60 Series Disk Systems Guide

COM-1124-000

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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.

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PREFACE

The *60 Series Disk Systems Guide* is designed as a reference manual for Cray Research, Inc. (CRI) field engineers who have had I/O subsystem model E (IOS-E) training. This manual incorporates diagnostic and hardware information relative to disk drive operations. The manual is broken down into eight sections:

"DD-60/61 Disk System Overview" briefly describes the components in the DD-60/61 system and includes tables listing component specifications and other quick reference information.

"DCA2 to Disk Drive Cabling" describes cabling hardware and configurations and includes diagrams and illustrations.

"DCA2 Basic Theory of Operations" describes specific DCA2 operations relative to disk drive operations including detailed information on intelligent peripheral interface-2 (IPI-2) protocol.

"DCA2 Channel Functions" describe each channel function and includes examples of function routines.

The DD-60 and DD-61 hardware description sections describe disk drive switches, displays, and panels, including diagrams and tables showing switch settings and locations.

The DD-60 and DD-61 format and flaw maintenance sections are quick reference sections to use during flaw maintenance. They describe cylinder locations, flaws, and flaw tables used during the media maintenance programs.

The DD-60 and DD-61 diagnostics and utilities sections describe the diagnostics and utilities under the device maintenance environment (DME) and disk diagnostic and maintenance system (ddms) programs.

"DD-60/61 Disk System Status" defines the status bits read back from the DCA2, including disk drive statuses and DCA2 statuses.

The following conventions are used throughout this manual:

- `Courier` font indicates directory pathnames, filenames, commands, utilities, and screen output.
- **`Courier bold`** font indicates commands and options that the user should enter.
- *Italic* font indicates a variable or user-supplied entry.
- Commands must be entered as shown in the command syntax. Spaces must be included or left out as shown; do not use tabs.
- The ↵ symbol indicates pressing the return key.

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DD-60/61 DISK SYSTEM OVERVIEW

1 DD-60/61 DISK SYSTEM OVERVIEW

A DD-60/61 disk system consists of DD-60 and/or DD-61 disk drives, a DE-60 disk enclosure, and a spare disk drive. The system connects to an I/O subsystem model E (IOS-E) through a disk channel adapter (DCA2).

Figure 1-1 is a block diagram of a typical DD-60/61 disk system connected to an IOS-E. The DE-60 contains ten disk drives. Three DD-61s (one is a spare DD-61) are connected to one DCA2 and seven DD-60s (one is a spare DD-60) are connected to another DCA2.

up to 4 daisy chained

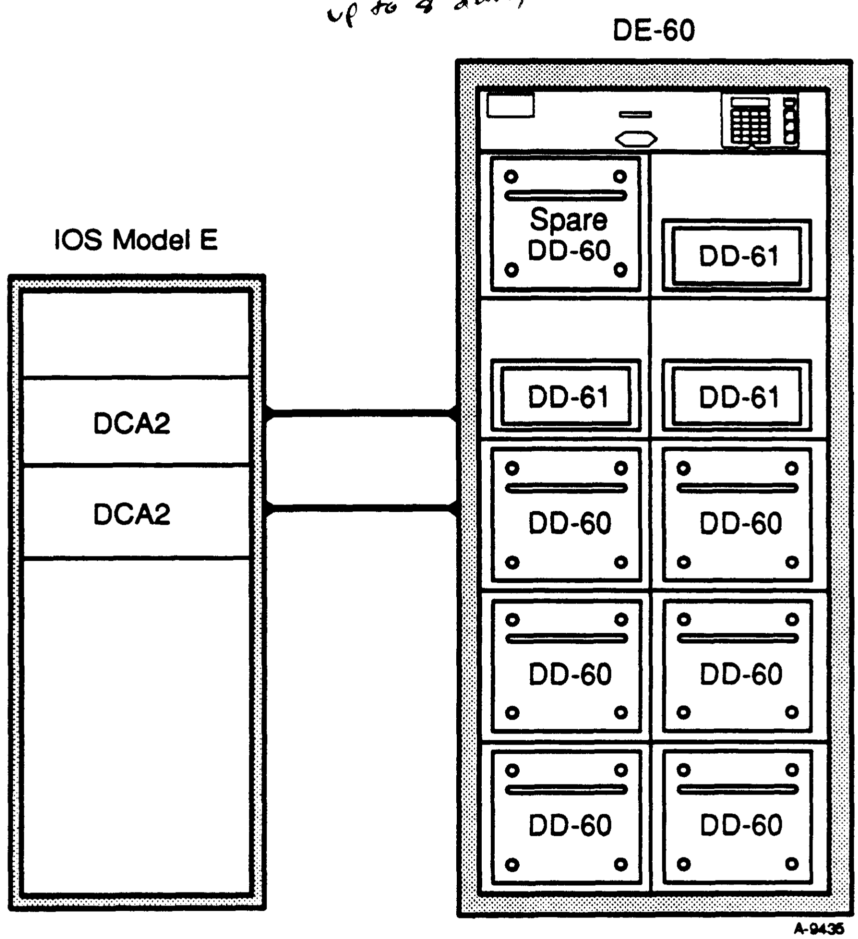

Figure 1-1. Typical DD-60/61 Disk System Connected to an IOS-E

Disk Drives

DD-60 and DD-61 disk drives provide long term data storage for a Cray Research, Inc. computer system. The DD-60 provides a high-data transfer rate and the DD-61 provides high-data storage capacity.

DD-60 Disk Drive

The DD-60 is a parallel head storage unit. Its sustained transfer rate ranges from 16 to 20 Mbytes/s, and it has a storage capacity of 1.96 Gbytes.

One DD-60 contains two groups of nine parallel read/write heads and one servo head. During data transfers to and from the DCA2, only one group of heads (0 or 1) is used at a time. Eight of the heads transfer data, while the ninth head transfers a parity bit. The servo head transfers head position information to the control circuitry in the DD-60.

A sector of data from a DD-60 contains 2,048 64-bit words of system data. The DCA2 creates the sector from eight physical sectors in the DD-60 (one from each head). Each physical sector contains 256 64-bit words of IOP data.

A track is made from eight physical tracks of data in the DD-60. One track contains 23 sectors where data can be stored and retrieved by the operating system.

Two tracks make up one cylinder. The DD-60 has 2,608 data cylinders, 2 maintenance cylinders, and 1 flaw table cylinder.

DD-61 Disk Drive

The DD-61 is a serial head storage unit. It has a sustained transfer rate of 2.6 Mbytes/s and a storage capacity of 2.23 Gbytes.

One DD-61 contains 19 serial read/write heads and one servo head. During data transfers to and from the DCA2, only one head (0 through 22_8) is used at a time. The servo head transfers head position information to the control circuitry in the DD-61.

A sector of data from a DD-61 contains 512 64-bit words of IOP data. Data is transferred between the DD-61 and DCA2 in blocks of this fixed size. One track contains 11 sectors where data can be stored and retrieved by the IOS-E.

Nineteen tracks make up one cylinder in the DD-61. DD-61s contain 2,608 data cylinders, 2 maintenance cylinders, and 1 flaw table cylinder.

DD-60 and DD-61 Comparison

DD-60s and DD-61s are Sabre VI disk drives formatted to Cray Research, Inc. (CRI) specifications. Table 1-1 lists the characteristics of the DD-60 and DD-61.

Table 1-1. DD-60 and DD-61 Characteristics

Characteristic	DD-60	DD-61
Spindle type	Sabre VI 9 head parallel	Sabre VI 19 head serial
Sustained transfer rate	16 - 20 Mbytes/s	2.3 - 2.6 Mbytes/s
Burst transfer rate	24 Mbytes/s	3.0 Mbytes/s
Storage capacity (formatted)	1.96 Gbytes	2.23 Gbytes
Heads per drive	16 data 2 parity 1 servo	19 data 1 servo
Heads active at one time	8 data 1 parity	1 data
Head groups	0 - 1 $0 - 1_8$	0 - 18 $0 - 22_8$
Logical sector size in 64-bit words	2,048 CRI words	512 CRI words
Sectors per logical track	0 - 22 $0 - 26_8$	0 - 10 $0 - 12_8$
Cylinders per drive	0 - 2,610 $0 - 5062_8$	0 - 2,610 $0 - 5062_8$
Average single track seek time	3 ms	3 ms
Average seek time	13 ms	13 ms
Full track seek time	26 ms	26 ms
Average latency	8.3 ms	8.3 ms
Rotational speed (nominal)	3,600 RPM	3,600 RPM
Start time (without sequence delay)	1 min, 30 s	1 min, 30 s
Stop time (maximum)	60 s	60 s
Single disk drive weight (including power supply)	55 lbs 25 Kg	41 lbs 19 Kg
Actuator type	Balanced rotary	Balanced rotary
Data coding to/from media	Nonreturn to zero (NRZ) / 2 - 7 run length limited (RLL)	Nonreturn to zero (NRZ) / 2 - 7 run length limited (RLL)
Type of interface	Intelligent peripheral interface-2 (IPI-2)	Intelligent peripheral interface-2 (IPI-2)

DE-60 Disk Enclosure

The DE-60 disk enclosure houses combinations from two to eight DD-60 or DD-61 disk drives and up to two spare disk drives. For example, Figure 1-2 shows a DE-60 with six DD-60s, two DD-61s, one spare DD-61, and one spare DD-60. In addition to the disk drives, the DE-60 contains a terminal block, cooling fans, and a maintenance panel.

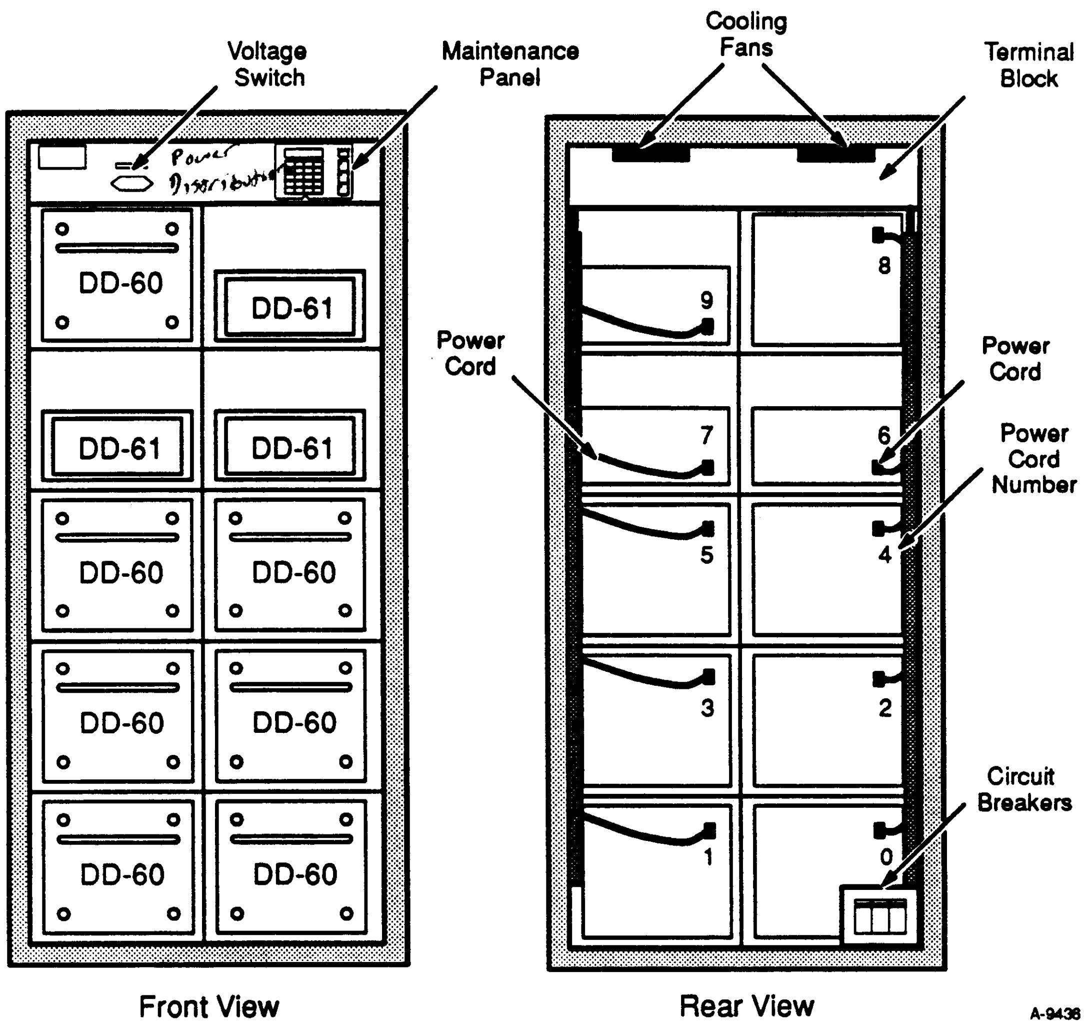

Figure 1-2. Front and Rear View of the DE-60

The terminal block converts three-phase AC voltage into single-phase AC voltage for each disk drive. Power cords connect the terminal block to each disk drive. The power cords run down the sides of the DE-60 and are cut to length for each position in the cabinet. The power cords are numbered as shown in Figure 1-2.

The cooling fans transfer exhaust air from the disk drives to the computer room. The exhaust air exits the rear of the disk drives, moves through the cooling fans, and leaves the DE-60 through a vent in the top of the cabinet.

The maintenance panel is used to run disk drive diagnostics. Refer to the hardware description sections of this manual for more information on the maintenance panel.

The characteristics of a fully loaded DE-60 vary depending on the number of DD-60s or DD-61s it contains. Table 1-2 compares physical characteristics of a DE-60 with eight DD-60s to a DE-60 with eight DD-61s.

Table 1-2. Characteristics of a Fully Loaded DE-60

Characteristic	Eight DD-60s	Eight DD-61s
Height	61.7 in. 156.7 cm	61.7 in. 156.7 cm
Width	24 in. 61 cm	24 in. 61 cm
Depth	32.9 in. 99.5 cm	32.9 in. 99.5 cm
Floor space	6.5 ft^2 0.6 m^2	6.5 ft^2 0.6 m^2
Weight	1,015 lbs 460 kg	900 lbs 408 kg
Heat load (8 disk drives)	7,500 BTU/hr 2,200 W	3,900 BTU/hr 1,144 W
Cooling	Air cooled	Air cooled
Side clearance	2 in. minimum 5 cm minimum	2 in. minimum 5 cm minimum
Front clearance	36 in. minimum 91 cm minimum	36 in. minimum 91 cm minimum
Back clearance	36 in. minimum 91 cm minimum	36 in. minimum 91 cm minimum
Power cable	6 ft 1.8 m	6 ft 1.8 m
Data cable length (standard)	66 ft maximum 20 m maximum	66 ft maximum 20 m maximum
Data cable length (optional)	99 ft maximum 30 m maximum	99 ft maximum 30 m maximum
Power	208 Vac, 3-phase, 50/60 Hz, 20 A/phase or 400 Vac, 3-phase, 50/60 Hz, 8.5 A/phase	208 Vac, 3-phase, 50/60 Hz, 20 A/phase or 400 Vac, 3-phase, 50/60 Hz, 8.5 A/phase

Spare Disk Drive

A spare DD-60 and/or DD-61 disk drive may be cabled into the disk system, but it does not store system data. If a disk drive is failing, move the data from the failing disk drive to the spare. The spare stores the data until the failing disk drive is repaired or replaced.

Only one spare DD-60 and/or DD-61 is needed per site, rather than per DE-60. With a spare connected, one of the DCA2s in a configuration can only connect to a maximum of seven usable disk drives.

DCA2 Disk Channel Adapter

The DCA2 is a communication link between the auxiliary input/output processor (EIOP) in the IOS-E and the DD-60 or DD-61 disk drives (refer to Figure 1-3). The DCA2 transfers system data from the EIOP buffer board to the disk drive. The DCA2 also converts control functions from the EIOP into intelligent peripheral interface-2 (IPI-2) protocol for the disk drives.

The primary functions of the DCA2 include:

- Communicating with up to eight disk drives
- Passing control functions from the EIOP to the disk drives
- Receiving status from the disk drives
- Generating error-correction codes for write data
- Checking read data error-correction codes

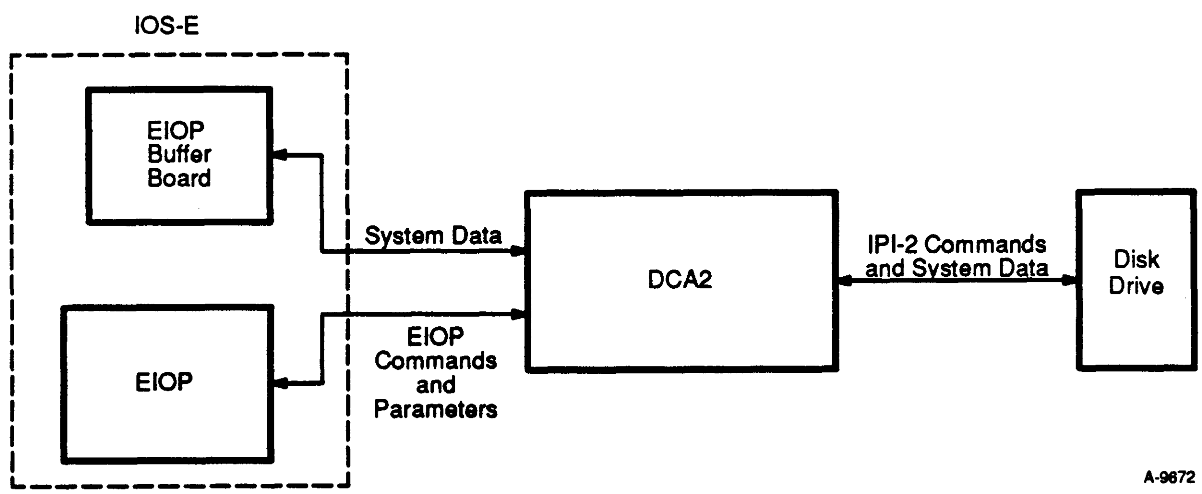

Figure 1-3. Block Diagram of DCA2 Operations

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2 DCA2-TO-DISK DRIVE CABLING

3 DCA2 BASIC THEORY OF OPERATIONS

4 DCA2 CHANNEL FUNCTIONS

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DCA2-TO-DISK DRIVE CABLING

2 DCA2-TO-DISK DRIVE CABLING

This section describes the cabling between the DCA2 channel adapter in an I/O subsystem model E (IOS-E) and DD-60 or DD-61 disk drives. Included is a description of the hardware used to connect the components, a method for labeling the cables, and the possible cabling configurations.

Cabling Hardware

The hardware that connects the DD-60 or DD-61 disk drives to the DCA2 includes the DCA2 connectors, a DCA2-to-disk drive cable, a daisy chain cable, and a terminator. Figure 2-1 identifies each hardware component.

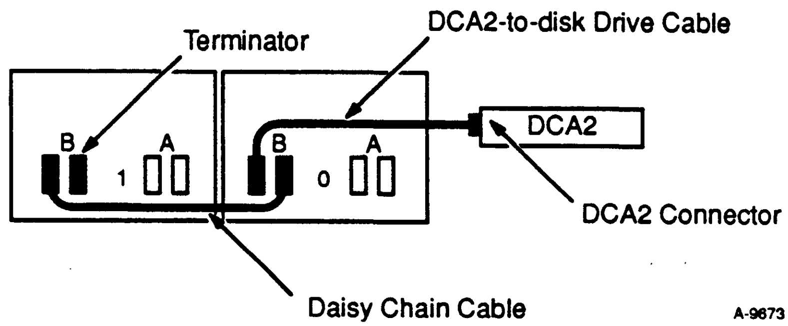

Figure 2-1. Cabling Hardware for 60 Series Disk Systems

The following subsections describe each of the cabling components and list the Cray Research, Inc. (CRI) part numbers for the components.

DCA2 Connectors

The DCA2 connectors are located on the IOS-E bulkhead. Figure 2-2 shows a possible input/output cluster (IOC) 0 connectors on the Z side of a CRAY Y-MP8I computer system.

Each EIOP has up to four channel adapters. The connectors for two of the four channel adapters are on each side of the chassis. For example, the connectors for channel adapters 0 and 2 which are connected to EIOP 0, are on the Z side of the chassis (refer to Figure 2-2). The connectors for channel adapters 1 and 3 which are also connected to EIOP 0, are on the Y side of the chassis (not shown in Figure 2-2).

DD-60 or DD-61 disk-drive cables attach to the even numbered connector (In) of the connector pair for each DCA2. For example, the cable for a DD-60 connected to the DCA2 in the number 5 channel adapter position would attach to connector 04 (refer to Figure 2-2).

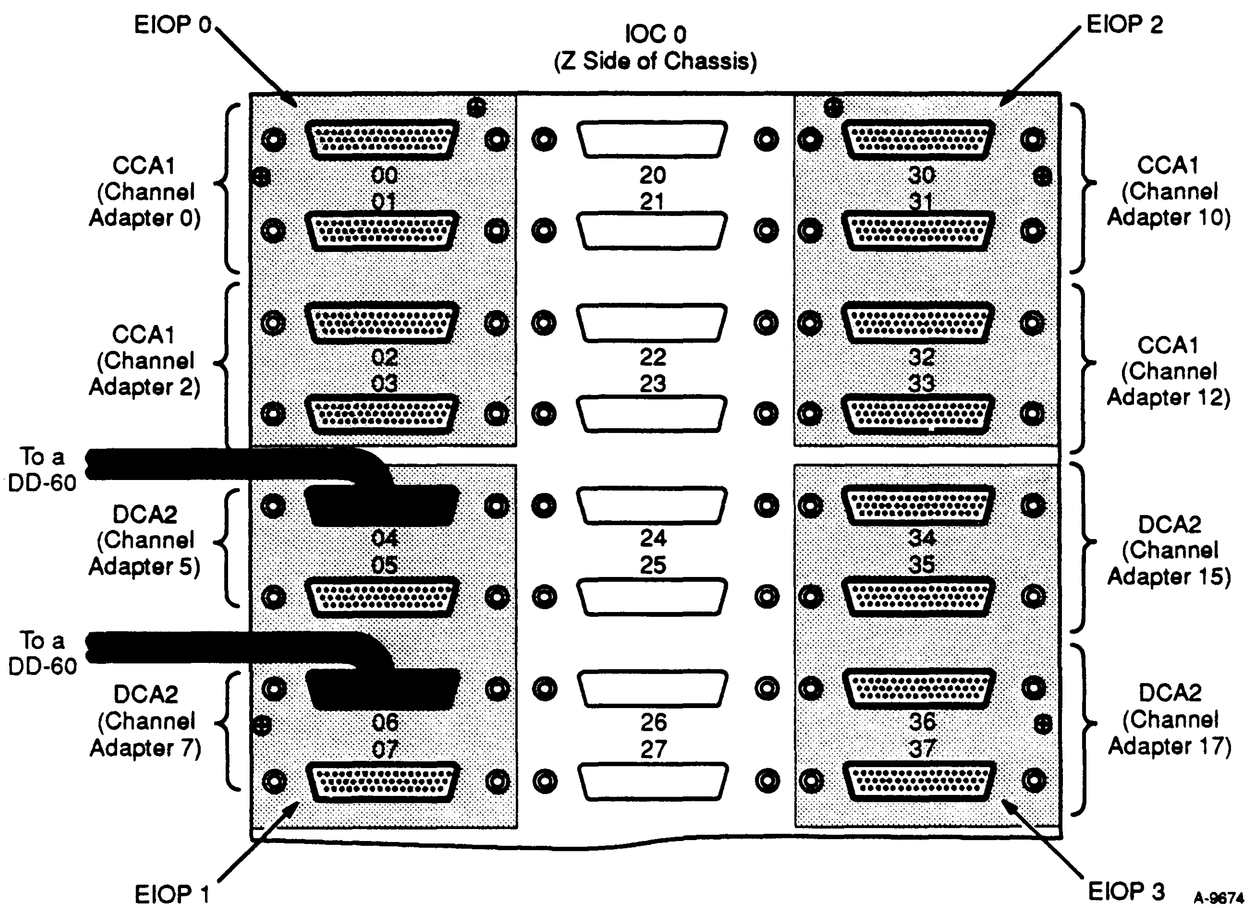

Figure 2-2. Possible IOC 0 Configuration on a CRAY Y-MP8I Computer System

Identical model disk-drive cables may be swapped to isolate a problem between the DCA2 and a disk drive. Only exchange cables that are connected to the same type of channel adapters. The easiest way to ensure the channel adapters are the same type is to exchange the cables at the disk drive end between the same type of disk drives.

CAUTION

Only connect the DCA2 to a DD-60 or DD-61 disk drive. Failure to do so will result in damage to the DCA2.

CAUTION ?

Power off the DD-60 and DD-61 disk drives before removing cables from the IOS-E or back of the disk drive. Failure to do so results in damage to DD-60s and DD-61s.

CAUTION

Only connect DD-60 or DD-61 disk drives to a DCA2. Failure to do so results in damage to DD-60s or DD-61s.

For example, if an IOC were configured as shown in Figure 2-2, a problem could exist in the DCA2 located in the number 5 channel adapter position or in the DD-60 it is connected to. To isolate the problem, exchange the DD-60 cable at the disk drive end with another DD-60 cable.

