

dsss.ttt, where:
- **d** is the drive type
- **s** is the user-supplied HDA serial number
- **t** is the file type

Drive type letters are as follows:

f - DD-40	**m** - DD-4R
j - DD-41	**n** - DD-42
k - RDS-5 (serial disk)	

File type extensions are as follows:
- **.flw** - backed-up user flaw table
- **.trk** - backed-up factory track headers
- **.his** - history file

All files created by the MWS version of MDMS are located in the **/u/mws/mdms** directory structure instead of the current directory. There are four subdirectories under **/u/mws/mdms**, which are used as follows:

> **/u/mws/mdms/flw** - backed-up flaw table files
> **/u/mws/mdms/trk** - backed-up track header files
> **/u/mws/mdms/his** - spindle history files
> **/u/mws/mdms/tmp** - temporary files used while MDMS is running

The file type naming convention is as follows:

> The **f123.flw** file name is a backup user flaw table file for a DS-40 spindle with a 123 HDA serial number.

Backup User Flaw Table Files

These files are created by the backup user flaw table or the convert factory track header functions of the formatter utility. The files are in a binary format and cannot be listed using the operating system. However, the files can be viewed from the list flaw table function in the flaw management utility.

Backup Factory Track Header Files

These files are created when converting factory track headers from a new head/disk assembly (HDA). They can later be used to convert factory track headers from a backup track header file if the need arises. These files are in ASCII format and can be listed using the operating system. Each line in the file should match an entry in a hard copy of the factory track headers.

History Files

These files track the following flaws:

- Flaws added by the add function of the flaw management utility
- Flaws deleted by the delete function of the flaw management utility
- Flaws found during surface analysis

Figure 7-14 shows a sample of the history file format for a DD-40 disk storage device with HDA serial number 000.

```
Flaws Found During Surface Analysis on Fri Sep 30 13:05:36 1990

CYLINDER    HEAD    SECTOR    DEFECT    PARITY    CA    DS    COUNT

   62         1       13        777        7       1     1      4
   23         3        2        175        3       1     0      1
   11         6       11        216        5       1     0      2
   42        10        0        777        7       1     1      1


Flaws Added on Fri Sep 30 13:05:38 1988

CYLINDER    HEAD    SECTOR    DEFECT    PARITY    CA    DS

   62         1       13        777        7       1     1
   11         6       11        216        5       1     0


Flaws Deleted on Fri Sep 30 13:14:30 1988

CYLINDER    HEAD    SECTOR    DEFECT    PARITY    CA    DS

  641        16        3        125        6       0     0
```

Figure 7-14. Sample DD-40 History File

1 - LOADING AND RUNNING DD40 DIAGNOSTICS

This section describes the steps necessary to load DD40, DD41 (previously DDXMD), and RDS5 diagnostic software in the I/O processor (IOP). It also explains how to run a diagnostic routine and how to save an updated diagnostic test. The diagnostic package includes three different versions: DD40, DD41, and RDS5, with the parameters pre-configured for each type of drive. All three versions as a whole will be referred to as DD40 diagnostics.

DD40 is a disk drive diagnostic and maintenance package designed to test DS-40/41 disk subsystems and disk systems using the DCU-S1 disk controller (such as the RDS-5). All three versions run in the IOP, use the following diagnostics, and have the following capabilities:

- DC-40/41 disk controller hardware diagnostics
- DCU-S1 disk controller hardware diagnostics
- DD-40/41 disk storage device hardware diagnostics
- Flaw table generation from factory headers
- DD-40/41 disk formatting
- User-added flaw generation using surface analysis
- Flaw table backed up and restored to the peripheral expander
- Interaction with the Cray Maintenance Operating System (CMOS monitor)
- Disk system exerciser for reliability runs

These tests do not support scope looping or a utility for creating loops. The DSKU utility allows you to create custom command loops and run single controller troubleshooting commands.

DS-40/41 HARDWARE INTERFACE

The IOP connects to a DD-40/41 disk drive through the disk controller unit (DCU-5) and the DC-40/41 disk controller. The IOP and the DCU-5 are referred to collectively as the I/O Subsystem (IOS) in this manual. The DCU-5 is located in the IOP cabinet. The DC-40/41 is in a cabinet next to the disk drive cabinets. When the IOP issues a write request to the drive, the DC-40/41 receives the request from the DCU-5 through the channel. The DC-40/41 buffers the data, and sends it to the disk drive. On a read request, the DC-40/41 controller reads the requested data from the DD-40/41 disk drive, buffers it, and sends it to the DCU-5.

HARDWARE REQUIREMENTS FOR RUNNING DD40 DIAGNOSTICS

The following are the minimum requirements for running DD40 diagnostics on the DS-40/41 disk subsystems or the RDS-5 disk storage system:

- IOP 0 and a fully operational IOP linked to a DC-40/41 disk controller through a DCU-5
- One CRT per IOP on the expander chassis
- Maintenance workstation (MWS)
- One display channel per IOP connected to the eight-port serial board on the MWS
- Peripheral expander chassis with an 80-Mbyte drive and tape drive
- Printer for hard copy of flaw table listings, etc.
- DC-40/41 disk controller unit (device under test)
- DD-40/41 disk storage device (device under test)
- A 2AH revision D real-time clock module. If a model A or B IOS is used, and the chaining test is to be run, the 2AH module must be at least revision D. This is necessary to allow accurate timing of chaining using the real-time clock. When activated, the chaining test checks the real-time clock and counter register.
- DCU-5 controller. DD40 diagnostics do not test the DCU-5 controller in the IOS chassis. The DCU-5 must be in working order. Use DCU-5 diagnostics to evaluate the controller.
- Buffer memory. Buffer memory is required for flaw-table backup procedures as well as deadstarting DD40 diagnostics using CMOS. The DD40 diagnostic package typically is activated in a processor other than A0 if the backup procedures are being used. Data is transferred through buffer memory to IOP A0 for disk storage of flaw tables, and from A0 to the disk processor for deadstarting. The minimum available buffer memory capacity is sufficient to perform both operations.

NOTATIONAL CONVENTIONS

- The prompt symbol > indicates that the DD40 diagnostic is idle and waiting for a user entry.
- The prompt symbol # indicates that the DD40 diagnostic is suspended from running a test and waiting for user input. Only display commands are allowed. To resume execution of the suspended test, enter the **DS** command.
- ↵ indicates the carriage return key

- < > indicates a required entry
- *Italic* font indicates a variable or user-supplied command
- Screen references appear in terminal-style text, `ds`; commands and key labels appear in bold, **DS**

HOW TO LOAD AND RUN DD40 DIAGNOSTICS UNDER CMOS AND IMS

Perform the following steps to load and run the DD40 diagnostics under CMOS:

1. Ensure the file DD40, DD41, DD4R, DD42, RDS5, or RDS20 is on the FNT3 partition of the expander disk drive.

2. Boot CMOS into the A0 processor using the diagnostic support system (DSS) operating system. Enter the following command at the A0 processor keyboard to boot CMOS:

   `BOOT CMOS` ↵

   Refer to the *CRAY-1 Computer Systems Models A, S, and M IOS-based Diagnostic Reference Manual,* publication number CDM-0003-000, or *CRAY X-MP Computer Systems IOS-based Diagnostic Reference Manual,* publication number CDM-0108-000, for details about the boot command and the DSS operating system.

3. Enter the following command at the A0 processor keyboard to select test multiple mode:

   `TM` ↵

4. Enter the following command at the A0 processor keyboard to select the number of the local processor (*x*) connected to the disk drive being tested:

   `PN X` ↵

5. Enter the following command at the A0 processor keyboard to send DD40, DD41, or RDS5 from the expander disk to buffer memory:

   `:BL DD40, DD41, DD4R, DD42, RDS5, or RDS20` ↵

6. Enter the following command at the A0 processor keyboard to transfer the DD40 diagnostic to the local processor's memory and deadstart the processor:

   `:DS` ↵

7. Press the **U** key on the keyboard of the selected processor.

   The DD40 diagnostic should now be active in the IOP you selected.

The screen shows the selected test section number and the subtest number. The screen also shows the selected channels and the channel and cylinder being tested. Below this is the data display area. Using display commands, you can view test results and other information stored in IOP local memory. The prompt at the bottom of the screen is used to enter commands. It also indicates that the DD40 diagnostic is idle and waiting for further instructions from the user.

Perform the following actions to load and run DD40 diagnostics at the processor being tested. Edit memory location parameters using the **S** command. Memory locations 220 and 221 identify the test sections being run (refer to Part 2, Section 3, "User Parameters").

Type **DS** ↵

- If an error occurs while the test is running, the message `ERROR` appears next to the prompt.
- Press the **ESC** key any time you want to interrupt a test section. There may be a short delay during the time it takes a test section operation to complete.
- At the end of each system pass, the screen is refreshed with a display of memory locations 200 to 277, indicating the user-selected parameters.

You can gain access to an FNT help file using DD40 by typing **.DD40**, **.DD41**, **.DD4R**, **.DD42**, **.RDS5**, or **.RDS20** from the command line of the CMOS display. You can also access many other help files using the **.FILENAME** command.

Perform the following steps to load the DD40 diagnostic package under the Cray IOS maintenance system (IMS):

1. Enter the following commands at the maintenance workstation (MWS):

   a. `IMS CHNXE` ↵

      This command brings up IMS echo mode. Enter the number (*x*) of the desired low-speed channel in the MWS.

   b. `PN` *x* ↵

      This command selects the number of the local processor (*x*) that runs the DD40 diagnostic package.

   c. `/DD40, /DD41, /DD4R, /DD42, /RDS5, or /RDS20` ↵

      This command sends the DD40 diagnostic package from the MWS hard disk to buffer memory.

   d. `DS` ↵

      This command transfers the DD40 diagnostic package to the local processor's memory and deadstarts the processor.

2. Enter the following command at the MWS to execute the BECHO program:

   `BECHO ↵`

3. Select a display channel for the processor that runs the DD40 diagnostic package and press **U** at the keyboard.

Note: In order to run DD40 diagnostics and back up or restore flaw tables to and from the MWS, the DD40 diagnostic must be in the imse/sys directory, and loaded using instructions similar to instructions for loading DD40 under CMOS. For example, to save a reconfigured version of DD40, follow the procedure in the DD40 diagnostic preamble and then use the :BS <*filename*> command, where *filename* is the name of the file you wish to save.

HOW TO LOAD AND RUN DD40 DIAGNOSTICS UNDER DSS

Perform the following steps to activate the DD40 diagnostics under the diagnostic support system (DSS) operating system:

1. Ensure the file DD40, DD41, DD4R, DD42, RDS5, or RDS20 is on the FNT2 partition of the expander disk drive.

2. Using the DSS operating system, type the following command at the A0 processor keyboard:

   `BOOT DD40, DD41, DD4R, DD42, RDS5, or RDS20 ↵`

   Refer to *CRAY-1 Computer Systems Models A, S, and M IOS-based Diagnostic Reference Manual*, publication number CDM-0003-000, or *CRAY X-MP Computer Systems IOS-based Diagnostic Reference Manual*, publication number CDM-0108-000, for details about the boot commands and the DSS operating system.

3. Press the **U** key on the A0 processor keyboard. A prompt requests the number of the processor you intend to use to run diagnostics.

4. Enter the number of the processor.

5. If the selected processor is not A0, press the **U** key on the keyboard of the selected processor. The DD40 diagnostic is now active in the IOP you selected.

6. Enter the following command to clear operand registers and error information in local memory:

   `MC ↵`

EXIT PROCEDURE

There is no built-in provision to exit from the DD40 diagnostic; however, the **EX** command prepares the spindles for power down. For more information, refer to the **EX** command description in Part 2, Section 2, "DD40 Commands."

SAVING AND RUNNING A RECONFIGURED DD40 DIAGNOSTIC PACKAGE

As long as the prompt is present, buffer memory always contains an updated copy of the DD40 diagnostic package. To save a copy of the DD40 diagnostic to the expander's 80-Mbyte disk drive, first store a 0 in local memory location 10. Boot CMOS in the A0 processor, then enter the **:BS** <*filename*> command to save a copy of the DD40 diagnostic on the expander disk drive. Finally, restore the processor number to location 10. The procedure to run a reconfigured copy of the DD40 diagnostic is the same as the procedure to run an old copy.

LOAD AND GO PROGRAM

The load and go program enables the user to create a version of the DD40 diagnostic that runs immediately after deadstart without any user intervention. Before saving a load and go program, test sections can be selected. After deadstart, the selected test sections automatically run.

To prepare a load and go program, set the load and go flag in local memory location 27 to a 1, and save the DD40 diagnostic as previously described. The next time the saved program is deadstarted, it begins running without any queries of the user. If you want to run a load and go program in a processor other than A0, it must be deadstarted through CMOS.

CMOS MONITOR

Whenever the > prompt is present at the bottom of the screen, buffer memory has been updated with an image of local memory. Diagnostic tests may be monitored using CMOS display commands in processor A0.

Also, whenever the > prompt is present, buffer memory has been updated with an image of the operand registers. The operand register image area starts with the first location in buffer memory after the local memory image area.

HOW TO LOAD AND RUN DD40 DIAGNOSTICS FROM MWS

DD40 diagnostics can be run from either the maintenance workstation (MWS) or from the IOP. Use the /usr/ul/mws directory to load DD40 diagnostics on the MWS. Enter the following command:

```
boot dd40, dd41, dd4R, dd42, rds5, or rds20 chn0 ↵
```

When the UNIX system prompt appears, enter the following command:

```
becho ↵
```

This command starts the becho program and it enables the user to select or deselect the IOP display channel for the MWS. The IOP display channel is connected to a serial interface board in the MWS.

Note: In order to run DD40 diagnostics and back up or restore flaw tables to and from the MWS, it is necessary to run DD40 under CMOS available on the MWS. The DD40 diagnostics must be in the cmos/user or cmos/sys directory, and must be properly loaded according to the previous instructions on running DD40 diagnostics under CMOS. Refer also to the flaw management procedures involving CMOS.

2 - DD40 COMMANDS

DD40 diagnostic commands perform various testing functions; for example, the **DS** command starts the diagnostic test sequence. Other commands allow you to display test results, manage flaw tables, store values in local memory, and so on. Command buffers are not available with DD40 diagnostic software; the user is expected to enter commands interactively.

DD40 CONTROL COMMANDS

The **DS, MC, RG, DE, H,** and **EX** commands control operation of the DD40 diagnostic. This subsection describes each of the commands.

DE (Display the Error Table)

The **DE** command enables you to view the error table. Certain test sections log recoverable errors in this table. After the test ends, all accumulated errors are displayed with this command. Pressing any key displays the next page. Pressing the **ESC** key ends the display.

Syntax: `DE` ↵

DS (Diagnostic Start)

The **DS** command causes the selected diagnostics to begin running. To select diagnostic test sections, refer to memory locations 220 and 221 in Part 2, Section 3, "User Parameters."

Syntax: `DS` ↵

H (Help)

The **H** command causes a help menu to be displayed so that the available DD40 commands can be viewed.

Syntax: `H` ↵

EX (Exit)

The **EX** command enables the user to prepare for spindle powerdown or idle. The spindles are reset, the heads are positioned to the scratch cylinder, and the controller is reset to 0.

Syntax: `EX` ↵

MC (Master Clear)

The **MC** command initializes the DD40 software. Memory locations, such as those containing error information, and certain operand registers are initialized. Use the **MC** command before issuing a **DS** command or initiating a test section.

Syntax: `MC` ↵

RG (Display the Contents of Operand Registers)

The **RG** command enables the user to display the contents of IOP operand registers. The following registers may be viewed, but their contents will be incorrect due to their use in the display routines B, CE, CF, CO, CP, CQ, DA, DC, DD, DS, KA, KE, TH, TX, and TY.

Syntax: `RG` *rrr*, ↵ where
rrr = starting register number

RESET DEVICE UNDER TEST COMMANDS

The **RC** and **RD** commands reset the device under test, such as a disk drive controller or the disk drive.

RC (Reset All Selected Disk Controllers)

The **RC** command resets the selected controllers. The parity registers are cleared, and faults are cleared when the command is issued.

Syntax: `RC` ↵

RD (Reset All Selected Disk Drives)

The **RD** command resets the selected spindles. The heads are returned to 0 and the status registers are cleared when the command is issued.

Syntax: `RD` ↵

DISPLAY LOCAL MEMORY COMMANDS

The **D**, **DC**, **DF**, **DL**, **DR**, and **S** commands display the contents of local memory of the IOP. The commands are described in the following subsections.

D (Display Memory: Left and Right)

The **D** command enables the user to view IOP local memory. Both sides of the screen are updated.

Syntax: `D` ↵ *aaaaaa*, where *aaaaaa* = memory address

DC (Display Flaw Table Counts)

The **DC** command displays a counts table. The table lists the number of defective sectors, hideable defects, factory defects, user-added defects, and total number of defects for each spindle. The user flaw tables in local memory are analyzed by this command, so they must be loaded with the **LF** command before executing this command. After surface analysis, this command can be used to tabulate the number of new flaws.

Syntax: `DC` ↵

DF (Display Forward)

The **DF** command enables the user to repeatedly scroll the memory display forward by 40 lines. Press the **LINEFEED** key to abort the command.

Syntax: `DF` ↵

DL (Display Memory: Left)

The **DL** command enables the user to view IOP local memory.

Syntax: `DL` *aaaaaa* ↵, where
aaaaaa = memory address

DR (Display Memory: Right)

The **DR** command enables the user to view IOP local memory.

Syntax: `DR` *aaaaaa* ↵, where
aaaaaa = memory address

S, S+ [Store Value(s) to Memory]

The **S** command enables the user to store a single parcel of data at an IOP local memory address. If the plus (**+**) sign is used, the command causes data to be placed in consecutive memory locations. Abort the **S+** command using the **LINEFEED** key; to skip a memory location press the ↵ key without entering data. The **S+** command is similar to the **S+** command found in CMOS.

Syntax: `S`, `S+` *aaaaaa ddddd* ↵, or `S+`*aaaaaa ddddddd* ↵, where
aaaaaa = address
dddddd = data

FLAW TABLE COMMANDS

The **AF**, **CF**, **CFA**, **LF**, **RF**, **RT**, and **ST** commands control use of the flaw table.

AF (Add a Flaw Table to the Active Flaw Table)

The **AF** command places a flaw entry in the active flaw table in IOP local memory. There is no writing to the disk flaw tables and no formatting takes place. The flaw entry is placed into the appropriate area of local memory to maintain the sort order of the flaw tables.

Note: Run the clear an active flaw table (**CF**) command before issuing the **AF** command.

Syntax: `AF` *cc u s yyyy hh ee fff n i* ↵, where
cc = channel number of the cabinet
u = unit
s = spindle number (0 - 3)
yyyy = cylinder
hh = head number
ee = sector number
fff = defect position
n = User-added (= 1)
i = unhideable defect (= 1)

The following example illustrates the procedure used to add a flaw to an existing flaw table:

1. Enter `CF 21 0 3` ↵, where
   `CF` = clear an active flaw table
   `21` = channel number of the cabinet (entries of 20 through 37 are possible)
   `0` = unit number (entries of 0 or 1 are possible)
   `3` = spindle number (entries of 0 through 3 are possible)

   This command removes a spindle's complete flaw table from the active flaw table area in IOP local memory.

2. Enter `AF 21 0 3 2613 07 03 0777 1 1` ↵, where
   `AF` = add a flaw to the active flaw table
   `21` = channel number of the cabinet
   `0` = unit number
   `3` = spindle number
   `2613` = cylinder number

   Note: Enter 3142 for the RDS-5 disk drive cylinder number.

   `07` = head number (entries of 0 through 22 are possible)

   Note: Head number entries of 0 through 16 are used for RDS-5 disk drives.

03 = sector number (entries of 0 through 13 are possible)
0777 = defect position (from the operating system disk error report)
1 = Cray added flaw
0 = unhideable flaw

This command places a flaw entry in the active flaw table in IOP local memory. Write operations to the disk flaw table and formatting do not occur.

3. Perform the following steps to run the DD40 disk formatting test section 21. (Refer to the test section 21 description in Section 5 of this manual for information on how to run the test.)

   a. Select spindle 3 (the spindle that was selected in step 2).
   b. Select format mode 2 by setting the FMTMDE parameter to 2.
   c. Run test section 21.

4. Enter `LF 21 0 3` ↵, where
   LF = load an active flaw table command
   21 = channel number of the cabinet
   0 = unit number
   3 = spindle number

   This command reads a complete flaw table from a selected spindle and writes it to the active flaw table area in IOP local memory. Write operations to the disk flaw tables and formatting do not occur.

5. Enter `VF 21 0 3` ↵

   This command displays the selected spindle's complete flaw table from the active flaw table area in IOP local memory and allows the added flaw(s) to be viewed and verified.

ST (Save a Flaw Table from Local Memory to the Expander Disk)

The **ST** command reads the user flaw table for the selected spindle from the active flaw table area in local memory. The command enables the user to convert the table to an ASCII format and store the flaw table in the IOP's image area in buffer memory. From buffer memory, using CMOS in processor A0, the flaw table may be transferred to the expander disk drive. This command is not used to access the disk drive, so if the user wants to save a flaw table from a spindle, the table must first be loaded to local memory using the **LF** command. Any IOP can issue this command, provided it is connected to an XMD disk storage device. An IOP equipped with the minimum available buffer memory size is required.

The serial number of the spindle whose flaw table is being saved is requested at the console. The serial number may be up to 4 digits long. The serial number becomes part of the header in the ASCII file written to buffer memory.

Syntax: `ST` *cc u s* ↵, where
cc = channel number
u = unit number
s = spindle number

Use the following procedure to save a flaw table from the spindles to the expander disk drive or tape drive:

1. Activate CMOS in processor A0 by entering the following DSS command:

   `BOOT CMOS` ↵

2. Select test multiple (TM) mode with the following command:

   `:TM` ↵

3. Select the processor that stored the flaw table in buffer memory. To find the processor number, look at the DD40 diagnostic memory location PROCNR (location 10). Use the following command under CMOS to select the processor:

   `PN` *X* ↵, where
   X = processor number

4. Enter the following command:

   `:BL DD40,DD41, or RDS5` ↵

5. Ensure the flaw table being saved is in the local memory of the IOP you are using. To load the flaw tables from the drive to local memory, enter the following command at the selected processor's keyboard:

   `LF` *cc u s* ↵, where
   cc = cabinet channel number
   u = unit number
   s = spindle number

6. Enter the **ST** command to transfer the flaw table to the IOP's image area in buffer memory.

CAUTION
Following Step 6, do not use the keyboard again until Step 7 is complete, or the CMOS monitor will be re-enabled, and the flaw table in buffer memory will be lost.

7. Enter the following CMOS command using the A0 processor keyboard:

   `:BS` *<filename>* ↵

Use the associated spindle's serial number as part of the filename when saving it. For example, enter:

`fl`*xxxx* ↵, where
xxxx = spindle serial number

This command transfers the flaw table from buffer memory to expander disk.

8. Repeat Steps 3, 5, 6, and 7 to save additional flaw tables to the expander disk drive using IOPs A1 through A3. If using IOP A0 to save additional flaw tables, repeat Steps 1 through 7.

9. Enter the **:BO** command in processor A0 to exit CMOS and enter DSS for the next step.

10. Mount the tape and enter the following DSS command for each flaw table to be transferred from the expander disk drive to the expander tape drive:

    `write fl`*xxxx* `fl`*xxxx* `3` ↵, where
    xxxx = spindle serial number

RT (Restore a Flaw Table from the Expander Disk to Local Memory)

The **RT** command reads a flaw table from the image area in buffer memory and converts it to compressed format. The **RT** command stores the data in the selected spindle's active flaw table area in local memory. Before this command is issued, the flaw table to be restored should have been written to buffer memory using the CMOS command **BW**. There is no reference to the XMD spindles, so if the table is to be written to the flaw table cylinder, use the formatter. Any of the four IOPs can perform the formatting function. An IOP equipped with the minimum available buffer memory size is required. If IOP A0 is connected to the XMD disk storage device being written to, switch between the CMOS and DD40/DD41 operating environments to transfer each table.

Syntax: `RT` *cc u s* ↵, where
cc = channel number
u = unit number
s = spindle number

Use the following procedure to restore a flaw table from expander tape or disk to the spindles:

1. Transfer each flaw table from tape to expander disk by issuing the following DSS command in IOP A0:

   `read fl`*xxxx* `fl`*xxxx* `3` ↵, where
   xxxx = spindle serial number

2. Enter the following command in IOP A0 to activate CMOS:

   `BOOT CMOS` ↵

3. Select the test multiple (TM) mode by entering the following CMOS command:

   :TM ↵

4. Select the number of the IOP to run the **RT** command with the following command:

   PN *X* ↵, where
   X = the processor number

5. Initialize DD40 in the destination IOP.

6. Enter the following CMOS command in IOP A0:

   :BW fl*xxxx* ↵, where
   xxxx = spindle serial number

   The command transfers the flaw table file from the expander disk drive to the image area of the selected IOP in buffer memory.

7. Enter the **RT** command at the keyboard of the selected IOP to send the table to disk. This command transfers the flaw table from the image area in buffer memory to the active flaw table area in the selected IOP's local memory.

8. Run format mode 0 on the scratch cylinder in the selected IOP. This causes the flaw tables to be written to the XMD spindles (refer to disk formatting in Part 2, Section 5, "Flaw Management," for details about format mode 0.

VF (View an Active Flaw Table)

The **VF** command displays any spindle's complete flaw table from the active flaw table area in IOP local memory. Press any key to display the next page. Press the **LINEFEED** key to terminate the display.

Syntax: VF *cc u s* ↵, where
cc = channel number of the cabinet
u = unit number
s = spindle number

LF (Load an Active Flaw Table from an XMD Spindle)

The **LF** command reads a complete flaw table from any spindle and writes it to the active flaw table area in IOP local memory. There are no writes to the disk flaw tables; formatting does not take place. The table is sent to the correct area of local memory, maintaining the sort order of the flaw tables.

Syntax: LF *cc u s* ↵, where
cc = channel number of the cabinet
u = unit number
s = spindle number

CF (Clear an Active Flaw Table)

The **CF** command removes a spindle's complete flaw table from the active flaw table area in IOP local memory. There are no writes to the disk flaw tables; formatting does not take place.

Syntax: `CF` *cc u s* ↵, where
cc = channel number of the cabinet
u = unit number
s = spindle number

CFA (Clear All Active Flaw Tables)

The **CFA** command removes all flaw tables from the active flaw table area in IOP local memory. There is no writing to the disk flaw tables; formatting does not take place.

Syntax: `CFA` ↵

RF (Remove a Flaw from the Active Flaw Table)

The **RF** command removes a flaw entry from the active flaw table in IOP local memory. There is no writing to the disk flaw tables; formatting does not take place.

Note: Enter the **LF** command before entering the **RF** command.

Syntax: `RF` *cc u s yyyy hh ee fff n i* ↵, where
cc = channel number of the cabinet
u = unit number
s = spindle number
yyyy = cylinder
hh = head number
ee = sector number
fff = defect position
n = user-added defect
i = unhideable defect

The following example illustrates the procedure used to remove a flaw from an active flaw table. (Refer to the previous description on how to add flaws to an existing flaw table for an explanation of the following command formats.)

1. Enter `CF 21 0 3` ↵
2. Enter `LF 21 0 3` ↵
3. Enter `RF 21 0 3 2613 07 03 0777 1 1` ↵

   Note: Enter 3142 instead of 2613 for RDS-5 disk systems.

4. Perform the following steps to run the DD40 disk formatting test section 21:

   a. Select spindle 3 (the spindle that was selected in Step 2).
   b. Select format mode 2 by setting the FMTMDE parameter to 2.
   c. Run test section 21.

5. Enter `CF 21 0 3` ↵

6. Enter `LF 21 0 3` ↵

7. Enter `VF 21 0 3` ↵

3 - USER PARAMETERS

User parameters enable the user to tailor diagnostic tests for specific purposes. When the diagnostic test sections are running, they read the IOP local memory locations where the parameters are stored. You can change parameters with the **S** command (refer to Part 2, Section 2, "DD40 Commands"). Each memory location contains 1 parcel of data. The maximum value of a user parameter is 177777.

SELECTING TEST SECTIONS TO RUN

The following memory locations contain parameters that select individual test sections:

```
Memory location 220 = Lower bits (diagnostic tests)
                221 = Upper bits (flaw management routines)
```

These two memory locations are bit mapped so you can select any combination of test sections to run. In the following example, location 220 is loaded with a 54 entry, which selects test sections 2, 3, and 5. The lower bit of location 221 represents test section 20.

```
Test Section: 17 16 15 14 13 12 11 10 7 6 5 4 3 2 1 0
Location 220: 0  0  0  0  0  0  0  0  0 0 1 0 1 1 0 0

Test Section:                             23 22 21 20
Location 221: 0 0 0 0 0 0 0 0 0 0 0 0      0  0  0  1
```

NUMBER OF PASSES TO RUN

The following memory location contains a parameter that selects the number of times specified test sections run:

Memory location 222 = Number of test section passes

An entry of 177777 in this parameter specifies an infinite number of passes. Press the **ESC** key to stop the test section. When you run a flaw management routine, the value in this parameter is forced to a 1.

DRIVE TYPE

The following memory location contains a parameter that selects the drive type:

Memory location 224 = Drive type:
0 = DD-40, DD-4R, DD-42
3000 = DD-41
12,000 = RDS-5

SCREEN REFRESH ENABLE

The following memory location contains parameters that enable and disable a screen refresh operation:

Memory location 225	0 = Disable
	1 = Enable (default)

Set this parameter to 1 to enable a screen refresh after a system pass count. Set this parameter to a 0 to inhibit the screen refresh.

FLAW TABLE REFERENCE ENABLE

The following memory location contains parameters that enable the flaw table reference function:

Memory location 226	0 = Disable
	1 = Enable (default)

If the flaw table reference is enabled, the diagnostic test reads the flaw tables from the selected spindles and sets up a flaw table reference function in local memory. The diagnostics use this information so that no data is written to defective sectors (refer to the "Defective Sector Reference Subroutine" in Part 2, Section 5). Disabling the flaw table reference enables the diagnostic to reference any sector, whether defective or not. An ID not-found error may occur if an attempt is made to use a defective sector, however. Flaw table reference enable is useful, for example, if you want to do a simple read test without first reading the flaw table from the spindle. The function is included as a diagnostic aid.

BUFFER MEMORY AVAILABLE FLAG

The following memory location contains parameters that enable the user to specify whether accesses to buffer memory are allowed:

Memory location 227	0 = Buffer memory not available
	1 = Buffer memory available

Buffer memory is used for the CMOS monitor as well as operand register display under CMOS. Refer to the "Saving and Running a Reconfigured DD40 Diagnostic Package" and "CMOS Monitor" subsections in Part 2, Section 1.

SPINDLE NUMBER

The following memory locations contain parameters that select the tested spindle number:

Memory location 230 = Starting spindle number
231 = Ending spindle number

Test sections address only spindles in this range. Enter the same number in both memory locations to define a single spindle.

HEAD NUMBER

The following memory locations contain parameters that select the tested head number:

Memory location 232 = Starting head number
233 = Ending head number

These parameters define starting and ending head numbers. Test sections address only heads in this range. Enter the same number in both memory locations to define a single head.

CYLINDER NUMBER

The following memory locations contain parameters that select the tested cylinder number:

Memory location 234 = Starting cylinder number
235 = Ending cylinder number

These parameters specify starting and ending cylinder numbers. Test sections address only cylinders in this range. Enter the same number in both memory locations to define a single cylinder.

IOP CHANNEL NUMBER FOR THE DISPLAY AND KEYBOARD

The following memory locations contain parameters that specify the display and keyboard channels of the IOP running diagnostic test sections:

Memory location 240 = BIOP or DIOP channel number for the display
241 = BIOP or DIOP channel number for the keyboard

When DD40 diagnostics are loaded into a processor, the user must press the **U** key to specify the keyboard and display channels. These two memory locations then are loaded automatically.

TIME-OUT DELAY USED IN WAITING FOR DONE FLAG

The following memory locations contain parameters that specify the maximum amount of time a function has to finish:

Memory location 242 = Time-out delay (lower bits)
243 = Time-out delay (upper bits)

Most disk commands require a certain amount of time to run. Under normal conditions, all functions complete within the time allowed. Error code 1 occurs if the delay time is exceeded.

NUMBER OF SECTORS, CYLINDERS, AND HEADS IN A SPINDLE

There are different size spindles available. The following memory locations contain parameters that specify the tested number of spindle sectors, cylinders, and heads:

Memory location 244 = Number of sectors per spindle
245 = Number of cylinders per spindle
246 = Number of heads per spindle

RETEST COUNT

The following memory location contains a parameter that specifies the number of retests for the diagnostic test:

Memory location 250 = Retest count

If recoverable errors occur during a test operation, the diagnostic test repeats the operation in an attempt to complete it without an error. The retest count indicates the number of times the operation is allowed to repeat. Refer to individual diagnostic test section descriptions in Part 2, Section 4 for more details.

DIAGNOSTIC SCRATCH CYLINDER NUMBER

The following memory location contains a parameter that specifies the number of the diagnostic scratch cylinder:

Memory location 251 = Diagnostic scratch cylinder number

The diagnostic scratch cylinder, also known as the CE cylinder, is the cylinder to which the test sections write. Only one cylinder can be defined as the diagnostic scratch cylinder.

CAUTION
Do not define a customer's data cylinder or flaw table cylinder as the scratch cylinder. If you do, valuable data will be lost.

FLAW TABLE CYLINDER AND HEAD NUMBER

The following memory location contains a parameter that specifies the flaw table cylinder and head number:

Memory location 252 = Flaw table cylinder number

Each spindle has a flaw table cylinder. The default flaw table cylinder is 2612_8 for DD-40 or DD-4R, 3141_8 for DD-41 or RDS-5, and 5061_8 for DD-42.

CAUTION
Do not define a customer's data cylinder as the flaw table cylinder. If you do, valuable data will be lost.

OPERATING SYSTEM FLAW TABLE LOCATION

The following memory locations contain parameters that specify the location of the operating system (OS) flaw table:

Memory location 254 = Sector number
255 = Spindle number
256 = Head number
257 = Cylinder number

CAUTION
Do not place the OS flaw table in one of the customer's data cylinders, the diagnostic scratch cylinder, or the flaw table cylinder. If you do, valuable data will be lost.

There are two modes of flaw table generation: one mode writes a table on each spindle, and the other mode selects a single spindle. Refer to "SECTION 22 (OPERATING SYSTEM FLAW TABLE GENERATION)" in Part 2, Section 5 for details about selecting one mode or the other.

DRIVE SELECTION

The following memory locations specify from one to eight disk drives:

Memory locations 260-267 = Disk drive

Each memory location contains a unit number (primary or shadow), disk type, and an IOP channel number. For example, a primary disk drive linked to IOP channel 25 has an entry of 000025. A shadow disk drive linked to IOP channel 26 is specified by 100026.

USER TEST MODES

The following memory locations contain parameters that specify certain user test modes:

Memory locations 330 through 477 = User test modes

The parameters at these locations enable the user to modify the operation of individual test sections. There are individual user test modes for each test section. Refer to a description of the individual test sections in Part 2, Sections 4 and 5 for details.

SEEK TIMES

The following memory locations contain parameters that specify seek times:

Memory locations 510 through 557 = Seek timing table addresses

The seek timing test uses a table contained in local memory to determine if seek times are correct. Location 510 contains the number of cylinders the head may move across in 5 ms or less. The next location is for 6 ms, and so on.

4 - DIAGNOSTIC TESTS

This section describes the DD40 diagnostic test sections. These tests automatically run in the selected IOP when the user issues the **DS** command. The user parameter in local memory location 220 defines which test sections run. Other user parameters control disk access, retest counts, pass counts and time-out delays. User test modes are user parameters that allow you to change the operating mode of individual test sections. Refer to "Saving and Running a Reconfigured DD40 Diagnostic Package" in Part 2, Section 1 for the procedures to edit parameters in local memory and to run a diagnostic test sequence. Refer to Part 2, Section 3, "User Parameters," for descriptions of all parameters.

Each test description contains the following:

- A description of test operation.
- A list of the subtests in the order they are performed. The CND (condition) label identifies each subtest.
- A list of user parameters that apply only to the test section being described. Define the parameters by storing values in local memory locations 330 through 477. The DD40 program listing contains the user test mode memory locations reserved for each test, the modes they control, and the default values.
- A list of the local memory data buffers used during the test and the data buffers' contents. Data buffers BUFFA through BUFFI each hold 4,000 parcels of data. Data buffers BFSMSD and BFSMRC hold 16 parcels of output data patterns and returned data patterns, respectively. Data buffer FLASPC contains the starting address of the active flaw table. View these buffers using the DD40 display commands. Data buffer addresses appear in the program listing.

TEST SECTION 0 (2EI MODULE ECHO DATA TEST)

This test runs walking 1's and walking 0's patterns through the 2EI module in the DC-40 disk controller unit. The data path is on the following Boolean terms: U7 through U22 or U31 through U46, A20 through A35 or A40 through A55, A0 through A15, D40 through D55, Z0 through Z15, R7 through R22, or R31 through R46. The test repeats for each disk drive cabinet selected by the user.

The following are the subtests, user test mode parameters, and data buffers for test section 0:

- Subtests:

  CND = 1; walking 1's
  CND = 2; walking 0's

- User test mode parameters: None

- Data buffers:

  BUFFA = Data written to the 2EI module
  BUFFB = Data returned from the 2EI module

TEST SECTION 1 (FORCE A PARITY ERROR)

This test forces a bus-in parity error and checks status register 0 for an error code of 241 in the lower 8 bits. A status parity error is then forced and the status register checked for an error code of 221. The test is repeated for each disk drive cabinet selected by the user.

The following are the subtests, user test mode parameters, and data buffers for test section 1:

- Subtests:

  CND = 1; bus-in parity error
  CND = 2; status parity error

- User test mode parameters: None

- Data buffers:

  BUFFA = Data written to the controller
  BUFFB = Data received from the controller

TEST SECTION 2 (FULL-TRACK BUFFER DATA BUS)

This test writes 16 parcels of the same pattern to the full-track buffer, reads it back, and verifies data. The pattern is then changed and the test is repeated. The first pattern used is a walking 1's, followed by a walking 0's pattern. The result of this test is recorded in local memory starting at the local memory address for data buffer BUFFA. The data pattern for the first 16 parcels in data buffer BUFFA is the first pattern written; the data pattern for the next 16 parcels is the first pattern read back. The data pattern in the next 16 parcels is the second pattern written; the data pattern in the next 16 parcels is the second pattern read back; and so on. The test is repeated for each disk drive cabinet selected by the user.

The following are the subtests, user test mode parameters, and data buffers for test section 2:

- Subtests:

  CND = 1; walking 1's
  CND = 2; walking 0's

- User test mode parameters: None

- Data buffers: BUFFA = Write/read data (refer to the test section 2 operation description)

TEST SECTION 3 (FULL-TRACK BUFFER SECDED)

This test prompts the user to set the single-error correction/double-error detection (SECDED) Test/Normal switch on the DC-40/41 panel to the Test position. The test then writes 16 parcels of walking 1's to the full-track buffer, reads the data back, and verifies that the read data is all 0's. The next iteration of walking 1's is then continued across the data word and the test is repeated, each time with an expected read data pattern of all 0's.

The result of this test is recorded in local memory starting at the local memory address for data buffer BUFFA. The data pattern for the first 16 parcels in data buffer BUFFA is the first pattern written; the data pattern for the next 16 parcels is the first pattern read back. The data pattern for the next 16 parcels is the second pattern written; the data pattern for the next 16 parcels is the second pattern read back; and so on. The test is repeated for each cabinet selected by the user.

The following are the subtests, user test mode parameters, and data buffers for test section 3:

- Subtests:

  CND = 1; walking 1's - first selected spindle
  CND = 2; walking 1's - second selected spindle
  CND = 3; walking 1's - third selected spindle
  CND = 4; walking 1's - fourth selected spindle

- User test mode parameters: None

- Data buffers: BUFFA = Write/read data

TEST SECTION 4 (FULL-TRACK BUFFER SPINDLE ADDRESSING)

This test loads each parcel location in full-track buffer spindle A with an entry of 1, track buffer spindle B with an entry of 2, track buffer spindle C with an entry of 3, and track buffer spindle D with an entry of 4. The test determines whether individual track buffer spindles can be addressed. After writing the full-track buffer, the test reads the data back and verifies it. The test accesses all four full-track buffer spindles regardless of the user-specified spindle range. The test is repeated for each disk drive cabinet selected by the user.

The following are the subtests, user test mode parameters, and data buffers for test section 4:

- Subtests:

  CND = 1; writes to the first selected spindle
  CND = 2; writes to the second selected spindle
  CND = 3; writes to the third selected spindle
  CND = 4; writes to the fourth selected spindle
  CND = 5; reads to the first selected spindle
  CND = 6; reads to the second selected spindle
  CND = 7; reads to the third selected spindle
  CND = 10; reads to the fourth selected spindle

- User test mode parameters: None

- Data buffers:

  BUFFA = Write data
  BUFFB = Read data

TEST SECTION 5 (FULL-TRACK BUFFER SECTOR ADDRESSING)

This test loads each parcel location in the track buffer with a count pattern. The test starts by writing 0's to parcel 0, sector 0, and sequentially all of the selected spindles' buffer sections being tested, ending with 57777 being written to the last parcel of sector 13. This count increments with each parcel, while buffer addressing actually increments after each parcel pair. The data is read back and verified. The process repeats for each selected spindle. Bank A (even parcels) receives even data and bank B (odd parcels) receives odd data. The test repeats for each disk drive cabinet selected by the user. Table 4-1 shows the increment pattern for full-track buffer sector addressing.

Table 4-1. Full-track Buffer Sector Addressing Increment Pattern

Sector Number	Value in First Parcel	Value in Last Parcel
0	000000	003777
1	004000	007777
2	010000	013777
3	014000	017777
4	020000	023777
5	024000	027777
6	030000	033777
7	034000	037777
10	040000	043777
11	044000	047777
12	050000	053777
13	054000	057777

The following are the subtests, user test mode parameters, and data buffers for test section 5:

- Subtests:

  CND = 1; writes/reads the first selected spindle
  CND = 2; writes/reads the second selected spindle
  CND = 3; writes/reads the third selected spindle
  CND = 4; writes/reads the fourth selected spindle

- User test mode parameters: None

- Data buffers:

  BUFFA = Write data
  BUFFB = Read data

TEST SECTION 6 (FULL-TRACK BUFFER MEMORY)

This test writes 4,000 parcels of the same data pattern to the full-track buffer sector 0 of the first selected spindle, reads it back, and verifies the test data. This process is repeated for each sector of the spindle. The next iteration of data patterns is continued across the data word and the test repeats.

The first pattern used is a walking 1's, followed by walking 0's, and then the user patterns. User patterns are defined in the user test mode parameters. This sequence repeats for each spindle and disk drive cabinet selected by the user. Allow SECDED to remain enabled at the DC-40/41 control panel so that all track buffer errors are reported.

The following are the subtests, user test mode parameters, and data buffers for test section 6:

- Subtests:

  CND = 1; walking 1's - even bank - first selected spindle
  CND = 2; walking 0's - even bank - first selected spindle
  CND = 3; user patterns - even bank - first selected spindle
  CND = 4; walking 1's - odd bank - first selected spindle
  CND = 5; walking 0's - odd bank - first selected spindle
  CND = 6; user patterns - odd bank - first selected spindle
  CND = 7; walking 1's - even bank - second selected spindle
  CND = 10; walking 0's - even bank - second selected spindle
  CND = 11; user patterns - even bank - second selected spindle
  CND = 12; walking 1's - odd bank - second selected spindle
  CND = 13; walking 0's - odd bank - second selected spindle
  CND = 14; user patterns - odd bank - second selected spindle
  CND = 15; walking 1's - even bank - third selected spindle
  CND = 16; walking 0's - even bank - third selected spindle
  CND = 17; user patterns - even bank - third selected spindle
  CND = 20; walking 1's - odd bank - third selected spindle
  CND = 21; walking 0's - odd bank - third selected spindle
  CND = 22; user patterns - odd bank - third selected spindle

CND = 23; walking 1's - even bank - fourth selected spindle
CND = 24; walking 0's - even bank - fourth selected spindle
CND = 25; user patterns - even bank - fourth selected spindle
CND = 26; walking 1's - odd bank - fourth selected spindle
CND = 27; walking 0's - odd bank - fourth selected spindle
CND = 30; user patterns - odd bank - fourth selected spindle

- User test mode parameters:

  BFPT1 = Test data pattern
  BFPT2 = Test data pattern

- Data buffers:

  BUFFA = Write data
  BUFFB = Read data

TEST SECTION 7 (HEADER READS, SEEK TIMING, HEAD ADDRESSING)

This test exercises the head positioners of the disk spindles. The heads are positioned and timed to ensure correct seek times. Measured seek times are compared to the seek times table. Then the track header or sector ID is read and verified to ensure that the head is over the correct track. The test is repeated for each head position during CND 1 testing. For all other conditions, only the first selected head is read. Data on the disk is not altered by this test. This test checks only the cylinders specified by the user. If only seek timing is selected, the test will not access any of the media; therefore, there are no spindle increments.

The following are the subtests, user test mode parameters, and data buffers for test section 7:

- Subtests:

  CND 1; (CND 1 starts at cylinder 0, head 0 and increments up to the highest selected cylinder.)

  CND 2; (CND 2 reads cylinders 0, 2, 1, 3, 4, 3, 5, etc., up to the highest selected cylinder.)

  CND 3; [CND 3 reads cylinders 0, 0, 0, 1, 0, 2, 0, 3, 0, 4, etc.; 400, 0, 400, 1, 400, 2, 400, 3, 400, 4, etc.; and 1000, 0, 1000, 1, 1000, 2, 1000, 3, 1000, 4, etc. User parameter (BSCIST) selects the base cylinder number step value.]

  CND 4; randomly selects cylinders (reads occur)

  CND 5; randomly selects cylinders (no reads or spindle increments)

- User test mode parameters:

  FACCRA - Track headers or sector IDs [If the test is run with formatted sectors (FACCRA = 1), only the first sector of the track is read.]