If the symptoms of the problem move to the other channel, the DD-60 is failing. If the symptoms of the problem remain on the same channel, the DCA2 is failing and should be exchanged with another DCA2.

DCA2-to-disk Drive Cables

The cables that connect the DCA2 to a disk drive come in two lengths: 20 meters (66 ft), CRI part number 12127800; and 30 meters (99 ft), CRI part number 12127801. The 20 meter cable is standard and the 30 meter cable is optional. Table 2-1 lists the socket assignments for each end of a DCA2-to-disk drive cable. Figure 2-3 shows the socket locations on both ends of the cable.

Table 2-1. DCA2-to-disk Drive Cable Socket Definitions

Pair No.	Signal Name	CINCH Connector Socket Number		Disk Drive Connector Socket Number	
		(+)	(–)	(+)	(–)
1	DC Ground	2	1	1	34
2	Select Out	14	13	43	27
3	Master Out	12	11	45	29
4	Sync Out	6	5	41	25
5	Sync In	10	9	15	48
6	Slave In	8	7	39	23
7	Attention In	4	3	20	4
8	Bus A – Bit 2^0	34	33	13	46
9	Bus A – Bit 2^1	37	36	30	14
10	Bus A – Bit 2^2	39	38	22	6
11	Bus A – Bit 2^3	41	40	26	10
12	Bus A – Bit 2^4	43	42	11	44
13	Bus A – Bit 2^5	45	44	28	12
14	Bus A – Bit 2^6	47	46	37	21
15	Bus A – Bit 2^7	49	48	5	38
16	Bus A – Parity Bit	50	51	47	31
17	Bus B – Bit 2^0	16	15	32	16
18	Bus B – Bit 2^1	18	17	49	33
19	Bus B – Bit 2^2	20	19	3	36
20	Bus B – Bit 2^3	22	21	7	40
21	Bus B – Bit 2^4	24	23	24	8
22	Bus B – Bit 2^5	26	25	9	42
23	Bus B – Bit 2^6	28	27	18	2
24	Bus B – Bit 2^7	30	29	35	19
25	Bus B – Parity Bit	32	31	17	50

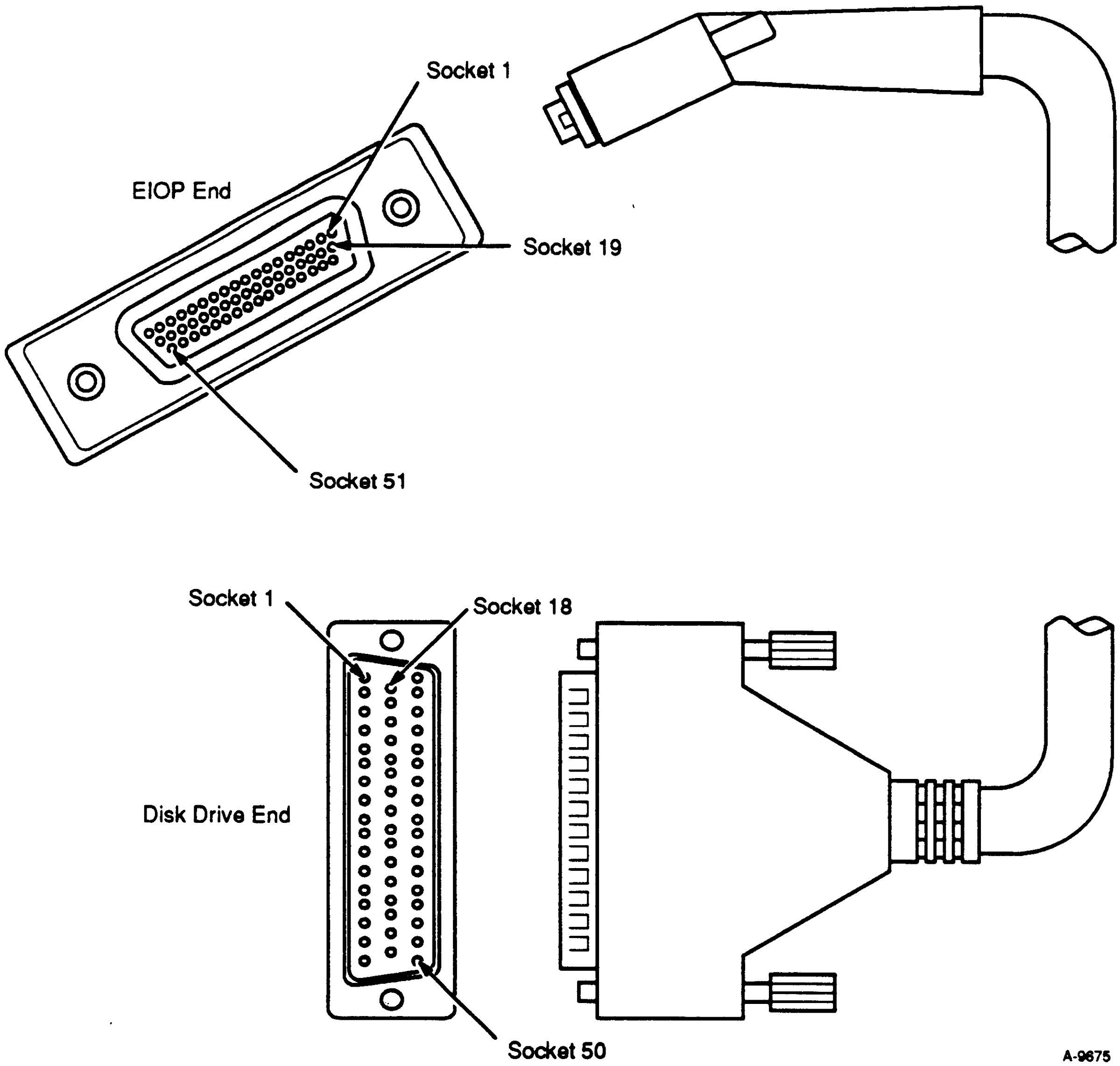

Figure 2-3. DCA2-to-disk Drive Cable Sockets

Daisy Chain Cable

The cable used to daisy chain disk drives is 61 cm (24 in.) long (CRI part number 12135100). Table 2-2 lists the pin and socket assignments for each end of the daisy chain cable. Figure 2-4 shows the pin and socket locations on both ends of the cable.

Table 2-2. Daisy Chain Cable Pin and Socket Definitions

Pair No.	Signal Name	Disk Drive Connector Pin Number (+)	(–)	Disk Drive Connector Socket Number (+)	(–)
1	DC Ground	1	34	1	34
2	Select Out	43	27	43	27
3	Master Out	45	29	45	29
4	Sync Out	41	25	41	25
5	Sync In	15	48	15	48
6	Slave In	39	23	39	23
7	Attention In	20	4	20	4
8	Bus A – Bit 2^0	13	46	13	46
9	Bus A – Bit 2^1	30	14	30	14
10	Bus A – Bit 2^2	22	6	22	6
11	Bus A – Bit 2^3	26	10	26	10
12	Bus A – Bit 2^4	11	44	11	44
13	Bus A – Bit 2^5	28	12	28	12
14	Bus A – Bit 2^6	37	21	37	21
15	Bus A – Bit 2^7	5	38	5	38
16	Bus A – Parity Bit	47	31	47	31
17	Bus B – Bit 2^0	32	16	32	16
18	Bus B – Bit 2^1	49	33	49	33
19	Bus B – Bit 2^2	3	36	3	36
20	Bus B – Bit 2^3	7	40	7	40
21	Bus B – Bit 2^4	24	8	24	8
22	Bus B – Bit 2^5	9	42	9	42
23	Bus B – Bit 2^6	18	2	18	2
24	Bus B – Bit 2^7	35	19	35	19
25	Bus B – Parity Bit	17	50	17	50

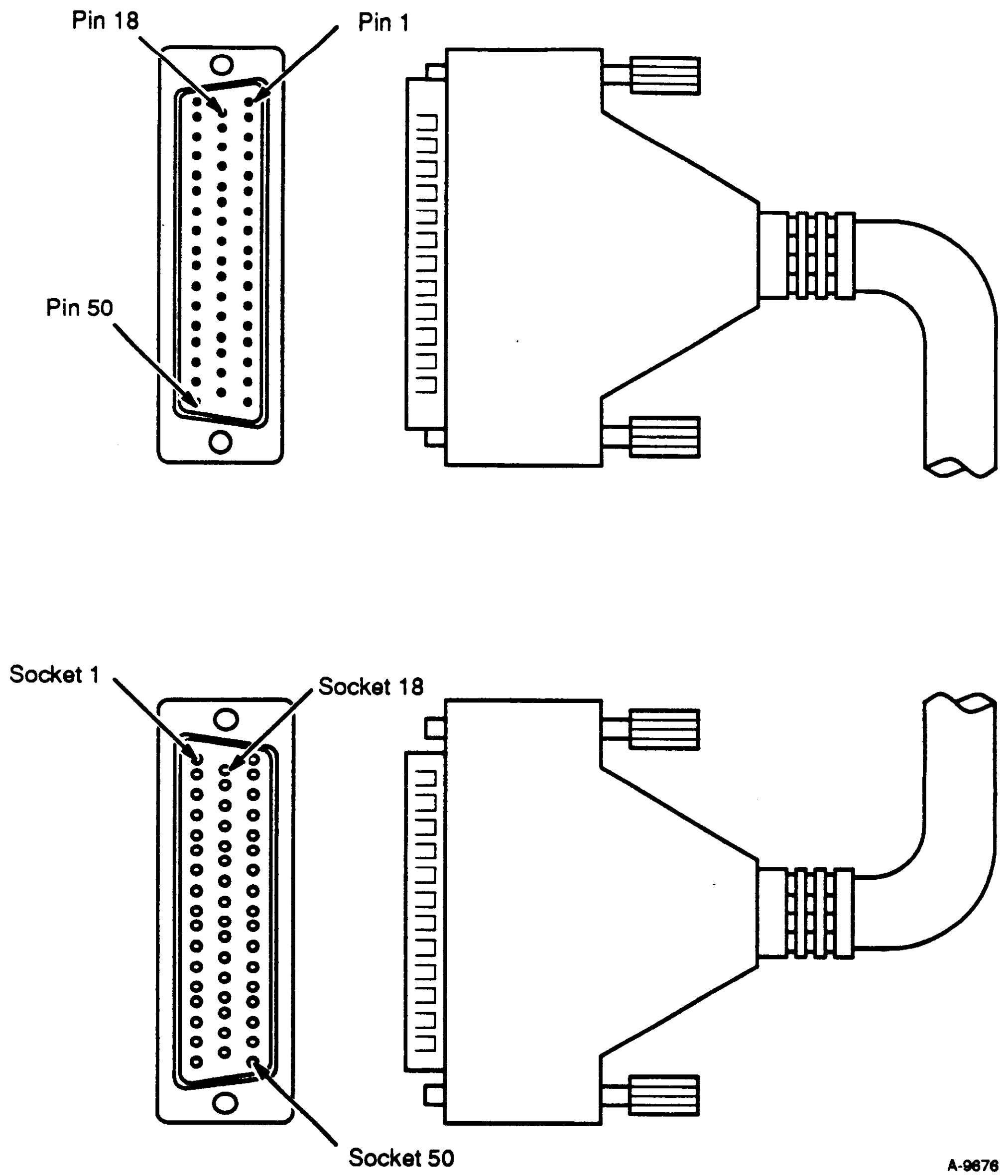

Figure 2-4. Daisy Chain Cable Pins and Sockets

Terminator

The terminator for 60 series disk drives has CRI part number 01686600. Figure 2-5 shows the terminator.

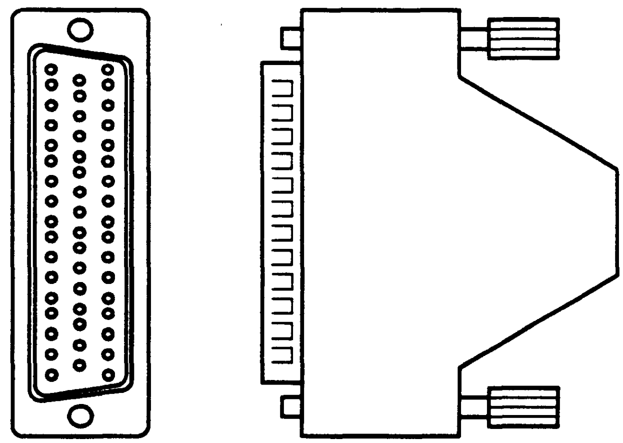

Figure 2-5. Terminator for 60 Series Disk Systems

Cable Labels

To prevent the connection of DD-60 or DD-61 disk drives to the wrong type of channel adapter, label all 60 series disk drive cables. Each label should contain the EIOP identification, channel number, and channel adapter number that the cable connects to.

The EIOP identification should include the IOC number and the EIOP number. Figure 2-6 shows an example of the EIOP identification on a cable label.

The channel number and channel adapter number provide further information about which channel adapter the cable is connected to. Figure 2-6 shows these numbers on a sample cable label.

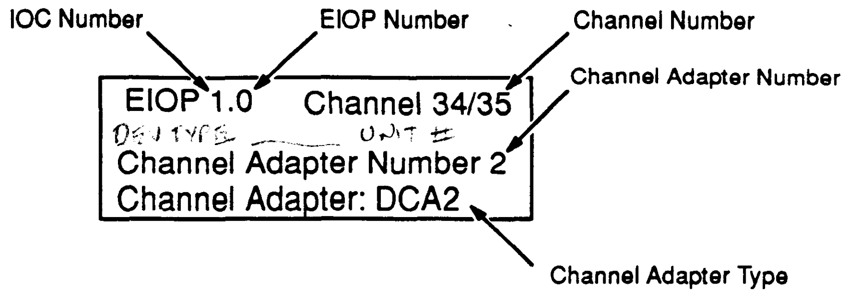

Figure 2-6. 60 Series Disk Drive Cable Label

In addition to this information, it may be helpful to write the channel adapter type on the label. This helps ensure that the disk drive is cabled to the correct channel adapter (refer to Figure 2-6).

Configurations

Sixty series disk drives can be cabled in three configurations: single-port, daisy chain, or alternate-path. Table 2-3 lists the number of components used in each configuration.

Table 2-3. Comparison of 60 Series Disk Drive Configurations

Configuration	DCA2s	Disk Drives	Advantages
Single-port	1	1	Fast data transfer rate
Daisy chain	1	2 to 8	Large storage capacity per channel
Alternate-path	2	2 to 8	Dual-channel access to data on the disk drives

Single-port Configuration

A single-port configuration connects one DCA2 to one disk drive. In this configuration, the channel accesses information at the maximum data transfer rate of the disk drive. Since only one disk drive connects to the channel, the storage capacity of the channel is the storage capacity of the disk drive.

Figure 2-7 shows eight disk drives, each connected in a single-port configuration. One DCA2 connects to the input of port A and a terminator connects to the output of port A for each disk drive. Port B is not used. Figure 2-8 shows the physical connections on the back of a disk drive.

Label every cable that connects a disk drive to a DCA2. Doing so ensures that the cable connects a disk drive to a DCA2 channel adapter. Cabling a 60 series disk drive to the wrong channel adapter damages both the disk drive and the channel adapter.

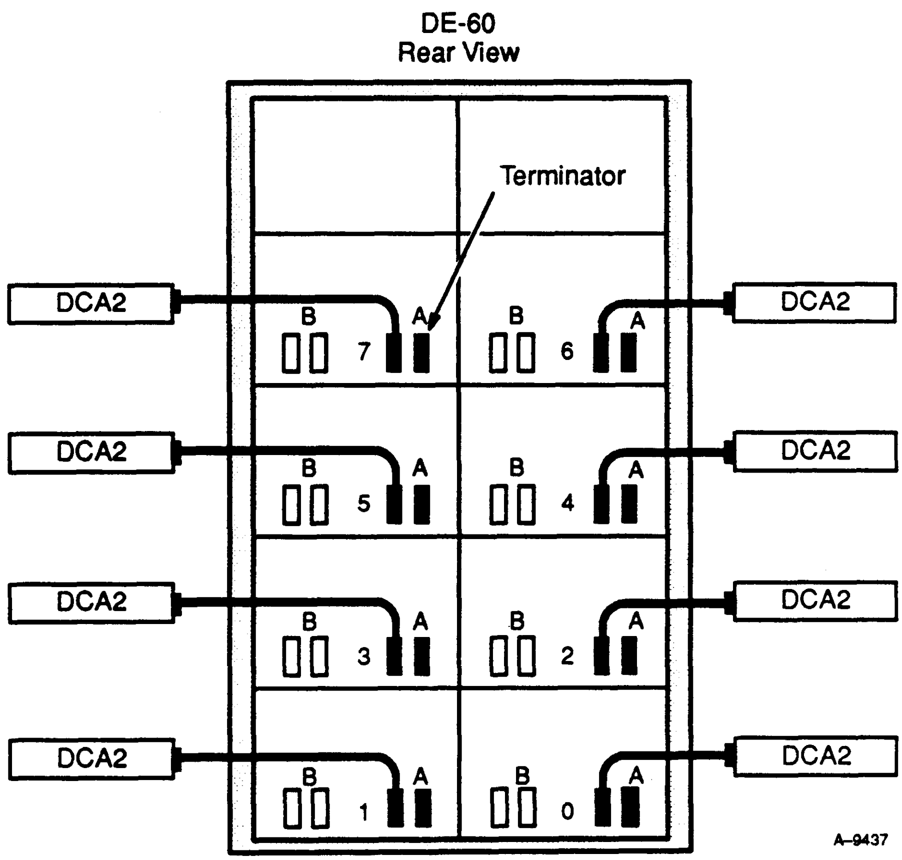

Figure 2-7. Single-port Configurations

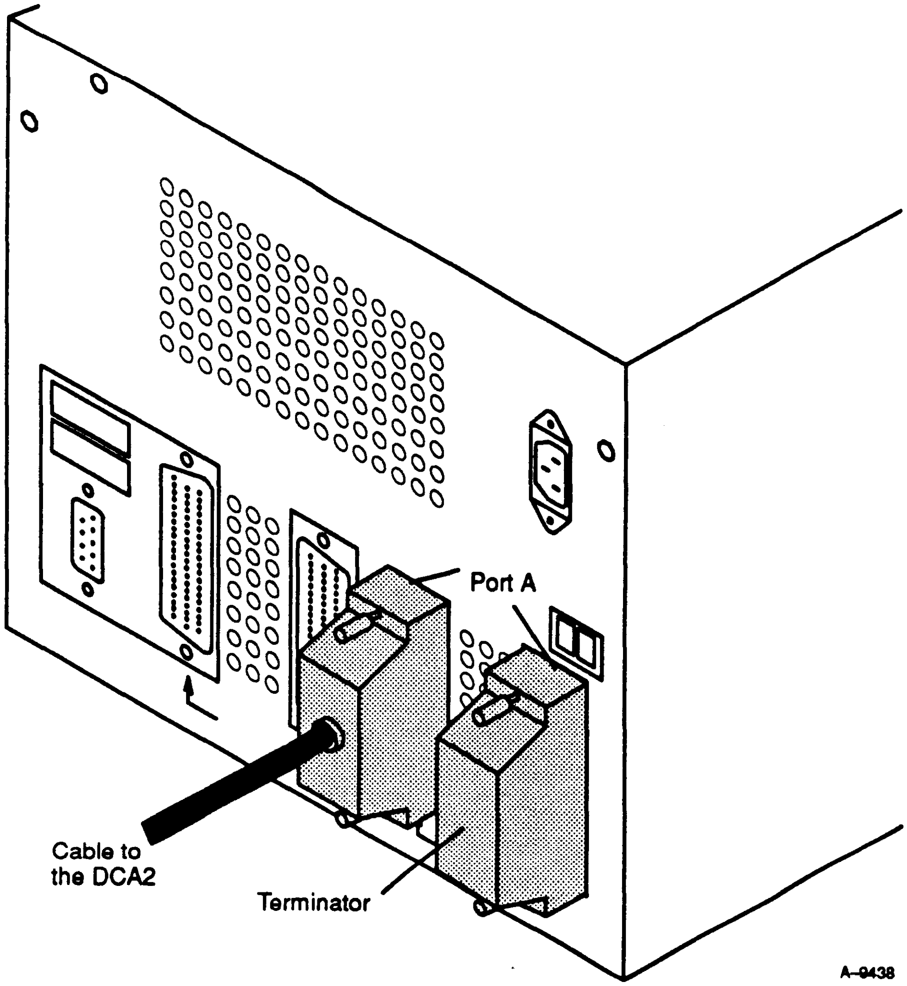

Figure 2-8. Single-port Configuration Cabling

Daisy Chain Configuration

A daisy chain configuration connects one DCA2 to a maximum of eight disk drives of the same model. The channel data storage capacity is the total storage capacity of all the disk drives in the daisy chain. Since only one disk drive can transfer data to the DCA2 at a time, the channel data transfer rate is the maximum transfer rate of one disk drive.

Figure 2-9 shows eight disk drives connected in a daisy chain configuration. One DCA2 connects to the input of port A on the first disk drive in the chain. The output of port A on the first disk drive connects to the input of port A on the next disk drive. The last disk drive in the chain has a terminator connected on the output of port A. Figure 2-10 shows the physical connections on the back of two disk drives.

Label every cable that connects a disk drive to a DCA2. Doing so ensures that the cable connects a disk drive to a DCA2 channel adapter. Cabling a 60 series disk drive to the wrong channel adapter damages both the disk drive and the channel adapter.

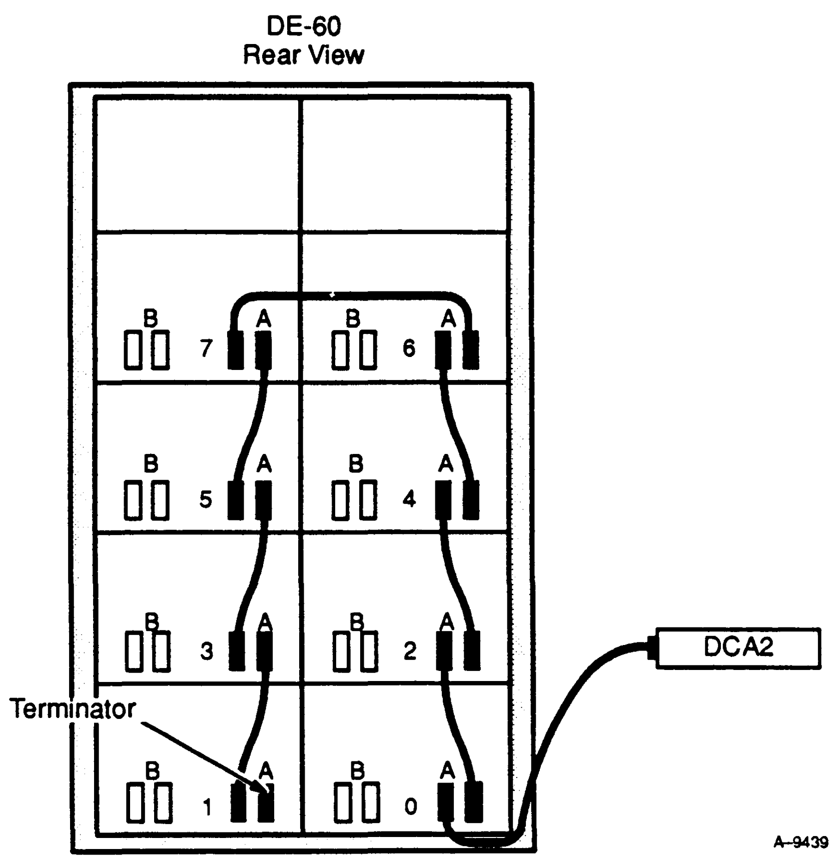

Figure 2-9. Daisy Chain Configuration

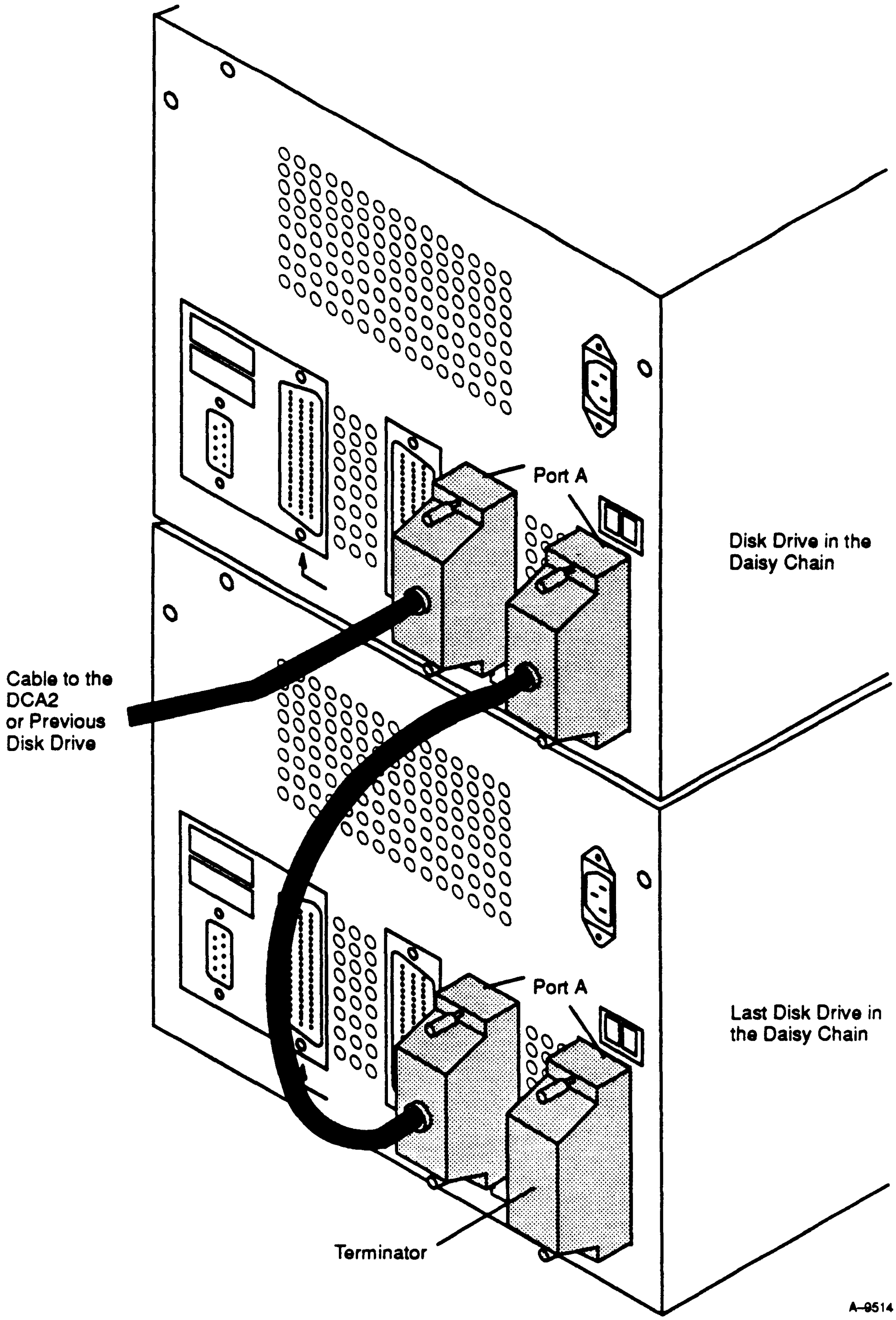

Figure 2-10. Daisy Chain Configuration Cabling

Alternate-path Configuration

An alternate-path configuration connects two DCA2s to a maximum of eight disk drives. In this configuration, the two DCA2s connect to the same set of disk drives on two separate daisy chains. Special software modifications must be made when the disk drives are cabled in an alternate-path configuration.