  0 = Factory track headers
  1 = Cray formatted sector IDs
  2 = Seek timing only - no reads

  CDSL7 - Condition (CND) selector (starting/ending)

  BSCIST - Base cylinder number step value

  DSPTRA - Cylinder number displayed

  0 = Disable cylinder number display update (default)
  1 = Enable cylinder number display update

  RDCT7 - Number of random seeks in condition 4

- Data buffers:

  BUFFB = Track header or sector ID
  BFSMSD = Expected data
  BFSMRC = Actual data

TEST SECTION 10 (CORRECTION VECTOR ANALYSIS)

This test section writes a pattern of 0's, with zero ECC and one of the data bits set to a 1. This is a forced data error condition. A normal read is then performed with an expected error. The status registers are checked to ensure that the error was detected. The error correction vector is read back and analyzed to ensure that it is correct. This sequence is repeated while the single bit is walked across the entire sector. The procedure is then repeated with an 8-bit burst walked across the sector, and repeated again with a 16-bit uncorrectable burst walked across the sector. This 16-bit burst is user modifiable. The pattern is located in memory location UCDTPT. Finally, a random test mode runs. This test section is repeated for each spindle and runs concurrently on all selected disk drives.

The following are the subtests, user test mode parameters, and data buffers for test section 10:

- Subtest:

  CND = 1; walking bit
  CND = 2; 8-bit burst
  CND = 3; uncorrectable burst (user modifiable)
  CND = 4; random offset and mask

- User test mode parameters:

  CDSL10 - Condition (CND) selector (starting/ending)

WLKINT - Walking 1 interval

0 = The walking 1's portion of the test is walked 1 bit position at a time.
1 = The walking 1's portion of the test is walked 16 bit positions at a time.

UCDTPT - Uncorrectable data pattern

RDCVP - Random pass count (177777 = infinity)

- Data buffers:

  BUFFA = Write data
  BUFFB = Read data
  BUFFC = Read correction vector
  BFSMSD = Actual correction data
  BFSMRC = Expected correction vector

TEST SECTION 11 (DISK DATA BUS - SCRATCH CYLINDER)

This test writes 4,000 (decimal) parcels to the disk with the first 16 parcels containing the pattern. The test clears the full-track buffer, reads the data back from the disk, and verifies the read data. The next iteration of the data pattern is continued across the data word and the test repeats. The first pattern is walking 1's, followed by walking 0's.

The result of this test is recorded in local memory starting at the local memory address for data buffer BUFFA. The data pattern for the first 16 parcels in the BUFFA buffer is the first pattern written; the data pattern for the next 16 parcels is the first pattern read back; the data pattern for the next 16 parcels is the second data pattern written; the data pattern for the next 16 parcels is the second pattern read back; and so on. The test is repeated for each cabinet selected by the user.

The following are the subtests, user test mode parameters, and data buffers for test section 11:

- Subtests:

  CND = 1; walking 1's - first selected spindle
  CND = 2; walking 0's - first selected spindle
  CND = 3; walking 1's - second selected spindle
  CND = 4; walking 0's - second selected spindle
  CND = 5; walking 1's - third selected spindle
  CND = 6; walking 0's - third selected spindle
  CND = 7; walking 1's - fourth selected spindle
  CND = 10; walking 0's - fourth selected spindle

- User test mode parameters: None

- Data buffers: BUFFA = Write/read data

TEST SECTION 12 (DISK SPINDLE ADDRESSING - SCRATCH CYLINDER)

This test writes a 1 to each parcel location in the first 12 sectors of spindle A. The test also writes a 2 to the first 12 sectors of spindle B. It writes a 3 to the first 12 sectors of spindle C, and it writes a 4 to the first 12 sectors of spindle D. The test evaluates whether individual spindles can be addressed. After the write operation, the track buffer is cleared, and data is read back and verified. The test is repeated for each cabinet selected by the user.

The following are the subtests, user test mode parameters, and data buffers for test section 12:

- Subtests:

  CND = 1; writes to the first selected spindle
  CND = 2; writes to the second selected spindle
  CND = 3; writes to the third selected spindle
  CND = 4; writes to the fourth selected spindle
  CND = 5; reads the first selected spindle
  CND = 6; reads the second selected spindle
  CND = 7; reads the third selected spindle
  CND = 10; reads the fourth selected spindle

- User test mode parameters: None

- Data buffers:

  BUFFA = Write data
  BUFFB = Read data

TEST SECTION 13 (DISK SECTOR ADDRESSING - SCRATCH CYLINDER)

This test section loads each parcel location in each sector of a spindle with a sequential count pattern. The test starts by writing 0's to parcel 0, sector 0; and sequentially fills all sectors of the spindle being tested; ending at 57777, sector 13. The count increments with each parcel while buffer addressing actually increments after each parcel pair. The track buffer is cleared, and the data is then read back and verified. All selected spindles are tested. The test repeats for each cabinet selected by the user. Table 4-2 shows the increment pattern for disk sector addressing.

The following are the subtests, user test mode parameters, and data buffers for test section 13:

- Subtests:
  CND = 1; write/read the first selected spindle
  CND = 2; write/read the second selected spindle
  CND = 3; write/read the third selected spindle
  CND = 4; write/read the fourth selected spindle

Table 4-2. Disk Sector Addressing Increment Pattern

Sector Number	Value in First Parcel	Value in Last Parcel
0	000000	003777
1	004000	007777
2	010000	013777
3	014000	017777
4	020000	023777
5	024000	027777
6	030000	033777
7	034000	037777
10	040000	043777
11	044000	047777
12	050000	053777
13	054000	057777

- User test mode parameters: None
- Data buffers:

  BUFFA = Write data
  BUFFB = Read data

TEST SECTION 14 (DEFECT PAD WRITE ABILITY)

This test verifies that the controller can write a defect pad to any location within a sector. An ID field is written with a defect pad created at the beginning of the sector. Then, all 1's are written across the sector. The defect address register is loaded so that the read begins in the correct part of the sector. During the first 200 passes, reading starts at the beginning of the sector; during the last 200 passes, reading starts 20 parcels from the beginning of the sector. This process is necessary because the actual read data is 4,000 parcels long; the sector, including the defect pad length, is 4,010 parcels.

Using read mode 2, the whole sector is read back regardless of the defect pad location. An ECC error is generated and then verified. The read data is analyzed to see if the defect pad has a pad of 0's in the correct part of the sector. Using the read mode 10 (a normal read), the whole sector is read back. The data read back is analyzed to ensure that there are all 1's. This procedure repeats as the defect pad is walked across the sector.

The diagnostic scratch cylinder is used in this test section. The spindle and head are selected by the user-defined beginning values. In the beginning of the test, the sector ID is read and saved for later restoration. In the event the test fails, the **MC** command restores the original sector ID.

The following are the subtests, user test mode parameters, and data buffers for test section 14:

- Subtests: CND = 1; (This is the only test condition.)
- User test mode parameters: None
- Data buffers:

  BFSMRC = Original ID storage (for later restoration of the ID)
  BUFFC = ID field buffer (write)
  BUFFA = Write data
  BUFFB = Read data (mode 2 - read absolute)
  BUFFD = Read data (mode 10 - normal read)

TEST SECTION 15 (CHAINING - WRITE AHEAD/READ AHEAD)

This test section first runs a write ahead function. It writes all sectors on the spindles selected by the user with write ahead enabled. The diagnostic scratch cylinder is used for this test. The data is then read back from the disk with the read ahead function disabled for verification. The first and last word of each sector contain an address pattern. As each sector is written, the write operation is timed to ensure chaining is functioning. The entire full-track write and full-cylinder write are also timed.

The read ahead function is then tested. All sectors on the spindles selected by the user are written with the write ahead function enabled. The write operation is the same as previously described. The data is then read back with read ahead enabled and data is verified. As previously described, the first and last word of each sector again contain an address pattern. As each sector is read, it is timed to ensure that chaining is functioning. The entire full-track read and full-cylinder read are also timed.

Data checking occurs when the condition 3 DC-40 parameters are set. Read ahead and write ahead are disabled to allow time for data checking with condition 3. For the DCU-S1, data checking is always enabled. Refer to the subtest description in this test section for more detail. The chaining test relies on the real-time clock and the real-time clock counter register for time-interval measurements. Therefore, when starting this test, a real-time clock test is run first to check for proper counting.

Some IOPs use a 2AH module of revision C or earlier. These modules have a real-time clock but no counter register. They do not support this chaining test. The diagnostic scratch cylinder is used for this test. The scratch cylinder is assumed to be formatted. The expected read/write times are defined by the user test mode parameters.

The following conditions (CND) are required for the DC-40 parameters:

CND	Write Ahead	Read Ahead	Data Checking	Chaining	Timing
1	Enabled	Disabled	No	Write	Write
2	Enabled	Enabled	No	Write/read	Write/read
3	Disabled	Disabled	Yes	Write/read	Write/read

The following conditions are required for the DCU-S1 parameters:

CND	Write Ahead	Read Ahead	Data Checking	Chaining	Timing
1	N/A	N/A	Yes	Write	Write
2	N/A	N/A	Yes	Write/read	Write/read

The following are the subtests, user test mode parameters, and data buffers for test section 15:

- Subtests:

  CND = 1; write ahead enabled/read ahead disabled
  CND = 2; write ahead enabled/read ahead enabled

- User test mode parameters :

  WTSCTM = Write sector time in RTC count (DC-40)
  WTSCTM+1 = Write sector time in milliseconds (DCU-S1)
  RDSCTM = Read sector time in RTC count (DC-40)
  RDSCTM + 1 = Read sector time in milliseconds (DCU-S1)
  WTFSTM = First sector write time (DCU-S1)
  RDFSTM = First sector read time
  RDFSTM + 1 = First sector read time (DCU-S1)
  WTFLTM = Full-track 48 sector write time in milliseconds
  WTFLTM + 1 = Full-track 12 sector write time in milliseconds (DCU-S1)
  RDFLTM = Full-track 48 sector read time in milliseconds
  RDFLTM + 1 = Full-track 12 sector read time in milliseconds (DCU-S1)
  WTCYTM = Full-cylinder write time in milliseconds
  WTCYTM + 1 = Full-cylinder write time in milliseconds (DCU-S1)
  RDCYTM = Full-cylinder read time in milliseconds
  RDCYTM + 1 = Full-cylinder read time in milliseconds (DCU-S1)

- Data buffers:

  BFSMSD = Expected data in compare
  BFSMRC = Actual data in compare
  BUFFA = Data buffer (write)
  BUFFB = Data buffer (write)
  BUFFC = Data buffer (read)
  BUFFD = Data buffer (read)
  BUFFE = Elapsed time storage

- Error messages: If an error is found in actual and expected timing, the following locations contain timing information (nanosecond precision):

  ERROR1 = Expected nanoseconds
  ERROR2 = Actual nanoseconds
  ERROR3 = Expected milliseconds
  ERROR4 = Actual milliseconds

TEST SECTION 16 (DISK SYSTEM EXERCISER)

CAUTION
This test can write over customer data cylinders. All writes/reads will occur within the parameters set at locations 230-235.

This test is written with the assumption that the disk being tested is sector formatted. The purpose of the test is to create a random write and read condition similar to the condition found in normal disk drive operation. The test is a quality assurance and burn-in routine. There are three subtest conditions in this test. The first two conditions are a sequential write and read to pattern the media. The test verifies that each sector received the correct data. The third condition then runs until the user presses the escape key. This condition does random writes, reads, seeks, and datastream lengths. Data is verified depending on the mode selected. The data patterns used for test data are random. The first 5 parcels written to each sector contain the following address pattern:

Parcel 0 = Channel number
Parcel 1 = Cylinder number
Parcel 2 = Head number
Parcel 3 = Spindle number
Parcel 4 = Sector number

When the test verifies data, only the first 5 parcels are checked. The ECC circuitry of the controller reports any data errors. For each cylinder, the data buffer is loaded with new random data. Up to eight disk drive cabinets may be selected and accessed simultaneously by the test. The flaw table cylinder is not tested even if it is within the selected range of cylinders to be accessed. If an unrecoverable error occurs, the error processing routine runs first, and finally the user query routine runs. Press the escape key to temporarily suspend the test. The system counts are now displayed. Any display command may be used. To resume execution of the test, enter the **DS** command, and answer yes to the prompt at the console. To terminate the test, enter the **DS** command and answer no to the prompt.

The following are the subtests, user test mode parameters, and data buffers for test section 16:

- Subtests:

  CND = 1; write data to the media sequentially
  CND = 2; read data from the media sequentially and record any errors
  CND = 3; random seeks, data, head, spindle, sector, read/write, data stream length

- User test mode parameters:

  DSEMD = 0; ID labels (default)
  DSEMD = 1; random data

RLOUT = 0; normal mode (DB = BUFFA)

RLOUT = 1; roll-out mode (DB = SPACE0). The purpose of roll-out mode is to gain more memory space when normal mode does not supply sufficient memory for the data buffers and flaw tables. Location SPACE0 now becomes the new starting point for the data buffers/scratch pad/flaw tables memory area. All code after this point is written to buffer memory for later restoration. The **MC** command restores the code.

Note: If no buffer memory is available, the code is lost and the software must be re-booted to regain use of the lost code.

- Data buffers:

  Register DB = Write buffer
  Register DB + 4000 = Write buffer
  Register DB + 10000 = Write buffer
  Register DB + 14000 = Write buffer
  Register DB + 20000 = Starting address of the read buffers (two 4 Kparcel read buffers per selected cabinet)

TEST SECTION 17 (SEEK DISTANCE/DATA VERIFICATION)

This test combines a seek test with data verification using read ahead/write ahead in chaining mode. The test repeats with the seek distance increased each time the test repeats. Depending on the mode, only the scratch cylinder is used or both cylinders are used. If both cylinders are used, the first seek is from the last user-specified cylinder to the scratch cylinder. The cylinder count is then decremented until the first user-specified cylinder is tested. The test does not require specific data so random data is written to the disk media. The test looks for ECC errors. Data is written and then read from all sectors of the spindle and head ranges specified by the user.

The following are the subtests, user test mode parameters, and data buffers for test section 17:

- Subtests:

  CND = 1; (Data is written to the cylinders and verified by the test to be error free.)

  CND = 2; (The read mode is subjected to the previously described conditions and checked for ECC errors.)

  CND = 3; (Write mode is subjected to the previously described conditions. Data is read back and then checked for ECC errors.)

- User test mode parameters:

  PSS17 - The number of passes to run this test section

  CDSL17 - Condition selector (starting/ending; for example, 12 = run condition 1 through 2)

CYLSKP - The number of cylinders to skip within the selected range

ACCSEL - Cylinder access selector

0 = Only the scratch cylinder is accessed.
1 = The scratch cylinder and starting cylinder are accessed.

CAUTION
Do not select mode 1; customer data will be destroyed.

DATSEL - Data selector

0 = Use random data
1 = Use the user specified data pattern

OPDAPT - User specified data pattern

- Data buffers: (Chaining is enabled for each buffer.)

BUFFA = Write buffer
BUFFB = Write buffer
BUFFC = Read buffer
BUFFD = Read buffer

5 - FLAW MANAGEMENT TESTS

The DD40 software package includes routines designed to generate, update, and back up flaw tables and format the disk media by writing sector IDs. The user parameter in local memory location 221 specifies which flaw management test runs when the **DS** command is issued. Other parameters control disk access and the mode of operation of individual flaw-management test sections. Refer to "How To Load and Run DD40 Diagnostics Under CMOS" in Part 2, Section 1 for information about editing parameters in local memory and running a diagnostic test sequence.

The following list describes the contents of each flaw management routine:

- A description of the routine's operation.
- Subsections: A list of the subroutines in the order they are performed. The condition (CND) label identifies each subroutine.
- User test mode parameters: Each flaw-management test description provides a list of user parameters. All flaw-management test sections (20, 21, 22, and 23) have selectable user test modes. Define the test modes by storing values in local memory locations 356 through 377. The program listing shows the user test mode memory locations reserved for each test section, the modes the test sections control, and the default values.
- Data buffers: Each flaw-management test description provides a list of the local memory data buffers and their contents. Data buffers BUFFA through BUFFI each hold 4,000 parcels of data. Data buffers BFSMSD and BFSMRC hold 16 parcels of output data patterns and returned data patterns, respectively. Data buffer FLASPC contains the starting address of the active flaw table. View these buffers using the DD40 display commands. Buffer addresses appear in the program listing.

SECTION 20 (NEW FLAW TABLE GENERATION)

This test generates a flaw table using the flaw information on the disk media. Depending on the mode, the factory track header or sector ID is read. Flaw entries are generated and added to the local memory flaw table area. Reads occur only on the spindles, cylinders, and heads specified by the user. The read information is analyzed and flaw table entries are generated according to the parameters at local memory locations 500 through 507. Allow the program to run to completion so the resulting flaw table is sorted and duplicate entries are resolved. Press the **ESC** key to abort the test. If the **ESC** key is pressed, the sort and delete duplicate entry operation occurs on all the flaws generated. The flaw table and scratch cylinders are now formatted, and the new flaw table is written to the flaw table cylinder (refer to the "Disk Formatting" subsection in this section for more details). The defective sector entries (unhideable entries) in the new flaw table contain a defective sector code in the defect position field. The following definitions are provided for each code:

0 = This code is undefined.
1 = The defect is in GAP1/I.D./GAP2/DATA SYNC field of the sector ID.
2 = The defect is longer than the defect pad.
3 = The defect crosses a defect pad border.
4 = The defect is too wide and does not have enough 0's after it.
5 = Multiple defects occur in the same sector.

The following subsections, user test mode parameters, and data buffers are contained in test section 20:

- Subsections:

  CND = 1; there is only one condition in this routine.

- User test mode parameters:

  DFLENFLG - Defect length flag - (stored in location 470)
  0 = DD-40
  1 = DD-41

  FLAMOD - Flaw table generation mode - (stored in location 442)
  0 = The flaw table is generated from factory track headers.
  1 = The flaw table is generated from sector IDs.

  INDLENBI - Number of bits in the index - (stored in location 467)
  1 = DD-4R/DD-42
  2 = DD-40/DD-41

  INDLENBY - Number of bytes in the index - (stored in location 466)
  2 = DD-40
  3 = DD-4R/DD-42
  11 = DD-41

- Data buffers:

  BUFFB = Header or sector ID
  BFSMSD = Expected data
  BFSMRC = Actual data

SECTION 21 (DISK FORMATTING)

This test formats the selected spindles based on the active flaw tables in local memory and updates the flaw tables on the spindles. Actual formatting takes place first, followed by verification. If an error occurs during verification, the program retries the write/read/verify sequence for that sector until the retry count is exceeded. If the retry count is exceeded, the routine jumps to the error routine. Defective sector ID fields are not verified. The spindle flaw table is updated at the end of the verification process. To reformat the spindle, first use the **LF** command to load the active flaw table with the disk flaw table. Only the spindles selected by the user parameters are referenced with this command.

The following subsections, user test mode parameters, and data buffers are contained in test section 21:

- Subsections:

  CND = 1; write IDs
  CND = 2; read IDs
  CND = 3; update the flaw table

- User test mode parameters:

  FMTMDE - Format mode

  0 = This is a full-formatting mode. ID fields are written to all sectors of the selected spindles, heads, and cylinders according to the flaw table in local memory. No defect IDs are written to sectors not specified in the flaw table. This mode is written with the assumption that the flaw table in IOP memory is complete. This mode overwrites the existing flaw tables on the disk spindles with the IOP flaw table information.

  CAUTION

  Do not run format mode 0 of test section 21 unless a copy of the permanent flaw table has been saved. Running format mode 0 results in the loss of existing data in the permanent flaw table. The data is overwritten and replaced with the active flaw table data.

  2 = This mode enables the user to add new flaws generated by surface analysis or to add new flaws manually. ID fields are written only to the sectors of the selected spindles according to the flaw table in local memory. The local memory flaw entries are merged with the spindle flaw table. The new flaw table is then sorted and written to the spindle flaw table cylinder. All cylinders and heads are accessed regardless of the user-specified range.

  4 = This is an ID field verify mode. No formatting takes place. In the selected cabinets, ID fields of all sectors on selected spindles, heads, and cylinders are verified against the flaw table. Defective sector ID fields are not verified. No writes occur in this mode. The test stops if an error occurs.

  VERIFY - Format mode 0 verify enable

  0 = Disable verification
  1 = Enable verification

- Data buffers:

  BUFFA = Write buffer

BUFFB = Read buffer
BFSMSD = Single ID buffer (write)
BFSMRC = Single ID buffer (read)
FLASPC = Main active flaw table

SECTION 22 (OPERATING SYSTEM FLAW TABLE GENERATION)

This test writes all defective sector entries in the user flaw table to the operating system (OS) flaw table cylinder. Defective sector entries in the user flaw table are identified by bit 14 (40000) of the first parcel for each flaw table entry. The user parameters specify where the OS flaw table will be written. The active flaw tables in local memory are cleared by this test and reloaded from the disk. There is no need to manually load flaw tables. If the track specified by the user has defective sectors, this routine increments to the next head until a clean track is found. The OS flaw table is then written to this track and verified.

Note: Only the first specified cabinet is to be processed.

The following subsections, user test mode parameters, and data buffers are contained in test section 22:

- Subsections:

  CND = 1; compile and write the OS flaw tables to the disk media
  CND = 2; verify that the OS flaw table is written to the media

- User test mode parameters:

  OSFLMD - Mode of operation

    0 = A unique table written on each spindle, containing flaws that pertain only to the individual spindle

    1 = A single table written to represent the entire cabinet

  SECNUM - The number of sectors allowed for OS flaw table storage

- Data buffers:

  BUFFC = New OS flaw table to be written
  BUFFI = Copy of the OS flaw table read back for verification

SECTION 23 (SURFACE ANALYSIS)

This test writes data, reads it back, and generates flaw table entries when data errors are found. If any error occurs more than once, the error is considered a flaw. It is assumed the disk being tested is sector formatted. The patterns used for test data are stored starting at the location after the local memory address for the PATNUM user parameter. These patterns are written back to back and repeated across the disk.

The same data buffer is written to each sector and head. During a random data write operation, the write buffer is loaded with random data; this data is written to the disk.

This write operation constitutes one random pass. For each random pass, the data buffer is loaded with new random data. Up to eight cabinets may be selected and accessed simultaneously. The flaw table cylinder is not overwritten even if it is within the selected range of cylinders to be analyzed, thus preventing accidental loss of the flaw tables.

The displayed shift count indicates the number of shifts that occurred. The display occurs during test pattern mode. In random number mode, there is a random pass count display. When all shifts or random passes on all cylinders are complete, the system pass count increments.

When an unrecoverable error occurs, the error processing routine begins. All discovered flaws are not compiled in order to preserve the error data in memory. To compile these flaws, do not reset the software with the **MC** command. Instead, enter **DS** as many times as necessary until a pass count is displayed. Press the **ESC** key to temporarily suspend the test. Any display command may now be used. To resume execution of the test, enter a **DS** command, and answer yes to the prompt. To terminate the test, enter a **DS** command, and answer no to the prompt.

The following subsections, user test mode parameters, and data buffers are contained in test section 23:

- Subsections:

  CND = 1; write to the disk media
  CND = 2; read from the disk media and record any flaws

- User test mode parameters:

  SFAMOD - Surface analysis mode

    0 = Write to all selected cylinders, then read all selected cylinders (The data pattern is then shifted, and the write/read sequence is repeated.)

    1 = Default mode (The test completely analyzes each cylinder before incrementing to the next cylinder.)

  HCPRND - Data pattern

    0 = Test pattern
    1 = Random numbers

  RNDPAS - Number of passes in random number mode

  SHFCNT - Shift count

  PATNUM - Number of data pattern parcels (Eight associated memory locations store patterns. Double or halve the default value of 2 to change the number of parcels.)

PASMOD - Passmode

0 = Multiple passes (The shift count is determined by the value in SHFCNT.)

1 = Multiple passes only with ECC error on the current cylinder (This mode is functional when SFAMOD = 1. During multiple test passes, the number of shifts is determined by the value in SHFCNT. During a single pass, the value in the PASSHF parameter is used.)

PASSHF - Number of shifts to constitute one pass

- Data Buffers:

BUFFA = Write data
BUFFB = First cabinet read buffer
BUFFC = Second cabinet read buffer
BUFFD = Third cabinet read buffer
BUFFE = Fourth cabinet read buffer
BUFFF = Fifth cabinet read buffer
BUFFG = Sixth cabinet read buffer
BUFFH = Seventh cabinet read buffer
BUFFI = Eighth cabinet read buffer

FLAW TABLE ORGANIZATION ON THE DISK

The following entries of the flaw table on each disk are sorted according to the highest priority sort parameter to the lowest priority:

- Defective sector
- Cylinder number
- Head number
- Sector number

The first half of the flaw table contains only defective sector entries. The last full Cray word in the list is all 1's.

ADDING FLAWS TO THE DISK

There are several types of flaws that can be added to the XMD disk; however, they are added in three similar steps. First, the flaws must be found; second, the IDs for the sectors to be flawed must be updated; and third, the flaws must be added to the disk flaw table on the flaw cylinder. Use the following steps to add the original factory flaw table, add flaws from surface analysis, or manually add flaws to the disk.

- Adding the original factory flaw table to the disk:

  1. Find the flaws: Run test section 20. This test reads the factory track headers and creates a flaw table in local memory that includes all the factory flaw information.

2. Write the IDs and add the flaw table to the disk: Run test section 21, format mode 0. This is the formatter. It accomplishes two things: it writes an ID to every ID on the disk; it then writes the complete flaw table to the disk. If a flaw table already exists on the disk, it will be lost.

   Note: Keep in mind that the previous steps are subject to the parameters specified by the user, such as specified spindles, cylinders, and heads. If certain ranges are specified, then only those ranges are processed. It is advisable during this procedure to specify the full ranges.

- Finding flaws with surface analysis:

1. Find the flaws: Run test section 23. This is surface analysis. It may be run on any range of spindles, cylinders, and heads. Surface analysis builds a flaw table in local memory. This flaw table contains all the new flaws found by surface analysis.

2. Write the IDs and add the new flaws to the disk: Run test section 21, format mode 2. This is the formatter. During format mode 2, the formatter writes IDs only to the sectors listed in the previously generated flaw table in local memory. Then, this new flaw table is added to the original flaw table on the disk. This procedure allows you to add flaws to the existing flaw table on the disk.

- Adding flaws manually:

1. Find the flaws: There may be situations where a flaw needs to be added manually, such as when the operating system reports ECC errors on a certain sector. These flaws may be entered using the **AF** command (refer to Part 2, Section 2, "DD40 Commands," which explains the use of the **AF** command and other commands associated with the local memory flaw table).

2. Write the IDs, and add the new flaws to the disk: Once all new flaws are entered into local memory, the formatting is done in the same manner as for surface analysis.

   Note: Use format mode 2 when formatting.

ADDING FLAWS EXAMPLE

After DD40 has been booted and set up to run in the appropriate IOP, the following procedure can be used to add flaws to the user flaw table:

CAUTION
Ensure that all customer data has been removed from the affected disk before performing any off-line flaw management or formatting.

1. Ensure that locations 261 through 267 are all set to 177777.
2. Set the appropriate device channel number at location 260.
3. Set location 220 to 0's to disable all diagnostic sections.
4. Set location 221 to 000002 to invoke Section 21 (Disk Formatting).
5. Set locations 230 and 231 to reflect the spindles to which the flaws are to be added. The sector number of the flaw to be added will determine which spindle's user flaw table will need to be referenced. Sector numbers may differ depending on the source used in determining the media flaw. (Refer to Table 5-1 for sector numbering cross-reference.)
6. Enter the **MC** command to transfer the above changes to the diagnostic residing in local memory.
7. Enter the **LF ch u s** command to load the current user flaw table into local memory.
8. Enter the **VF ch u s** command to view the current user flaw table. The current table can now be examined to determine if the new flaw is being added to a sector with a previous hideable flaw. If so, the new flaw will be added as an unhideable flaw.
9. Enter the **CF ch u s** command to clear the spindle's complete flaw table from local memory. This is necessary because the diagnostic assumes that all flaw entries in local memory are new flaws to be added. When the diagnostic is deadstarted, it will read the user flaw table from the disk and display an error message for any duplicate entries found in local memory. Repeat this step for each spindle enabled in step 5.
10. Enter each new flaw using the **AF ch u s cyln hd sc dfct c d** command. The **dfct** parameter can be any number ranging from 0000 to 0400 for a DD-40 hideable flaw or from 0000 to 1000 for a DD-41 hideable flaw. If the flaw is unhideable, the **dfct** parameter should be set to 0777 for a DD-40 or 1777 for a DD-41 and **d** set to 1 to indicate a defective sector. **c** should be set to 1 for all entries to indicate that the flaw is Cray added.
11. Repeat step 10 for each new flaw added to the spindle(s) that were enabled in step 5.
12. Enter the **VF ch u s** command to examine the flaw table as it currently exists in local memory. This table should now contain only the new flaw(s) that were added in step 10. If a new flaw's parameters were entered incorrectly, they should be removed using the **RF ch u s cyln hd sc dfct c d** command and re-entered correctly (step 10). If all new flaw entries are correct, proceed to step 13.

Table 5-1. DD-40/41 Sector Numbering Cross-reference

	Decimal Sectors	Octal Sectors Sequential	Octal Sectors With Holes	Relative to Spindles Spindle - Sec.	Binary Spindle/Sector
Spindle A	0	0	0	0 - 0	00/0000
	1	1	1	0 - 1	00/0001
	2	2	2	0 - 2	00/0010
	3	3	3	0 - 3	00/0011
	4	4	4	0 - 4	00/0100
	5	5	5	0 - 5	00/0101
	6	6	6	0 - 6	00/0110
	7	7	7	0 - 7	00/0111
	8	10	10	0 - 10	00/1000
	9	11	11	0 - 11	00/1001
	10	12	12	0 - 12	00/1010
	11	13	13	0 - 13	00/1011
Spindle B	12	14	20	1 - 0	01/0000
	13	15	21	1 - 1	01/0001
	14	16	22	1 - 2	01/0010
	15	17	23	1 - 3	01/0011
	16	20	24	1 - 4	01/0100
	17	21	25	1 - 5	01/0101
	18	22	26	1 - 6	01/0110
	19	23	27	1 - 7	01/0111
	20	24	30	1 - 10	01/1000
	21	25	31	1 - 11	01/1001
	22	26	32	1 - 12	01/1010
	23	27	33	1 - 13	01/1011
Spindle C	24	30	40	2 - 0	10/0000
	25	31	41	2 - 1	10/0001
	26	32	42	2 - 2	10/0010
	27	33	43	2 - 3	10/0011
	28	34	44	2 - 4	10/0100
	29	35	45	2 - 5	10/0101
	30	36	46	2 - 6	10/0110
	31	37	47	2 - 7	10/0111
	32	40	50	2 - 10	10/1000
	33	41	51	2 - 11	10/1001
	34	42	52	2 - 12	10/1010
	35	43	53	2 - 13	10/1011
Spindle D	36	44	60	3 - 0	11/0000
	37	45	61	3 - 1	11/0001
	38	46	62	3 - 2	11/0010
	39	47	63	3 - 3	11/0011
	40	50	64	3 - 4	11/0100
	41	51	65	3 - 5	11/0101
	42	52	66	3 - 6	11/0110
	43	53	67	3 - 7	11/0111
	44	54	70	3 - 10	11/1000
	45	55	71	3 - 11	11/1001
	46	56	72	3 - 12	11/1010
	47	57	73	3 - 13	11/1011

Sector numbering used to call out Sector in Error Reports also used by DONUT

Sector numbering used as 2^0- 2^5 in all DD-40 status parcels (hardware format)

Sector numbering used in ID fields and for MDMS and DD40 parameters

CAUTION
Do not enter a 0. Mode 0 can destroy all previous flaws in the spindle's user flaw table.

13. Enter the **RC**, **RD**, and **DS** commands to reset the drive and start the formatting section. The diagnostic will issue warning messages and ask if the current user flaw table should be rewritten; answer YES, and press return. The program will then ask for the desired format mode. Enter a **2** to invoke mode 2 for adding/merging new flaws. Press return and all affected sectors will be reformatted and the updated user flaw table will be written to the drive.

14. Steps 7 and 8 may be repeated at this time to verify that the new flaws were added correctly.

15. If any hideable flaws were added and the affected sector was reformatted, the ECC field for that sector will not represent the data it contains. This means that any read of that sector (including the UNICOS surf utility) will continue to display ECC errors until the new data is written to the reformatted sector. Running surface analysis on the affected sectors can eliminate this problem and verify that the media defect was properly hidden.

16. If any unhideable defects were added, the OS flaw table must also be updated. This can be done by selecting Section 22 (set location 221 to 000004), and issuing an **MC** command followed by a **DS** command.

FLAW TABLE ORGANIZATION IN LOCAL MEMORY

The organization of flaw tables in local memory is similar to the disk flaw table organization. If more than one flaw table is loaded into memory, each table is split into two parts. One contains the defective sector entries, and the other contains the hideable entries. All defective sector parts are stored together and precede all hideable entry parts. This is done so that the flaw table reference routine functions correctly and rapidly.

Since more than one flaw table may be stored in memory, it is necessary to differentiate the flaw tables. Differentiate the flaw tables by specifying the channel, unit, and spindle number for each flaw table entry in local memory during the flaw table load. The unused fields in each 3-parcel entry are used for this purpose. The channel number is located in parcel 1, bits 5 through 0. The unit number is located in parcel 1, bits 7 through 6. The spindle number is located in parcel 2, bits 13 through 12. These values are used only in IOP local memory and are cleared before the flaw table gets written to disk. The flaw table memory is located following the data buffers diagnostic starting at location FLASPC, and extends to the limit of memory. The end-of-table marker is 1777777.

DEFECTIVE SECTOR REFERENCE SUBROUTINE

During disk transfers, it is necessary to keep track of defective sector locations to avoid transfer attempts to them. Upon initial execution of any diagnostic that performs a transfer to disk, the portion of the disk flaw table that contains the defective sector entries is loaded into the flaw table area in local memory. This operation is repeated for each selected spindle and cabinet.

A pointer system is set up by the subroutine so that each selected spindle has three pointers indicating the beginning of its specific table, active pointer, and end. Since each table is sorted in the same order as sequential transfers occur, the active pointer may be bumped forward during transfers.

Initially, the active pointer is set so it points to the first entry after the starting pointer that corresponds to the starting cylinder number specified by the user in the user parameter section. Before every single-sector transfer, the flaw table entry at the active pointer is checked to determine whether the current sector is defective. If the current sector is defective, a flag is set. The active pointer is always updated to keep it ahead of the current sector. The following entry points are used for this subroutine:

- LDFLUD - Active flaw tables loaded from disk, and flaw table pointers set up and initialized
- IDFLUD - Pointers initialized
- CKFLUD - Running index of the flaw table and UD flag set if current sector defective
- ACPOA - All active pointers for all selected cabinets reset
- ACPOS - Active pointers for the current cabinet reset

Update the following parameters before accessing the LDFLUD, IDFLUD, and CKFLUD entry points:

- LDFLUD - User specified cabinets
  DF = Spindle start
  DG = Spindle end
  FR = Flaw table reference enable
- IDFLUD - Unchanged parameters for LDFLUD
- CKFLUD, ACPOA, and ACPOS user specified cabinets
  CG = Current cabinet index
  SN = Current sector number
  SP = Current spindle number
  HN = Current head number
  CI = Current cylinder number
  DF = Spindle start
  DG = Spindle end
  FR = Flaw table reference enable

FLAW TABLE BACKUP AND RESTORE

A feature is available to write a flaw table from local memory to the expander disk. Refer to the **ST** command description in Part 2, Section 2, "DD40 Commands." Refer to the **RT** command for a description of how to restore a flaw table from the expander disk to local memory.

DISPLAYING FLAW TABLE COUNTS

It is useful to know the number of defective sectors and hideable defects on a spindle. The **DC** command displays this information (refer to Part 2, Section 2, "DD40 Commands").

6 - STATUS AND ERROR REPORTING

Local memory locations 12 through 14 contain error information. The user can display these locations to determine the nature of a specific error. This section defines each memory location containing error information.

Each test section also lists errors unique to that test section. Refer to the individual test sections for more detail.

DIAGNOSTIC STATUS AND ERROR INFORMATION

This subsection describes the diagnostic status for the following local memory locations. Error information associated with each location is also described.

Location	Description
12	Current test section
13	Current test condition
14	Error code

The following are the error codes and descriptions for local memory location 14:

1 - Timeout - channel did not complete
2 - Channel error (busy = 1, done = 1)
3 - Channel took too long to finish
4 - Hardware error - check status registers
5 - Unexpected interrupt
6 - Channel busy flag not set early
7 - Channel done flag set early
10 - Status register error
11 - Data compare error
13 - Exit stack underrun (software problem)
14 - The track header defect position is past the logical end of track
15 - No defective sector entries found
16 - No more local memory space available
17 - Chaining broken
20 - Hardware error during chaining- check status registers for error information
21 - Did not get an expected ECC error
22 - Timeout while waiting for an interrupt
23 - Did not get an expected sync timeout
24 - ECC error received, but data compare did not fail
25 - Only defective sectors found

Location	Description
14	Error code (continued)
	26 - OS flaw table buffer overflow 27 - No more local memory space for the active flaw table buffer 30 - End of the flaw table not located 31 - Incorrect flaw table on the current spindle 32 - Flaw table in active memory not found 33 - Out of temporary buffer space 34 - Flaw table entry not found 35 - Flaw table too big for the buffer memory image 36 - Flaw table missing hideable or unhideable defects 37 - Empty disk flaw table 40 - Defective real-time clock 41 - Not enough space on the current spindle track 42 - Clean track on the selected cylinder not found 43 - Seek distance exceeded the last entry of the seek time chart 44 - Factory hideable defect flaw table entries not found 45 - Illegal user-entered parameters 46 - Duplicate entries found in new and old flaw tables 47 - Current read did not start 50 - Done flag did not set 51 - Cabinet is idle
20	Logical difference
21	Actual data
22	Expected data
23	Error count
24	Pass count
25	Location in listing where error occurred
300	Sector address where the error occurred
301	Channel error count
304-307	General error information (refer to DD40/DD41 test descriptions)
310	Channel number in error
311	Cylinder number in error
312	Head number in error
313	Spindle number in error
314	Sector number in error
315	Last cylinder number
324	Local memory address register 0
325	Local memory address register 1
560-577	Exit stack storage area after an error

DISK STATUS AND ERROR INFORMATION

When displaying DD-40/41 and DCU-S1 local memory locations 320 through 324, the program lists the Stat0 through Stat3 descriptions under the memory display area.

The following are the DD-40 Stat0 through Stat3 descriptions:

Location	Description
320	Stat0 (status register 0) contains the following status bits: Bit 0 = Cabinet ready Bit 1 = Cabinet status available Bit 2 = Cabinet busy / invalid command Bit 3 = Cabinet error Bit 4 = Status parity error Bit 5 = Bus-in parity error Bit 6 = Read data parity error Bit 7 = Error flag Bits 8-15 = Parameter register
321	Statl (general status) contains the following status bits in the general status word: Bits 0-3 = Sector number of last error Bits 4-5 = Spindle number of last error Bit 6 = Channel error Bit 7 = Buffer error Bit 8 = Unit ready (DD-40 cabinet) Bit 9 = On-cylinder (DD-40 cabinet) Bit 10 = Seek error (on any of the four spindles) Bit 11 = Spindle fault (on any of the four spindles) Bit 12 = ECC error (sector status of last error) Bit 13 = ID not found (sector status of last error) Bit 14 = Sync timeout (sector status of last error) Bit 15 = Defect parity error (sector status of last error)
322	Stat2 (track buffer status) contains the following status bits in the track buffer status word: Bits 0-3 = Sector number Bits 4-5 = Spindle number Bit 6 = Uncorrectable buffer error Bit 7 = Buffer error Bit 8 = Unit ready (on specified spindle) Bit 9 = On-cylinder (on specified spindle) Bit 10 = Seek error (on specified spindle) Bit 11 = Drive fault (on specified spindle) Bit 12 = ECC error (on specified sector) Bit 13 = ID not found (on specified sector) Bit 14 = Sync timeout (on specified sector) Bit 15 = Defect field parity error (on specified sector)

Location	Description
324	Stat3 (spindle 0 status - fault) contains the following status bits in the spindle status word:

Bits 0-3 = Sector number
Bits 4-5 = Spindle number
Bit 6 = Command error
Bit 7 = DD40 in channel diagnostic mode
Bit 8 = Read and write attempted at same time
Bit 9 = Not on cylinder during read/write
Bit 10 = First seek failed
Bit 11 = Write fault
Bit 12 = Write attempted while write protected
Bit 13 = More than one head active at once
Bit 14 = Low voltage
Bit 15 = Status available

330 Stat4 (spindle 0 status - operating) contains the following status bits in the spindle status word:

Bits 0-3 = Sector number
Bits 4-5 = Spindle number
Bit 6 = Command error
Bit 7 = DD40 in channel diagnostic mode
Bit 8-15 = Operating status code

334 Stat5 (spindle 0 status - unit code) contains the following status bits in the spindle status word:

Bits 0-3 = Sector number
Bits 4-5 = Spindle number
Bit 6 = Command error
Bit 7 = DD40 in channel diagnostic mode
Bit 8-15 = Unit status code

325, 331, 335 (spindle 1 status)
326, 332, 336 (spindle 2 status)
327, 333, 337 (spindle 3 status)

The following is the DCU-S1 Stat0 description:

Location	Description
320	Stat0 (status register 0) contains the following status bits in status register 0: Bit 0 = 0 Bit 1 = 0 Bit 2 = Sync timeout on read or write Bit 3 = ID not found Bit 4 = ID error Bit 5 = Defect parity error Bit 6 = ECC error Bit 7 = Overrun/underrun Bits 8-15 = Drive status
321	Not used
322	Not used
323	Not used
560	(EXT STK) = Exit stack dump

1 - CRAY-2 DIAGNOSTICS OVERVIEW

The diagnostic programs GDTB/GSAB (DD-40), GDTC/GSAC (DD-41), GDTD/GSAD (DD-4R), and GDTE/GSAE (DD-42) run in the foreground processor (FP) of the CRAY-2 computer system using the foreground resident monitor (FRED) program. The maintenance control console (MCC) program that runs in the maintenance control unit (MCU) is the operating system for the diagnostic software.

The diagnostic program CD40/41/4R/42 runs in the background processor using the disk-aid virtual machine (DAVE) program. The DAVE program runs in a CRAY-2 background processor and makes I/O function calls to the foreground resident background diagnostic monitor (BART). DAVE may be run in a single background processor (BP), several BPs, or all BPs simultaneously.

The virtual machine concept in the DAVE program involves the way the hardware and software defines the user's view of the computer and how it appears to run a program. For example, in a computer system with virtual storage, the computer appears to store the entire user program in main memory while it is running, when actually it stores the program in virtual storage; only portions of the program are brought into main memory when they are run.

The DAVE program emulates 100 (octal) registers and 9 buffers in hardware for each external device. It also emulates a separate instruction stack for each device. These virtual machine components are common memory locations that appear to create the registers, buffers, and instruction stacks.

MCC OPERATING MODES

Different operating modes are used for the type of diagnostics running in the CRAY-2 computer system. The MCC program uses the following two modes of operation:

Operating Mode	Description
FP diagnostic mode	Used when running FP-based diagnostics. FRED controls the FP diagnostic and communicates with the MCC program.
BP diagnostic mode	Used when running BP-based diagnostics. BART controls the BP(s) and communicates with the MCC program.

Starting the MCC Program

The MCC program resides in the /user/bin directory on the MCU. The command that calls the MCC program from MS-DOS has the following format:

```
mcc [filename] [-m] [-pfilename] [-spathname] [-t]
```

Examples:

`mcc`	Starts the MCC program in FP mode.
`mcc bp4`	Starts the MCC program and runs the bp4 file. The operating mode may or may not be determined by the execute file.
`mcc -t`	Starts the MCC program and runs it in the test phase. A CRAY-2 computer system does not need to be attached to the personal computer (PC).

Refer to the *CRAY-2 Computer Systems Off-line Diagnostic Reference Manual,* CRI publication number CDM-0201-0A0, for more information on the MCC program.

FOREGROUND RESIDENT MONITOR

The FRED program performs the following functions:

- Provides FP local memory communication with the maintenance control console (MCC)
- Controls the diagnostic code running in the FP

The FRED program is written with the assumption that all nonchannel instructions can issue, and that the first 100 locations of local memory are operational.

Diagnostic code is assembled in conjunction with the FRED program. The FRED program does not wait for any communication to complete before returning to the diagnostic, so the diagnostic program must return to the FRED program to maintain communication with the MCC.

DISK-AID VIRTUAL MACHINE PROGRAM

The DAVE program is a virtual processor that controls up to 32 disk drives (DD-29, DD-40, DD-41, DD-4R, DD-42, or DD-49) or up to four front-end adapter modules on a single channel. The DAVE program has registers, I/O data buffers, an instruction set (disk-aid microcode), and an instruction buffer. The program is assembled by including the monitor at the front of each diagnostic that is written in disk-aid microcode.

The following list contains the virtual device controller specifications.

- Word size: 64 bits
- Instruction size: 64 bits and 128 bits
- Instruction buffer: 2000 octal words, starting at 4000 octal
- Registers: 100 octal registers per device
- I/O buffers: eight 1000 octal word buffers and one 100000 octal word buffer per device

The DAVE program runs in a CRAY-2 BP and makes I/O function calls to the BART program. The DAVE program may be run in a single BP, several BPs, or all BPs simultaneously.

For information on communication between the background processor and external devices, refer to the *CRAY-2 Computer Systems Off-line Diagnostic Reference Manual,* CRI publication number CDM-0201-0A0.

I/O Buffers and Registers

The DAVE program maintains a block of 100 (octal) registers for each device that is controlled. These registers are used as single-word storage locations during execution of a DAVE-based test. Twenty-two of these registers are used by all device types whether they are disk drives, tape drives, etc.; while the rest of the registers are used by specific device types.

The DAVE program also uses nine I/O buffers for each device being controlled. Eight of the I/O buffers are 1000 octal words long and are referenced as B*x*, where *x* is a number 0 through 7. The ninth buffer is 100000 octal words long and is referred to as B8. These buffers are used in a DAVE-based program for large data storage and processing, such as drive sector reads, writes, or compares.

GDTB, GDTC, GDTD, and GDTE OFFLINE DIAGNOSTIC PROGRAMS

The GDTB, GDTC, GDTD, and GDTE offline diagnostic programs run in the CRAY-2 foreground processor using the FRED program.

The CRAY-2 computer system DC module, disk controller, and disk drives are tested by these offline tests. GDTB tests the DC module, DC-40 disk controller, and DD-40 disk drives. GDTC tests the DC module, DC-41 disk controller, and DD-41 disk drives. GDTD tests the DC module, DC-40 disk controller, and DD-4R disk drives. GDTE tests the DC module, DC-40 disk controller, and DD-42 disk drives.