Figure 2-11 shows eight disk drives connected in alternate-path configurations. Each disk drive has one DCA2 connected to port A (primary path) and another DCA2 connected to port B (secondary path). Figure 2-12 shows the physical connections on the back of two disk drives.

Label every cable that connects a disk drive to a DCA2. Doing so ensures that the cable connects a disk drive to a DCA2 channel adapter. Cabling a 60 series disk drive to the wrong channel adapter damages both the disk drive and the channel adapter.

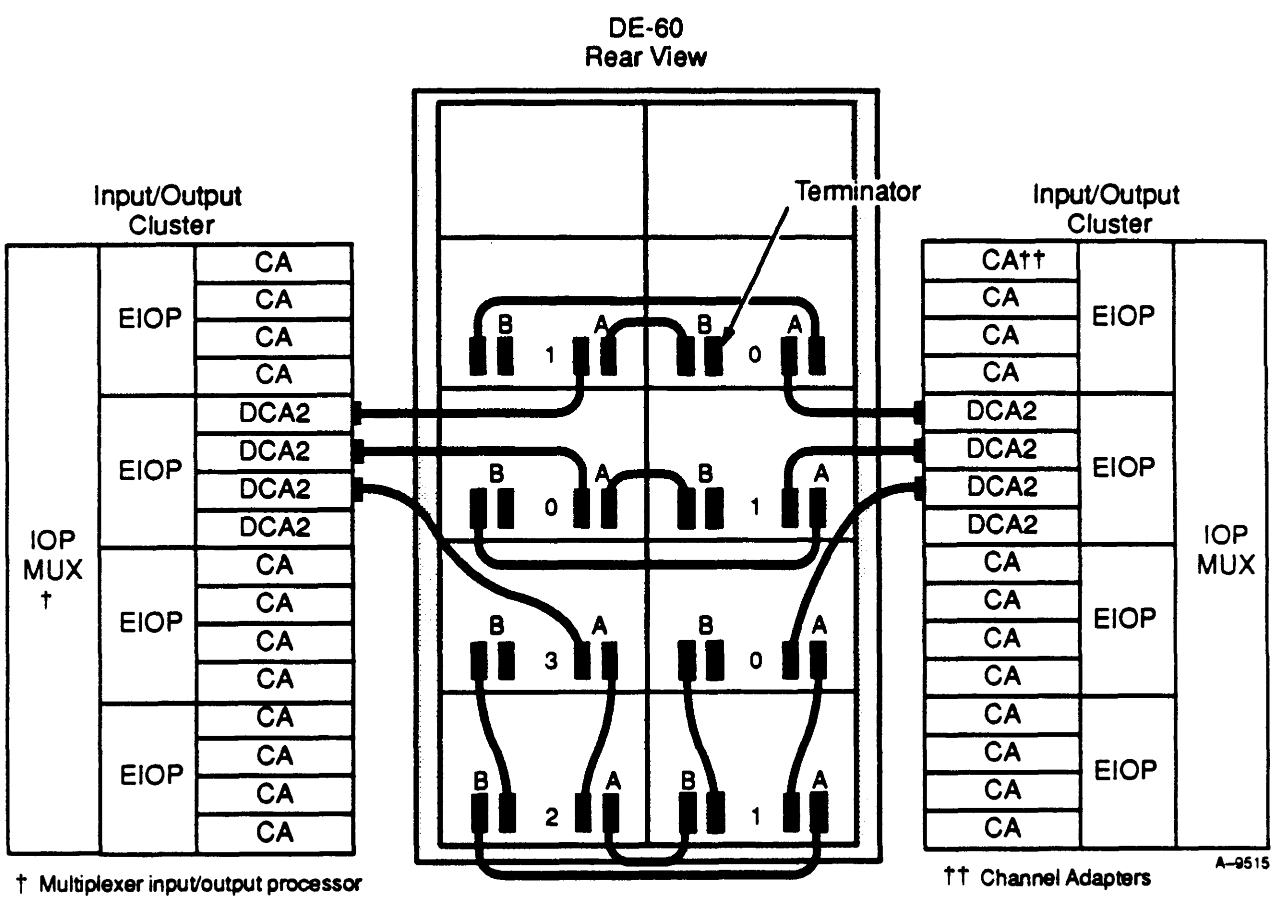

Figure 2-11. Alternate-path Configurations

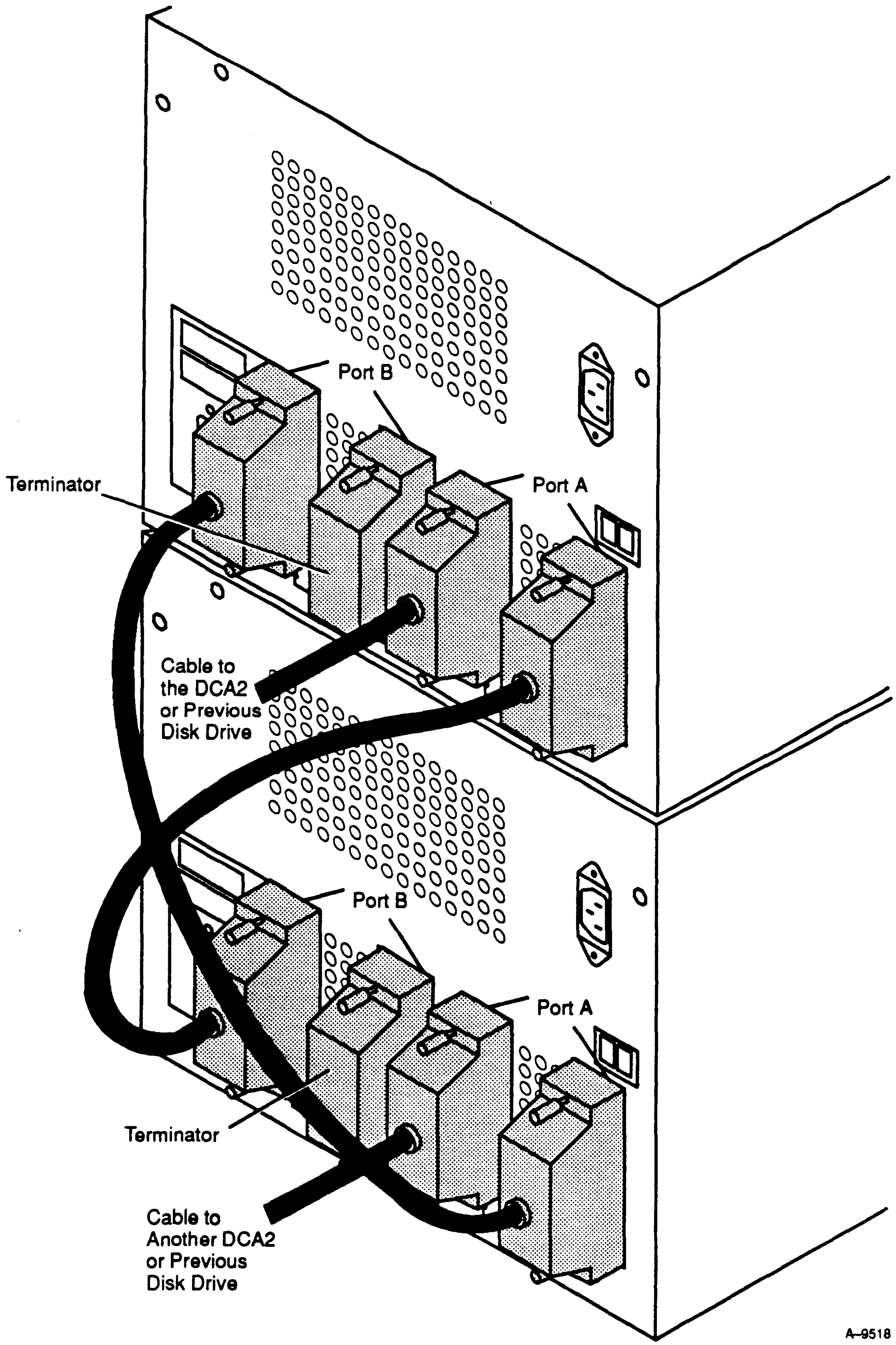

Figure 2-12. Alternate-path Configuration Cabling

Alternate-path configurations may connect to two DCA2s in three combinations: within an EIOP, between two EIOPs, or between two IOCs. Figure 2-13 shows each of these combinations.

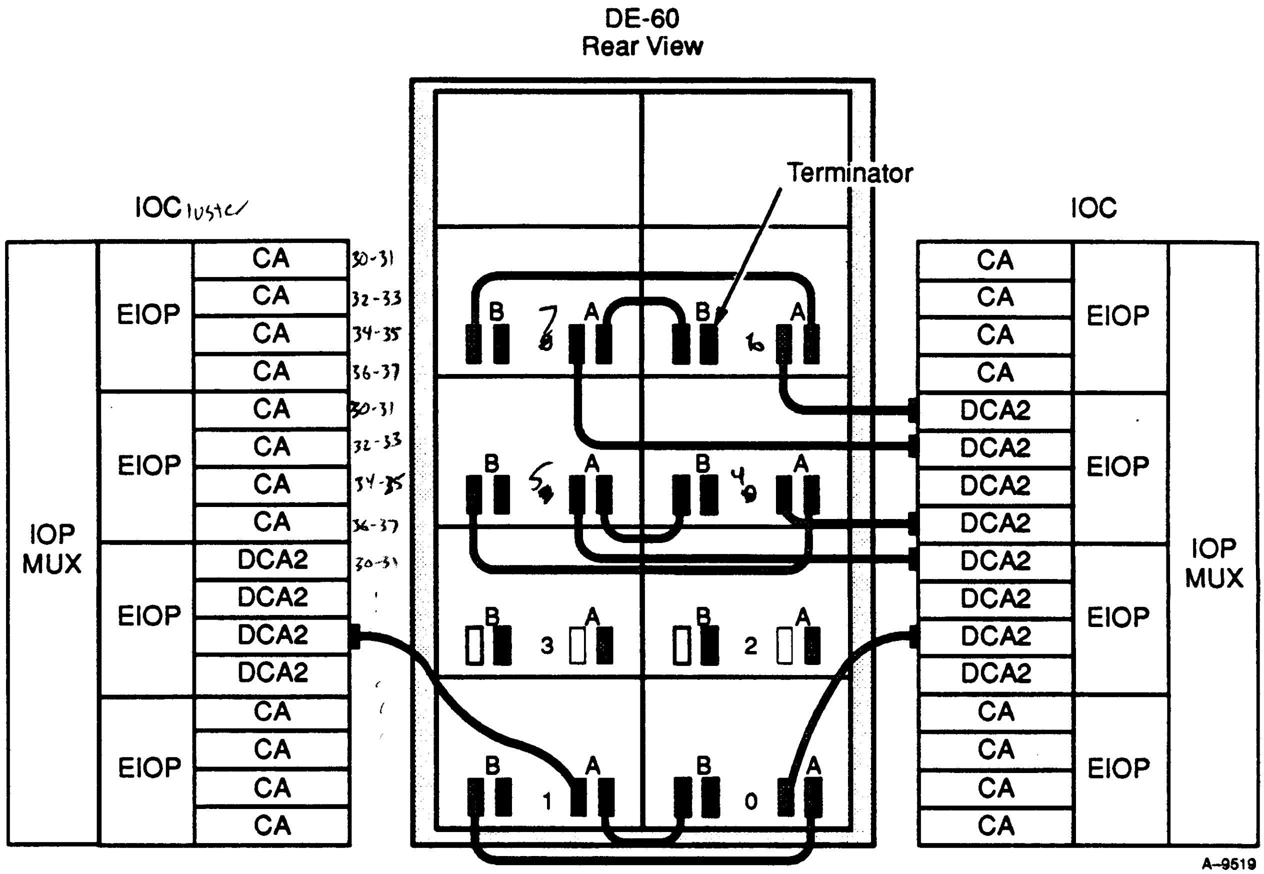

Figure 2-13. Alternate-path Daisy Chain Configuration Combinations

GOOD — Disk drives 6 and 7 in Figure 2-13 are connected to DCA2s within an EIOP. If one of the DCA2s fails to function normally, the other DCA2 in the EIOP can transfer information to or from the disk drive.

BETTER — Disk drives 4 and 5 in Figure 2-13 are connected to DCA2s within an IOC. If one EIOP fails to function normally, the other EIOP can transfer information to or from the disk drive.

BEST — Disk drives 0 and 1 in Figure 2-13 are connected to DCA2s in two separate IOCs. If one IOC fails to function normally, the other IOC can transfer information to or from the disk drive.

SECTION 3
DCA2 BASIC THEORY OF OPERATIONS

3 DCA2 BASIC THEORY OF OPERATIONS

This section covers the basic theory of the DCA2 disk channel adapter, including a description of the options on the DCA2 and a description of the intelligent peripheral interface-2 (IPI-2) protocol.

DCA2 Options

The DCA2 contains 12 options that translate EIOP commands into IPI-2 protocol and transfer data between the EIOP and the disk drives. These options are described below. Figure 3-1 is a block diagram of the options on the DCA2.

3YA Option

The 3YA option is an interface between the DCA2 and the EIOP buffer board. It stores information during write and read data operations.

During write operations, the EIOP transfers a 72-bit word of information to the 3YA option in six 12-bit transfers. A word contains 64 bits of data and 8 single-error correction/double-error detection (SECDED [†]) check bits. After receiving the word of data, the 3YA option sends the data and check bits to the 3YC option in five 16-bit transfers (8 bits of the last 16-bit parcel are not used).

During read operations, the 3YA option receives data for a word from the 3YB option in four 16-bit transfers. During the last two data transfers, the 3YA also receives the check bits from the 3YB in 4-bit transfers. After receiving the data and check bits, the 3YA option sends the word of information to the EIOP buffer board in six 12-bit transfers.

3YC Option

The 3YC option stores data and checks for errors during write data operations. After receiving the data and check bits from the 3YA, the 3YC generates a new set of check bits for the data. If the new check bits do not match the previous check bits, the 3YC checks for a single-bit or double-bit SECDED error.

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

If a single-bit error has occurred, the 3YC changes the value of the incorrect bit and sends a signal to the 3DD option that a single-bit error occurred. If a double-bit error occurred, the 3YC cannot change the value of the incorrect bits and sends a signal to the 3DD option that a double-bit error occurred.

After performing SECDED, the 3YC generates 2 parity bits for each parcel of data. One parity bit is for bits 2^0 through 2^7 (bus B information) and the other parity bit is for bits 2^8 through 2^{15} (bus A information). The 3YC sends the parcel and parity bits to the 3DH options.

3DH0 Option

The 3DH0 option contains four separate circuits that generate error correction code (ECC) for four of the physical sectors in a DD-60 or half of a sector in a DD-61. For example, one circuit generates ECC for bits 2^0 and 2^8. These bits correspond to the data read from or written to channel 0 of a head group in a DD-60 (refer to Figure 5-9).

During write data operations, the 3DH0 receives a byte of data (bits 2^0 through 2^3 and bits 2^8 through 2^{11} of a parcel) from the 3YC option. The 3DH0 calculates a partial ECC for each byte of data and sends the byte of data to the 3DF option. After a sector of data passes through the 3DH0, the 3DH0 sends the complete ECC for four of the channels in a head group to the 3DF option in 8-bit transfers.

The 3DH0 also receives a parity bit for bits 2^0 through 2^7 of a parcel (bus B information) from the 3YC option. The 3DH0 sends this parity bit with each byte of data it transfers to the 3DF.

During read data operations, the 3DH0 receives a byte of data from the 3DE option (bits 2^0 through 2^3 and bits 2^8 through 2^{11} of a parcel). The 3DH0 calculates a partial ECC for each byte of data and stores the information. Immediately after receiving a sector of data, the 3DH0 receives ECC for four of the channels in a head group from the 3DE option. The 3DH0 compares this ECC with the ECC it generated. If the codes do not match, the 3DH0 sends an ECC error to the 3DG option.

3DH1 Option

The 3DH1 option performs the same operations as the 3DH0 option; however, it receives bits 2^4 through 2^7 and 2^{12} through 2^{15} of a parcel. These bits correspond to channels 4 through 7 of a head group in a DD-60. The 3DH1 also transfers the parity bit for bits 2^8 through 2^{15} of a parcel (bus A information) from the 3YC to the 3DF.

3DF Option

The 3DF option contains signal lines and registers used for IPI-2 information transfers to the disk drive. It also transfers write data from the DCA2 to the disk drive.

The 3DF option is the IPI-2 communication link for transfers from the DCA2 to the disk drive. It contains the Select Out, Master Out, Sync Out, bus A, and bus B signals used for IPI-2 protocol.

The 3DF option also contains *i, j,* and *k* registers, which store IPI commands. Before an information transfer occurs, the *i, j,* or *k* registers of the 3DF option are loaded with IPI commands. After receiving a signal from the sequencer (RAM), 3DF transfers the information stored in the registers to the disk drive over bus A.

During a write data operation, 3DF receives a parcel of information from the 3DH options. The 3DF option receives bits 2^0 through 2^3 and 2^8 through 2^{11} from 3DH0 and bits 2^4 through 2^7 and 2^{12} through 2^{15} from 3DH1. After receiving the parcel of data, 3DF loads bus B with bits 2^0 through 2^7 and bus A with bits 2^8 through 2^{15}.

The 3DF option also receives 2 parity bits from the 3DH options. Write data on bus B is protected with the parity bit from 3DH0 and write data on bus A is protected with the parity bit from 3DH1. The 3DF option sends the data and parity bits to the disk drive after it receives them from the 3DH options.

3DE Option

The 3DE option receives IPI-2 control and information transfers from the disk drive. It also receives read data from the disk drive and transfers it to the other options on the DCA2.

The 3DE option is the IPI-2 communication link for transfers from the disk drive to the DCA2. It receives the Slave In, Sync In, bus A, and bus B signals used for IPI-2 protocol.

During a read data operation, 3DE receives a byte of data plus a parity bit from both bus A and bus B. After receiving the data and parity bits, 3DE transfers the information to 3YB, 3DG, 3DH0, and 3DH1. If the read data is ending status or status response information, 3DE transfers the information from bus B to 3DJ and 3DI.

The 3DE option can also perform bit stream replacement, which corrects misread data from a failing head. The 3DE option replaces the data from the failing head with a sum of the data from the other heads and the parity head. The DCA2:17 channel function transfers the information needed for bit stream replacement to 3DE. For more information on channel functions, refer to the "DCA2 Channel Functions" section of this manual.

3YB Option

The 3YB option stores data and generates SECDED check bits during read data operations. It also checks the parity information.

During read data operations, 3YB receives a word of data from 3DE in four 16-bit transfers. While receiving the word of data, 3YB generates eight SECDED check bits for the word. It sends the word of data to the 3YA option in four 16-bit transfers. During the last two transfers of data, 3YB sends the check bits in 4-bit transfers.

The 3YB option also generates a new parity bit for each byte of data it receives from 3DE. If the new parity bit does not match the previous parity bit, 3YB signals 3DD that a byte 0 (bus B) or byte 1 (bus A) parity error occurred.

3DG Option

The 3DG option contains registers for comparing the sector ID field to the expected ID field. It also contains counters for counting parcels of information transferred between the DCA2 and the disk drive.

The parameter register and cylinder register in 3DG store sector ID field parameters. The parameter register stores the head, sector, and option bits (ID parameter 1) of the ID field. The cylinder register stores the cylinder address (ID parameter 0) of the ID field. For more information on the sector ID field, refer to the format and flaw management disk drive sections of this manual.

The 3DG also contains a parcel counter and defect counter. The parcel counter counts each parcel as it is transferred between the DCA2 and the disk drive. The defect counter is used to create a defect pad that hides media flaws. For more information on media flaws and the defect pad, refer to the "Format and Flaw Management" disk drive sections of this manual.

3DD Option

The 3DD option receives DCA2 channel functions and transfers control signals between the EIOP and DCA2. After receiving a DCA2 channel function from the EIOP, 3DD transfers the function information to the appropriate options on the DCA2. The 3DD option also contains registers that store errors and internal status generated by the DCA2. When requested, 3DD transfers this status information to the EIOP.

3DI Option

The 3DI option counts the number of information transfers between the EIOP and the DCA2. It also controls the sequencer address (3DJ option) and sends data to the RAM, hereafter referred to as the sequencer.

The transfer counter in the 3DI option counts the transfers between the EIOP local memory or EIOP buffer board and the DCA2. Before an information transfer occurs, the transfer counter is loaded with the number of parcels to be transferred. The transfer counter decrements once for each parcel transferred.

The 3DI option also controls the sequencer address. The 3DI option signals 3DJ when to reset the sequencer address, when to advance the sequencer address, and when the transfer counter reaches zero.

3DJ Option

The 3DJ option transfers the sequencer address to the sequencer. After receiving the signals from 3DI, 3DJ increments the sequencer address or resets the sequencer address to zero. The 3DJ option also monitors conditions from the other options on the DCA2 that are used for branch control of the sequencer address.

RAM

The RAM is a sequencer that controls the operation of the DCA2 registers and IPI-2 signal lines. It contains 1,024 addresses that hold 32 bits of sequencer data.

After receiving the sequencer address from the 3DJ option, the sequencer transfers the sequencer data to 3DI and 3DJ. As 3DJ increments through the addresses of the sequencer, the sequencer data controls when the registers on each option are transferred to signal lines, and when the IPI-2 signal lines are set or reset.

The information stored in the RAM may be transferred to the EIOP local memory, or written over by information from EIOP local memory. For more information on loading or reading the sequencer data, refer to the "DCA2 Channel Functions" section of this manual.

IPI-2 Interface Signals

IPI-2 interface signals transfer information between the DCA2 to 60 series disk drives. The 24 signals consist of control, attention in, and data signals. Figure 3-2 shows the signals in an IPI-2 interface.

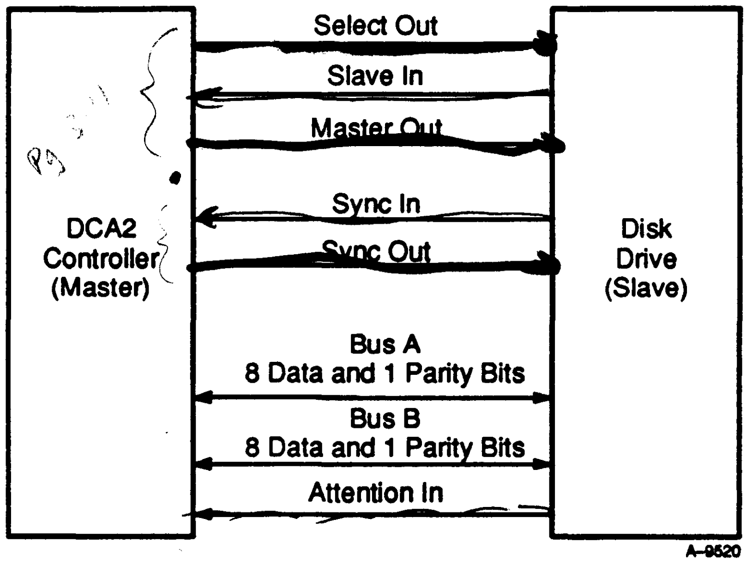

Figure 3-2. IPI-2 Interface Signals

Control Signals

Five signals control disk drive operations. These signals are Select Out, Slave in, Master Out, Sync In, and Sync Out.