Hardware Limitations and Restrictions

A DC controller module, revision 2,000 or above, must be installed in the foreground processor of the CRAY-2 mainframe. In addition, a DB/DF module must be present on the foreground channel loop associated with the drive being tested.

Loading Instructions

To load the GDTB, GDTC, GDTD, or GDTE diagnostic program, perform the following procedure:

1. Deadstart GDTB , GDTC, GDTD, or GDTE by entering the following command:

   `!GDTB` or `!GDTC` or `!GDTD` or `!GDTE` ↵

2. Enter the **GO** command (`g` ↵).
3. Set parameters as defined in the following entry conditions subsection.
4. Enter the **RESTART** command (`r` ↵).

Entry Conditions

Set the following parameters if they are different than the default value. (Refer to the "Test Section Detailed Description" subsection in this section for the test associated with each specific parameter.)

Location	Label	Parameter being set
070	@IF0	Interface on channel 0 DB/DF module IDs present; default = 1 (for example, 0001 = device ID 40; 0002 = device ID 41; 0003 = device ID 40 and 41)
071	@IF1	Interface on channel 1 DB/DF module IDs selected; default = 1
072	@IF2	Interface on channel 2 DB/DF module IDs selected; default = 1
073	@IF3	Interface on channel 3 DB/DF module IDs selected; default = 1
074	@MS0	Mass storage device. Channel 0 disk drive IDs selected; default = 0 (The lower parcel selects the primary drive and the upper parcel selects the secondary drive. For example, 0001 = ID 100 primary drive; 200002= ID 101 primary drive and ID 100 secondary drive; 600003 = ID 100 and 101 both primary and secondary drives.)
075	@MS1	Mass storage device. Channel 1 disk drive IDs selected; default = 0
076	@MS2	Mass storage device. Channel 2 disk drive IDs selected; default = 0
077	@MS3	Mass storage device. Channel 3 disk drive IDs selected; default = 0

Location	Label	Parameter being set
102	@MODS	Mode select. Run bit/device select; default = 1. Set the following bits:

- Bit 0 - Stop on error
- Bit 3 - DF module select flag; default = 1. Set to 1 when the DF module is used instead of a DB module.
- Bit 5 - Run quick version of ECC test section 22. If bit 5 = 0, test all bits of every word in WBUF. If bit 5 = 1, test 1 bit of every word in WBUF.

CAUTION
Do not use bit 21 under normal test conditions. Errors will result.

- Bit 21 - Continue on time-out error
- Bit 22 - Not used
- Bit 23 - Not used
- Bit 24 - Not used
- Bit 25 - Not used
- Bit 26 - Not used
- Bit 27 - Not used
- Bit 28 - Manual data mode (applies to sections 6, 8, 16, 18, and 20 only)
- Bit 29 - Dump all seven DC-40/DD-40, DC-41/DD-41, DC-40/DD-4R, or DC-40/DD-42 statuses when an error occurs beginning at the STAT parameter location. (The stop-on-error condition must be enabled. Set location SECTOR to dump the desired spindle status. For example, 0 to 13 = spindle 0, 20 to 33 = spindle 1, and so on.) Restart the test after the stop-on-error condition occurs in order to dump statuses. Restart the test a second time to start at the beginning. The following list includes seven STAT parameters.

Location	Label	Parameter being set
102	@MODS (continued)	• STAT+0 = DC-40/41/4R/42 controller status • STAT+1 = Drive status • STAT+2 = Current sector • STAT+3 = Fault status • STAT+4 = Operating status • STAT+5 = Field-replaceable unit • STAT+6 = Device type status • Bit 30 - Dump general status on error at location GSTAT. (The procedure is the same as the procedure used for bit 29.) • Bit 31 - Not used
103	@SECS	Section select; default = 77777577
116	PLMT	Pass limit; default = 10 (Set to 0 for unlimited passes.)
120	CYLBEG	Beginning cylinder; default = 0
121	CYLEND	Ending cylinder (DD-40/4R); default is 2613 (Data cylinders are 0 through 2611; flaw table cylinder = 2612; CE cylinder = 2613.) Ending cylinder (DD-41); default is 3142 (Data cylinders are 0 through 3140; flaw table cylinder = 3141; CE cylinder = 3142.) Ending cylinder (DD-42); default is 5062 (Data cylinders are 0 through 5061; flaw table cylinder = 5061; CE cylinder = 5062.)
122	HEADBEG	Beginning head; default = 0
123	HEADEND	Ending head (DD-40/4R/42); default is 22 (Valid head range is 0 through 22.) Ending head (DD-41); default is 16 (Valid head range is 0 through 16.)
124	SECBEG	Beginning sector; default = 0
125	SECEND	Ending sector; default = 73 (Valid sector range is 0 through 73. **Note:** The sector range must be at least three sectors for sections 18 through 21.)
126	SPINBEG	Beginning spindle (DD-40/4R/42); default = 0 (This parameter is used only in sections 11, 12, and 13.) Beginning spindle (DD-41); default = 0 (This parameter is used only in sections 11, 12, 13, and 23.
127	SPINEND	Ending spindle (DD-40/4R/42); default = 3 (This parameter is used only in sections 11, 12, and 13.)

Location	Label	Parameter being set
127	SPINEND (continued)	Ending spindle (DD-41); default = 3 (This parameter is used in sections 11, 12, 13, and 23.)
134	FCYL	Flaw table cylinder (DD-40); default = 2612 (This is the cylinder number where the flaw table is located; XMD 2 = 2046, XMD 3 = 2612.) Flaw table cylinder (DD-41); default = 3141 (This is the cylinder number where the flaw table is located.) Flaw table cylinder (DD-4R); default = 2612 (This is the cylinder number where the flaw table is located.) Flaw table cylinder (DD-42); default = 5061 (This is the cylinder number where the flaw table is located.)
135	CECYL	CE cylinder (DD-40); default = 2613 (This is the location of the CE cylinder; XMD 2 =2047, XMD 3 = 2613.) CE cylinder (DD-41); default = 3142 (This is the location of the CE cylinder.) CE cylinder (DD-4R); default = 2613 (This is the location of the CE cylinder.) CE cylinder (DD-42); default = 5062 (This is the location of the CE cylinder.)
136	USRCYL	Cylinder used in section 11 only (DD-40/4R); default = 2613 Cylinder used in section 11 only (DD-41); default = 3142 Cylinder used in section 11 only (DD-42); default = 5062
137	PATSEL	Pattern select for sections 8, 16, 18, and 20; default = 17. Set the following bits: • Bit 0 - [enter 1 (octal)] - 0's pattern • Bit 1 - (enter 2) - 1's pattern • Bit 2 - (enter 4) - 1010's pattern • Bit 3 - (enter 10) - Random pattern • Bit 4 - (enter 20) - User pattern (32-bit pattern used is in the USER parameter location)
140	USER	User data pattern for sections 8, 16, 18, and 20; default = 0
165	SMASK	Global status mask; default = 37777777777
220	RANLMT	Random limit. All random parts of this test repeat based on the RANLMT loop counter's value of different random numbers. Used for sections 4, 5, 6, 8, and 13. (default = 100)
441	DEVINA	Input device number corresponding to output device 40; default = 44

Location	Label	Parameter being set
442	DEVINB	Input device number corresponding to output device 41; default = 45
443	DEVINC	Input device number corresponding to output device 42; default = 46
444	DEVIND	Input device number corresponding to output device 43; default = 47

Error Information

If the GDTB, GDTC, GDTD, or GDTE diagnostic program stops with an error, error information is stored in the following local memory locations:

Location	Label	Error information
067	@CPU	Bit mask of current CPU channel
100	@PASC	Pass count (bit 32 set = test done). Allow test to stop itself to ensure the channel is not locked up.
101	@ERRC	Error count
104	@CURS	Section under test
105	@ERJA	Address jumped on error occurrence. The error address is the address of the next executable instruction if an error did not occur. Each subroutine has a unique location <nameR> that contains the return address from the subroutine. If the error address is in a subroutine, the user can trace back in the program to the place that subroutine is called by looking at its return address location.

The previously described procedure may include several subroutine return addresses. The value of bits 27 through 29 may give the following additional error information:

- 01 - Channel time-out error (Did not receive a call/response pulse.)
- 02 - Call data error (Data was in error after a call pulse.)
- 03 - Response data error (See error address for specific type of data error.)
- 05 - Function time out (Disk function time exceeded limits.)
- 10 - Parameter error (See error address for specific type of parameter error.)

Location	Label	Error information
107	@EXPL	Expected data
111	@RECL	Received (actual) data
113	@DIFL	Difference
117	DBID	Channel address of the DB module to be used for data transfer to the disk drive. (If the DF module is used, the DBID parameter is the output device address.)
130	SECTOR	Sector
131	HEAD	Head group
132	CYLNDR	Cylinder
145	EDATA0	Expected data buffer [10 octal local memory (LM) words]
155	ADATA0	Actual data buffer (10 octal LM words)
166	FUNC	Channel function
167	PARAM	Channel function parameter
170	BUFFER	This location is used to indicate which buffer on the DC module is currently being used in test section 4. (0 = buffer A, 1 = buffer B)
171	DCID	Current DC module ID (0 = ID 100, 1 = ID 101, etc.)
227	GSTAT	General status (Dump general status on error at location GSTAT.)
230	STAT	Seven decimal disk statuses
240	SECPAS	Section pass count (Information in this location is used in sections 4, 5, 6, 8, and 13. It is set equal to the value of the RANLMT loop counter and then decremented with each pass through the section or random part of the section.)
273	TOCNT	Time-out count (This location records the number of times the test continues after a time-out error occurs.)
1000	WBUF	Write buffer (2000 octal LM words)
3000	RBUF1	Read buffer 1 (2000 octal LM words)

Location	Label	Error information
5000	RBUF2	Read buffer 2 (2000 octal LM words)

Test Section Detailed Description

The following list describes test sections in the CRAY-2 GDTB, GDTC, GDTD, and GDTE diagnostic programs:

- Section 0 (enter `0000001` for the @SECS parameter) - Clear EA and EB statuses. Deselect this section if EA and EB modules are not present by clearing bit 2^0 (enter `@SECS = 0000000`).
- Section 1 (enter `0000002` for the @SECS parameter) - Clear DB/DF status for all DB/DF modules.
- Section 2 (enter `0000004` for the @SECS parameter) - Check for channels cleared. This test section allows the user to verify that no channel node has an interrupt pending.
- Section 3 (enter `0000010` for the @SECS parameter) - Check controller status. This section allows the user to verify that the DC module has no errors.
- Section 4 (enter `0000020` for the @SECS parameter) - Buffer echo test. This test section uses the buffer echo mode to test buffer A and B on the DC module with 0's, 1's, and random data.
- Section 5 (enter `0000040` for the @SECS parameter) - Diagnostic parameter echo test. This test performs an echo test that uses a walking 1's pattern, a walking 0's pattern, and random data from the DC module to the DC-40/41. The RANLMT loop counter's value of random patterns are tested.
- Section 6 (enter `0000100` for the @SECS parameter) - Reads or writes 16 parcels to or from the track buffer with fixed and random data. The 16-parcel transfer writes to a buffer at EDATA0 and reads to a buffer at ADATA0. After the write and read completes the two buffers are compared. The RANLMT loop counter's value of random data patterns are used in this test.
- Section 7 (enter `0000200` for the @SECS parameter) - Track buffer SECDED test.

  Note: The SECDED TEST/NORM switch on the DC-40/41 control panel must be set to the TEST position for this section. **This section should be run alone for correct operation of the test or errors will result.**

  This test section performs a write test to the track buffer using the 16-parcel write buffer function. The SECDED test switch on the DC-40/41 control panel is set to the TEST position during this test. As a result, the DC-40/41 generates all 0's for SECDED. The test data consists of only 1 bit set in the 16 parcels. The data is then read from the track buffer using the 16-parcel read buffer function. A drive error is expected in the DC controller status and a buffer error is expected in the DC-40/41 controller status. The error correction logic should also have toggled the bit set in the test data. This procedure is repeated for all bits in the 16 parcels.

- Section 8 (enter 0000400 for the @SECS parameter) - Full-track buffer memory data test. This test section uses data patterns selected by the PATSEL parameter to write to all sectors of the full-track buffer and reads and compares each pattern.

- Section 9 (enter 0001000 for the @SECS parameter) - Full-track buffer memory addressing test. This test section writes two addressing patterns to the full-track buffer. The test reads and checks data after each pattern. The first address pattern has the sector number in all odd-numbered parcels and the parcel number in all even numbered parcels. The second address pattern is just the opposite, with the sector number in the even-numbered parcels and the parcel number in the odd-numbered parcels.

- Section 10 (enter 0002000 for the @SECS parameter) - Basic drive functionality test. This test section performs some basic drive functions for timing and correct status. The functions are select, clear faults, return to zero (RTZ), reset, and release.

- Section 11 (enter 0004000 for the @SECS parameter) - Head select test. This test section performs and tests the head select function for all heads in the selected range. A head select is performed and then a sector ID is read from each spindle in the drive. The head number is decoded from the sector ID and compared to the selected head. The user can limit the spindle range from which an ID is read with the SPINBEG and SPINEND parameters.

- Section 12 (enter 0010000 for the @SECS parameter) - Cylinder select test. This test section performs and tests the cylinder select function for all cylinders in the selected range. A cylinder select is performed and then a sector ID is read from each spindle in the drive. The cylinder is decoded from the sector ID and compared to the selected cylinder. The user can limit the spindle range from which an ID is read with the SPINBEG and SPINEND parameters.

- Section 13 (enter 0020000 for the @SECS parameter) - Random cylinder, head, and sector select test. This test section randomly performs cylinder and head selects in the selected head and cylinder range. A cylinder and head select are performed and then a sector ID is read from each spindle in the drive. The cylinder and head are decoded from the sector ID and compared to the selected cylinder and head. The RANLMT parameter determines the number of selects that will be performed. The user can limit the spindle range from which an ID is read with the SPINBEG and SPINEND parameter values.

- Section 14 (enter 0040000 for the @SECS parameter) - Bus-in and status-in parity errors test. This test section forces bus-in and status-in parity errors with the diagnostic function. The status is read to verify the errors.

- Section 15 (enter 0100000 for the @SECS parameter) - Seek timing test. This section tests the timing of one stroke (1 cylinder), average stroke (731 cylinders), and full stroke (2613 cylinder) seeks. The time calculated for each seek must fall into a specific range.

- Section 16 (enter 0200000 for the @SECS parameter) - Write/read single sector mode data test with data compare. This test section writes data patterns selected by the PATSEL parameter value to all sectors of the first track of the CE cylinder and reads and compares each pattern. All reads and writes are single sector reads and writes. The track is selected with the HEADBEG parameter value and the sector range is determined by SECBEG and SECEND parameter values.

- Section 17 (enter 0400000 for the @SECS parameter) - Write/read single sector mode address with data compare test. This test section is the same as section 16, except two addressing patterns are used for data. The first address pattern places the sector number in all odd numbered parcels and the parcel number in all even numbered parcels. The second address pattern is just the opposite, with the sector number in the even-numbered parcels and the parcel number in the odd-numbered parcels.

- Section 18 (enter 1000000 for the @SECS parameter) - Continue write data with data compare test. This test section writes data patterns selected by the PATSEL parameter to all of the CE cylinders and reads and compares each pattern. The data is written in continue mode and then is read in single sector mode. The head and sector range can be narrowed within the CE cylinder with the HEADBEG, HEADEND, SECBEG, and SECEND parameter values.

- Section 19 (enter 2000000 for the @SECS parameter) - Continue write address with data compare test. This test section is the same as test section 18, except two addressing patterns are used for data. The first address pattern has the sector and head number in all odd-numbered parcels and the parcel number in all even numbered parcels. The second address pattern is just the opposite, with the sector and head number in the even-numbered parcels and the parcel number in the odd-numbered parcels.

- Section 20 (enter 4000000 for the @SECS parameter) - Continue write/read data with no data compare test. This test section writes data patterns selected by the PATSEL value to all of the CE cylinder and then reads but does not compare the data. The data is written and read in continue mode. The head and sector range can be narrowed within the CE cylinder with the HEADBEG, HEADEND, SECBEG, and SECEND parameter values. Data is not compared in this section because the length of time required to transfer data into the foreground is too great and the foreground also lacks local memory to buffer all of the data.

- Section 21 (enter 10000000 for the @SECS parameter) - Continue write/read address test with data compare. This test section writes an addressing pattern to all of the CE cylinder and then reads and compares only the first 32 bits in each sector. The data is written and read in continue mode. Only the first 32 bits of data are read and compared, as in section 20. These 32 bits from each sector are buffered, starting at the RBUF1 parameter value. The head and sector range can be narrowed within the CE cylinder with the HEADBEG, HEADEND, SECBEG, and SECEND parameter values.

- Section 22 (enter 20000000 for the @SECS parameter) - Error correction test. This test section creates a write buffer in local memory at the WBUF parameter. Only 1 bit is set in the write buffer. The data in this buffer is then written to the CE cylinder using the write with zero ECC function. This write function creates a syndrome for that sector that corresponds to a data sector of all 0's. The sector is then read into local memory at both RBUF1 and RBUF2 locations.

After the read operation, the general status should indicate an ECC error. The test then performs a compute and transfer correction vectors function. The correction vectors are tested for the legal range of the masks and parcel offsets. The correction vectors are then applied to the read buffer at the RBUF2 location.

Application of the correction vectors should result in a read buffer (RBUF2) parameter value of all 0's. If an error occurs, the user should visually inspect the RBUF1 parameter to ensure that the error occurred in the ECC logic rather than on the read function; the RBUF1 value should equal the WBUF value. If no error is found, the bit in the WBUF parameter is shifted to the bit position and the test is repeated. This operation is done until all bits are tested. After all bits are tested, an uncorrectable error is created using the write with zero ECC function. The correction vectors are computed and tested to see if they indicate an uncorrectable error.

- Section 23 (enter `@SECS = 40000000`) - Defect pad address test. This test section checks the ability of the logic to correctly address all possible defect pad addresses. The test first searches the sector IDs for the first perfect sector in the CE cylinder. This sector is then used as the test sector.

  Note: If this test section fails, it may leave a sector on the CE cylinder with an incorrect ID. Reformat the CE cylinder using the GSAB or GSAC diagnostic program.

  A new ID is written to the test sector, starting with a defect address of 0. The sector is then written with all 1's from the local memory buffer at the WBUF parameter. The test then reads the sector with a normal single sector read. The data is verified to be all 1's. The test now writes a new ID to the test sector with no defect address. Another normal single sector read is performed. This time the defect pad area, addressed by the first ID written, should show the data as all 0's. The tested defect address is incremented by 1 and the test is repeated until all possible defect addresses are tested (0 through 377).

GSAB, GSAC, GSAD, and GSAE OFFLINE DIAGNOSTIC PROGRAMS

The GSAB, GSAC, GSAD, and GSAE offline diagnostic programs run in the CRAY-2 foreground processor using the FRED program.

The GSAB, GSAC, GSAD, and GSAE offline diagnostic programs are used for surface analysis and for formatting DD-40, DD-41, DD-4R, and DD-42 disk drives respectively.

Hardware Limitations and Restrictions

A DC controller module, revision 2,000 or above, must be installed in the foreground processor. In addition a DB/DF module must be present on the foreground channel loop associated with the drive being tested.

Loading Instructions

To load the GSAB, GSAC, GSAD, or GSAE diagnostic, perform the following procedure:

1. Deadstart GSAB, GSAC, GSAD, or GSAE by entering the following command:

   `!GSAB or !GSAC or !GSAD or !GSAE` ↵

2. Enter the **GO** command (g ↵).
3. Set parameters as defined in the following "Entry Conditions" subsection.
4. Enter the **RESTART** command (r ↵).

Entry Conditions

Set the following parameters if different than the default value: (See the "Test Section Detailed Description" subsection for the test section associated with each specific parameter.)

Location	Label	Parameter being set
070	@IF0	Interface on channel 0 DB/DF module IDs present; default = 1 (for example, 0001 = device ID 40; 0002 = device ID 41; 0003 = device ID 40 and 41)
071	@IF1	Interface on channel 1 DB/DF module IDs selected; default = 1
072	@IF2	Interface on channel 2 DB/DF module IDs selected; default = 1
073	@IF3	Interface on channel 3 DB/DF module IDs selected; default = 1
074	@MS0	Mass storage device. Channel 0 disk drive IDs selected; default = 0 (The lower parcel is used to select the primary drive and the upper parcel is used to select the secondary drive. For example, 0001 = ID 100 primary drive; 200002 = ID 101 primary drive and ID 100 secondary drive; 600003 = ID 100 and 101 for both primary and secondary drives.)
075	@MS1	Mass Storage device. Channel 1 disk drive ID's selected; default = 0
076	@MS2	Mass Storage device. Channel 2 disk drive ID's selected; default = 0
077	@MS3	Mass Storage device. Channel 3 disk drive ID's selected; default = 0

Location	Label	Parameter being set
102	@MODS	Mode Select. Run bit/device select; default = 1. Set the following bits as shown:

- Bit 0 - Stop on error
- Bit 3 - DF module select flag; default = 1. Set to 1 when the DF module is used instead of a DB module.

CAUTION

Do not use bit 21 under normal test conditions. Errors will result.

- Bit 21 - Continue on time-out error.
- Bit 22 - Read the ETABLE and STABLE values from disk on first pass (This bit is only used in sections 5 and 6. If the bit is clear, the section will start with empty error tables. If the bit is set, it is assumed there are already existing error tables on the disk from a previous pass of section 5.)

  Note: Sections 5 and 6 are not designed to run consecutively with the following bit 22 clear.
- Bit 23 - Read raw spindle flaw table to the FLAW local memory location (section 14 only)
- Bit 24 - Read unhideable flaws from spindle in a readable format to the FLAW local memory location (section 14 only)
- Bit 25 - Read hideable flaws from spindle in a readable format to the FLAW local memory location (section 14 only)
- Bit 26 - Allow surface analysis or formatting on CE cylinder (This bit must be set if sections 5 or 7 are selected and the CE cylinder is in the cylinder range selected by the CYLBEG and CYLEND parameters.)
- Bit 27 - Allow surface analysis or formatting on flaw table cylinder (This bit must be set if sections 5 or 7 are selected and the flaw table

Location	Label	Parameter being set
102	@MODS (continued)	cylinder is in the cylinder range selected by the CYLBEG and CYLEND parameters.)

CAUTION

Do not perform surface analysis or disk formatting on the flaw table cylinder. Set the correct cylinder limits so that the flaw tables are not lost or destroyed. Cylinders 2612 (XMD 3) and 2046 (XMD 2) contain the disk drive flaw tables.