Select Out

The DCA2 sends the Select Out signal to select a disk drive for use by the channel. Initially, when the Select Out signal is set, the requested disk drive address is transferred on bus A. The Select Out signal remains set until the controller releases the disk drive from the channel.

Slave In

The disk drive sends the Slave In signal to respond to a Select Out signal or a Master Out signal from the DCA2. During a select operation, the disk drive responds to the Select Out signal with the Slave In signal to acknowledge channel reservation. During a reset operation, the disk drive responds to the Master Out signal with the Slave In signal to acknowledge the reset operation.

Master Out

The DCA2 sends the Master Out signal during a data transfer or disk drive reset. To initiate a data transfer, the DCA2 sets the Master Out signal after loading bus A and B with data. To initiate a disk drive reset, the DCA2 sets the Master Out signal after loading bus A with a reset parameter.

Sync In

The disk drive sends the Sync In signal during a data transfer or bus control operation. During read or write operations, the disk drive sets the Sync In signal to acknowledge the data transfer. For a read operation, the Sync In signal indicates valid data on the bus lines. For a write operation, the Sync In signal indicates that the disk drive is ready to accept data over the bus lines. During a bus control operation, the disk drive sets the Sync In signal to indicate acceptance of the bus control parameter.

Sync Out

The DCA2 sends the Sync Out signal during a data transfer or bus control operation. During a read or write operation, the DCA2 sets the Sync Out signal to acknowledge the data transfer. For a read operation, the Sync Out signal indicates the data on the bus lines was received. For a write operation, the Sync Out signal indicates valid data on the bus lines. During a bus control operation, the DCA2 sets the Sync Out signal after loading bus A with the bus control parameter.

Attention In Signal

The disk drive uses the Attention In signal to inform the DCA2 that service is required. The disk drive sets the Attention In signal if any of the following interrupts occur:

- Rotational position sensing (RPS) interrupt
- Command completion interrupt
- Status pending interrupt
- No longer busy interrupt

Data Signals

All information transfers between the DCA2 and disk drive occur over bus A and bus B. Each bus carries nine signals. Eight of the signals are data bits and one signal is an odd parity bit.

Bus A

The DCA2 uses bus A to transfer command parameters to the disk drive. Refer to the "IPI-2 Interface States" subsection in this section for more information on disk drive operations.

Bus B

The disk drive uses bus B to transfer command responses to the DCA2. Refer to the "IPI-2 Interface States" subsection in this section for more information on disk drive operations.

Bus A and Bus B

During write operations, the DCA2 uses bus A and bus B to transfer 18 bits of information to the disk drive. During read operations, the disk drive uses bus A and bus B to transfer 18 bits of information to the DCA2. Refer to the "IPI-2 Interface States" subsection in this section for more information on disk drive operations.

IPI-2 Interface States

An IPI-2 interface state occurs when all control signals on the IPI-2 interface have a stable logical value. For example, the BUS CONTROL state has the Select Out signal set to 1, the Slave In signal set to 1, the Master Out signal set to 0, the Sync In signal set to 0, and the Sync Out signal set to 1 (refer to Figure 3-3).

Figure 3-3 shows all the IPI-2 states. The arrows indicate which states are accessible from the other states. For example, the SLAVE ACKNOWLEDGE state can change into the DESELECT, BUS CONTROL, or TRANSFER READY state.

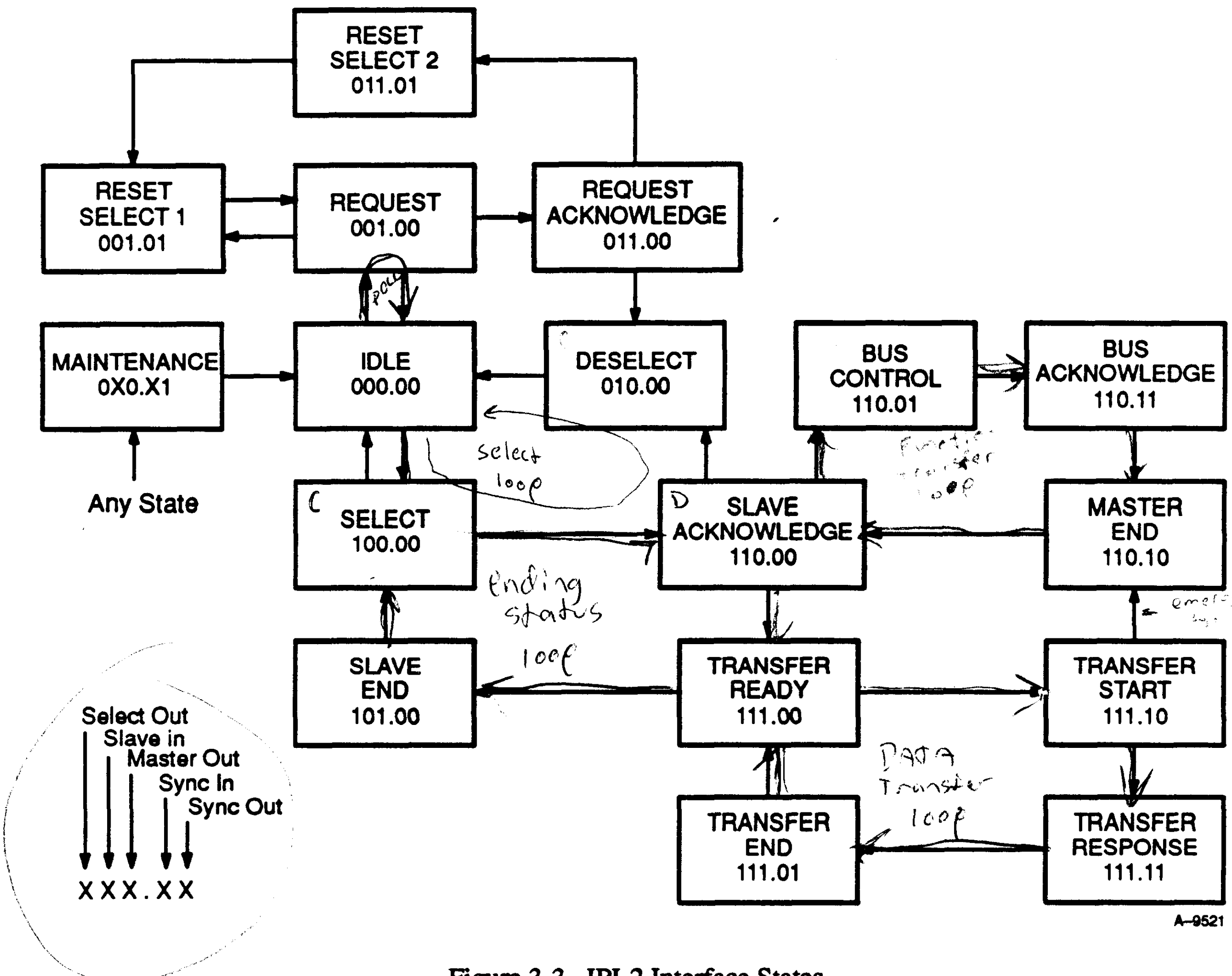

Figure 3-3. IPI-2 Interface States

During normal operation, the IPI-2 interface changes state when one signal changes logical value. For example, to change from the BUS CONTROL state to the BUS ACKNOWLEDGE state, only the Sync In signal changes from a 0 to a 1 (refer again to Figure 3-3).

All communication between the DCA2 and disk drive follow a call and response sequence through the IPI-2 states. For example, when the interface is in the IDLE state, the DCA2 sets the Select Out signal to 1, which puts the interface in the SELECT state. In response, the disk drive sets the Slave In signal to 1, which puts the interface into the SLAVE ACKNOWLEDGE state.

Each disk drive operation follows a sequence through the IPI-2 states. The sequencer on the DCA2 controls the IPI-2 signals, which determine the order of the sequence. At the appropriate time in a sequence, the sequencer loads bus A and bus B with information and transfers it to the disk drive.

IPI-2 Interface State Sequences

An IPI-2 interface state sequence is a set path through the IPI-2 interface states that the sequencer controls. During the sequence, the DCA2 and disk drive exchange information needed for disk drive operations. The sequences for disk drive operations are:

- select disk drive
- bus control
- interlocked transfer to disk
- interlocked transfer from disk
- noninterlocked transfer to disk
- noninterlocked transfer from disk
- ending status
- deselect
- interrupts request (poll)
- reset disk drive
- master reset
- transfer settings request
- drive interrupts request

Each sequence determines what information the sequencer or disk drive must place on bus A or bus B. Table 3-1 lists the contents of bus A and bus B for all of the IPI-2 interface state sequences.

The following subsections describe each of the disk drive operation sequences in detail. Each subsection contains a figure and tables that show the location of the sequence in Figure 3-3 and Table 3-1.

Table 3-1. Bus A and Bus B Contents for Each IPI Bus State Sequence

Sequence	Bus A 2^7	Bus A 2^6	Bus A 2^5	Bus A 2^4	Bus A 2^3	Bus A 2^2	Bus A 2^1	Bus A 2^0	Bus B 2^7	Bus B 2^6	Bus B 2^5	Bus B 2^4	Bus B 2^3	Bus B 2^2	Bus B 2^1	Bus B 2^0
Select disk drive	0	Disk drive address Bit 2^4 is the least significant bit			0	0	0	Priority select	Disk drive 7	Disk drive 6	Disk drive 5	Disk drive 4	Disk drive 3	Disk drive 2	Disk drive 1	Disk drive 0
Bus control	Transfer control or data	Transfer out or in	0	Advance head	Bus control parameter				Bus B is not defined so each bit is set to 0							
Interlocked transfer-to-disk	IPI command parameters from the EIOP local memory to the disk drive								IPI command parameters from the EIOP local memory to the disk drive							
Interlocked transfer-from-disk	IPI status from the disk drive to the DCA2								IPI status from the disk drive to the DCA2							
Noninterlocked transfer-to-disk	Write data from the EIOP buffer board to the disk drive								Write data from the EIOP buffer board to the disk drive							
Noninterlocked transfer-from-disk	Read data from the disk drive to the EIOP buffer board								Read data from the disk drive to the EIOP buffer board							
Ending status	Good transfer	Bus parity error	0	0	0	0	0	0	Good transfer	Bus parity error	Odd byte transfer	Time dependant operation	Final status after operation			
Deselect	Bus A is not defined during a deselect sequence								Bus B is not defined during a deselect sequence							
Interrupt request (Poll)	0	Report busy status	Report ready status	Slave power failure alert	Power on status request	Report status pending interrupt	Report RPS interrupt	Report command complete interrupt	Disk drive 7	Disk drive 6	Disk drive 5	Disk drive 4	Disk drive 3	Disk drive 2	Disk drive 1	Disk drive 0
Reset disk drive	1	Disk drive address Bit 2^4 is the least significant bit			Disable interface drivers	Reset disk drive	Reset logical interface	Reset physical interface	Bus B is not defined during a reset disk drive sequence							
Master reset	Data out 2	Not used	Not used	Data out 1	Not used	Not used	Data out 0	Not used	Bus B is not defined during a master reset sequence							
Transfer settings request	1	Disk drive address Bit 2^4 is the least significant bit			0	0	0	0	0	0	1	0	0	1	1	0
Drive interrupts request	1	Disk drive address Bit 2^4 is the least significant bit			1	0	0	0	0	Busy status	Ready status	0	Priority select status	Status pending interrupt active	RPS interrupt active	Command complete interrupt

Select Disk Drive Sequence

The select disk drive sequence logically connects the DCA2 to a disk drive. Figure 3-4 shows a select disk drive sequence.

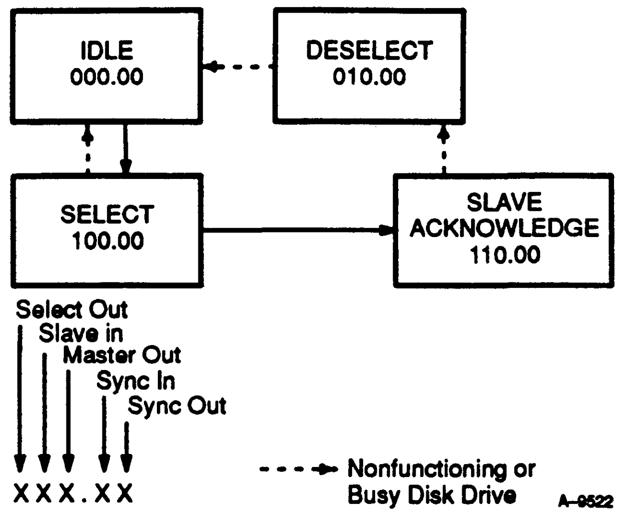

Figure 3-4. Select Disk Drive Sequence

Before a select disk drive sequence begins, the *j* register in the 3DF option must be loaded with the disk drive address (refer to Table 3-2).

Normal Selection

If no errors occur during the select disk drive sequence, a normal selection occurs. The following sequence describes a normal selection.

1. While in the IDLE state, the sequencer transfers the disk drive address from the *j* register in the 3DF option to bus A (refer to Table 3-2).

Table 3-2. Disk Drive Address on Bus A

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
0	Disk drive address Bit 2^4 is the least significant bit			0	0	0	Priority select

2. The sequencer sets the Select Out signal to 1, which puts the IPI-2 interface in the SELECT state.

3. The disk drive loads bus B with the drive select response and sets the Slave In signal equal to 1 (refer to Table 3-3), which puts the interface in the SLAVE ACKNOWLEDGE state and completes the select disk drive sequence.

Table 3-3. Drive Select Response on Bus B

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Disk drive 7	Disk drive 6	Disk drive 5	Disk drive 4	Disk drive 3	Disk drive 2	Disk drive 1	Disk drive 0

Busy Drive Selection

The following sequence describes a busy disk drive selection.

1. While in the IDLE state, the sequencer transfers the disk drive address (refer to Table 3-2) from the *j* register in the 3DF option to bus A.

2. The sequencer sets the Select Out signal to 1, which puts the IPI-2 interface in the SELECT state.

3. If the requested disk drive is functioning normally, but cannot perform bus exchanges or information transfers, the disk drive sets the Slave In signal equal to 1 but does not load bus B with the select response. As a result, the interface is put in the SLAVE ACKNOWLEDGE state.

4. The sequencer resets the Select Out signal to 0 to enter the DESELECT state. The disk drive resets the Slave In signal to 0 to return the interface to the IDLE state.

Nonfunctioning Drive Selection

The following sequence describes a nonfunctioning disk drive selection.

1. While in the IDLE state, the sequencer transfers the disk drive address from the *j* register in the 3DF option to bus A (refer to Table 3-2).

2. The sequencer sets the Select Out signal to 1, which puts the IPI-2 interface in the SELECT state.

3. If the requested disk drive does not set the Slave In signal within a given time limit, the sequencer resets the Select Out signal to 0 and returns the interface to the IDLE state.

Bus Control Sequence

The bus control sequence transfers IPI-2 commands from the DCA2 to the disk drive. Figure 3-5 shows a bus control sequence.

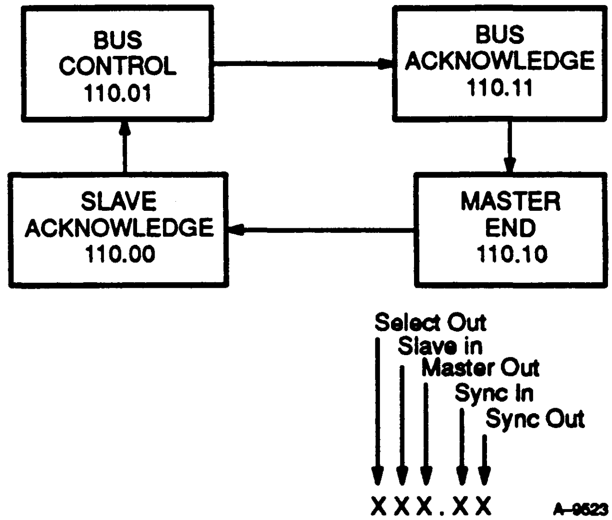

Figure 3-5. Bus Control Sequence

Before a bus control sequence begins, the *j* and *k* registers in the 3DF option (refer to Figure 3-1) must be loaded with bus control commands (refer to Table 3-4).

1. While in the SLAVE ACKNOWLEDGE state, the sequencer transfers a bus control command from the *j* or *k* register in the 3DF option to bus A (refer to Table 3-4).

Table 3-4. Bus Control Command on Bus A

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Transfer control or data	Transfer out or in	0	Advance head	Bus control parameter			

Table 3-5 shows some examples of bus control commands used by Cray Research, Inc. (CRI).

Table 3-5. Sample Bus Control Commands Used by CRI

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	Description
0	0	0	0	0	1	0	0	Load cylinder address
0	0	0	0	0	1	0	1	Load head address
0	0	0	0	0	1	1	0	Load rotational positional sensing (RPS) target sector
0	0	0	0	0	1	1	1	Load position
1	1	0	0	1	0	0	0	Read header
1	1	0	0	1	1	0	0	Read header at target
1	1	0	0	0	0	0	1	Read field
1	0	0	0	0	0	0	1	Write field
1	0	0	0	1	1	0	0	Write header at target

2. The sequencer sets the Sync Out signal to 1, which puts the interface into the BUS CONTROL state.

3. The disk drive loads bus B with the bus control response (refer to Table 3-6) and sets the Sync In signal to 1, which puts the interface into the BUS ACKNOWLEDGE state.

Table 3-6. Bus Control Response on Bus B

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Bus B is not defined, so each bit is set to 0							

4. The sequencer resets the Sync Out signal to 0, which puts the interface in the MASTER END state. Bus A is not loaded with any information.

5. The disk drive resets the Sync In signal to 0. This puts the interface in the SLAVE ACKNOWLEDGE state and completes a bus control sequence. Bus B is not loaded with any information.

Interlocked Transfer-to-disk Sequence

The interlocked transfer-to-disk sequence is used to transfer IPI command parameters from the EIOP local memory to the disk drive. Figure 3-6 shows an interlocked transfer-to-disk sequence.

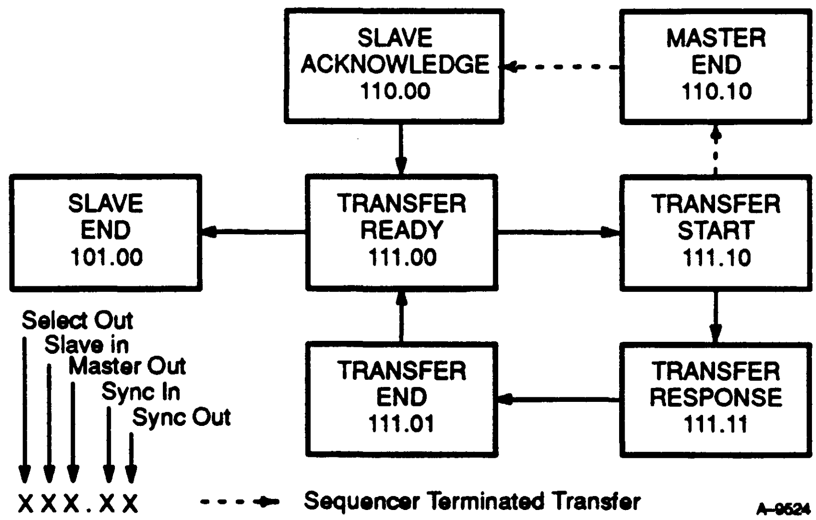

Figure 3-6. Interlocked Transfer-to-disk Sequence

Before starting an interlocked transfer-to-disk sequence, the sequencer must have successfully completed a bus control sequence.

Drive Terminated Transfer

If an interlocked transfer to disk has completed successfully, the disk drive terminates the transfer as shown in the following sequence.

1. While in the SLAVE ACKNOWLEDGE state, the sequencer sets the Master Out signal to 1. Doing so puts the interface into the TRANSFER READY state and signals the disk drive that an information transfer is about to begin.

2. The disk drive sets the Sync In signal to 1, which puts the interface into the TRANSFER START state and signals the controller that the disk drive is ready to receive information.

3. The sequencer transfers one parcel of the command parameter from EIOP local memory to bus A and bus B and sets the Sync Out signal to 1, which puts the interface into the TRANSFER RESPONSE state.

4. The disk drive resets the Sync In signal to 0 to acknowledge that it received the parcel of information, which puts the interface into the TRANSFER END state.

5. The sequencer resets the Sync Out signal to 0 to acknowledge the transfer of 1 parcel of information to the disk drive. This puts the interface into the TRANSFER READY state.

   If there is more than 1 parcel of information to be transferred to the disk drive, the sequencer repeats Steps 2 through 5 until all of the parcels are transferred from local memory to the disk drive.

6. The disk drive resets the Slave In signal to 0 to end the interlocked transfer, which puts the interface into the SLAVE END state.

Sequencer Terminated Transfer

If an error occurs during an interlocked transfer to disk, the sequencer terminates the transfer as shown in the following sequence.

1. At some point in the transfer, the disk drive sets the Sync In signal to 1, which puts the interface into the TRANSFER START state and signals the controller that the disk drive is ready to receive information.

2. While in the TRANSFER START state, the sequencer resets the Master Out signal to 0 to terminate the interlocked transfer, which puts the interface into the MASTER END state.

3. The disk drive resets the Sync In signal to 0 to acknowledge the termination, which puts the interface into the SLAVE ACKNOWLEDGE state.

4. The sequencer sets the Master Out signal to 1 to put the interface into the TRANSFER READY state.

5. The disk drive resets the Slave In signal to 0 to exit the transfer loop, which puts the interface into the SLAVE END state.

Interlocked Transfer-from-disk Sequence

The interlocked transfer-from-disk sequence is used to transfer IPI-2 status information from the disk drive to the EIOP local memory. Figure 3-7 shows an interlocked transfer-from-disk sequence.

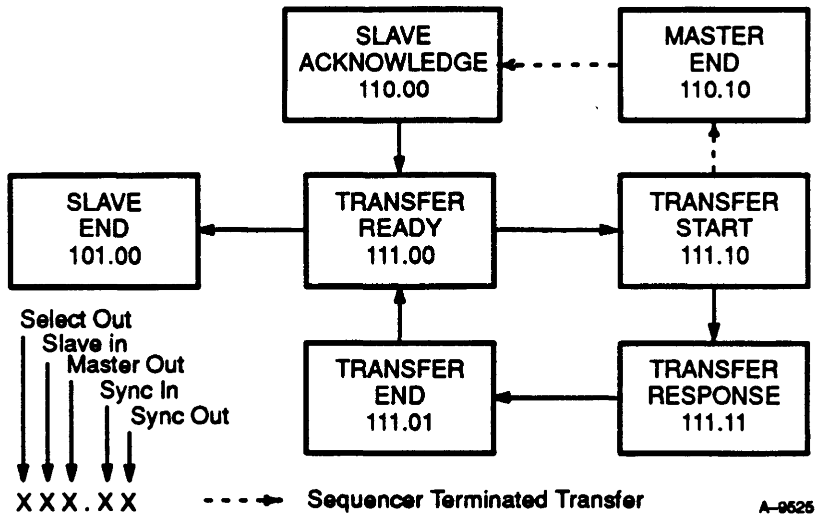

Figure 3-7. Interlocked Transfer-from-disk Sequence

Before starting an interlocked transfer-from-disk sequence, the sequencer must have successfully completed a bus control sequence.

Drive Terminated Transfer

If an interlocked transfer-from-disk sequence completes successfully, the disk drive terminates the transfer as shown in the following sequence.

1. While in the SLAVE ACKNOWLEDGE state, the sequencer sets the Master Out signal to 1. Doing so puts the interface into the TRANSFER READY state and signals the disk drive that an information transfer is about to begin.

2. The disk drive loads bus A and bus B with information and sets the Sync In signal to 1. Doing so puts the interface into the TRANSFER START state.

3. The sequencer sets the Sync Out signal to 1 to acknowledge that it received the data. Doing so puts the interface into the TRANSFER RESPONSE state.

4. The disk drive resets the Sync In signal to 0 to acknowledge that the DCA2 received a parcel of data. Doing so puts the interface into the TRANSFER END state.

5. The sequencer resets the Sync Out signal to 0 to acknowledge that the transfer of 1 parcel of information from the disk drive. Doing so puts the interface into the TRANSFER READY state.

   If there is more than 1 parcel of information to be transferred from the disk drive, the sequencer repeats Steps 2 through 5 until all of the parcels are transferred from the disk drive.

6. The disk drive resets the Slave In signal to 0 to terminate the interlocked transfer, which puts the interface into the SLAVE END state.

Sequencer Terminated Transfer

If an error occurs during an interlocked transfer from disk, the sequencer terminates the transfer as shown in the following sequence.

1. At some point in the transfer, the disk drive sets the Sync In signal to 1, which puts the interface into the TRANSFER START state and signals the controller that the disk drive is ready to receive information.