- Bit 28 - Not used
- Bit 29 - Beginning at the STAT local memory location dump all seven DC-40/DD-40, DC-41/DD-41, DC-40/DD-4R, or DC-40/DD-42 statuses when an error occurs. (The stop-on-error condition must be enabled. Restart the test after the stop-on-error condition occurs to dump statuses. Restart the test a second time to restart at the beginning of the test.) The following values are the seven STAT values:
  - STAT+0 = DC-40/41 controller status
  - STAT+1 = Drive status
  - STAT+2 = Current sector
  - STAT+3 = Fault status
  - STAT+4 = Operating status
  - STAT+5 = Field replaceable unit
  - STAT+6 = Device type status
- Bit 30 - Dump general status on error at the GSTAT location. (The procedure is the same as the procedure used for bit 29.)
- Bit 31 - Not used

103	@SECS	Section select; default = 417
116	PLMT	Pass limit; default = 1 (Set to 0 for unlimited passes.)
120	CYLBEG	Beginning cylinder; default = 0

Location	Label	Parameter being set
121	CYLEND	Ending cylinder (DD-40/4R); default = 2613 (Data cylinders are 0 through 2611; flaw table cylinder = 2612; the CE cylinder is 2613.) Ending cylinder (DD-41); default = 3140 (Data cylinders are 0 through 3140; flaw table cylinder =3141; the CE cylinder is 3142.) Ending cylinder (DD-42); default = 5062 (Data cylinders are 0 through 5060; flaw table cylinder =5061; the CE cylinder is 5062.)
122	HEADBEG	Beginning head; default = 0
123	HEADEND	Ending head (DD-40/4R/42); default = 22 (The valid head range is 0 through 22.) Ending head (DD-41); default = 16 (The valid head range is 0 through 16.)
124	SECBEG	Beginning sector; default = 0
125	SECEND	Ending sector; default = 73 (The sector range, as defined by the SECBEG and SECEND parameters, cannot define a range of less than three sectors.)
126	SPINBEG	Beginning spindle; default = 0 (This parameter is only used in test section 4.)
127	SPINEND	Ending spindle; default = 3 (This parameter is only used in test section 4.)
130	FCYL	Flaw table cylinder (DD-40); default = 2046 - XMD 2; 2612 - XMD 3 Flaw table cylinder (DD-41); default = 3141 Flaw table cylinder (DD-4R); default = 2612 Flaw table cylinder (DD-42); default = 5061
131	CECYL	CE cylinder (DD-40); default = 2047 - XMD 2; 2613 - XMD 3 CE cylinder (DD-41); default = 3142 CE cylinder (DD-4R); default = 2613 CE cylinder (DD-42); default = 5062
136	PATSEL	Pattern select; default is 77. (This parameter is only used for test section 5.) Set the following bits to select the corresponding patterns:

Bit	Pattern
0	133333 066666 155555
1	066666 155555 133333
2	155555 133333 066666
3	163471 147144
4	021222 024442

Location	Label	Parameter being set
136	PATSEL (continued)	Bit / Pattern 5 random data 6 user data pattern (See the PATTERN parameter.)
137	PATTERN	User data pattern
140	RSEC	Read sector for sections 9 and 11
141	RHEAD	Read head for section 9
142	RCYL	Read cylinder for section 9
143	RADD	Local memory address for read data for sections 9 and 11 (default = 0); set this parameter to 4000 before you run any diagnostic program.

CAUTION

Before you run any diagnostic program, set RADD to 4000 to prevent the diagnostics from writing over any data or code.

144	WSEC	Write sector for sections 10 and 12
145	WHEAD	Write head for section 10
146	WCYL	Write cylinder for section 10
147	WADD	Local memory address for write data for sections 10 and 12 (default = 0); set this parameter to 6000 before you run any diagnostic program.

CAUTION

Before you run any diagnostic program, set WADD to 6000 to prevent the diagnostics from writing over any data or code.

150	SPINDLE	Spindle number (section 14 only)
151	MINCNT	Minimum error count needed for an error in the ETABLE parameter to be placed in the flaw table in section 6; default = 2

Location	Label	Parameter being set
152	MAXCNT	Maximum number of times section 4 will try reading a track header if an error occurs on the read; default = 10
200	SMASK	Global status mask; default = 37777777777
151	MINCNT	Minimum error count needed for an error in the ETABLE parameter to be placed in the flaw table in section 6; default = 2
152	MAXCNT	Maximum number of times section 4 will try reading a track header if an error occurs on the read; default = 10
200	SMASK	Global status mask; default = 37777777777
330	DLEN	Defect length used to determine a hideable or unhideable flaw in section 5; default = 20
500	DEVINA	Input device number corresponding to output device 40; default = 44 (DD-40)
502	DEVINA	Input device number corresponding to output device 40; default = 44 (DD-41/4R/42)
501	DEVINB	Input device number corresponding to output device 41; default = 45 (DD-40)
503	DEVINB	Input device number corresponding to output device 41; default = 45 (DD-41/4R/42)
502	DEVINC	Input device number corresponding to output device 42; default = 46 (DD-40)
504	DEVINC	Input device number corresponding to output device 42; default = 46 (DD-41/4R/42)
503	DEVIND	Input device number corresponding to output device 43; default = 47 (DD-40)
505	DEVIND	Input device number corresponding to output device 43; default = 47 (DD-41/4R/42)

Error Information

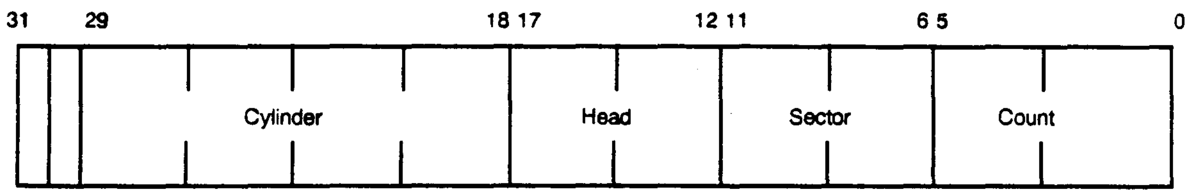
If the GSAB, GSAC, GSAD, or GSAE diagnostic program stops with an error, error information is stored in the following local memory locations:

Location	Label	Error information
067	@CPU	Bit mask of current CPU channel
100	@PASC	Pass count (Bit 32 set = test done. Allow the test to stop itself to ensure that the channel is not locked up.)
101	@ERRC	Error count
104	@CURS	Section under test

Location	Label	Error information
105	@ERJA (continued)	Address jumped on error occurrence. (The error address will be the address of the next executable instruction if an error did not occur. Each subroutine has a unique location <nameR> that contains the return address from the subroutine. If the error address is in a subroutine, the user can trace back in the program to where that subroutine is called by looking at the subroutine's return address location. This procedure may include several subroutine return addresses.) The value of bits 27 through 31 gives the following additional error information: • 01 - Channel timeout error (A call/response pulse was not received.) • 02 - Call data error (Data error occurred after a call pulse.) • 03 - Response data error (See error address for specific type of data error.) • 05 - Function timeout (Disk function time exceeded limits.) • 10 - Parameter error (See error address for specific type of parameter error.) • 11 - Program error • 12 - Error table full (STABLE or ETABLE parameters) • 13 - Fatal seek error
107	@EXPL	Expected data
111	@RECL	Actual data
113	@DIFL	Difference
117	DBID	Channel address of the DB module to be used for data transfer to the disk drive. (If the DF module is used, the DBID parameter is the output device address.)
132	SECTOR	Sector
133	HEAD	Head group
134	CYLNDR	Cylinder
160	EDATA0	Expected data buffer [10 (octal) local memory (LM) words]
170	ADATA0	Actual data buffer (10 LM words)
201	FUNC	Channel function
202	PARAM	Function parameter

Location	Label	Error information
216	DCID	Current DC module ID
251	GSTAT	General status. Dump general status on error at location GSTAT.
252	STAT	This location contains seven (decimal) disk statuses
600	STABLE	Seek error table (100 LM words)

The following format is used for the seek error table.

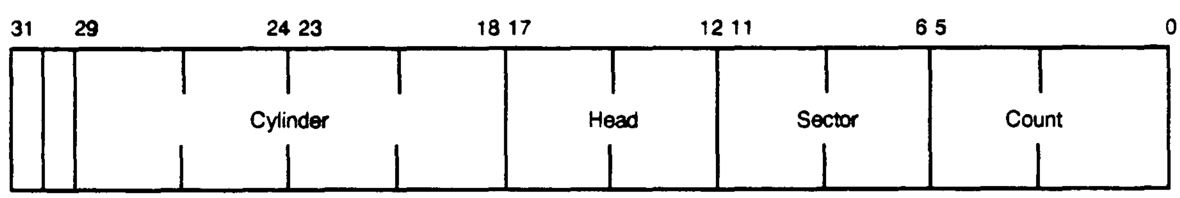


The following list describes how the bits are used in the seek error table.

Bits	Description
29 through 18	Cylinder
17 through 12	Head
11 through 6	Sector
5 through 0 (Bits will always = 1 or 2)	Error count

700	ETABLE	Error table (1,200 LM words). The 2-word format for the error table is shown below.
2000	FLAW	Beginning of flaw table (may be up to 6,000 LM words)
4000	RBUF	Read buffer (2,000 LM words)
6000	WBUF	Write buffer (2,000 LM words)

The following format is the ETABLE format for word N (even).

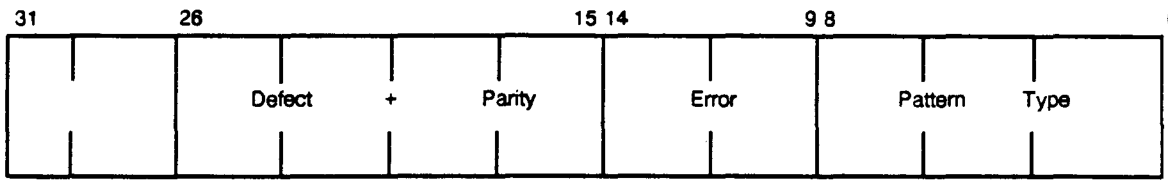


The following list describes how the bits are used for the word N ETABLE format.

Bits	Description
31 (used only in section 6)	Remove flaw flag
29 through 18	Cylinder

Bits	Description
17 through 12	Head
11 through 6	Sector
5 through 0 (maximum count = 77)	Error count

The following format is the ETABLE format for word N + 1 (odd):



The following list describes how the bits are used in the word N+1 ETABLE format:

Bits	Description
26 through 15	Defect pad + parity
26 through 18 (DD-40)	Defect pad address
26 through 17 (DD-41)	Defect pad address
17 through 15 (DD-40)	Defect pad parity
16 through 15 (DD-41)	Defect pad parity
14 through 9	Error type: 1 - ECC error; 2 - ID not found error; and 4 - sync timeout error
8 through 0	Pattern type (refer to PATSEL parameter definition for pattern type bit masks)

Note: Display STABLE and ETABLE tables in half-word format. The different fields are on digit (3-bit) boundaries so they are easy to read if displayed in half-word format.

Test Section Detailed Description

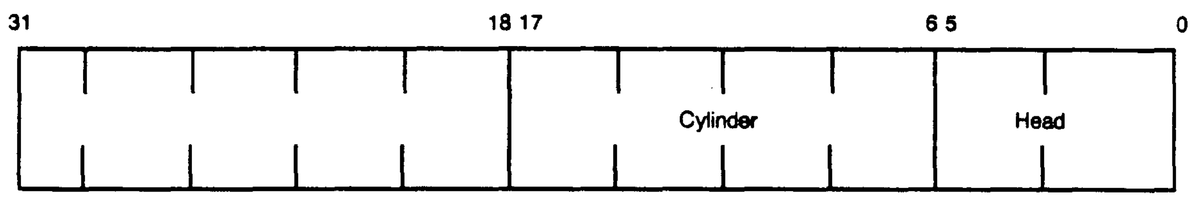
The following list describes test sections in the GSAB, GSAC, GSAD, and GSAE diagnostic programs.

- Section 0 - Clear EA and EB statuses. Deselect this section if EA and EB modules are not present by clearing bit 2^0 (enter `@SECCS = 0000000`).
- Section 1 - Clears DB/DF status for all DB/DF modules.
- Section 2 - Check for channels cleared. This test section allows the user to verify that no channel node has an interrupt pending.
- Section 3 - Check controller status. This test section allows the user to verify that the DC module has no errors.

- Section 4 - Initialize disk. This test section reads all the track headers and assembles a flaw table. The test then formats the flaw table and CE cylinders and writes the flaw table to the flaw table cylinder. This test is performed on a per spindle basis. Any spindle range (from all spindles to one spindle) can be selected using the SPINBEG and SPINEND parameters.

  After the test has assembled the flaw table and before it formats the flaw table and CE cylinders, the test halts. The user then has the opportunity to examine the flaw table and/or dump the flaw table to floppy disk before the flaw table and CE cylinders are formatted and the track headers are destroyed. The flaw count contained in the FLWCNT local memory location can be compared to the total flaw count given in the manufacturer's flaw data. This test also enables the user to see if there are any track headers that cannot be read.

  The list of track headers created in test section 4 begins at the ETABLE location and is in the following format:



  Issue a **RESTART** command to continue the test after a scheduled halt.

  Note: Section 4 is disabled for the GSAD and GSAE diagnostic programs.

- Section 5 - Surface analysis. This test section performs surface analysis on the disk by writing and reading different data patterns. The test first initializes the STABLE and ETABLE error tables. By default the test starts with empty error tables. If the error tables already exist on the drive, the user must set bit 22 of the @MODS parameter to read the error tables from CE cylinder, sector 0, heads 0 through 22. The test then writes the entire cylinder and head range that is selected by the user with a data pattern using the continue write mode. The section then reads the same data using the continue read mode. If a drive error is detected on the read status, the appropriate statuses are examined and the error is recorded in the ETABLE error table. The ETABLE and STABLE error tables are stored at the end of this test section on the CE cylinder, sector 0, using all heads.

- Section 6 - Edit flaws in flaw table. This section uses the entries in the ETABLE location to edit the flaw table. Bit 22 in the @MODS parameter enables the use of the error table created by this test section or an empty error table. After issuing a **RESTART** command, the test stops in this test section and enables the user to edit the error table in order to add or delete flaws from the disk drive flaw table. All entries in the error table with an error count greater than or equal to the MINCNT parameter value are added to the flaw table.

All entries in the error table with bit 31 set are deleted from the flaw table regardless of the error count. To delete a flaw, ensure that the defect pad and parity match the data in the flaw table. After the error table is edited, use the **RESTART** command to add or delete the indicated flaws to or from the disk drive flaw table.

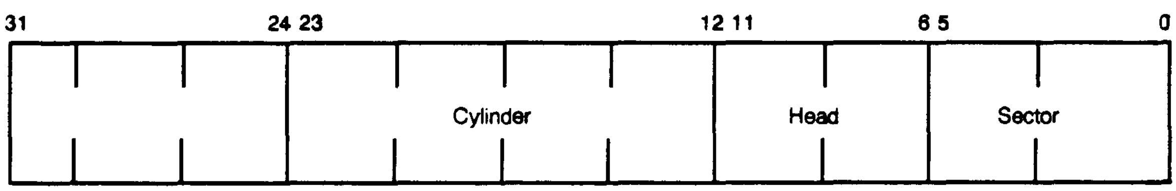
- Section 7 - Write IDs using flaw table. This test section formats the drive (writes IDs) within the cylinder, head, and sector range selected by the user.

- Section 8 - Read and verify IDs. This test section reads and checks the sector IDs within the cylinder, head, and sector range selected by the user. If an error is encountered in an ID with no defect or an ID with a hideable defect, the test stops and provides error information. If an error is found in an ID with an unhideable defect, the test will log that error information at the ETABLE parameter and continue.

  An unhideable ID should contain all 1's in the ID field. The reason the test does not stop for an error on an unhideable ID is because a sector is considered to have an unhideable defect if the bad area in the media falls within the ID field. Therefore, when an ID is read from an unhideable sector it is possible the drive is trying to read the ID from a bad spot in the media and the results are not as expected or there is a sync timeout error.

  The following four formats are used for the unhideable ID error table: word N, word N+1, word N+2, and word N+3. The word N error table is encoded from the sector location of the error. The format of the word N+1 error table shows the expected value for the first 32 bits of an unhideable ID if the error is an ID miscompare. The expected value is 0 if the error is a sync timeout error. The left half of the word N+2 error table shows the expected value of the last 16 bits of an unhideable ID if the error is an ID miscompare. The expected value is 0 if it is a sync timeout error. The word N+3 error table is a filler word of 0's if the error is an ID miscompare. The word N+3 error table contains general and controller status if a sync timeout error occurs.

  The following format is used for the word N unhideable ID error table:



  The following list describes how the bits are used in the word N unhideable ID error table:

Bits	Description
31 through 24	Not used
23 through 12	Cylinder
11 through 6	Head
5 through 0	Sector

The following format is used for the word N + 1 unhideable ID error table.

31 … 0
ID / 0's

If an ID miscompare occurs, the ID is contained in bits 31 through 0 with an expected value of 37777777777. If a sync timeout occurs, bits 31 through 0 equal 0's.

The following format is used for the word N + 2 unhideable ID error table.

31 … 16	15 … 0					
ID / 0's	0	0	0	0	0	0

If an ID miscompare occurs, the ID is contained in bits 31 through 16 with an expected value of 37777600000. If sync timeout occurs, bits 31 through 0 equal 0's.

The following format is used for the word N + 3 unhideable ID error table:

31 … 0
0's / General Status and Controller Status

If an ID miscompare occurs, bits 31 through 0 equal 0's. If a sync timeout occurs, bits 31 through 16 equal general status information; bits 15 through 0 equal controller status information.

- Section 9 - Read data sector. This test section reads the sector determined by the contents of the RCLY, RHEAD, and RSEC parameters. The sector data read is placed at the local memory location in the RADD parameter.
- Section 10 - Write data sector. This test section writes to the sector determined by the contents of the WCYL, WHEAD, and WSEC parameters. The sector data is read from the local memory location for the WADD parameter.
- Section 11 - Read track buffer sector. This test section reads the track buffer sector determined by the contents of the RSEC parameter.

- Section 12 - Write track buffer sector. This test section writes the track buffer sector determined by the contents of the WSEC parameter.

- Section 13 - Dump general status and the selected drive statuses for sectors 0 through 73. The general status is in the GSTAT parameter location, and the selected drive statuses begin at the FLAW parameter location. Each sector's statuses can be found with the following equation: FLAW location + (sector × 10). For example, sector 43's statuses are at the FLAW location plus 430. It is assumed that the drive has stopped on an error and the drive is still selected.

  Note: Do not run test section 13 if the drive error was a channel or function timeout since this may cause more errors. In addition, no other test sections can be selected when section 13 is running if the results from section 13 are to be meaningful error data.

- Section 14 - Read spindle flaw table. This test section has two purposes: first, it provides a method of saving a raw spindle flaw table on floppy disk; second, it allows the user to display the unhideable and/or hideable flaws of a spindle in a readable format. This information can also be sent to the printer or stored on a floppy disk. Refer to bits 23 through 25 of the @MODS parameter for the selection of the type of flaw table to be displayed. The spindle is selected by the value (0 through 3) in the SPINDLE parameter.

  It is possible to display one, two, or all three flaw tables (raw, unhideable, and hideable) with one pass through the section. If all three tables are selected, the first table to be displayed will be the raw spindle flaw table beginning at the value in the FLAW parameter. Issuing a **RESTART** command displays the unhideable flaws in a readable format. Issuing another **RESTART** command displays the hideable flaws.
  Load the backed-up flaw table from floppy disk into local memory to restore flaw tables that have been destroyed. Then use test section 10 to restore the flaw table one sector at a time.

  A 3-parcel format is used for the raw flaw table in this test section. The following format is the parcel 0 raw flaw table format:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CA	UD			Head				Cylinder (Upper)							

The following format is the parcel 1 raw flaw table format:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Cylinder				Sector				Not Used							

The following format is the parcel 2 raw flaw table format:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Not Used				Defect Pad									Parity		

The unhideable and hideable flaw table two-word format is as follows. Each field is on a 3-bit (octal digit) boundary making it easy to read if displayed in half-word format.

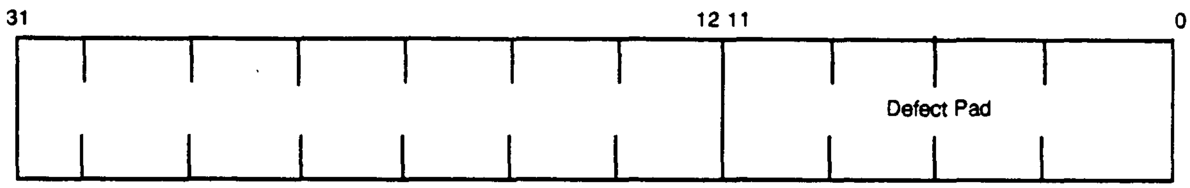
The following format is the unhideable and hideable flaw table format for word N (even):

31–24	23–12	11–6	5–0
	Cylinder	Head	Sector

The following list describes how the bits are used in the word N unhideable and hideable ID error table:

Bits	Description
31 through 24	Not used
23 through 12	Cylinder
11 through 6	Head
5 through 0	Sector

The following format is the unhideable and hideable flaw table format for word N + 1 (odd):



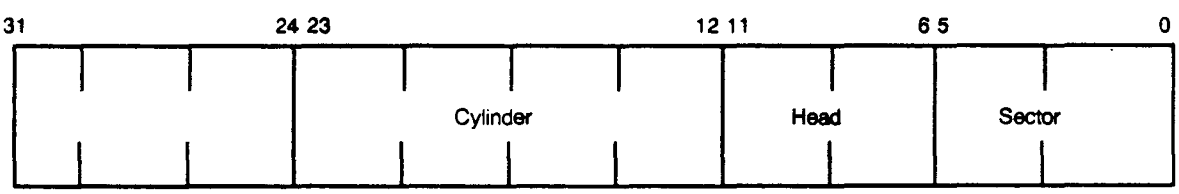
The following list describes how the bits are used in the word N+1 unhideable and hideable ID error table:

Bits	Description
31 through 12	Not used
11 through 0	Defect pad + parity

Note: When storing the spindle flaw table on floppy disk, it is recommended that the flaw table is prefaced with the spindle serial number in 4 parcels. For example, if the spindle serial number is 382, the FLAW location minus 2 and the FLAW location minus 1 would be 000000 000003 and 000010 000002, respectively. Write the flaw table to disk locations FLAW minus 2 through FLAW location plus 5777.

- Section 15 - Display DD-40/41/4R/42 unhideable flaws in a readable format. This test section assembles, sorts, and displays the unhideable flaws from all spindles in a DD-40/41/4R/42 drive. The table is displayed beginning at the location specified in the FLAW parameter.

The following format is the unhideable flaw table format:



The following list describes how the bits are used in the unhideable flaw table:

Bits	Description
31 through 24	Not used
23 through 12	Cylinder
11 through 6	Head
5 through 0	Sector

CD40/41/4R/42 OFFLINE DIAGNOSTIC PROGRAMS

The CD40/41/4R/42 diagnostic programs run in the CRAY-2 background processor using the BART program.

The CD40/41/4R/42 diagnostic programs are comprehensive tests for the DD-40/41/4R/42 disk drives, DC-40/41 disk controllers, and DC controller module.

Hardware Limitations and Restrictions

The CD40/41/4R/42 diagnostic programs test only those drives connected to the channel where CD40/41/4R/42 is loaded. To test drives on other channels, load CD40/41/4R/42 into the respective CPU and run as described in this subsection. The CD40/41/4R/42 diagnostic programs may be loaded and run in all CPUs simultaneously if desired. Refer to Section 9 of the *CRAY-2 Computer Systems Off-line Diagnostic Reference Manual*, publication number CDM-0201-0A0, which describes the disk I/O diagnostics.