2. While in the TRANSFER START state, the sequencer resets the Master Out signal to 0 to terminate the interlocked transfer. Doing so puts the interface into the MASTER END sate.

3. The disk drive resets the Sync In signal to 0 to acknowledge the termination. Doing so puts the interface into the SLAVE ACKNOWLEDGE state.

4. The sequencer sets the Master Out signal to 1 to put the interface into the TRANSFER READY state.

5. The disk drive resets the Slave In signal to 0 to exit the transfer loop. Doing so puts the interface into the SLAVE END state.

NonInterlocked Transfer-to-disk Sequence

The noninterlocked transfer-to-disk sequence is used to transfer data from the EIOP buffer board to the disk drive media. Figure 3-8 shows a noninterlocked transfer-to-disk sequence.

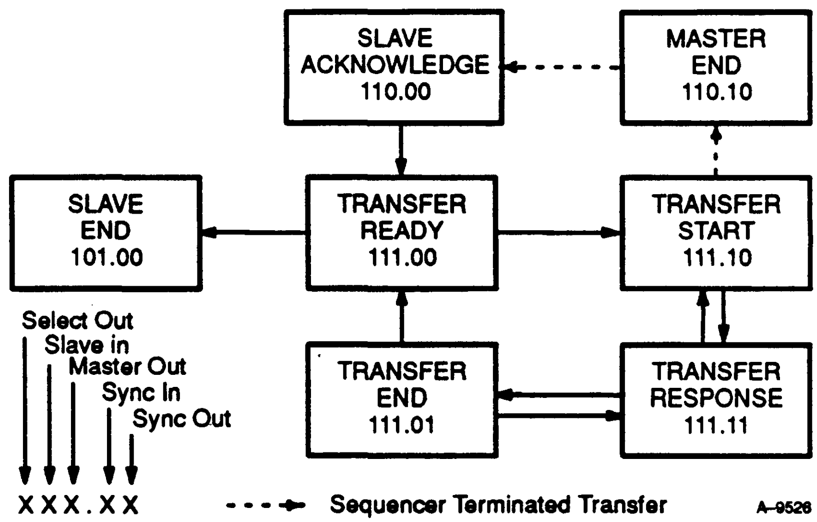

Figure 3-8. Noninterlocked Transfer-to-disk Sequence

Before starting a noninterlocked transfer-to-disk sequence, the sequencer must have successfully completed a bus control sequence.

Drive Terminated Transfer

If a noninterlocked information transfer-to-disk completes successfully, the disk drive terminates the transfer as shown in the following sequence.

1. While in the SLAVE ACKNOWLEDGE state, the sequencer sets the Master Out signal to 1. Doing so puts the interface into the TRANSFER READY state and signals the disk drive that an information transfer is about to begin.

2. The disk drive and sequencer enter a noninterlocked transfer mode. Noninterlocked mode is a condition where the interface does not follow a set sequence through the IPI bus states. All information transfers between the DCA2 and disk drive media occur in noninterlocked mode.

   The disk drive sets and resets the Sync In signal to create a pulse. After recognizing the pulse, the sequencer transfers a parcel from the EIOP buffer board to bus A and bus B and sets the Sync Out signal to 1.

Every pulse of the Sync In signal created by the disk drive must be answered with a pulse of the Sync Out signal from the sequencer. Each Sync Out signal pulse sends a parcel of information over bus A and bus B. The pulses continue until all of the information has been transferred to the disk drive.

3. The disk drive waits until it receives the same number of Sync Out signal pulses from the sequencer as Sync In signal pulses it sent to the sequencer. When this occurs, the disk drive resets the Slave In signal to 0 and terminates the information transfer. Doing so puts the interface into the SLAVE END state.

Sequencer Terminated Transfer

If an error occurs during an information transfer to disk, the sequencer terminates the transfer as shown in the following sequence.

1. While in the SLAVE ACKNOWLEDGE state, the sequencer sets the Master Out signal to 1. Doing so puts the interface into the TRANSFER READY state and signals the disk drive an information transfer is about to begin.

2. The disk drive and sequencer enter a noninterlocked transfer mode. The disk drive sets and resets the Sync In signal to create a pulse. After recognizing the pulse, the sequencer transfers a parcel of information from the EIOP buffer board to bus A and bus B and sets the Sync Out signal to 1.

   Every Sync In signal pulse created by the disk drive must be answered with a Sync Out signal pulse by the sequencer. Each Sync Out signal pulse sends a parcel of information out on bus A and bus B.

3. To terminate the data transfer, the sequencer replaces one of the Sync Out signal pulses with a Master Out signal pulse. After sending the Master Out signal pulse, the sequencer stops transferring information to bus A and bus B.

4. The disk drive waits until it receives the same number of Sync Out signal pulses (including the one Master Out signal pulse) as Sync In signal pulses it sent to the sequencer. When this occurs, the disk drive resets the Slave In signal to 0 and terminates the information transfer. Doing so puts the interface into the SLAVE END state.

NonInterlocked Transfer-from-disk Sequence

The noninterlocked transfer-from-disk sequence is used to transfer data from the disk drive to the EIOP buffer board. Figure 3-9 shows a noninterlocked transfer-from-disk sequence.

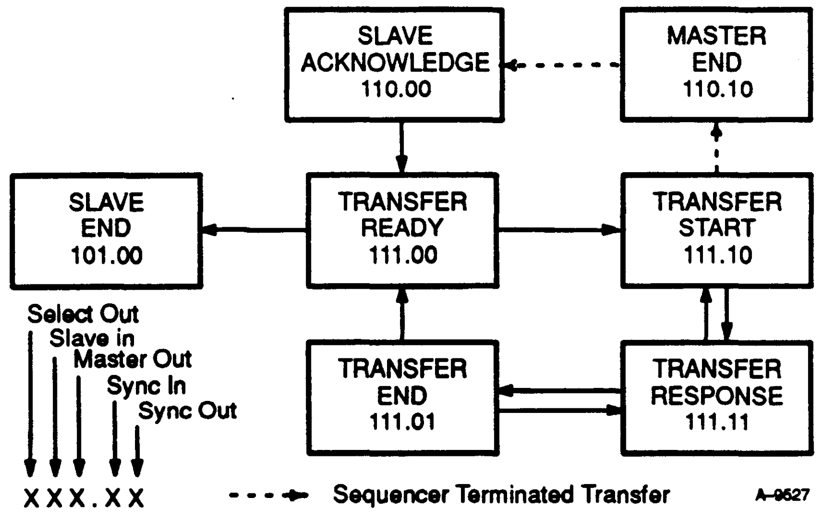

Figure 3-9. Noninterlocked Transfer-from-disk Sequence

Before starting a noninterlocked transfer-from-disk sequence, the sequencer must have successfully completed a bus control sequence.

Drive Terminated Transfer

If an information transfer from disk completes successfully, the disk drive terminates the transfer as shown in the following sequence.

1. While in the SLAVE ACKNOWLEDGE state, the sequencer sets the Master Out signal to 1. Doing so puts the interface into the TRANSFER READY state and signals the disk drive that an information transfer is about to begin.

2. The disk drive and sequencer enter a noninterlocked transfer mode. Noninterlocked mode is a condition where the interface does not follow a set sequence through the IPI-2 bus states. All information transfers between the DCA2 and disk drive media occur in noninterlocked mode.

The disk drive loads a parcel of information on bus A and bus B and sets the Sync In signal to 1. The disk drive then resets the Sync In signal to 0 to create a pulse. Each pulse sends a parcel of information on bus A and bus B.

3. After receiving the first parcel of information, the sequencer transfers the parcel to the EIOP buffer board and generates a Sync Out signal pulse. Every Sync In signal pulse created by the disk drive must be answered by a Sync Out signal pulse from the sequencer; however, the disk drive does not have to wait for a Sync Out signal pulse before sending another parcel of information.

4. After sending all the parcels of information, the disk drive waits until it has received the same number of Sync Out signal pulses from the sequencer as the Sync In signal pulses it sent to the sequencer. When this occurs, the disk drive resets the Slave In signal to 0 and terminates the information transfer. Doing so puts the interface into the SLAVE END state.

Sequencer Terminated Transfer

If an error occurs during an information transfer-from-disk sequence, the sequencer terminates the transfer as shown in the following sequence.

1. While in the SLAVE ACKNOWLEDGE state, the sequencer sets the Master Out signal to 1. Doing so puts the interface into the TRANSFER READY state and signals the disk drive that an information transfer is about to begin.

2. The disk drive and sequencer enter a noninterlocked transfer mode. The disk drive loads a parcel of information on bus A and bus B and sets the Sync In signal to 1. The disk drive then resets the Sync In signal to 0 to create a pulse. Each pulse sends a parcel of information on bus A and bus B. Every Sync In signal pulse must be answered by a Sync Out signal pulse from the sequencer.

3. To terminate the data transfer, the sequencer replaces one of the Sync Out signal pulses with a Master Out signal pulse. After sending the Master Out signal pulse, the sequencer accepts up to eight Sync In signal pulses while it waits for the disk drive response.

4. The disk drive waits until it receives the same number of Sync Out signal pulses (including the one Master Out signal pulse) as Sync In signal pulses it sent to the sequencer. After receiving the pulses, the disk drive resets the Slave In signal to 0 and terminates the information transfer. Doing so puts the interface into the SLAVE END state.

Ending Status Sequence

The ending status sequence generates controller and disk drive status after an information transfer. Figure 3-10 shows a block diagram of an ending status sequence.

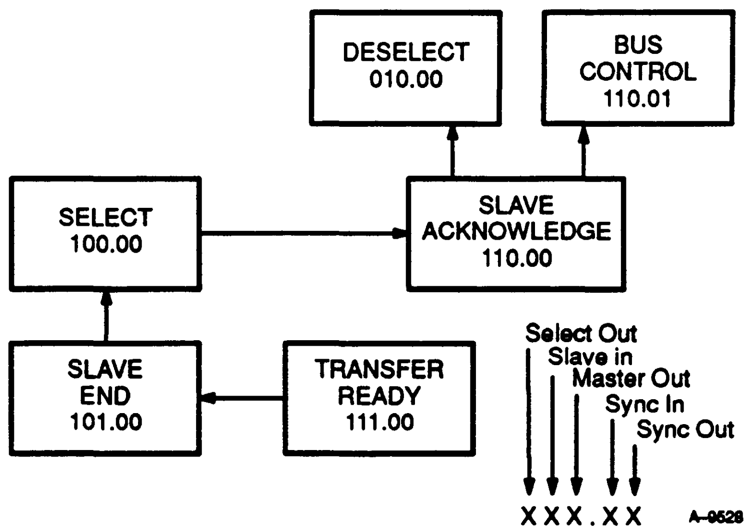

Figure 3-10. Ending Status Sequence

After every information transfer between the DCA2 and disk drive, the sequencer must perform an ending status sequence.

1. After an information transfer, the disk drive resets the Slave In signal to 0. Doing so puts the interface into the SLAVE END state.

2. The sequencer places the controller status on bus A, and resets the Master Out signal to 0 (refer to Table 3-7). Doing so puts the interface into the SELECT state.

Table 3-7. Controller Status on Bus A

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Good transfer	Bus parity error	0	0	0	0	0	0

Table 3-8 shows examples of a successful and an unsuccessful information transfer.

Table 3-8. Sample Controller Statuses

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	Description
1	0	0	0	0	0	0	0	The DCA2 indicates a successful information transfer.
0	0	0	0	0	0	0	0	The DCA2 indicates the information transfer was not successful.

3. The disk drive places the drive ending status on bus B and sets the Slave In signal to 1 (refer to Table 3-9). Doing so puts the interface into the SLAVE ACKNOWLEDGE state.

Table 3-9. Drive Ending Status on Bus B

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Good transfer	Bus parity error	Odd byte transfer	Timed operation	Final status after operation			

Table 3-10 shows examples of drive ending status. For more information on the drive ending status on bus B, refer to the "DD-60/61 Disk Systems Status" section.

Table 3-10. Sample Drive Ending Statuses

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	Description
1	0	0	0	0	0	0	0	The disk drive indicates a successful information transfer.
0	1	0	0	0	0	0	0	The disk drive detected a parity error on a bus control command, information transfer, or controller status.
0	0	0	1	0	0	0	0	The disk drive has not completed the last command.
0	0	0	0	0	0	0	1	The disk drive is busy and did not accept the last bus control command.

If the sequencer is starting another disk drive operation, it loads bus A with a bus control command and starts a bus control sequence.

If the sequencer is deselecting the disk drive, it starts a deselect sequence.

Deselect Sequence

The deselect sequence logically disconnects a disk drive from the DCA2. Figure 3-11 shows a deselect sequence.

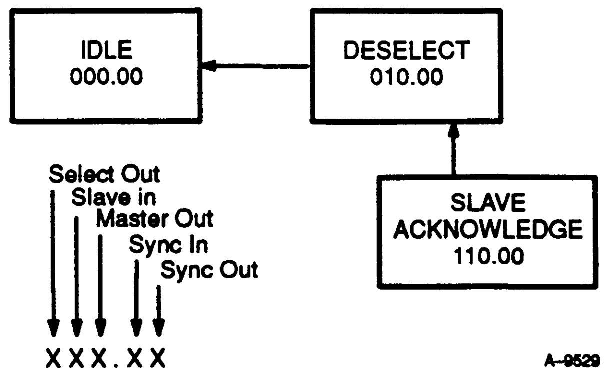

Figure 3-11. Deselect Sequence

The deselect sequence starts from the SLAVE ACKNOWLEDGE state. The sequencer performs a deselect sequence after an ending status or select sequence.

1. While in the SLAVE ACKNOWLEDGE state, the sequencer resets the Select Out signal to 0. Doing so puts the interface into the DESELECT state. Bus A and bus B do not contain any information.

2. The disk drive resets the Slave In signal to 0. Doing so puts the interface into the IDLE state. Bus A and bus B do not contain any information.

During disk drive operations, the sequencer must perform a deselect sequence before performing an interrupt request (poll), reset disk drive, master reset, transfer settings request, or drive interrupts request sequence.

Interrupt Request (Poll) Sequence

The interrupt request (poll) sequence requests all disk drives connected to the channel with specific interrupts pending to respond on bus B. Figure 3-12 shows an interrupt request sequence.

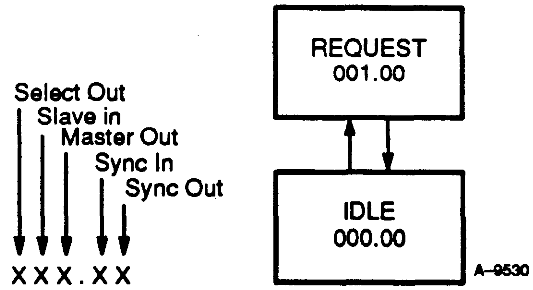

Figure 3-12. Interrupt Request (Poll) Sequence

Before an interrupt request sequence begins, the *j* and *k* registers in the 3DF option (refer to Figure 3-1) must be loaded with the interrupt request (refer to Table 3-11). The *i* register in the 3DF option must also be loaded with a bit mask set for the requested disk drive.

1. The sequencer transfers the interrupt request from the *j* register to bus A and sets the Master Out signal to 1 (refer to Table 3-11). Doing so puts the interface into the REQUEST state.

Table 3-11. Interrupt Request on Bus A

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
0	Report busy status	Report ready status	Slave power failure alert	Power on status request	Report status pending interrupt	Report RPS interrupt	Report command complete interrupt

2. Each disk drive that matches the interrupt request loads bus B with the drive select response (refer to Table 3-12) and sets the Attention In signal. As soon as the disk drive that matches the bit mask in the *i* register responds, the sequencer resets the Master Out signal to 0 to complete the interrupt request sequence.

Table 3-12. Drive Select Response on Bus B

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Disk drive 7	Disk drive 6	Disk drive 5	Disk drive 4	Disk drive 3	Disk drive 2	Disk drive 1	Disk drive 0

Reset Disk Drive Sequence

The reset disk drive sequence resets a selected disk drive. Figure 3-13 shows a reset disk drive sequence.

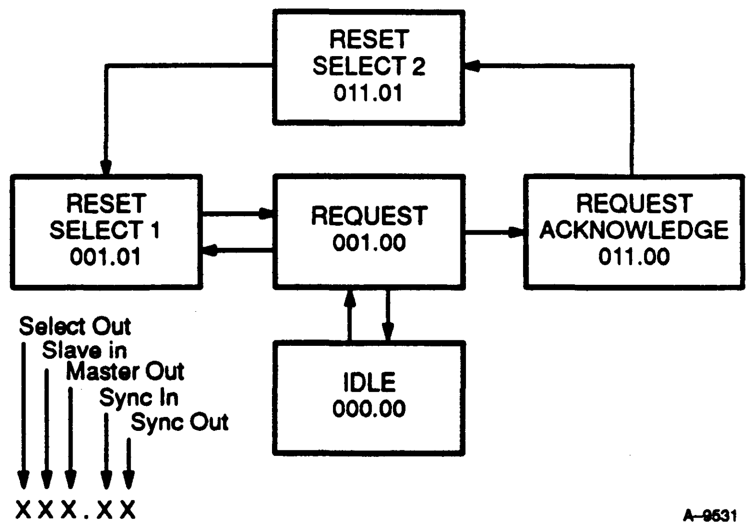

Figure 3-13. Reset Disk Drive Sequence

Before a reset disk drive sequence begins, the *j* register in the 3DF option (refer to Figure 3-1) must be loaded with the selective reset (refer to Table 3-13).

1. The sequencer transfers the selective reset (refer to Table 3-13) from the *j* register in the 3DF option to bus A and sets the Master Out signal to 1. Doing so puts the interface in the REQUEST state.

Table 3-13. Selective Reset on Bus A

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	Disk drive address Bit 2^4 is the least significant bit			Disable interface drivers	Reset disk drive	Reset logical interface	Reset physical interface

2. The disk drive sets the Slave In signal to 1 to enter the REQUEST ACKNOWLEDGE state. Bus B is not defined during a reset disk drive sequence.

3. The sequencer sets the Sync Out signal to 1 to put the interface into the RESET SELECT 2 state.

4. The disk drive resets the Slave In signal to 0 to enter the RESET SELECT 1 state.

5. The disk drive starts the reset action after the Sync Out signal is set to 1 for at least 2 microseconds.

6. After a set amount of time, the sequencer resets the Sync Out signal to 0 to re-enter the REQUEST state.

7. The sequencer terminates the reset disk drive sequence by resetting the Master Out signal to 0.

Master Reset Sequence

The sequencer performs a master reset sequence to enter the maintenance state. Figure 3-14 shows a master reset sequence.

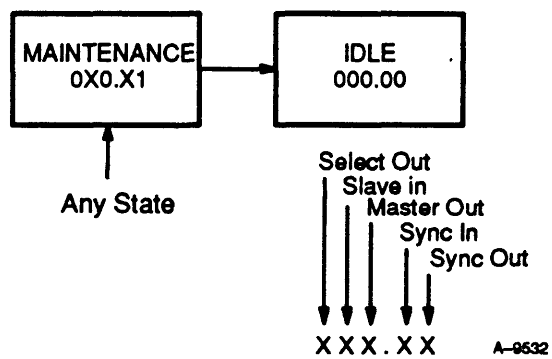

Figure 3-14. Master Reset Sequence

The master reset sequence starts from any state on the IPI-2 interface.

1. The sequencer resets the Select Out and Master Out signals to 0 and sets the Sync Out signal to 1 for at least 10 microseconds. Doing so puts the interface into the MAINTENANCE state.

2. The sequencer loads bus A with a master reset parameter (refer to Table 3-14) and resets the Sync Out signal to 0 to enter the IDLE state. (Only two of the three data out bits, 2^1, 2^4, or 2^7 are set.)

Table 3-14. Master Reset on Bus A

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Data out 2	Not used	Not used	Data out 1	Not used	Not used	Data out 0	Not used

Transfer Settings Request Sequence

The transfer settings request sequence transfers the transfer settings for a specific disk drive to the DCA2. Figure 3-15 shows a transfer settings request sequence.

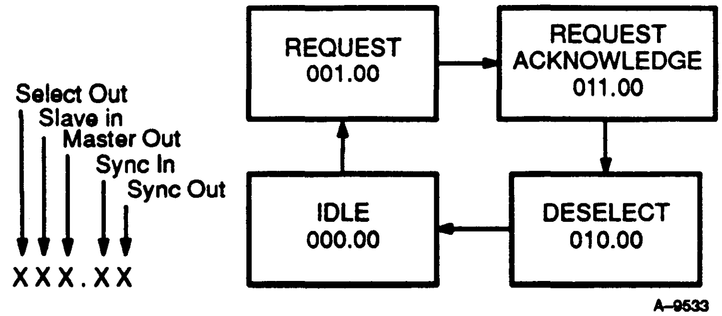

Figure 3-15. Transfer Settings Request and Drive Interrupts Request Sequence

Before a transfer settings request sequence begins, the *j* and *k* registers in the 3DF option (refer to Figure 3-1) must be loaded with the transfer settings request (refer to Table 3-15).

1. The sequencer transfers the transfer settings request (refer to Table 3-15) from the *j* register in the 3DF option to bus A and sets the Master Out signal to 1. Doing so puts the interface into the REQUEST state.

Table 3-15. Transfer Settings Request on Bus A

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	Disk drive address Bit 2^4 is the least significant bit			0	0	0	0

2. The disk drive loads bus B with the transfer settings (refer to Table 3-16) and sets the Slave In signal to 1. Doing so puts the interface into the REQUEST ACKNOWLEDGE state.

Table 3-16. Transfer Settings on Bus B

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
0	0	1	0	0	1	1	0

3. The sequencer resets the Master Out signal to 0 to terminate the transfer settings request. Doing so puts the interface into the DESELECT state.

4. The disk drive acknowledges the termination and resets the Slave In signal to 0 to enter in the IDLE state.

Drive Interrupts Request Sequence

The drive interrupts request sequence transfers the interrupts for a specific disk drive to the DCA2. Figure 3-15 shows a drive interrupts request sequence. Before a transfer settings request sequence begins, the *j* and *k* registers in the 3DF option (refer to Figure 3-1) must be loaded with the drive interrupts request (refer to Table 3-17).

1. The sequencer transfers the drive interrupts request (refer to Table 3-17) from the *j* register in the 3DF option to bus A and sets the Master Out signal to 1. Doing so puts the interface into the REQUEST state.

Table 3-17. Drive Interrupts Request on Bus A

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	Disk drive address Bit 2^4 is the least significant bit			1	0	0	0

2. The disk drive loads bus B with the drive interrupts (refer to Table 3-18) and sets the Slave In signal to 1. Doing so puts the interface into the REQUEST ACKNOWLEDGE state.

Table 3-18. Drive Interrupts on Bus B

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
0	Busy status	Ready status	0	Priority select status	Status pending interrupt active	RPS interrupt active	Command complete interrupt

3. The sequencer resets the Master Out signal to 0 to terminate the drive interrupts request. Doing so puts the interface into the DESELECT state.

4. The disk drive acknowledges the termination and resets the Slave In signal to 0 to enter in the IDLE state.

SECTION 4
DCA2 CHANNEL FUNCTIONS

4 DCA2 CHANNEL FUNCTIONS

Channel functions for the DCA2 channel adapter load registers in the DCA2 and auxiliary input/output processor (EIOP) with information used during disk drive operations. The channel functions also transfer a starting address for the sequencer to perform an IPI-2 bus state sequence. This section describes each channel function and includes sample function routines for disk drive operations.

Channel Function Descriptions

The DCA2 channel functions range from DCA2:0 to DCA2:17. Table 4-1 briefly describes each DCA2 channel function.

Table 4-1. Channel Functions

Function	EIOP Channel	Description
DCA2:0	Even or odd	Clears the channel busy and done flags
DCA2:1	Even	Transfers information from the DCA2 to local memory
DCA2:1	Odd	Transfers information from local memory to the DCA2
DCA2:2	Even or odd	Loads the cylinder register with ID parameter 0
DCA2:3	Even or odd	Loads the parameter register with ID parameter 1
DCA2:4	Even or odd	Loads the DCA2 transfer counter with the transfer count
DCA2:5	Even or odd	Transfers information between the DCA2 and buffer board
DCA2:6	Even or odd	Disables channel interrupts
DCA2:7	Even or odd	Enables channel interrupts
DCA2:10	Even or odd	Reads the channel local memory address register
DCA2:11	Even or odd	Reads the channel parcel counter
DCA2:12	Even or odd	Reads one of four status parcels
DCA2:13	Even or odd	Reads one of three status parcels
DCA2:14	Even or odd	Loads the channel local memory address register
DCA2:15	Even or odd	Loads the channel local memory parcel counter
DCA2:16	Even or odd	Loads the DCA2 *j* and *k* registers with IPI-2 commands
DCA2:17	Even	Loads the sequencer mode select register
DCA2:17	Odd	Loads the bit stream head select register

DCA2:0 – Clear Channel Busy and Done Flags

The DCA2:0 function resets the EIOP channel busy and channel done flags to 0 or performs a master clear of the channel. The value of the function modifier bits in the *d*-field of the EIOP instruction or in the B register on the EIOP selects the operation to perform (refer to Figure 4-1).

d-field or B Register

2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
M 2^3	M 2^2	M 2^1	M 2^0	C 2^4	C 2^3	C 2^2	C 2^1	C 2^0

M = Function Modifier Bits
C = Channel Number

Figure 4-1. EIOP Instruction *d*-field or EIOP B Register

If the function modifier bits are set to 0, the function clears the channel busy and channel done flags. The flags cannot be sampled until 8 clock pulses have passed since the function was issued.

If function modifier bits 1, 2, and 3 are set to 1, this function performs a master clear of the DCA2.

DCA2:1 – Local Memory Input and Output Transfer

The DCA2:1 function transfers the starting address for the sequencer and a value for the *i* register from the accumulator to the DCA2. This function is used for information transfers between the DCA2 and EIOP local memory.

Figure 4-2 shows the format of the sequencer starting address and *i* register value in the accumulator. When this function is executed, the DCA2 loads the *i* register in the 3DF option with the *i* register value and loads the sequencer with the sequencer starting address.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
i 2^7	i 2^6	i 2^5	i 2^4	i 2^3	i 2^2	i 2^1	i 2^0	X x	SQ 2^6	SQ 2^5	SQ 2^4	SQ 2^3	SQ 2^2	SQ 2^1	SQ 2^0

i = *i* Register Value
X = Not Used
SQ = Sequencer Starting Address

Figure 4-2. DCA2:1 Sequencer Starting Address

After receiving the starting address, the sequencer starts an interlocked information transfer. If the DCA2:1 function is executed on the even EIOP channel, the sequencer transfers information from the DCA2 to local memory. If the function is executed on the odd EIOP channel, the sequencer transfers information from local memory to the DCA2. The value of the function modifier bits selects the type of information transferred: IPI-2 protocol, sequencer microcode, or the error-correction code (ECC) registers contents (refer to Table 4-2).

Table 4-2. Function Modifier Bits

Modifier Bits 2^3	2^2	2^1	2^0	Description
0	0	0	0	IPI-2 protocol transfer from local memory to the disk drive.
0	0	0	1	IPI-2 status transfer from the disk drive to local memory.
0	0	1	0	Sequencer microcode transfer from local memory to the DCA2.
0	0	1	1	Sequencer microcode transfer from the DCA2 to local memory.
0	1	0	1	ECC register transfer from the DCA2 to local memory.

IPI-2 Protocol Transfers

IPI-2 information is transferred from local memory to the disk drive in an interlocked transfer-to-disk sequence. For an example of this operation, refer to the "Seek Routine" subsection in this section.

IPI-2 status information is transferred from the drive to local memory in an interlocked transfer-from-disk sequence (refer to Figure 3-7). The *i* register value determines what type of status is transferred.

Sequencer Microcode Transfers

All transfers start at the first address of the sequencer and exchange 1,024 32-bit data words. After executing a transfer of sequencer microcode, execute the DCA2:0 function. This function clears the DCA2 control logic and direct memory access (DMA) references. Use the same channel numbering convention for the DCA2:0 function as for the DCA2:1 function.

Error Correction Code Register Transfer

During an ECC register transfer, the contents of all eight 4-byte ECC registers are transferred from the 3DH options to local memory.

DCA2:2 – Set ID Parameter 0

The DCA2:2 function transfers the cylinder address (ID parameter 0) from the accumulator to the cylinder register in the 3DG option of the DCA2. Figure 4-3 shows the format of ID parameter 0 in the accumulator.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

C = Cylinder Address (0 - 5062_8)

Figure 4-3. ID Parameter 0 Format

DCA2:3 – Set ID Parameter 1

The DCA2:3 function transfers the sector address, head address, and option bits (ID parameter 1) from the accumulator to the parameter register in the 3DG option of the DCA2. Figure 4-4 shows the format of ID parameter 1 in the accumulator. Refer to the format and flaw management disk drive sections of this manual for more information on the ID information bit descriptions (which includes ID parameter 1).

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
X	X	WP	RP	X	H	H	H	H	H	S	S	S	S	S	S
x	x	2^0	2^0	x	2^4	2^3	2^2	2^1	2^0	2^5	2^4	2^3	2^2	2^1	2^0

X = Not Used
WP = Write Protected
RP = Read Protected
H = Head Group Address
S = Sector Address

Figure 4-4. ID Parameter 1 Format

DCA2:4 – Set Transfer Count

The DCA2:4 function transfers the transfer count from the accumulator to the 3DI option in the DCA2. The transfer count is the total number of parcels to be transferred between the DCA2 and the disk drive (in octal). Figure 4-5 shows the format of the transfer count in the accumulator.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
T 2^{15}	T 2^{14}	T 2^{13}	T 2^{12}	T 2^{11}	T 2^{10}	T 2^9	T 2^8	T 2^7	T 2^6	T 2^5	T 2^4	T 2^3	T 2^2	T 2^1	T 2^0

T = Transfer Count

Figure 4-5. Transfer Count Format

DCA2:5 – Starting Sequencer Address and *I* Register Value

The DCA2:5 function transfers the starting address for the sequencer and a value for the *i* register from the accumulator to the DCA2. This function is used for information transfers between the DCA2 and the EIOP buffer board.

Figure 4-6 shows the format of the sequencer starting address and *i* register value in the accumulator. When this function is executed, the DCA2 loads the *i* register in the 3DF option with the *i* register value and loads the sequencer with the sequencer starting address.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
i 2^7	i 2^6	i 2^5	i 2^4	i 2^3	i 2^2	i 2^1	i 2^0	X x	SQ 2^6	SQ 2^5	SQ 2^4	SQ 2^3	SQ 2^2	SQ 2^1	SQ 2^0

i = *i* Register Value
X = Not Used
SQ = Sequencer Starting Address

Figure 4-6. DCA2:5 Sequencer Starting Address Format

After receiving the starting address, the sequencer starts an IPI-2 bus state sequence. For an example, refer to the "Write Sector Data Routine" subsection later in this section.

DCA2:6 – Disable Interrupt Enable

The DCA2:6 function sets the EIOP channel enable interrupts flag to 0. When the enable interrupts flag is 0, the channel does not acknowledge any interrupts it receives. This function does not change the states of the channel busy or channel done flags.

DCA2:7 – Enable Interrupt Enable

The DCA2:7 function sets the EIOP channel enable interrupts flag to 1. When the enable interrupts flag is 1, the channel acknowledges any interrupts it receives. This function does not change the states of the busy or done flags.

DCA2:10 – Read Local Memory Address

The DCA2:10 function transfers the current local memory address from the EIOP channel local memory address register to the accumulator. Figure 4-7 shows the format of the local memory address in the accumulator.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
LM 2^{15}	LM 2^{14}	LM 2^{13}	LM 2^{12}	LM 2^{11}	LM 2^{10}	LM 2^9	LM 2^8	LM 2^7	LM 2^6	LM 2^5	LM 2^4	LM 2^3	LM 2^2	LM 2^1	LM 2^0

LM = Current Local Memory Address

Figure 4-7. Current Local Memory Address Format

DCA2:11 – Read Local Memory Parcel Count

The DCA2:11 function transfers the inverse of the EIOP channel parcel counter to the accumulator. To obtain the correct parcel count, invert the accumulator contents. Figure 4-8 shows the format of the inverted parcel count in the accumulator.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
IP 2^{15}	IP 2^{14}	IP 2^{13}	IP 2^{12}	IP 2^{11}	IP 2^{10}	IP 2^9	IP 2^8	IP 2^7	IP 2^6	IP 2^5	IP 2^4	IP 2^3	IP 2^2	IP 2^1	IP 2^0

IP = Inverted Parcel Count from the 3DG Option

Figure 4-8. Inverted Parcel Count Format

DCA2:12 – Status Function 0

The DCA2:12 function transfers 1 of 5 status parcels from the DCA2 to the accumulator. The initial value of the accumulator determines which status parcel is transferred. Figure 4-9 shows the format of the initial accumulator value.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
X x	X x	X x	X x	X x	X x	X x	X x	X x	X x	X x	X x	X x	X x	ST 2^1	ST 2^0

X = Not Used ST = Status Select Bits

Figure 4-9. Status Select Format

Adapter Status

If the status select bits are both 0, the DCA2 transfers the adapter status to the accumulator. Figure 4-10 shows the format of the adapter status in the accumulator. For more information on status refer to the "DD-60/61 Disk Systems Status" section of this manual.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
SP 2^3	SP 2^2	SP 2^1	SP 2^0	V5 2^0	V4 2^0	DS 2^0	SS 2^0	CS 2^7	CS 2^6	CS 2^5	CS 2^4	CS 2^3	CS 2^2	CS 2^1	CS 2^0

SP = Sequencer Parity Error
V5 = Voltage Fault +5 V
V4 = Voltage Fault –4.5 V
DS = Double-bit Error
SS = Single-bit Error
CS = Channel Adapter Status

Figure 4-10. Adapter Status Format

6X Condition Bits

If the status select bits are both 0 and the sequencer is first given a starting address of 36_8 (using the DCA2:5 function), the DCA2 transfers the 6X condition bits to the accumulator. Figure 4-11 shows the format of the 6X condition bits in the accumulator. For more information on status refer to the "DD-60/61 Disk Systems Status" section of this manual.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
X x	X x	X x	X x	X x	X x	X x	X x	6X 2^7	6X 2^6	6X 2^5	6X 2^4	6X 2^3	6X 2^2	6X 2^1	6X 2^0

6X = 6X Condition Bits

Figure 4-11. 6X Condition Bits Format

7X Condition Bits

If the status select bits are both 0 and the sequencer is first given a starting address of 37_8 (using the DCA2:5 function), the DCA2 transfers the 7X condition bits to the accumulator. Figure 4-12 shows the format of the 7X condition bits in the accumulator. For more information on status refer to the "DD-60/61 Disk Systems Status" section of this manual.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
X x	X x	X x	X x	X x	X x	X x	X x	7X 2^7	7X 2^6	7X 2^5	7X 2^4	7X 2^3	7X 2^2	7X 2^1	7X 2^0

7X = 7X Condition Bits

Figure 4-12. 7X Condition Bits Format

Syndrome Status

If status select bit 2^1 is 0 and bit 2^0 is 1, the DCA2 transfers the syndrome status to the accumulator. Figure 4-13 shows the format of the syndrome status in the accumulator. For more information on status refer to the "DD-60/61 Disk Systems Status" section of this manual.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
DC 2^3	DC 2^2	DC 2^1	DC 2^0	SC 2^3	SC 2^2	SC 2^1	SC 2^0	SY 2^7	SY 2^6	SY 2^5	SY 2^4	SY 2^3	SY 2^2	SY 2^1	SY 2^0

DC = Double-bit Error Count SY = Syndrome Bits
SC = Single-bit Error Count

Figure 4-13. Syndrome Status Format

Transfer Count Status

If status select bit 2^1 is 1 and bit 2^0 is 0, the DCA2 transfers the transfer count status to the accumulator. The transfer count is the current value of the transfer counter in the 3DI option of the DCA2. Figure 4-14 shows the format of the byte count status in the accumulator.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

T = Transfer Count

Figure 4-14. Byte Count Status Format

Tag Status

If both status select bits are 1, the DCA2 transfers the tag status to the accumulator. Figure 4-15 shows the format of the tag status in the accumulator. For more information on status refer to the "DD-60/61 Disk Systems Status" section of this manual.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{11}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^1
X	X	X	X	X	X	X	X	X	SO	MO	SL	X	SI	SV	AI
x	x	x	x	x	x	x	x	x	2^0	2^0	2^0	x	2^0	2^0	2^0

X = Not Used
SO = Sync Out Signal
MO = Master Out Signal
SL = Select Out Signal
SI = Sync In Signal
SV = Slave In Signal
AI = Attention In Signal

Figure 4-15. Tag Status Format

DCA2:13 – Status Function 1

The DCA2:13 function transfers 1 of 3 status parcels to the accumulator. The initial value of the accumulator determines which status parcel is transferred. Figure 4-9 shows the format of the initial accumulator value.

Drive Ending Status

If the status select bits are both 0, the DCA2 transfers the drive ending status to the accumulator. Figure 4-16 shows the format of the drive ending status in the accumulator. For more information on status refer to the "DD-60/61 Disk Systems Status" section of this manual.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
FS 2^7	FS 2^6	FS 2^5	FS 2^4	FS 2^3	FS 2^2	FS 2^1	FS 2^0	IS 2^7	IS 2^6	IS 2^5	IS 2^4	IS 2^3	IS 2^2	IS 2^1	IS 2^0

FS = Final Drive Ending Status IS = Initial Drive Ending Status

Figure 4-16. Drive Ending Status Format

ID Parameter 0 Status

If status select bit 2^1 is 0 and bit 2^0 is 1, the DCA2 transfers ID parameter 0 status to the accumulator. ID parameter 0 status is the current value stored in the cylinder register (ID parameter 0) of the 3DG option on the DCA2. Refer to Figure 4-3 for the format of ID parameter 0 in the accumulator.

ID Parameter 1 Status

If status select bit 2^1 is 1 and bit 2^0 is 0, the DCA2 transfers ID parameter 1 status to the accumulator. ID parameter 1 status is the current value stored in the parameter register (ID parameter 1) of the 3DG option on the DCA2. Refer to Figure 4-4 for the format of ID parameter 1 in the accumulator.

DCA2:14 – Enter Local Memory Starting Address

The DCA2:14 function transfers the local memory starting address from the accumulator to the EIOP channel local memory address register. The local memory starting address is the EIOP local memory address that contains the first parcel of data to be transferred to the DCA2, or the EIOP local memory address to which the DCA2 transfers the first parcel of data. Figure 4-17 shows the format of local memory starting address in the accumulator.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
LS 2^{15}	LS 2^{14}	LS 2^{13}	LS 2^{12}	LS 2^{11}	LS 2^{10}	LS 2^{9}	LS 2^{8}	LS 2^{7}	LS 2^{6}	LS 2^{5}	LS 2^{4}	LS 2^{3}	LS 2^{2}	LS 2^{1}	LS 2^{0}

LS = Local Memory Starting Address

Figure 4-17. Local Memory Starting Address Format

During a data transfer, the channel local memory address register automatically increments once with each parcel transferred. Execute the DCA2:10 function to transfer the current value of the channel local memory address register to the accumulator.

DCA2:15 – Enter Local Memory Parcel Count

The DCA2:15 function transfers the local memory parcel count from the accumulator to the EIOP channel parcel counter. The parcel count is the number of parcels to be transferred between the EIOP local memory and the DCA2. Figure 4-18 shows the format of the parcel count in the accumulator.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
PC 2^{15}	PC 2^{14}	PC 2^{13}	PC 2^{12}	PC 2^{11}	PC 2^{10}	PC 2^{9}	PC 2^{8}	PC 2^{7}	PC 2^{6}	PC 2^{5}	PC 2^{4}	PC 2^{3}	PC 2^{2}	PC 2^{1}	PC 2^{0}

PC = Parcel Count

Figure 4-18. Parcel Count Format

During a data transfer, the channel parcel counter automatically decrements once for each parcel transferred. Execute the DCA2:11 function to transfer the inverted current value of the channel parcel counter to the accumulator.

DCA2:16 – Enter *j* and *k* Control Register Contents

The DCA2:16 function transfers values for the *j* and *k* registers from the accumulator to the 3DF option in the DCA2. The *j* and *k* registers store bus control codes or IPI-2 command information bytes. Figure 4-19 shows the format of the *j* and *k* register values in the accumulator.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
k 2^7	k 2^6	k 2^5	k 2^4	k 2^3	k 2^2	k 2^1	k 2^0	j 2^7	j 2^6	j 2^5	j 2^4	j 2^3	j 2^2	j 2^1	j 2^0

k = *k* Register Value j = *j* Register Value

Figure 4-19. *j* and *k* Register Values

The sequencer on the DCA2 controls when the *j* and *k* register contents are sent to the disk drive over bus A or both bus A and bus B. For an example of this, refer to the "Write Sector Data Routine" subsection later in this section.

DCA2:17 – Enter Mode Select

The DCA2:17 function performs different operations when it is executed on the even channel than when it is executed on the odd channel. The differences are described below.

Even Channel

When executed on the even channel, the DCA2:17 function transfers sequencer mode bits from the accumulator to the sequencer on the DCA2. The mode bits can be altered for any function sequence. Figure 4-20 shows the format of the sequencer mode bits in the accumulator.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
X x	X x	X x	X x	X x	X x	X x	X x	M 2^7	M 2^6	M 2^5	M 2^4	M 2^3	M 2^2	M 2^1	M 2^0

X = Not Used M = Mode Bits for Sequencer

Figure 4-20. Mode Bits for the Sequencer

The sequencer mode bits abort an executing DCA2 function, disable error correction code (ECC) circuitry, disable ID compare circuitry, enable bit stream mode, toggle the parity bit, read the IPI diagnostic cylinder, or identify a serial disk drive. Table 4-3 describes each sequencer mode bit.

Table 4-3. Sequencer Mode Bits

Bit	Name	Description
2^0	Abort	When set to 1, this bit signals the sequencer to terminate its operation. The channel Busy, Done, and Active signals are set to 0. (This bit is only used during a interrupt request (poll) sequence.
2^1	No ECC	When set to 1, this bit signals the sequencer to disable the ECC circuits.
2^2	Read ID	When set to 1, this bit signals the sequencer to read the ID field and compare it to the ID parameters stored in the 3DG option.
2^3	Read absolute	When set to 1, this bit signals the sequencer to read the data field without comparing the read ID field to the stored ID parameters.
2^4	Bit stream replacement	When set to 1, this bit signals the sequencer to enter the bit stream replacement mode. This mode is used with the DCA2:17 channel function on the odd channel.
2^5	Toggle parity	When set to 1, this bit signals the sequencer to toggle the parity bit.
2^6	Read IPI diagnostic cylinder	When set to 1, this bit signals the sequencer to read the information stored in the IPI diagnostic cylinder.
2^7	Serial disk drive mode	When set to 1, this bit signals the sequencer that it is connected to a serial head disk drive.

Odd Channel

When executed on the odd channel, the DCA2:17 function transfers the lower byte of the accumulator to the bit stream number register in the sequencer. Figure 4-21 shows the format of the bit stream select bits in the accumulator.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
X x	X x	X x	X x	X x	X x	X x	X x	B 2^7	B 2^6	B 2^5	B 2^4	B 2^3	B 2^2	B 2^1	B 2^0

X = Not Used B = Bit Stream Select Bits

Figure 4-21. Bit Stream Select Bits

NOTE: When not performing bit stream replacement, the bit stream number register must be set to 0's or data will be read incorrectly.

When a bit stream select bit is set to 1, the corresponding bit of bus A and bus B is replaced with a bit stream. The bit stream is calculated by summing the parity stream data with the other seven data streams. This recovers data after a head, head preamp, read, or write circuit failure within the DD-60.

Sample Disk Drive Function Routines

Unlike previous Cray Research, Inc. channel adapter functions, DCA2 channel functions do not correspond in a one-to-one relationship to disk drive functions. For example, executing the DCA2:2 function (load cylinder register) does not cause the disk drive to seek to the cylinder address loaded in the accumulator.

Disk drive functions such as select, seek, or read operations are done with a function routine that may contain several channel functions. Generally, function routines consist of the following procedures:

1. Clearing the channel busy and channel done flags for both EIOP channels.

2. Loading the EIOP local memory or EIOP buffer board with information for the disk drive operation.

3. Loading the registers in the DCA2 with the values needed for the disk drive operation.

4. Loading the counter registers in the DCA2 and EIOP channel with the number of parcels to be transferred.

5. Loading the sequencer with the starting address of the IPI-2 sequence for the disk drive operation.

The following subsections describe sample disk drive function routines. The actual routines and control codes used by the drivers, recovery routines, diagnostics, and utilities may not be the same as the following routines.

Select Unit Routine

The select unit routine logically connects the IOS to a disk drive. The routine consists of the following steps:

1. Execute the DCA2:0 function on both channels to clear the EIOP channel busy and channel done flags.

2. Load the accumulator with the disk drive address (refer to Table 3-2). Figure 4-22 shows an example of a disk drive address in the accumulator. This example selects the disk drive with the logical address 5. Refer to the "DD-60 Hardware Description" section of this manual for more information on the logical address.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
k	k	k	k	k	k	k	k	j	j	j	j	j	j	j	j
0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0

k = *k* Register Value j = *j* Register Value

Figure 4-22. Disk Drive Address for Logical Address 5

3. Execute the DCA2:16 function. This function transfers the disk drive address to the *j* register in the 3DF option on the DCA2.

4. Load the accumulator with 13_8, the starting address of the select disk drive sequence (refer to Figure 4-23).

Accumulator Contents															
2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
i	i	i	i	i	i	i	i	X	SQ	SQ	SQ	SQ	SQ	SQ	SQ
0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1

i = *i* Register Value
X = Not Used
SQ = Sequencer Starting Address

Figure 4-23. Sequencer Starting Address for Select Disk Drive Sequence

5. Execute the DCA2:5 function. This function transfers the starting address to the sequencer. After receiving the address, the sequencer performs a select disk drive sequence (refer to Figure 3-4). When the sequence is finished, the IPI-2 interface is in the SLAVE ACKNOWLEDGE state.

The following steps check whether the disk drive was successfully selected or not. These steps are optional.

6. Load the accumulator with 00_8, the status select bits for status 01 (refer to Figure 4-24).

Accumulator Contents															
2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
X	X	X	X	X	X	X	X	X	X	X	X	X	X	ST	ST
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

X = Not Used
ST = Status Select Bits

Figure 4-24. Status Select for Status 01

7. Execute the DCA2:13 function. This function transfers the drive ending status to the accumulator. The ending status for a select disk drive sequence is the drive select response (refer to Table 3-3). Figure 4-25 shows the drive select response for logical address 5 in the accumulator.

Accumulator Contents															
2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
ES	ES	ES	ES	ES	ES	ES	ES	X	X	X	X	X	X	X	X
0	0	1	0	0	0	0	0	x	x	x	x	x	x	x	x

X = Not Used
ES = Ending Status

Figure 4-25. Drive Select Response in the Accumulator

Seek Routine

The seek routine moves the heads to a desired location over the platters. The seek routine consists of the following steps:

1. Perform a select unit routine.

2. Load two sequential local memory addresses with data; the first with 0's and the second with the cylinder address (ID parameter 0). Refer to Figure 4-3 for the format of the cylinder address.

3. Execute the DCA2:0 function on both EIOP channels to clear the channel busy and channel done flags.

4. Load the accumulator with 02_8, the transfer count for a seek routine (refer to Figure 4-26).

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

T= Transfer Count

Figure 4-26. Transfer Count for a Seek Routine

5. Execute the DCA2:4 function. This function transfers the transfer count from the accumulator to the transfer counter in the 3DI option.

6. Load the accumulator with the local memory starting address. The local memory starting address is the address that contains the cylinder address you entered in Step 2.

7. Execute the DCA2:14 function. This function transfers the local memory starting address to the EIOP channel local memory address register.

8. Load the accumulator with 02_8, the local memory parcel count for a seek routine (refer to Figure 4-27).

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC	PC
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

PC = Parcel Count

Figure 4-27. Parcel Count for a Seek Routine

9. Execute the DCA2:15 function. This function transfers the parcel count to the EIOP channel parcel count register.

10. Load bits 2^0 through 2^8 of the accumulator with the load cylinder bus control code (refer to Figure 4-28).

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
k	k	k	k	k	k	k	k	j	j	j	j	j	j	j	j
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0

k = *k* Register Value j = *j* Register Value

Figure 4-28. Load Cylinder Bus Control Code

11. Execute the DCA2:16 function. This function transfers the bus control codes to the *j* and *k* registers in the 3DF option on the DCA2.

12. Load the accumulator with 04_8, the sequencer starting address for a command load (refer to Figure 4-29).

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
i	i	i	i	i	i	i	i	X	SQ	SQ	SQ	SQ	SQ	SQ	SQ
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0

i = *i* Register Value SQ = Sequencer Starting Address
X = Not Used

Figure 4-29. Sequencer Starting Address for Command Load

13. Execute the DCA2:1 function. This function signals the sequencer to perform a bus control sequence (refer to Figure 3-5), an interlocked transfer-to-disk sequence (refer to Figure 3-6), and an ending status sequence (refer to Figure 3-10). When the sequences are finished, the IPI-2 interface is in the SLAVE ACKNOWLEDGE state.

Load Position Routine

The load position routine moves the heads to a desired location over the platters and selects the desired head. The load position routine consists of the following steps:

1. Perform a select unit routine.

2. Load 11_8 sequential local memory addresses with the rotational positional sensing (RPS) parameter. Refer to Table 4-4 for the format of the RPS parameter.

Table 4-4. RPS Parameter Parcel Descriptions

Parcels	Description
0 through 1	Cylinder address (ID parameter 0)
2	Head address
3	RPS target sector address
4	RPS pulse width extension
5 through 6	RPS pulse width
7 through 10_8	RPS pulse width skew

3. Execute the DCA2:0 function on both channels to clear the channel busy and done flags.

4. Load the accumulator with 11_8, the transfer count for a load position routine (refer to Figure 4-30).

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1

T = Transfer Count

Figure 4-30. Transfer Count for a Load Position Routine

5. Execute the DCA2:4 function. This function transfers the transfer count from the accumulator to the transfer counter in the 3DI option.

6. Load the accumulator with the local memory starting address. The local memory starting address is the address that contains the parameters you entered in Step 2.