Loading Instructions

Perform the following steps to load the CD40/41/4R/42 diagnostic:

1. Deadstart the BART program by entering the following command: `IBART` ↵.
2. Set the MCC mode BP diagnostics (enter `SMB`).
3. Set BP/port A (B, C, D) base address 0 (enter `SPB0`).
4. Load file common CD40/41/4R/42 (enter `LCD40` or `LCD41` or `LCD4R` or `LCD42`).
5. Enter the following commands to view memory locations containing error codes and the contents of the registers and buffers:
   - View top left 4000 (enter `vl4000`)
   - View top right 10000 (enter `vr10000`)
   - View bottom left 3700 (enter `vbl3700`)
   - View bottom right 20000 (enter `vbr20000`)
6. Set parameters as shown in the following "Entry Conditions" subsection. (All parameters except 4003 and 4004 default to nondestructive mode.)

CAUTION
Do not change parameters when the diagnostic is running, or customer data may be lost.

Note: All parameters also default to the parameters required for SMD3 disk drives. If SMD2 disk drives are being tested, the cylinder and head limits need to be changed as described below in the "Entry Conditions" subsection.

7. Enter the **GO** command (`g`, ↵).

8. If a failure occurs, list the following data:

   - Snapshot of current screen showing the contents of the P register, status register, and base address
   - 4000 through 4040 parameters
   - 1*xx*00 through 1*xx*77 registers for each device in use (where xx is the logical unit as shown in the DAVE register file/buffer map)
   - B0 through B7 buffers for each device in use

   Example: If device 102 stops, the MCC commands for dumping failure data would be:

   - Press the **PRT SC** key and enter text, i.e., `device 102 failed`
   - Enter `d prn 4000 to 4041`
   - Enter `d prn 10200 to 10277`
   - Enter `d prn 40000 to 47000`

Entry Conditions

All mandatory and optional parameters described are applied to all selected drives. Set the following parameters if they are different than the default value:

Mandatory control parameters:

Location	Label	Parameter being set
4003	LUS	Logical unit select; default = 0 (Select units by setting bit 2^0 for unit 0, 2^1 for unit 1, and so on. Each bit maps to the physical device number in the unit summary table at 3700. Multiple devices may be selected also. For example, LUS = 000062 selects devices 101, 104, and 105.) **Note:** Modify the LUS parameter only when CD40/41/4R/42 is halted. Halt conditions are described in the "Error Information" subsection.
4004	PSS	Primary/secondary select; default = 0 (This value is used by the **RESERVE, RELEASE, and RLSOPP** drive commands. When bit 2^0 is set, unit 0 will reserve and release the secondary drive. When bit 2^0 is cleared, unit 0 will reserve and release the primary drive. Bit 2^1 is used for unit 1, bit 2^2 is used for unit 2, and so on.)

For SMD2 disk drives, the following mandatory control parameters must be changed:

Location	Label	Parameter being set
4011	CRLAST	Last cylinder used for all reads; set to 2613 (DD-40/4R), 3142 (DD-41), or 5062 (DD-42)
4012	CWFIRST	First cylinder used for all writes; set to 2613 (DD-40/4R), 3142 (DD-41), or 5062 (DD-42)
4013	CWLAST	Last cylinder used for all writes; set to 2613 (DD-40/4R), 3142 (DD-41), or 5062 (DD-42)
4015	HLAST	Last head address; set to 22 (DD-40/4R/42) or 17 (DD-41)

Optional control parameters:

Location	Label	Parameter being set
4005	SECSEL	Section select; default = 077767_8 (Select the desired sections by setting the corresponding bits, such as bit 2^0 for section 0, bit 2^1 for section 1, and so on.)

This diagnostic currently contains the following 17 (0-16) sections:

- Section 0 (000001) - Controller test: Buffer echo mode
- Section 1 (000002) - Echo mode test
- Section 2 (000004) - 16-parcel track buffer test
- Section 3 (000010) - Track buffer SECDED test
- Section 4 (000020) - Full-track buffer test
- Section 5 (000040) - Basic drive functions test
- Section 6 (000100) - Head select test
- Section 7 (000200) - Cylinder select test
- Section 8 (000400) - Drive performance
- Section 9 (001000) - Diagnostic mode test
- Section 10 (002000) - Single sector write/read test
- Section 11 (004000) - Continue write test with data compare

Location	Label	Parameter being set
4005	SECSEL (continued)	• Section 12 (010000) - Continue write/continue read test • Section 13 - (Not currently used.) • Section 14 - (Not currently used.) • Section 15 (100000) - Read ID test • Section 16 (200000) - Read status registers test

Note: Test section 3 is not defaulted because the SECDED TEST/NORM switch must be in the TEST position. Test section 15 is not defaulted because it is not used during normal testing. Test section 16 is not defaulted because it is used during troubleshooting. Test section 16 should be run when a drive is selected and all status registers from a DD-40/41/4R/42 are needed to debug a problem.

Location	Label	Parameter being set
4006	PASSLMT	Pass limit [Enables the user to select the number of passes (error free and error filled) to run before the diagnostic halts. This number is used for all selected units. If the PASSLMT parameter = 0, each unit runs until an error occurs.]
4007	PARMSEL	Parameter select; default = 0776. Set parameter selection bits as follows:

Name	Bit	Description
N/A	2^0	Not used; default = clear
HDBIT	2^1	Stop on each head select error; default = set
CYLBIT	2^2	Stop on each cylinder select error; default = set
TRBIT	2^3	Stop on each track buffer error; default = set
ECCBIT	2^4	Stop on each ECC error; default=set
RDBIT	2^5	Stop on each read data error; default=set
WDBIT	2^6	Stop on each write data error; default=set
IDBIT	2^7	Stop on each read ID error; default=set
DPBIT	2^8	Stop on each defect pad error; default = set

Location	Label	Parameter being set
4007	PARMSEL (continued)	Name: MANUAL; Bit: 2^{15}; Description: Allow user data for transfers; default=clear
4010	CRFIRST	First cylinder used for all reads; default = 0. (This parameter should be set to the cylinder number where all reads are to begin. Seeks to cylinder numbers smaller than this number are not issued.)
4011	CRLAST	Last cylinder used for all reads; default = 2613 (CE cylinder). For SMD2s, set the default to 2613 (DD-40/4R), 3142 (DD-41), or 5062 (DD-42). (Set this parameter to the cylinder number where all reads are to end. Seeks to cylinder numbers larger than this number are not issued.)
4012	CWFIRST	First cylinder used for all writes; default = 2613 (CE cylinder). For SMD2s, set the default to 2613 (DD-40/4R), 3142 (DD-41), or 5062 (DD-42). (Set this parameter to the cylinder number where all data writes are to begin. Seeks to cylinder numbers smaller than this number are not issued.)
4013	CWLAST	Last cylinder used for all writes; default = 2613 (CE cylinder). For SMD2s, set the default to 2613 (DD-40/4R), 3142 (DD-41), or 5062 (DD-42). (Set this parameter to the cylinder number where all data writes are to end. Seeks to cylinder numbers larger than this number are not issued.)
4014	HFIRST	First head address; default = 0 (Set this parameter to the head number where all seeks are to start. Seeks to head numbers smaller than this number are not issued.)
4015	HLAST	Last head address; default = 22. For SMD2s, set the default to 22 (DD-40/4R/42) or 17 (DD-41). (Set this parameter to the head number where all seeks are to end. Seeks to head numbers larger than this number are not issued.)
4016	SFIRST	First sector address; default = 0 (Set this parameter to the sector number where all seeks are to start. Seeks to sector numbers smaller than this number are not issued.)
4017	SLAST	Last sector address; default = 73 (Set this parameter to the sector number where all seeks are to end. Seeks to sector numbers larger than this number are not issued.)
4020	SPFIRST	First spindle address; default = 0 (Set this parameter to the spindle number where all seeks are to start. Seeks to spindle numbers smaller than this number are not issued.)

Location	Label	Parameter being set
4021	SPLAST	Last spindle address; default = 3 (Set this parameter to the spindle number where all seeks are to end. Seeks to spindle numbers larger than this number are not issued.)
4022	RMAX	Random maximum count; default = 10 (Set this parameter to the maximum number of random patterns to be written to the drive during a write data function. Used in test sections 4, 10, 11, 12.)
4023	PATTM	Pattern mask; default = 777 [Each bit maps to a pattern in the pattern table (PATT). These patterns are used for various read and write operations. Any number or combinations of patterns may be selected by setting the corresponding bits. The user may run his own pattern by entering it in PATT and selecting the corresponding bit.]

The following are the patterns currently defined in PATT:

PATT Address	PATTM Bit	Pattern
4024	2^1	177777 177777 177777 177777
4025	2^0	000000 000000 000000 000000
4026	2^2	022222 222222 222222 222222
4037	2^3	055555 055555 055555 055555
4040	2^4	177777 000000 177777 000000
4031	2^5	000000 177777 000000 177777
4032	2^6	000377 177100 000377 177100
4033	2^7	163471 147144 163471 147144
4034	2^8	021222 024442 021222 024442
4035	2^9	Available for user data
4036	2^{10}	Available for user data

Example: Setting bit 2^3 enables the pattern 05...5 for write and read operations; PATTM = 3007 enables the patterns 0...0, 17...7, 02...2, and the two user data patterns.

Location	Label	Parameter being set
4037	CE1	CE cylinder 1; default = 2612. For SMD2s, set the default to 2046 (DD-40/41), 2612 (DD-4R), or 5061 (DD-42). (Set this parameter to the cylinder number where the user flaw table resides.)
4040	CE2	CE cylinder 2; default = 2613. For SMD2s, set the default to 2047 (DD-40/41), 2613 (DD-4R), or 5062 (DD-42). (Set this parameter to the cylinder number designated for CE work.)
4041	DCSEC	DC controller sector number; default=0 (Use this parameter in test section 16 to determine which sector to use for the DC controller status request.)

Error Information

The CD40/41/4R/42 diagnostic program halts when the ERC register contents are anything other than zero. When this occurs, it is safe to use the MCC **HALT** command. The **HALT** command stops the DAVE monitor.

Note: Stopping the CD40/41/4R/42 diagnostic program using the MCC **HALT** command when the ERC register is zero may lock the channel. If the channel is locked, a deadstart of the BART program unlocks it.

The CD40/41/4R/42 diagnostic program halts when one of the following three conditions is met:

- The pass limit specified in the PASSLMT parameter has been reached. The ERC register is set to the PLR (pass limit reached) value.
- A nonrecoverable error has occurred. The ERC register is set to an applicable error code.
- A stop-on-error condition has occurred based on the bits set in the PARMSEL parameter. The ERC register is set to an applicable error code.

Note: The user may halt CD40/41/4R/42 by changing the PASSLMT parameter to the contents of the PASS register (plus 1). The CD40/41/4R/42 diagnostic program then halts on the next completed pass.

Once halted, the LINE register points to the error stop location. The B0 (ERBUF) register contains basic errors for each test section when the PARMSEL bits are set to 0. Each word of the B0 register (or group of 2 or 5 words) represents one recoverable error. Refer to the "Test Section Detailed Description" subsection for the format of the B0 register in each test section. The device is deselected on completion of the diagnostic program whenever possible.

The following list describes the DAVE monitor diagnostic error codes (1 through 31). The error codes appear in the ERC register for each device.

Error Code	Label	Description
1	ERDF	Disk function error
2	ERRD	Disk read error
3	ERWT	Disk write error
6	ERDS	Disk status error
7	ERD	Disk diagnostic error
10	EREC	Disk echo error
11	ERSE	Disk select error
20	ERFTO	Disk function time-out
30	ERMAR	Microcode address range error
31	ERMIR	Microcode instruction range error

Note: Error codes 0, 4, 12 through 17, and 21 through 27 are not used.

The following list describes the CD40/41/4R/42 diagnostic error codes (100 and above):

Error Code	Label	Description
100	PLR	Pass limit reached (The value in PASSLMT has been reached by the current unit.)
101	ERPARAM	Test parameter error (A parameter has been entered which does not make sense for the DD-40/41 hardware or this test. For example, a sector number of 14-17, 34-37, 54-57, or 74-77.)
102	ERSEL	Drive select error (The current unit could not be selected.)
103	ERRLS	Drive release error (The current unit could not be released.)
104	ERCLRF	Clear faults error (The current unit has hardware faults that could not be cleared.)
105	ERRESET	Reset error (The current unit has hardware faults that could not be cleared with a reset function.)
106	ERRTZ	Return-to-zero error (The current unit hardware faults could not be cleared with an RTZ function.)
107	ERSTAT	Status error [Error occurred while performing a select status (040), general status (050) or a controller status (060) request.]
110	ERCOMP	Data compare error (The current data comparison failed.)
111	ERHD	Head select error (Error occurred while performing a head select function.)
112	ERCYL	Cylinder select error (Error occurred while performing a cylinder select function.)
113	ERTB	Track buffer error (Error occurred while performing a write or read to the track buffer.)
114	EREBF	Error buffer full [B0 register contains 1000 (octal) errors. The end of the buffer has been reached.]
115	ERRID	ID error [Error occurred while performing a read ID function (201).]
116	ERDW	Write error [Error occurred while performing a data write function (300).]
117	ERDR	Read error [Error occurred while performing a data read function (200).]

Error Code	Label	Description
120	ERUFL	User flaw table read error (The program could not read any copy of the user flaw table on the device.)
121	ENDST	End of read status section (section 16).
122	EREFL	User flaw table error (The program could not find the ending parcel of 1's on any copy of the user flaw table on the device.)
123	EROFST	Correction offset error (The correction vector offset was greater than 100040 or less than 40.)
124	ERMSK	Correction mask error (The mask found in correction vector was expected to be zero and was not.)
125	ERECC	Error in error correction test (The status returned was in error.)
126	ERDPL	Error in defect pad location test (A miscompare between the actual and expected buffers occurred.)

This program is written in the disk aid macro assembler and runs under control of the DAVE program.

The "DAVE Register File/Buffer Map," "General Register File Example for Logical Unit 0," and "Status Register Bit Definitions" subsections compose a reference guide for the DAVE register definitions and logical unit summary table. (Refer to Section 7 of the *CRAY-2 Computer Systems Off-line Diagnostic Reference Manual*, publication number CDM-0201-0A0.)

DAVE Register File/Buffer Map

The following is the DAVE file/buffer map used with the CD40/41/4R/42 diagnostic test. The map shows common memory (CM) locations for the general register and buffers associated with each DD-40/41/4R/42 logical unit number.

DD-40/41/4R/42 Logical Unit	General Register CM Location	Buffer CM Locations			
		B0	B1 through B7		B8
0	10000	20000	21000...	27000	500000
1	10100	30000	31000...	37000	600000
2	10200	40000	41000...	47000	700000
3	10300	50000	51000...	57000	1000000
4	10400	60000	61000...	67000	1100000
5	10500	70000	71000...	77000	1200000
6	10600	100000	101000...	107000	1300000
7	10700	110000	111000...	117000	1400000
10	11000	120000	121000...	127000	1500000
11	11100	130000	131000...	137000	1600000

DD-40/41/4R/42 Logical Unit	General Register CM Location	Buffer CM Locations B0	B1 through B7		B8
12	11200	140000	141000...	147000	1700000
13	11300	150000	151000...	157000	2000000
14	11400	160000	161000...	167000	2100000
15	11500	170000	171000...	177000	2200000
16	11600	200000	201000...	207000	2300000
17	11700	210000	211000...	217000	2400000
20	12000	220000	221000...	227000	2500000
21	12100	230000	231000...	237000	2600000
22	12200	240000	241000...	247000	2700000
23	12300	250000	251000...	257000	3000000
24	12400	260000	261000...	267000	3100000
25	12500	270000	271000...	277000	3200000
26	12600	300000	301000...	307000	3300000
27	12700	310000	311000...	317000	3400000
30	13000	320000	321000...	327000	3500000
31	13100	330000	331000...	337000	3600000
32	13200	340000	341000...	347000	3700000
33	13300	350000	351000...	357000	4000000
34	13400	360000	361000...	367000	4100000
35	13500	370000	371000...	377000	4200000
36	13600	400000	401000...	407000	4300000
37	13700	410000	411000...	417000	4400000
40	14000	420000	421000...	427000	4500000
41	14100	430000	431000...	437000	4600000
42	14200	440000	441000...	447000	4700000
43	14300	450000	451000...	457000	5000000

General Register File Example for Logical Unit 0

This subsection shows the general register file for DD-40/41/4R/42 logical unit 0 used with device 100. It also shows the CM address for each general register and describes each register.

CM Address	Register Number	Usage	Description
10000	0	R0	8 general purpose registers
10001	1	R1	
10002	2	R2	
10003	3	R3	
10004	4	R4	
10005	5	R5	
10006	6	R6	
10007	7	R7	
10010	10	CSEC	Current section under test

CM Address	Register Number	Usage	Description
10011	11	PASS	Pass count
10012	12	ERCNT	Error count
10013	13	DEV	Physical device number
10014	14	STATUS	Last drive status; parcel 2 = General status/function echo, parcel 3 = Controller status (Refer to the GENRAL and CNTROL registers descriptions in this subsection.)
10015	15	LINE	Execution line address
10016	16	ERC	Error code
10017	17	EPTR	Pointer to buffer error
10020	20	CYL	Cylinder register
10021	21	HEAD	Head register
10022	22	SECTOR	Sector register
10023	23	SPINDLE	Spindle
10024	24	NXTHEAD	Next head
10025	25	NXTSECT	Next sector
10026	26	CONTINUE	Continue bits; bit 2^1 = read/write continue bit, bit 2^2 = last write continue bit, and bit 2^3 = first write continue bit
10027	27	STVALID	Status valid bits; bit 2^0 = status data not valid for last completed function (R40 through R51), bit 2^1 = status data valid for last completed function
10030	30	TIME	Time of function
10031	31	ETIME	Time limit of current function
10032	32	UNITP	DAVE internal
10033	33	SPTR	DAVE internal
10034	34	LEN	Length register
10035	35	LP0	Do loop pointer 0
10036	36	LP1	Do loop pointer 1
10037	37	LP2	Do loop pointer 2
10040	40 †		CNTROL Controller status word
10041	41	GENRAL	General status word
10042	42	DCCNTRL	DC-40 controller status word
10043	43	DRIVE	Drive status word
10044	44	CSECCNT	Current sector count
10045	45	FAULT	Fault status word
10046	46	OPERATE	Operating status word
10047	47	REPLUNIT	Field replaceable unit code
10050	50	DIAGEXEC	Diagnostic execute status word
10051	51	DEVTYPE	Device type status word
10052	52	LSTSEC	Last sector number
10053-10057	53-57	Not used	

† Registers 40, 41, 42, 43, 44, 45, 46, 47, 50, and 51 are updated only after their associated status commands are called from the microcode program.

CM Address	Register Number	Usage	Description
10060	60	F0PTR	Flaw table spindle 0 pointer
10061	61	F1PTR	Flaw table spindle 1 pointer
10062	62	F2PTR	Flaw table spindle 2 pointer
10063	63	F3PTR	Flaw table spindle 3 pointer
10064	64	CURPTR	Current Flaw table pointer
10070	70	R70	(R70-77 used in subroutines)
10071	71	R71	
10072	72	R72	
10073	73	R73	
10074	74	R74	
10075	75	R75	
10076	76	R76	
10077	77	R77	

Status Register Bit Definitions

The following list describes the individual bit definitions for status register R14.

Note: Bits 2^0 through 2^{15} represent controller status bits; bits 2^{16} through 2^{32} represent general status bits.

R14 Bit	Definition
2^0	Drive ready
2^1	Drive status available
2^2	Drive busy/invalid drive command
2^3	Drive error
2^5	Bus-in parity error
2^4	Status parity error
2^6	Status parity
2^7	Bus-in parity
2^8	Lost function
2^9	Buffer A read parity error
2^{10}	Buffer B read parity error
2^{11}	Read status invalid
2^{12}	Wait interrupted last continue write
2^{13}	Last continue write done
2^{14}	Not used
2^{15}	Not used
2^{16}-2^{19}	Sector number of most recent error
2^{20}	Drive number of most recent error
2^{21}	Drive number of most recent error
2^{22}	Channel error
2^{23}	Buffer error status
2^{24}	Unit ready on all drives
2^{25}	On cylinder on all drives

R14 Bit	Definition
2^{26}	Seek error on any drive
2^{27}	Drive fault on any drive
2^{28}	ECC error (sector status of last error)
2^{29}	ID not found (sector status of last error)
2^{30}	Sync time out (sector status of last error)
2^{31}	Defect parity error (sector status of last error)
2^{32}-2^{63}	Not used

Note: Bits 2^{16} through 2^{31} may be the parameter echo data instead of general status bits.

Logical Unit Summary Table

You can monitor a condensed status of all units by displaying the logical unit summary table (LUST) at location 3700. One word is allocated per unit in the table, with word 3700 being logical unit 0, 3701 being logical unit 1, and so on. Each word is broken down to provide the following information:

*u*00*s*00000*ddddddd* 0000*aaaaaaaaaaaaa* 00000*lllllllllll* *eppppppppppppppp*, where

u = unit select bit. This bit is set if the unit has been selected by setting its corresponding logical unit select bit at location LUS.

s = STBUFF valid bit. This bit is set if the values in the DD-40/41/4R/42 status buffer (STBUFF) are valid for the current drive function. This bit is also set during a FILL STBUFF microinstruction, and cleared after every function is sent to the DD-40/41/4R/42 disk drive.

d = physical device number. This number indicates the physical device number assigned to the logical unit number. Any physical device number may be mapped to any logical unit number by setting this field before starting the test. By default, logical unit 0 is physical device 100, logical unit 1 is physical device 101, and so on. Logical units 40 through 44 are set by default to physical devices 40 through 44, which correspond to the DB channel adapter modules.

a = address of the register file. This field is the memory location of the register file for the given logical unit. If an error occurs, examine this field for additional information.

l = current microinstruction LINE number. This field gives the microinstruction line currently in execution by showing the contents of the line register for a given unit.

e = error flag. This bit is set if an error stop occurs.

p = pass count/error code. Ordinarily this field contains the pass count for the given unit. However, in case of an error stop (e bit set), the p field is set to the error code.

Test Section Detailed Description

The following subsection describes in detail the CD40/41/4R/42 diagnostic test sections. There are 17 (0 through 16) sections in the CD40/41/4R/42 diagnostic programs:

- Section 0 - Controller test in buffer echo mode. In this test section the data path to and from controller buffer A is checked with the following patterns:

    1. All fixed patterns selected by the PATTM parameter.

       Note: User-defined patterns may be entered into the PATT table as previously described. Fixed patterns may also be disabled using the PATTM parameter.

    2. Walking 0's
    3. Walking 1's
    4. 1000 octal random buffers, each word of the buffer is the same random number

  The data path to and from controller buffer B is then checked with the following patterns:

    1. All fixed patterns selected by the PATTM parameter
    2. Walking 0's
    3. Walking 1's
    4. 1000 octal random buffers, where each word of buffer is the same random number

  Next, data separation between controller buffer A and B is checked by writing to one buffer and reading from the other buffer with 1000 (octal) random buffers.

  RLSOPP, RESET, CLRFLTS, and RELEASE commands are then sent to the drive to eliminate any faults created from the buffer echo mode.

  The following information shows the buffer use in this test:

  B0 = Not used
  B1 = Source data for buffer A writes
  B2 = Source data for buffer B writes
  B3 = Destination for buffer reads
  B4 through B7 = Not used

  Any error found in this section is considered nonrecoverable. This section will stop with the appropriate error code set.

- Section 1 - Echo mode test. This test section uses diagnostic mode parameter 7 which reserves or releases only the port (not the drive). The data path to and from the drive buffer is then checked with the following patterns:

    1. All fixed patterns selected by the PATTM parameter.

       Note: User-defined patterns may be entered into the PATT table. Also, fixed patterns may be disabled using the PATTM parameter.