7. Execute the DCA2:14 function. This function transfers the local memory starting address to the EIOP channel local memory address register.

8. Load the accumulator with 11_8, the local memory parcel count for a load position routine (refer to Figure 4-31).

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
PC 0	PC 0	PC 0	PC 0	PC 0	PC 0	PC 0	PC 0	PC 0	PC 0	PC 0	PC 0	PC 1	PC 0	PC 0	PC 1

PC = Parcel Count

Figure 4-31. Parcel Count for a Load Position Routine

9. Execute the DCA2:15 function. This function transfers the parcel count to the EIOP channel parcel count register.

10. Load bits 2^0 through 2^8 of the accumulator with the load position bus control code (refer to Figure 4-32).

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
k 0	k 0	k 0	k 0	k 0	k 0	k 0	k 0	j 0	j 0	j 0	j 0	j 0	j 1	j 1	j 1

k = *k* Register Value j = *j* Register Value

Figure 4-32. Load Position Bus Control Code

11. Execute the DCA2:16 function. This function transfers the bus control codes to the *j* and *k* registers in the 3DF option on the DCA2.

12. Load the accumulator with 04_8, the sequencer starting address for a command load (refer to Figure 4-29).

13. Execute the DCA2:1 function. This function signals the sequencer to perform a bus control sequence (refer to Figure 3-5), an interlocked transfer-to-disk sequence (refer to Figure 3-6), and an ending status sequence (refer to Figure 3-10). When the sequences are finished, the IPI-2 interface is in the SLAVE ACKNOWLEDGE state.

Poll Routine

The poll routine requests all the disk drives connected to the channel with certain interrupts pending to report back to the DCA2. Before the sequencer performs an interrupt request (poll) sequence, the IPI-2 interface must be in the IDLE state. This example assumes the interface is in the SLAVE ACKNOWLEDGE state. The poll routine consists of the following steps:

1. Execute the DCA2:0 function on both channels to clear the channel busy and channel done flags.

2. Load the accumulator with 0's.

3. Execute the DCA2:16 function. This function transmits the 0's to the *j* and *k* registers of the 3DF option in the DCA2.

4. Load the accumulator with 14_8, the sequencer starting address for a deselect sequence (refer to Figure 4-33).

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
i	i	i	i	i	i	i	i	X	SQ	SQ	SQ	SQ	SQ	SQ	SQ
0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0

i = *i* Register Value
X = Not Used
SQ = Sequencer Starting Address

Figure 4-33. Sequencer Starting Address for a Deselect Sequence

5. Execute the DCA2:5 function. This function signals the sequencer to perform a deselect sequence (refer to Figure 3-11). When finished, the IPI-2 interface is in the IDLE state.

6. Load the accumulator with the interrupt request (refer to Table 3-11). Figure 4-34 shows the interrupt request for an RPS interrupt. This request checks whether a disk drive has completed a load position routine.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
k	k	k	k	k	k	k	k	j	j	j	j	j	j	j	j
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

k = *k* Register Value j = *j* Register Value

Figure 4-34. Interrupt Request in the Accumulator

7. Execute the DCA2:16 function. This function transfers the interrupt request to the *j* register in the 3DF option of the DCA2.

8. Load the accumulator with a bit-mapped drive address and the sequencer starting address (10_8) of an interrupt request (poll) sequence. Figure 4-35 shows the bit-mapped drive address for logical address 5 and the starting sequencer address for a poll sequence.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
i	i	i	i	i	i	i	i	X	SQ	SQ	SQ	SQ	SQ	SQ	SQ
0	0	1	0	0	0	0	0	x	0	0	0	1	0	0	0

i = *i* Register Value SQ = Sequencer Starting Address
X = Not Used

Figure 4-35. Sequencer Starting Address for a Poll Sequence

9. Execute the DCA2:5 function. This function signals the sequencer to perform an interrupt request (poll) sequence (refer to Figure 3-12). When the disk drive with the logical address selected in the *i* register responds, the sequencer returns the IPI-2 interface to the IDLE state.

Write Sector Data Routine

The write sector data routine writes a sector of data to the disk drive and consists of the following steps:

1. Perform a select unit routine.

2. Perform a load position routine.

3. Load the accumulator with the cylinder address, ID parameter 0 (refer to Figure 4-3).

4. Execute the DCA2:2 function. This function transfers the cylinder address to the cylinder register in the 3DG option of the DCA2.

5. Load the accumulator with the head and sector address, ID parameter 1 (refer to Figure 4-4).

6. Execute the DCA2:3 function. This function transfers the head and sector address to the parameter register in the 3DG option of the DCA2.

7. Load the accumulator with the transfer count. The transfer count for a write sector data routine is the total number of parcels in the ID field, ID error correction code (ECC) field, data field, defect swallow field, and data ECC field. Figure 4-36 shows the transfer count for a DD-60 disk drive ($20,154_8$).

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
0	0	1	0	0	0	0	0	0	1	1	0	1	1	0	0

T = Transfer Count in Octal

Figure 4-36. Transfer Count for a DD-60 Disk Drive

8. Execute the DCA2:4 function. This function transfers the transfer count from the accumulator to the transfer counter in the 3DI option.

9. Load the accumulator with the read header at target and write field bus control commands. Load the read header at target bus control command in the *j* register contents and the write field bus control command in the *k* register contents (refer to Figure 4-37).

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
k	k	k	k	k	k	k	k	j	j	j	j	j	j	j	j
1	0	0	0	0	0	0	1	1	1	0	0	1	1	0	0

k = *k* Register Value j = *j* Register Value

Figure 4-37. Read Header at Target and Write Field Bus Control Codes

10. Execute the DCA2:16 function. This function transfers the bus control codes to the *j* and *k* registers in the 3DF option of the DCA2.

11. Load the accumulator with 24_8, the sequencer starting address for a write data sequence (refer to Figure 4-38).

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
i	i	i	i	i	i	i	i	X	SQ	SQ	SQ	SQ	SQ	SQ	SQ
0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0

i = *i* Register Value
X = Not Used
SQ = Sequencer Starting Address

Figure 4-38. Sequencer Starting Address for a Write Data Sequence

12. Execute the DCA2:5 function. This function signals the sequencer to perform a write data sequence, which contains several IPI-2 sequences:

    a. The sequencer performs a bus control sequence (refer to Figure 3-5). During this sequence, the sequencer transfers the contents of the *j* register (read header at target bus control code) to the disk drive.

    b. The sequencer performs a noninterlocked transfer-from-disk sequence (refer to Figure 3-9). During this sequence, the DCA2 compares the ID field read from the disk drive to the ID parameters stored in the 3DG option.

    c. The sequencer performs an ending status sequence (refer to Figure 3-10). During this sequence the DCA2 and disk drive exchange statuses.

    d. The sequencer performs another bus control sequence (refer to Figure 3-5). During this sequence, the sequencer transfers the contents of the *k* register (write data field bus control code) to the disk drive.

    e. The sequencer performs a noninterlocked transfer-to-disk sequence (refer to Figure 3-8). During this sequence, the DCA2 receives a sector of data from the EIOP buffer board and transfers it to the disk drive.

    f. The sequencer performs another ending status sequence (refer to Figure 3-10). When finished, the IPI-2 interface is in the SLAVE ACKNOWLEDGE state.

Read Sector Data Routine

The read sector data routine reads a sector of data from the disk drive and consists of the following steps:

1. Perform a select unit routine.
2. Perform a load position routine.
3. Load the accumulator with the cylinder address, ID parameter 0. Refer to Figure 4-3.
4. Execute the DCA2:2 function. This function transfers the cylinder address to the cylinder register in the 3DG option of the DCA2.
5. Load the accumulator with the head and sector address, ID parameter 1. Refer to Figure 4-4.
6. Execute the DCA2:3 function. This function transfers the head and sector address to the parameter register in the 3DG option of the DCA2.
7. Load the accumulator with the transfer count. The transfer count for a read sector data routine is the total number of parcels in the ID field, ID ECC field, data field, defect swallow field, and data ECC field. Figure 4-36 shows the transfer count for a DD-60 disk drive ($20,154_8$).
8. Execute the DCA2:4 function. This function transfers the transfer count from the accumulator to the transfer counter in the 3DI option.
9. Load the accumulator with the read header at target (*j* register contents) and read field (*k* register contents) bus control commands. Refer to Figure 4-39.

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
k 1	k 1	k 0	k 0	k 0	k 0	k 0	k 1	j 1	j 1	j 0	j 0	j 1	j 1	j 0	j 0

k = *k* Register Value j = *j* Register Value

Figure 4-39. Read Header at Target and Read Field Bus Control Codes

10. Execute the DCA2:16 function. This function transfers the bus control codes to the *j* and *k* registers in the 3DF option of the DCA2.

11. Load the accumulator with 20_8, the sequencer starting address for a read data sequence (refer to Figure 4-40).

Accumulator Contents

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
i	i	i	i	i	i	i	i	X	SQ	SQ	SQ	SQ	SQ	SQ	SQ
0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

i = i Register Value
X = Not Used
SQ = Sequencer Starting Address

Figure 4-40. Sequencer Starting Address for a Read Data Sequence

12. Execute the DCA2:5 function. This function signals the sequencer to perform a read data sequence, which contains several IPI-2 sequences.

    a. The sequencer performs a bus control sequence (refer to Figure 3-5). During this sequence, the sequencer transfers the contents of the *j* register (read header at target bus control code) to the disk drive.

    b. The sequencer performs a noninterlocked transfer-from-disk sequence (refer to Figure 3-9). During this sequence, the DCA2 compares the ID field read from the disk drive to the ID parameters stored in the 3DG option.

    c. The sequencer performs an ending status sequence (refer to Figure 3-10). During this sequence the DCA2 and disk drive exchange statuses.

    d. The sequencer performs another bus control sequence (refer to Figure 3-5). During this sequence, the sequencer transfers the contents of the *k* register (read data field bus control code) to the disk drive.

    e. The sequencer performs another noninterlocked transfer-from-disk sequence (refer to Figure 3-9). During this sequence, the DCA2 receives a sector of data from the disk drive and transfers it to the EIOP buffer board.

    f. The sequencer performs another ending status sequence (refer to Figure 3-10). When finished, the IPI-2 interface is in the SLAVE ACKNOWLEDGE state.

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5 DD-60 HARDWARE DESCRIPTION (continued)

6 DD-60 FORMAT AND FLAW MANAGEMENT

7 DD-60 DIAGNOSTICS AND UTILITIES

FIGURES

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SECTION 5
DD-60 HARDWARE DESCRIPTION

5 DD-60 HARDWARE DESCRIPTION

The DD-60 contains hardware that displays status, changes the disk drive format, and tests the internal circuitry. The hardware includes the rear panel, maintenance panel, and internal components.

Rear Panel

A set of dual-in-line package (DIP) switches and LED displays are located on the rear panel of the DD-60. The DIP switches set the format of the disk drive and the displays show I/O status. Figure 5-1 shows the locations of the DIP switches and displays.

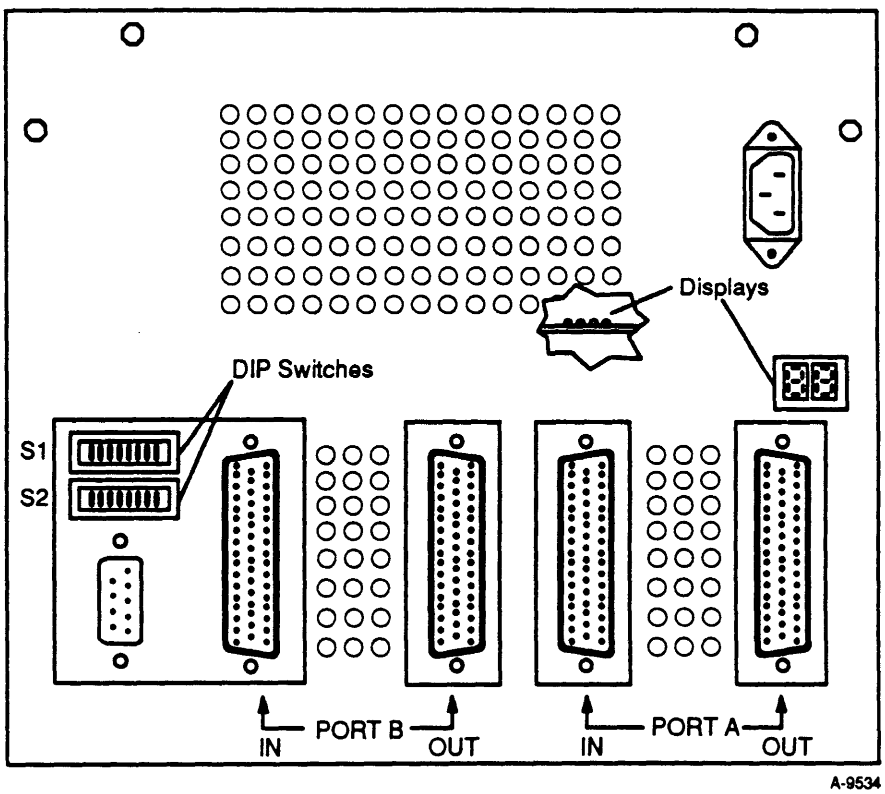

Figure 5-1. Rear Panel of a DD-60 Disk Drive

Upper DIP Switches (S1)

The upper DIP switches change the modes of disk drive operation. These switches are shown in Figure 5-2 below.

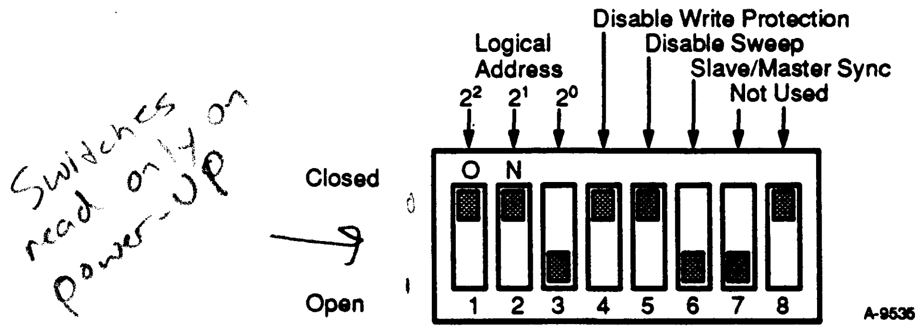

Figure 5-2. Upper DIP Switches (S1) on the DD-60

Disable Write Protection

Set this switch to the closed (on) position to disable write protection mode. Set this switch to the open (off) position to enable write protection. If the write protection is enabled, data cannot be written to the disk drive.

Disable Sweep

Set this switch to the closed (on) position to disable the sweep cycle. A sweep cycle moves the heads across the surface of the platter at least once every 12 minutes.

Slave/Master Sync

Set this switch to the open (off) position to make the disk drive a slave for synchronization. A slave synchronizes its rotation to the signal from a master.

If this switch is in the closed (on) position, the disk drive is the master for synchronization. This option is currently not used by Cray Research, Inc., so the switch should be set to the off position.

Logical Address

Set these switches to the appropriate logical address of the disk drive (refer to Table 5-1). Each disk drive in a daisy chain or alternate-path configuration must have a unique logical address (refer to Figure 5-3).

Table 5-1. Upper DIP Switch Settings for Logical Address

Logical Address	Switch 1	Switch 2	Switch 3
0	Closed (on)	Closed (on)	Closed (on)
1	Closed (on)	Closed (on)	Open (off)
2	Closed (on)	Open (off)	Closed (on)
3	Closed (on)	Open (off)	Open (off)
4	Open (off)	Closed (on)	Closed (on)
5	Open (off)	Closed (on)	Open (off)
6	Open (off)	Open (off)	Closed (on)
7	Open (off)	Open (off)	Open (off)

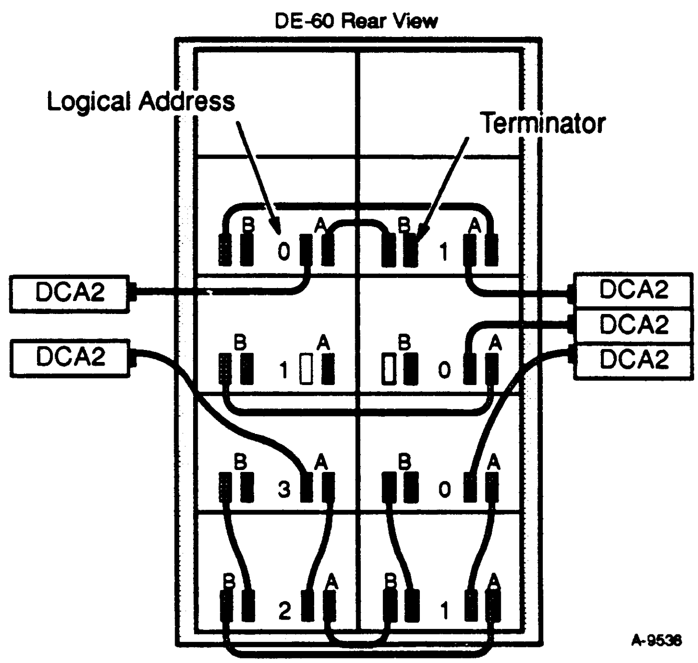

Figure 5-3. Logical Addresses of Disk Drives in a DE-60

If the maintenance panel is connected to the disk drive, the maintenance panel overrides the logical address set on the DIP switches. Refer to the "Maintenance Panel" subsection later in this section for information on setting the logical address using the maintenance panel.

Lower DIP Switches (S2)

The lower DIP switches change the modes of disk drive operation. These switches are shown below in Figure 5-4.

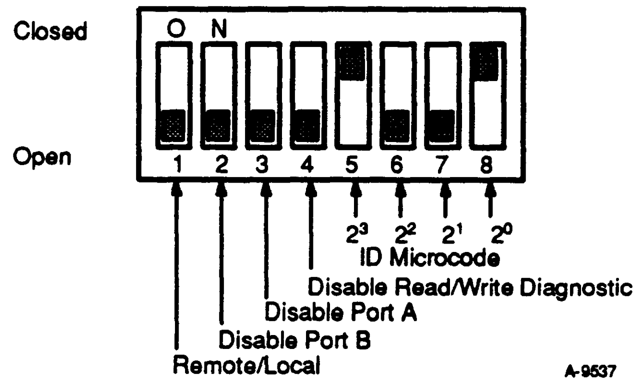

Figure 5-4. Lower DIP Switches (S2) on the DD-60

Remote/Local

Set this switch to the open (off) position to enable local mode. In local mode, the disk drive spins up when the START/STOP switch is pressed on the maintenance panel. If the disk drive does not have a maintenance panel and it is in local mode, it spins up when DC power is applied.

If this switch is set to the closed (on) position, the remote mode is enabled. In remote mode, the disk drive spins up only after it receives a spin-up command from a host controller.

Disable Port B

Set this switch to the open (off) position to enable port B. Set this switch to the closed (on) position to disable port B.

Disable Port A

Set this switch to the open (off) position to enable port A. Set this switch to the closed (on) position to disable port A.

Disable Read/Write Diagnostic

Set this switch to the open (off) position to enable the internal diagnostic read/write operation to the IPI diagnostic cylinder (5061_8).

ID Microcode

Make sure the ID microcode switches are set as shown in Table 5-2 before powering on the disk drive. Do not reset these switches. If these switches change position, the DD-60 may be reformatted and the stored data overwritten.

Table 5-2. Lower DIP Switch Settings for ID Microcode

Switch 5	Switch 6	Switch 7	Switch 8
Closed	Open	Open	Closed

CAUTION

Make sure the ID microcode switches are set to the correct positions before powering on the DD-60. If the switches are not correct and power is applied, the data stored in the DD-60 may be overwritten with a new format.

The ID microcode switches enable or disable internal disk drive circuitry. This circuitry enables or disables the disk drive internal parity checking and establishes eight or nine head parallel information transfers.

Rear Panel Displays

The rear panel contains two displays: a two-digit LED display and a four-LED display. Figure 5-5 shows the two displays.

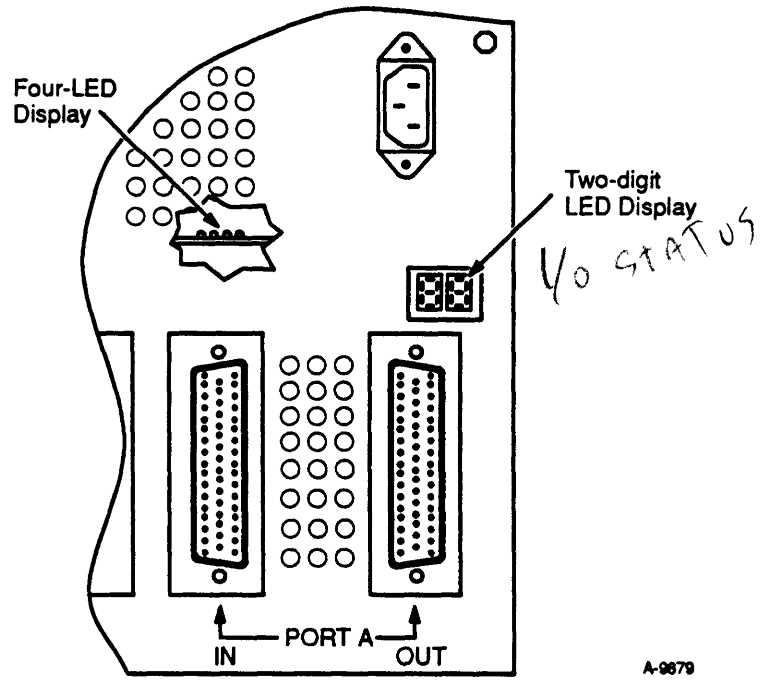

Figure 5-5. DD-60 Rear Panel Displays

Two-digit LED Display

If the maintenance panel is not connected to the disk drive, use the two-digit LED display to view status. During disk drive operations, the two-digit LED display shows the current I/O status.

The I/O status is generated by the I/O microprocessor unit (I/O MPU) in the DD-60. The I/O MPU controls the signal lines that connect the DD-60 to the DCA2.

Under normal disk drive operating conditions, the rear panel display should show the 01_{16} or 09_{16} I/O status code. For more information on the rear panel display I/O status codes, refer to page 11-20 of the "DD-60/61 Disk Systems Status" section of this manual.

Four-LED Display

The four-LED display, which is connected to the control board in the DD-60, displays the current condition of the power supply and DD-60 (refer to Figure 5-6).

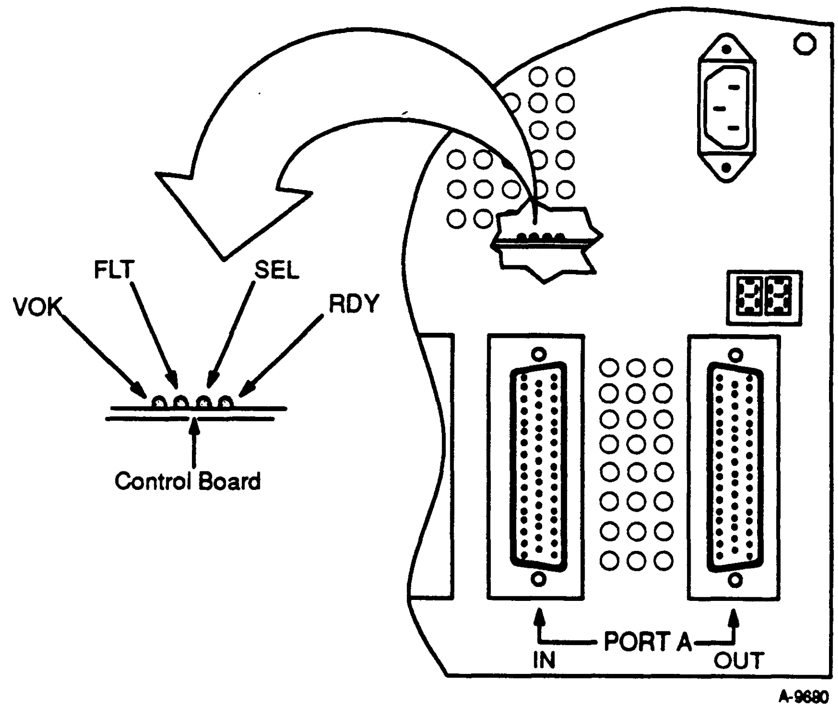

Figure 5-6. Four-LED Display in the DD-60

Table 5-3 describes each of the four LEDs in the display.

Table 5-3. Four-LED Display Description

Name	Description
VOK	The voltage (VOK) LED illuminates if the +5 V power supply is working correctly.
FLT	The drive fault (FLT) LED illuminates if a fault condition is detected by the disk drive.
SEL	The drive selected (SEL) LED illuminates when the DD-60 acknowledges a select command.
RDY	The drive ready (RDY) LED illuminates when the platters are up to speed, the heads are positioned over the first cylinder, and the disk drive is ready for use. The RDY LED also flashes during spin-up and spin-down sequences.

Maintenance Panel

Each DE-60 disk enclosure cabinet contains one maintenance panel. When connected to an individual disk drive, the maintenance panel is used to run diagnostic tests or request status.

Switches and Displays

The maintenance panel contains several switches and displays which enable you to power-up or power-down the disk drive, change the logical address, clear fault latches, enable or disable write protection, and run diagnostic tests. Figure 5-7 shows the switches and displays on the maintenance panel.