2. Walking 0's pattern
3. Walking 1's pattern
4. 1000 octal random patterns

Next, each pattern is compared with the result returned in the controller register and with the result returned in the drive echo status word.

The following information shows the buffer use in this test:

B0 through B7 = Not used.

Any error found in this section is considered nonrecoverable. This section stops with the appropriate error code set.

- Section 2 - Write/read 16-parcel track buffer test. If manual mode is set in this test section (bit 2^{15} of the PARMSEL parameter), 16 parcels of user-entered data in buffer B1 are sent to the track buffer and read back to B2; the results are then compared.

  If manual mode is clear (bit 2^{15} of the PARMSEL parameter), 16 parcels of the track buffer are written with the following patterns from buffer B1 and read back to B2; the results are then compared:

  1. All fixed patterns selected by the PATTM parameter
  2. 100 (octal) random patterns

  The following information describes buffer use in this test:

  B0 = Error log (ERBUF)
  B1 = Source for write functions
  B2 = Destination for read functions
  B3 through B7 = Not used

  Any read/write errors will be recorded in the ERBUF error buffer in the following format:

  Word 0 parcel 0 = Section number 4
  Word 0 parcel 1 = 0
  Word 0 parcel 2 = 0
  Word 0 parcel 3 = Element number of B1 and B2 buffers where the first mismatch occurred
  Word 1 = Data sent to the drive

  If bit 2^3 of the PARMSEL parameter (TRBIT) is set, this section logs the error, updates the statuses, and stops execution. Otherwise, it logs errors in the error buffer and continues running.

- Section 3 - Track buffer SECDED test. This test writes test data to the track buffer using the 16-parcel write buffer function. Set the SECDED/TEST switch on the DC-40/41 control panel to the TEST position. This position causes the DC-40/41 to generate all 0's for SECDED. The test data consists of only one bit set in the 16 parcels.

Note: Set the SECDED TEST/NORM switch on the DC-40/41 control panel to the TEST position for this test section.

The data is read from the track buffer using the 16-parcel read buffer function. A drive error is expected in the DC controller status and a buffer error is expected in the DC-40/41/4R/42 controller status. The error correction logic should also have toggled the bit set in the test data. This test is then repeated for all bits in the 16 parcels.

The following information describes buffer use in this test:

B0 = Error log (ERBUF)
B1 = Source for write functions
B2 = Destination for read functions
B3 = Comparison buffer of all 0's
B4 through B7 = Not used

Any read or write errors will be recorded in the ERBUF error buffer in the following format:

Word 0 parcel 0 = Section number 10
Word 0 parcel 1 = Zero
Word 0 parcel 2 = Zero
Word 0 parcel 3 = Element number of buffers B1 and B2 where the first mismatch occurred
Word 1 = Data sent to the drive

If bit 2^3 of the PARMSEL parameter (TRBIT) is set, this section logs the error, updates the statuses, and stops execution. Otherwise, it logs errors in the error buffer and continues running.

- Section 4 - Write and read full track buffer test. If manual mode is set (bit 2^{15} of the PARMSEL parameter), one sector of user-entered data in buffer B1 is sent to the track buffer and read back to buffer B2; the results are compared.

  If manual mode is clear (bit 2^{15} of the PARMSEL parameter), one sector of the track buffer is written with the following patterns from the B1 buffer, and read back to the B2 buffer; the results are compared as follows:

  1. All fixed patterns selected by the PATTM parameter
  2. 100 (octal) random patterns
  3. Even addressing pattern
  4. Odd addressing pattern

  Example of even parcel addressing pattern:

Word		Parcel 0	Parcel 1	Parcel 2	Parcel 3
Word 0	=	000000	sector number	000002	Sector number
Word 1	=	000004	sector number	000006	Sector number

Word	Parcel 0	Parcel 1	Parcel 2	Parcel 3
Word 2 =	000010	sector number	000012	Sector number
•				
•				
•				
Word 776 =	003770	sector number	003772	Sector number
Word 777 =	003774	sector number	003776	Sector number

Example of odd parcel addressing pattern:

Word	Parcel 0	Parcel 1	Parcel 2	Parcel 3
Word 0 =	Sector number	000001	Sector sector	000003
Word 1 =	Sector number	000005	Sector number	000007
Word 2 =	Sector number	000011	Sector number	000013
•				
•				
•				
Word 776 =	Sector number	003771	Sector number	003773
Word 777 =	Sector number	003775	Sector number	003777

The following information describes buffer use:

B0 = Error log (ERBUF register)
B1 = Source for write functions
B2 = Destination for read functions
B3 through B7 = Not used

Any read/write errors are recorded in the ERBUF error buffer in the following format:

Word 0 parcel 0 = Section number 20
Word 0 parcel 1 = Zero
Word 0 parcel 2 = Zero
Word 0 parcel 3 = Element number of buffers B1 and B2 where the first mismatch occurred
Word 1 = Data sent to the drive

If bit 2^3 of the PARMSEL parameter (TRBIT) is set, this section will log the error, update the statuses, and stop execution. Otherwise, it will log errors in the error buffer and continue execution.

- Section 5 - Basic drive functions test. This test checks drive functions in the following order:

  1. The **RESERVE** command is issued and statuses are checked.
  2. The **RELEASE** command is issued and statuses are checked.
  3. The **RLSOPP** command is issued and statuses are checked.
  4. All possible statuses from the drive are read and inserted into each logical unit's register file.
  5. The **CLRFLTS** command is issued and statuses are checked.
  6. The **RTZ** command is issued and statuses are checked.

7. The **RESET** command is issued and statuses are checked.
8. The drive is released.

The following information describes buffer use in this test:

B0 through B7 = Not used.

Any error found in this section is considered non-recoverable. This section stops with the appropriate error code set.

- Section 6 - Head select test. The CRFIRST parameter is selected in this test after the **RESERVE** and **RESET** commands are issued. A valid ID is then read into buffer B1. The head number received is compared to the head number sent for all HFIRST to HLAST and for all SPFIRST to SPLAST parameter values.

  The following information describes buffer use in this test:

  B0 = Error log (ERBUF)
  B1 = ID read from drive to verify the **HEADSEL** command worked
  B2 through B7 = Not used

  Any head select errors will be recorded in the ERBUF error buffer in the following format:

  Word 0 parcel 0 = Section number 100
  Word 0 parcel 1 = Head number sent
  Word 0 parcel 2 = Head number received
  Word 0 parcel 3 = Previously selected head number.
  Note: This parcel will be 177777 if the very first head select fails.

  If bit 2^1 of the PARMSEL parameter (HDBIT) is set, this section will log the error, update the statuses, and stop execution. Otherwise, it will log errors in the error buffer and continue execution.

- Section 7 - Cylinder select test. A **CYLSEL** command is issued. Cylinder values from the CRFIRST to the CRLAST parameters are selected with the CRFIRST cylinder value selected between incrementing cylinder values. The test then selects cylinder values from the CRLAST down to CRFIRST parameters with the CRFIRST cylinder value selected between decrementing cylinder values. Next, 100 (octal) random cylinder values are selected.

  Servo Offset In and **Servo Offset Out** subcommands are then issued and checked. A **RTZ** command is then issued and checked to verify the offset has been cleared and the cylinder register has a value of 0.

  The following information describes buffer use:

  B0 = Error log (ERBUF)
  B1 = ID read from drive to verify the **CYLSEL** command worked
  B2 through B7 = Not used

Any cylinder select errors are recorded in the ERBUF error buffer in the following format:

Word 0 parcel 0 = Section number 200
Word 0 parcel 1 = Cylinder number sent
Word 0 parcel 2 = Cylinder number received
Word 0 parcel 3 = Previously selected cylinder number. **Note:** This parcel is 177777 if the very first cylinder select fails.

If bit 2^2 of the PARMSEL parameter (CYLBIT) is set, this section logs the error, updates the statuses, and stops execution. Otherwise, it logs errors in the error buffer and continues execution.

- Section 8 - Drive performance test. This test is only used for random motion on the drive; data checking is not performed. This test performs 1,000 data reads with random spindle, head, cylinder, and sector numbers.

  The following information describes buffer use:

  B0 = Error log (ERBUF register)
  B1 = Destination for read data functions
  B2 through B7 = Not used
  B8 = Flaw table

  Any read data errors are recorded in the ERBUF error buffer in the following format:

  Word 0 parcel 0 = Section number 400
  Word 0 parcel 1 = Cylinder number sent to drive
  Word 0 parcel 2 = Head number sent to drive
  Word 0 parcel 3 = Sector number sent to drive
  Word 1 parcel 0 = Zero
  Word 1 parcel 1 = Previous cylinder number sent to drive
  Word 1 parcel 2 = Previous head number sent to drive
  Word 1 parcel 3 = Previous sector number sent to drive

  If bit 2^5 of the PARMSEL parameter (RDBIT) is set, this section logs the error, updates the statuses, and stops execution. Otherwise, it logs errors in the error buffer and continues execution.

- Section 9 - Parity errors test. In this test, bus-in parity and status parity are forced using a **DIAG 37** command. Statuses are also checked. A **CLRFLTS** command is then issued and both parity errors are checked to see if they were cleared.

  The following information describes buffer use in this test:

  B0 through B7 = Not used

  Any error found in this section is considered nonrecoverable. This section stops with the appropriate error code set.

- Section 10 - Single sector write or read test. All fixed patterns selected by the PATTM parameter are sent to the drive one at a time from the B1 buffer (one sector full) using the following parameter values:

  - All cylinder values set for the CWFIRST to CWLAST parameters
  - All head values set for the HFIRST to HLAST parameters
  - All sector values set for the SFIRST to SLAST parameters

  The sector data is then read back to the B2 buffer and compared against the data in the B1 buffer.

  Note: The CWFIRST and CWLAST parameter values are defaulted to use only the CE cylinder. In addition, user-defined patterns may be entered into the PATT table as described in the "Entry Conditions" subsections.

  For all cylinder values from the CWFIRST to CWLAST parameters, all head values from the HFIRST to HLAST parameters, and all sector values from SFIRST to SLAST parameters, the RMAX parameter values of random patterns are then sent to the drive one at a time from the B1 buffer (one sector full). The sector data is read back to buffer B2 and compared against data in the B1 buffer. Defective sectors found in the flaw table are skipped.

  The following describes buffer use in this test:

  B0 = Error log (ERBUF)
  B1 = Source for write data functions
  B2 = Destination for read data functions
  B3 through B7 = Not used
  B8 = Flaw Table

  Any write data errors are recorded in the ERBUF buffer in the following format:

  Word 0 parcel 0 = Section number 2000
  Word 0 parcel 1 = Cylinder number sent to drive
  Word 0 parcel 2 = Head number sent to drive
  Word 0 parcel 3 = Sector number sent to drive
  Word 1 parcel 0 = Data sent to the drive

  If bit 2^6 of PARMSEL parameter (WDBIT) is set, this section logs the error, updates the statuses, and stops execution. Otherwise, it logs errors in the error buffer and continues execution.

- Section 11 - Continuous write with data compare test. This test is done for all cylinder values from the CWFIRST to CWLAST parameters, all head values from HFIRST to HLAST parameters, and all sector values from SFIRST to SLAST parameters. The following patterns are sent to the drive from buffer B1:

  1. All fixed patterns in PATT table
  2. RMAX value of random patterns
  3. Even addressing patterns
  4. Odd addressing patterns

The pattern is written to the entire range, then read back and compared: the next pattern is selected. Defective sectors found in the flaw table are skipped.

Note: CWFIRST and CWLAST parameters are defaulted to use only the CE cylinder. In addition, a sector range of three or more sectors is required for this test section.

The following information describes buffer use in this test:

B0 = Error log (ERBUF)
B1 = Source for write data functions
B2 = Destination for read data functions
B3 through B7 = Not used
B8 = Flaw table

Any write data errors are recorded in the ERBUF error buffer in the following format:

Word 0 parcel 0 = Section number 11 (4000 octal)
Word 0 parcel 1 = Cylinder number sent to drive
Word 0 parcel 2 = Head number sent to drive
Word 0 parcel 3 = Sector number sent to drive

Word 1 parcel 0 = Zero
Word 1 parcel 1 = Zero
Word 1 parcel 2 = GENRAL status of current write function
Word 1 parcel 3 = CNTROL status of current write function

Word 2 = Data sent to the drive

Note: Parcels 0 and 1 of word 1 contain all 0's for all sectors except the last sector of each track. In this case, they contain the GENRAL and CNTROL status of the previous sector write function.

Any RTZ errors are recorded in the ERBUF error buffer in the following format:

Word 0 parcel 0 = Section number 11 (4000 octal)
Word 0 parcel 1 = To be determined
Word 0 parcel 2 = To be determined
Word 0 parcel 3 = To be determined

If bit 2^6 of the PARMSEL parameter (WDBIT) is set, this section logs the error, updates the statuses, and stops execution. Otherwise, it logs errors in the error buffer and continues execution.

- Section 12 - Continuous write or read test. For all cylinder values from CWFIRST to CWLAST parameters, all head values from HFIRST to HLAST parameters, and all sector values from SFIRST to SLAST parameters, all fixed patterns selected by the PATTM parameter are sent to the drive one at a time from buffer B1 (1 track full). The track is read back without a data compare.

Note: The CWFIRST and CWLAST parameters default to use only the CE cylinder. A sector range of three or more sectors is required for this section. Defective sectors found in the flaw table are skipped.

For the same range of head and sector values, the RMAX parameter's number of random patterns are then sent to the drive one at a time from buffer B1 (1 track full). The track is read back without a data compare.

For the same head and sector range, even and odd addressing patterns are next sent to the drive one at a time from buffer B1 (1 track full). The track is read back without a data compare.

The following information describes buffer use in this test:

B0 = Error log (ERBUF)
B1 = Source for write data functions
B2 = Destination for read data functions
B3 through B7 = Not used
B8 = Flaw table

Any write data errors are recorded in the ERBUF error buffer in the following format:

Word 0 parcel 0 = Section number 12 (10000 octal)
Word 0 parcel 1 = Cylinder number sent to drive
Word 0 parcel 2 = Head number sent to drive
Word 0 parcel 3 = Sector number sent to drive

Word 1 parcel 0 = 0
Word 1 parcel 1 = 0
Word 1 parcel 2 = GENRAL status of current write function
Word 1 parcel 3 = CNTROL status of current write function

Word 2 = Data sent to the drive

Note: Parcels 0 and 1 of word 1 contain all 0's for all sectors except on the last sector of each track. In the last sector they are the GENRAL and CNTROL status of the previous sector write function.

Any RTZ errors are recorded in the ERBUF error buffer in the following format:

Word 0 parcel 0 = Section number 11 (4000)
Word 0 parcel 1 through word 0 parcel 3 = To be determined

If bit 2^6 of the PARMSEL parameter (WDBIT) is set this section logs the error, updates the statuses, and stops execution. Otherwise, it logs errors in the error buffer and continues execution.

- Section 13 - (Not currently used.)
- Section 14 - (Not currently used.)

- Section 15 - Read ID test. For all cylinder values from CRFIRST to CRLAST parameters, all head values from HFIRST to HLAST parameters, and all sector values from SFIRST to SLAST parameters, check if current cylinder, head, and sector numbers are found in the ID field of this test.

  The following describes buffer use in this test:

  B0 = Error log (ERBUF)
  B2 = Destination for read ID functions
  B1, B3 through B5 = Not used

  Any read ID errors are recorded in the ERBUF error buffer in the following format:

  Word 0 parcel 0 = Section number 100000
  Word 0 parcel 1 = Cylinder number sent to drive
  Word 0 parcel 2 = Head number sent to drive
  Word 0 parcel 3 = Sector number sent to drive

  If bit 2^7 of the PARMSEL parameter (IDBIT) is set, this section logs the error, updates the statuses, and stops execution. Otherwise, it logs errors in the error buffer and continues execution.

- Section 16 - Read Status Registers Test. In this test the drive is assumed to be already selected. If the drive is not selected, a **RESERVE** command may be hand-coded into the PASS instruction. All other SECSEL parameters are ignored. All drive statuses are read and put into the following registers:

Register Number	Label	Description
R40	CNTROL	DC module controller status word
R41	GENRAL	DC module general status word
R43	DCCNTRL	DC-40/41 controller status word
R44	DRIVE	Drive status word
R45	CSECCNT	Current sector count
R46	FAULT	Fault status word
R47	OPERATE	Operating status word
R50	REPLUNIT	Field-replaceable unit code
R51	DIAGEXEC	Diagnostic execute status word
R52	DEVTYPE	Device type status word

  At the end of the test, the device is halted with an error code of 121 (ENDST, End of Read Status Section).

  Buffers B0 through B7 are not used.

  No errors reported. The test section is complete when the ERC register = 121 (ENDST)

GLOSSARY

GLOSSARY

A

Active drive - The MCU or MWS disk partition or disk drive whose designator appears in the prompt displayed on the screen. The CP/M operating system runs with the assumption that files identified in the instruction line are stored at an active drive location unless another drive is identified in the instruction line.

Assembler - A program that translates source-code instructions into binary form.

C

Compound instruction - A group of instructions. The first line of the compound instruction is always BEGIN and the last line is END.

CP/M - Control Program/Microprocessor is an 8-bit microcomputer operating system. It is the operating system used in the MCU.

Cray flaw - A defect discovered by surface analysis and placed in the user flaw table.

Cylinder - Two vertical columns of tracks distributed across the four spindles of a DD-40 disk storage unit. The **CYL =** instruction identifies the cylinder by positioning read/write heads next to the same 2 tracks on all surfaces in a DD-40 disk storage unit. There are 2614 (1,420 decimal) cylinders in a DD-40 disk storage unit. Two of the cylinders are used for maintenance. The outermost is cylinder 0.

Command operator - A symbol that represents a computation that is used in an expression. (Refer to Expression.)

D

Data buffer - The memory device in the 2XF module of the offline channel disk tester that holds 4000 parcels of data. The MCU or MWS and the DC-40/41 disk controller unit can read or write to the buffer.

Data checker - Compares data read from the disk with the data pattern the data generator originally wrote to the disk. The data generator recreates the pattern for comparison. (Refer to data generator.)

Data generator - Creates from a 1-parcel seed value a pseudo-random or fixed data pattern called for by a write instruction. This generator is in the 2XF module.

D (continued)

DCC-2 controller cabinet - The interface between a DCU-5 or offline channel disk tester and DD-40/41 disk storage devices. Four DC-40/41 disk controller units occupy a single DCC-2 disk controller cabinet. (Refer to DC-40/41 disk controller unit).

DC-40/41 disk controller unit - One of four interfaces in a DCC-2 controller cabinet that manages DC-40/41 data flow between a DCU-5 and DD-40/41 disk storage devices. Each DC-40/41 disk controller unit transfers data to and from as many as two DD-40/41 disk storage units.

Defect pad - A string of zero bits, 20 bytes long, in a sector ID or track header that masks media defects of hideable length.

Diagnostic routine - A program designed to locate a malfunction in computer equipment.

Diagnostic test - The actions performed by a diagnostic routine when it is run.

Disk controller unit-5 (DCU-5) - The interface between an I/O processor (IOP) and a DC-40 disk controller.

Disk subsystem - All disk-based mass storage devices and controllers that can be connected to a single IOP.

E

ECC - An error correction code is implemented with hardware logic to ensure data integrity.

Expression - A combination of constants, variables, operators, and parentheses used in an instruction to perform a computation. (Refer to Command operator.)

F

Factory flaw - A defect in the user flaw table originally recorded in a track header.

Flaw table cylinder - Cylinder 2612 in the DD-40 disk storage unit reserved for user flaw tables.

4-parcel data pattern - Eight bytes of test data assigned to the DATA variable. A write instruction sends the contents of the data variable to a disk location, repeating the pattern as it writes a complete sector. Also, four parcels are assigned to the DATA variable.

I

Instruction - A command entered by the user on a terminal keyboard that instructs the computer to perform a function.

I (continued)

Input/Output processor (IOP) - The programmable interface between the CPU and the disk storage subsystem.

IOS - The input/output subsystem includes as many as four IOPs connected to DCU-5s, DC-40/41s, DD-40/41s.

L

LOSP channel - The low-speed (LOSP) channel cable connection between the MCU and the 2XF module in the offline channel disk tester.

M

MCU - The maintenance control unit (MCU) is a device that connects to a computer system in order to run diagnostic tests.

MWS - A maintenance workstation (MWS) is a VME-based microcomputer system used for hardware maintenance and monitoring.

O

Offline channel disk tester - Used in place of a disk controller unit-5 (DCU-5) to test a DC-40/41 disk controller unit and the connected DD-40/41 disk storage unit.

1-parcel data pattern - Data entered as a parameter in a write instruction. The pattern repeats each time a parcel is sent to a different disk location.

Operating system flaw table - The table is found at only one location in a DD-40/41 disk storage unit. The table contains a list of all the defective sector locations in the drive. The address of the table is cylinder 0, head 0, sector 21.

P

Parcel - 2 bytes of data.

Primary/secondary drives - Each DC-40/51 disk controller unit can communicate with as many as two DD-40/41 disk storage cabinets. One storage device is called the primary drive. The other device is the shadow drive.

R

Random data pattern - A parcel of test data entered as a parameter in a write instruction. The data generator in the 2XF module creates a new data pattern from the seed value for each parcel sent to a disk location.

R (continued)

Read/write head - An electromagnetic device that transfers data to and from the surface of a magnetic storage medium. Each DD-40 spindle has 23 (19 decimal) read/write heads.

S

Sector - A numbered track location that can hold 4000 (2,048 decimal) parcels of stored data. There are 60 (48 decimal) sectors per track. Sectors with the same numbers in different tracks form a pie shape from the center to the outer edge of a disk surface. All sectors store the same amount of data regardless of their distance from the center of the disk. (Refer to Track.)

Sector ID - A sector's 3-parcel header field. The sector ID contains the cylinder number, head number, sector number, and all media defect locations. A string of 1-bits in the sector ID indicates a defective sector.

Sequential data pattern - A parcel of test data entered as a parameter in a write instruction. The write instruction increments the pattern value by one each time it sends a new parcel to the disk.

Servo-head - A read head that monitors the track positions of all heads on the spindle.

Short transfer - 16 parcels used for reading and writing sector IDs and as test data.

Spindle - A disk storage unit with disks attached. A DD-40 disk storage cabinet consists of four spindles.

Status buffers 0, 1 - Buffers in the 2XF module that store status information from the DC-40/41 disk controller unit and DD-40/41 disk storage devices. Status buffer 0 contains drive status flags, bus parity error flags, and an 8-bit register for echoed parameters. Status buffer 1 contains a DC-40/41 disk controller unit, a DD-40/41 disk storage device, or general status parcels or echo data, depending on the function performed.

Surface analysis- A diagnostic utility that tests disk media for defects.

Syndrome block - Four bytes of error-correction code (ECC) stored at the end of the data field in each disk sector.

T

Track - The location on a disk surface for all four DD-40 spindles to be addressed by a head number and a cylinder number. A track has 1,412 (decimal) sectors on each of the four disk surfaces. (Refer to Sector).

Track header - A field at the beginning of every cylinder containing the manufacturer's list of all media-defect locations.

U

User flaw table - A table on each spindle that contains the disk locations of all defects in the spindle media. The list is compiled from track headers and from surface analysis input. (Refer to Cray flaw and Factory flaw).

W

Walking 1's - A 1 bit is shifted through a string of 0 bits. Used in fault isolation.

Word - 4 parcels of data.

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