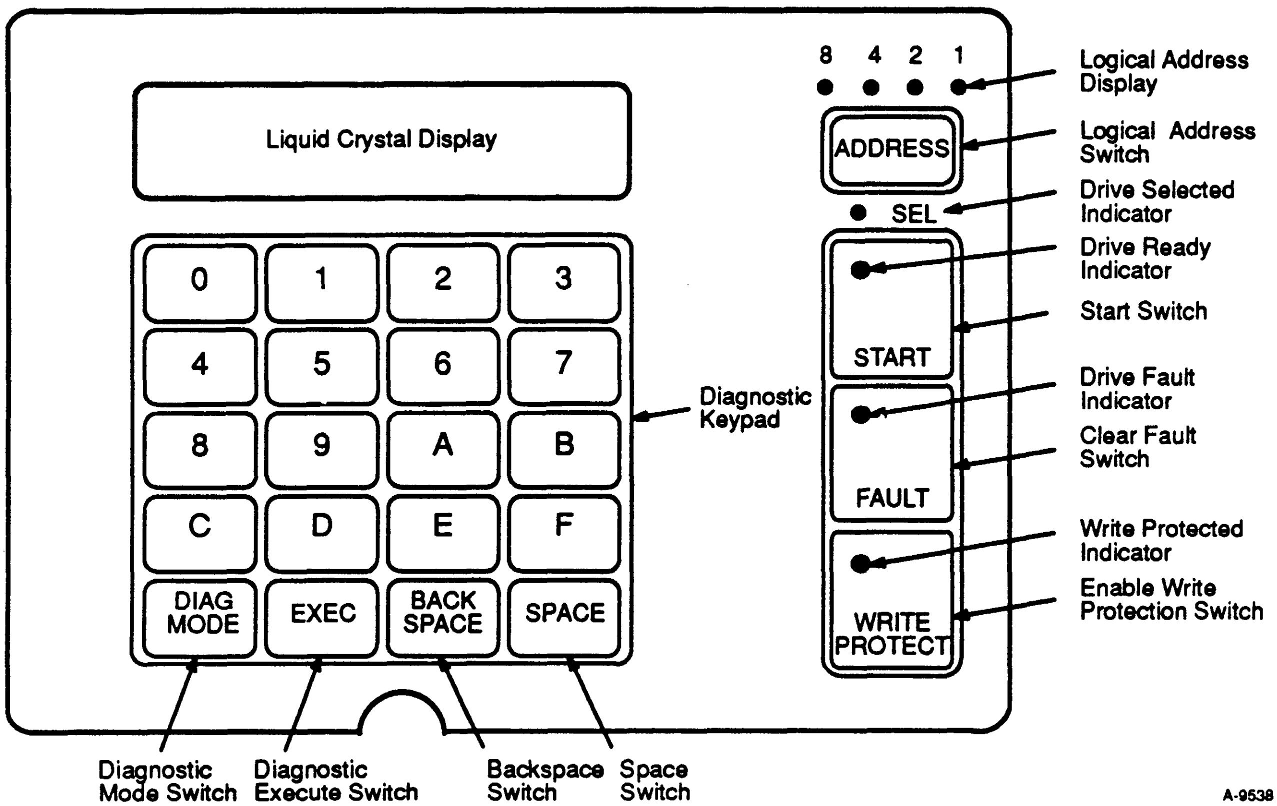

Figure 5-7. Maintenance Panel

Table 5-4 describes each of the switches and displays on the maintenance panel.

Table 5-4. Maintenance Panel Switches and Displays

Switch or Display	Description
Logical Address Display	These LEDs display the logical address of the disk drive. LED number 1 is the least significant bit. LED number 8 is the most significant bit.
Logical Address Switch	Use the ADDRESS switch to enter the logical address. First, press and hold the logical address switch. The display increments through the addresses. When the display shows the correct address, release the logical address switch. When a maintenance panel is installed on a disk drive, the logical address switch overrides the top panel DIP switches.
Drive Selected Indicator	The drive selected indicator (SEL) lights when the DCA2 selects the DD-61 for use by the channel.
Start Switch	Use the START switch to start the power-up sequence or power-down sequence for the disk drive.
Drive Ready Indicator	This drive ready indicator illuminates when the platters are up to speed, the heads are positioned over the first cylinder, and the disk drive is ready for use.
Clear Fault Switch	The FAULT switch clears all fault latches in the disk drive. Seek errors must be cleared with a return-to-zero command.
Drive Fault Indicator	The drive fault indicator illuminates if a fault condition exists on the disk drive.
Enable Write Protection Switch	Use the WRITE PROTECT switch to prevent data from being written to the disk drive.
Write Protected Indicator	The write protected indicator illuminates if the disk drive is in write protected mode.
Space Switch	Use the SPACE switch to add a space in diagnostic mode.
Backspace Switch	Use the BACKSPACE switch to remove the last character entered in diagnostic mode.
Diagnostic Mode Switch	Use the DIAG MODE switch to enter and exit diagnostic mode.
Diagnostic Execute Switch	Use the EXEC switch to start a selected test.
Diagnostic Keypad	Use the diagnostic keypad to enter the hexadecimal codes for diagnostic tests.
Liquid Crystal Display	The liquid crystal display displays the diagnostic tests and results.

Installation and Removal

One maintenance panel display is provided per DE-60. The following procedures describe how to connect the maintenance panel to the disk drives.

> **CAUTION**
>
> **Do not remove or install the maintenance panel while the disk drive power supply is on. Severe damage to the maintenance panel may result.**

Installation

Use this procedure to connect the maintenance panel to a disk drive:

1. Make sure the disk drive is powered down and the on/standby switch on the front panel of the DD-60 is in the standby position.
2. Plug the maintenance panel cable into the connector on the front panel of the disk drive.
3. Set the on/standby switch on the DD-60 to the on position. The on/standby switch is located on the front panel of the DD-60.
4. Press the START switch on the maintenance panel. The disk drive spins up and the ready indicator temporarily flashes.
5. After the disk drive is ready, enter the correct logical address and power cycle the disk drive.
6. After the disk drive is ready, press the DIAG MODE switch and execute tests 06 and 07 to clear the fault and status registers.

Removal

Use this procedure to disconnect the maintenance panel from a disk drive:

1. Press the START switch on the maintenance panel. The disk drive starts to spin down and the ready indicator on the START switch flashes.
2. After the ready indicator stops flashing, set the on/standby switch on the disk drive power supply to the standby position.

3. Disconnect the maintenance panel cable from the disk drive.

Diagnostic Test Execution

The DD-60 has internal diagnostic tests stored in memory. Perform the following steps on the maintenance panel keypad to select and begin a test:

1. Enter the diagnostic mode by pressing the DIAG MODE switch. The LCD display should show the following message:

   ```
   DIAG TEST XX
   ```

2. Enter the desired two-digit test number on the keypad. (Table 5-5 contains a list of DD-60 Sabre VI tests and their descriptions.)

3. Press the EXEC switch to start the test.

4. To end the test, press the EXEC switch again.

5. If running another test, repeat Steps 2 through 4. When finished, press the DIAG MODE switch to exit the diagnostic mode.

Table 5-5. DD-60 Sabre VI Maintenance Panel Tests

Test	Description
00	Displays the contents of the status/error log.
01	Displays the contents of the fault log or cylinder log.
04	Displays the three internal components most likely to have failed.
05	Performs a servo test.
06	Clears the status/error log.
07	Clears the fault log.
08	Performs a seek to a specific cylinder from cylinder 0.
09	Performs seeks to random cylinders.
0C	Displays the erasable programmable read only memory (EPROM) part number.
0E	Performs a return-to-zero seek.
12	Performs seeks to sequential cylinders.

Internal Components

DD-60 disk drives are Sabre VI 9 head parallel (9HP) disk drives. The Sabre VI 9HP disk drive contains three groups of internal components: the circuit boards, head disk assembly (HDA) module, and the power supply.

Circuit Boards

The DD-60 contains eight circuit boards that are broken down into four groups: a control board, read/write boards, an IPI logic board, and an I/O transceiver board.

Read/Write Boards

Five read/write boards transfer data from the IPI logic board to the HDA module. They mount to the top of the control board as shown in Figure 5-8. Figure 5-9 shows which physical heads are connected to each of the read/write channels.

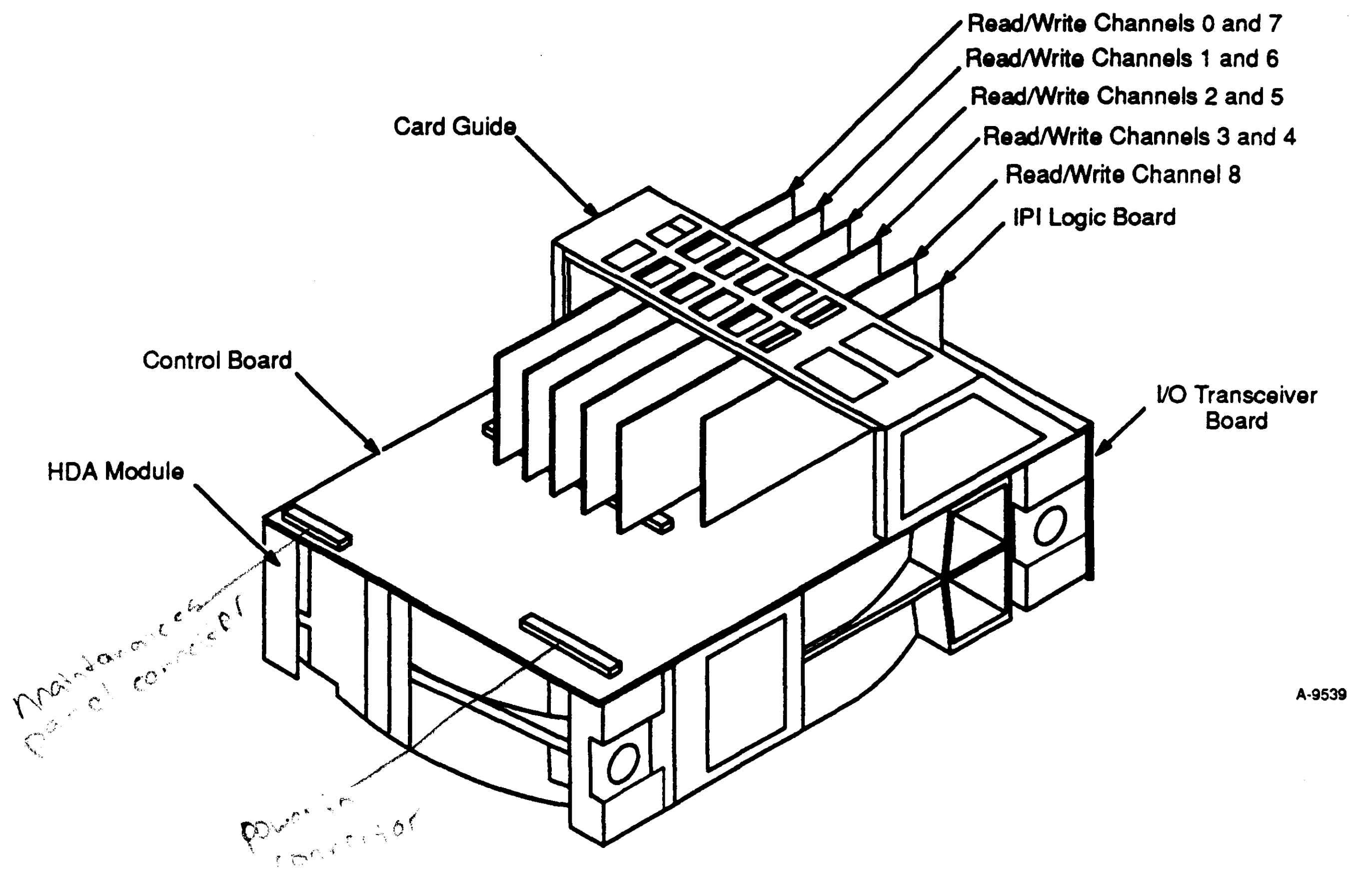

Figure 5-8. DD-60 Read/Write Circuit Board Locations

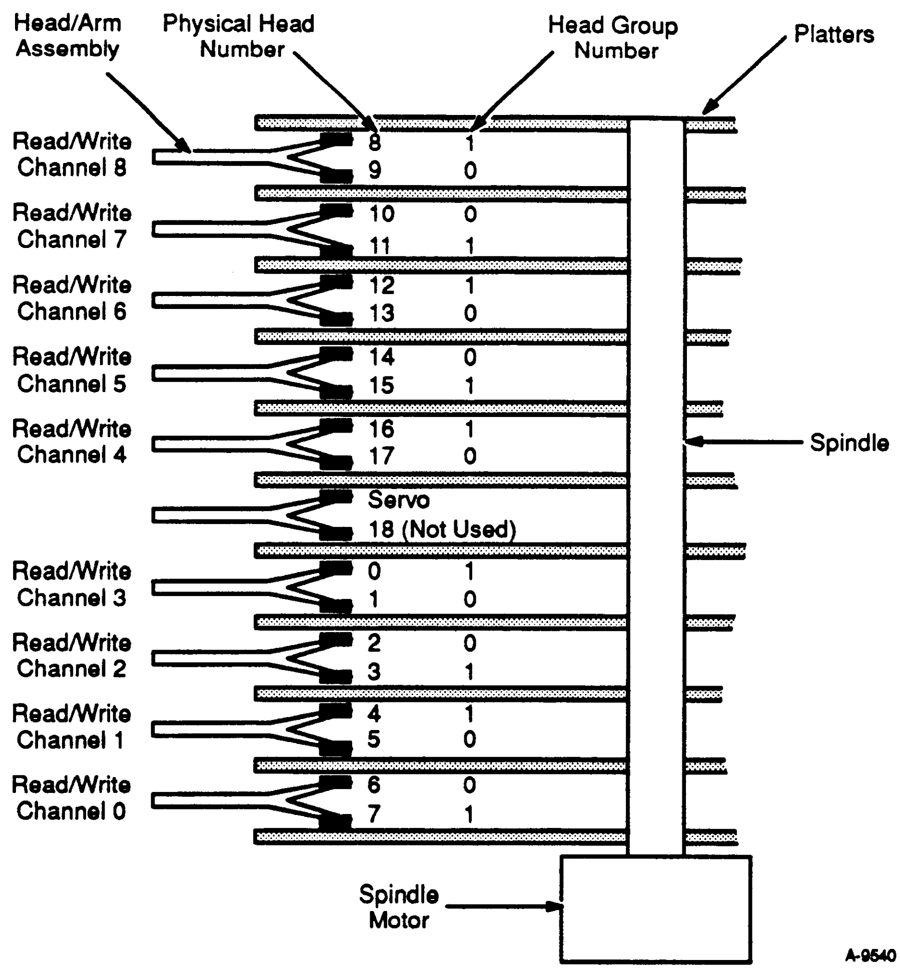

Figure 5-9. DD-60 Physical Head Locations in the HDA

IPI Logic Board

The IPI logic board translates IPI-2 commands from the DCA2. Figure 5-8 shows the location of the IPI logic board in the DD-60.

Control Board

The control board directly controls most disk drive functions. It mounts to the top of the HDA module and connects to the HDA module through pin connectors under the control board.

I/O Transceiver Board

The I/O transceiver board mounts to the back of the DD-60. It contains the rear panel DIP switches and LED display. It also contains external cable connectors.

HDA Module

The HDA is a sealed module that contains the circuitry and hardware used to store information, including platters, heads, an actuator, a spindle, and a spindle motor.

Platters

The HDA module contains 11 platters that rotate at 3,600 revolutions per minute. Nine of the platters contain two thin film media surfaces for reading or writing data. The top and bottom platter contain only one thin film media data surface (refer to Figure 5-9).

Heads

The heads transfer information to or from the platter media surface. One head transfers servo information and 18 heads transfer data. The remaining head is not used (refer to Figure 5-9).

Actuator

The actuator positions the heads over any of the 2,611 cylinders on the platter surface. The DD-60 has a balanced rotary actuator so the heads move in an arc over the platters.

Spindle

The spindle attaches to the center of all the platters and holds them in place. It is directly connected to the spindle motor (refer to Figure 5-9).

Spindle Motor

The spindle motor is a 3-phase motor that rotates at 3,600 revolutions per minute. It is directly connected to the spindle and platter assembly (refer to Figure 5-9). The spindle motor is controlled by a dedicated motor microprocessor unit on the control board.

Power Supply

The power supply converts 115 Vac or 230 Vac into DC voltages. All components of the disk drive operate on DC voltage. These voltages are +5 Vdc, –5 Vdc, +12 Vdc, –12 Vdc, and +24 Vdc.

SECTION 6
DD-60 FORMAT AND FLAW MANAGEMENT

6 DD-60 FORMAT AND FLAW MANAGEMENT

This section covers format specifications and flaw management properties of the DD-60, including cylinder format, sector format, media flaws, and flaw maps and tables.

Cylinder Format

The DD-60 has 2,611 cylinders, including data cylinders, diagnostic cylinders, and a flaw table cylinder. Table 6-1 shows the addresses of these cylinders in decimal and octal.

Table 6-1. DD-60 Cylinder Map

Cylinder Type	Addresses
Data cylinders	0 - 2,607 0 - 5057_8
Diagnostic scratch cylinder	2,608 5060_8
IPI diagnostic cylinder	2,609 5061_8
User flaw table cylinder	2,610 (odd sectors) 5062_8 (odd sectors)
Factory flaw table cylinder	2,610 (even sectors) 5062_8 (even sectors)

Data cylinders store system data. Do not write data patterns to these cylinders unless a problem is narrowed to a specific data cylinder.

The diagnostic scratch cylinder is reserved for DD-60 diagnostics. Use this cylinder to read and write data patterns without destroying system data.

The IPI diagnostic cylinder is reserved for the disk drive. The internal read/write diagnostics use this cylinder during spin-up of the DD-60.

The flaw table cylinder contains both the factory flaw table and the user flaw table. For more information on flaw tables, refer to the "Flaw Maps and Tables" subsection later in this section.

Sector Format

After receiving information from the DCA2, the DD-60 stores the information in 8 physical sectors (one under each head in a head group). Figure 6-1 shows the format of a physical sector under one head in the head group.

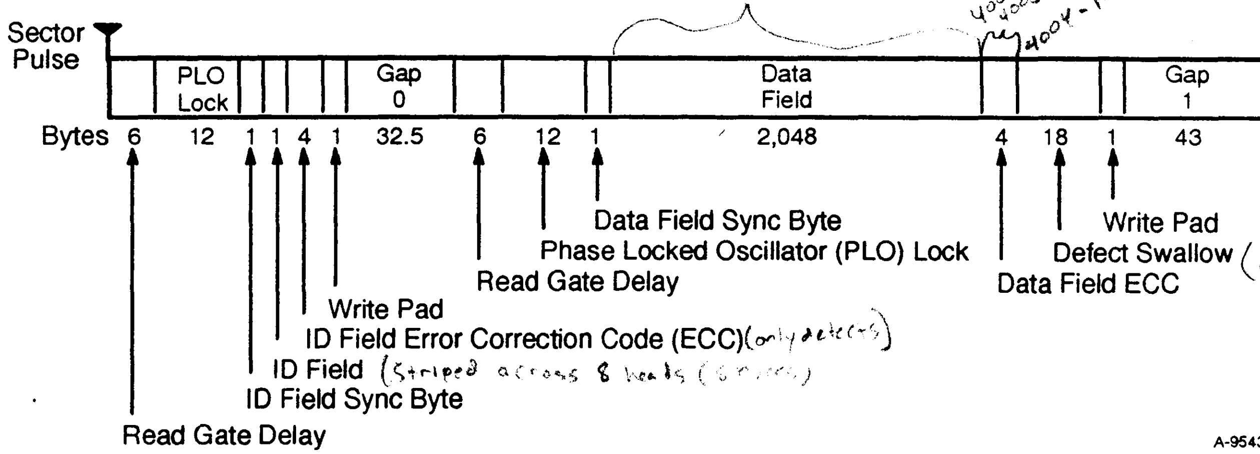

Figure 6-1. DD-60 Physical Sector Format

Each sector contains five field types: timing, data, ECC, defect swallow, and ID fields. Table 6-2 shows the relationship between the size of a physical field and the logical size of the information from the combined 8 heads.

Table 6-2. DD-60 Sector Field Sizes

Sector Field	Physical Size in Bytes	Logical Size in Bytes
Read gate delay	6.0	48.0
PLO lock	12.0	96.0
ID field sync byte	1.0	8.0
ID	1.0	8.0
ID field ECC	4.0	32
Write pad	1.0	8.0
Gap 0	32.5	260.0
Data field sync byte	1.0	8.0
Data	2,048.0	16,384.0
Data field ECC	4.0	32.0
Defect swallow	18.0	144.0
Gap 1	43.0	344.0

Timing Fields

Timing fields create time delays for synchronization of the timing circuits during read or write operations. These fields are read gate delay, PLO lock, sync bytes, write pad, gap 0, and gap 1.

For an example of how a timing field is used, gap 0 provides a time delay for the DD-60 to interpret the next command (a read or write data field). Without this delay, the information stored in the data field would be sent to the DCA2 immediately after the ID information.

Data Field

The data field contains 2,048 bytes of system data. The DD-60 distributes 16,384 bytes of data received from the DCA2 into the 8 physical data fields.

ECC Fields

The ECC fields contain ECC generated by the DCA2 during a write data operation. Each physical sector contains 4 bytes of ECC for the ID field in that sector and 4 bytes of ECC for the data field in that sector. The DCA2 uses this information during a read operation.

During a read data operation, the DCA2 reads the data or ID field and generates a new ECC for that field from each physical sector. The DCA2 then compares the new ECCs to the information read from the sector ECC fields.

If the ID or data field ECCs do not match the generated ECCs, the DCA2 signals the input/output cluster that an error occurred. If the error occurred in the data field, the DCA2 can detect the bits that are incorrect and correct them.

Defect Swallow

The defect swallow allows the data field to expand if a hideable flaw is placed in the sector. For more information on defect swallow and hideable flaws, refer to the "Media Flaws" subsection in this section.

ID Field

The DD-60 stores 8 bytes of logical ID information among the 8 physical ID fields. The ID information contains the logical sector address and media flaw information (refer to Figure 6-2). Table 6-3 describes each bit of the ID information.

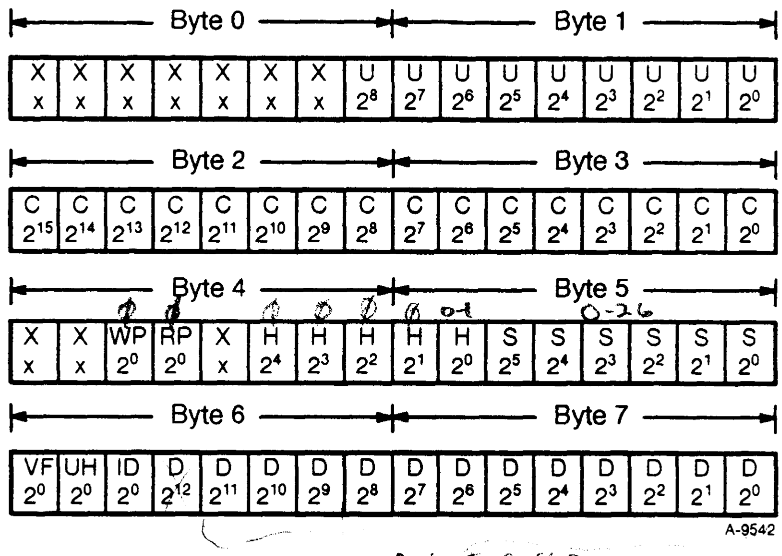

Figure 6-2. DD-60 Logical ID Information

Table 6-3. DD-60 Logical ID Information Description

Bit Symbol	Name	Description
X	Not used	This bit is not used.
U	Defective head	When set to 1, this bit indicates that the physical sector corresponding to this head contains a media flaw.
C	Cylinder address	These bits contain the cylinder address of the data (0 - 5062_8).
WP	Write protect	When set to 1, this bit indicates that data cannot be written to the sector unless this bit is also set in the parameter register of the DCA2.
RP	Read protect	When set to 1, this bit indicates that data cannot be read from the sector unless this bit is also set in the parameter register of the DCA2.
H	Head address	These bits contain the logical head address of the data (0 - 1).
S	Sector address	These bits contain the sector address of the data (0 - 26_8).
VF	Valid flaw	When set to 1, this bit indicates that the flaw in the sector is a known hideable [redacted] flaw.
UH	Unhideable flaw	When set to 1, this bit indicates that the flaw in the sector is unhideable.
ID	ID field flaw	When set to 1, this bit indicates that the ID field contains a flaw (unhideable).
D	Defect parameter	These bits contain the defect parameter. If the sector does not have a media flaw in the data field, the defect parameter is 4004_8.

The ID information is transferred between the disk drive and DCA2 in four 16-bit parcels utilizing both bus A and bus B. For example, the first parcel transferred contains byte 0 and byte 1 of the logical ID information.

The entire logical ID information does not exist under an individual head in the head group. Each physical ID field contains 8 bits of the information. Bit 2^0 of each byte transferred is stored under head 0 of the head group. Bit 2^1 of each byte transferred is stored under head 1 of the head group, and so on.

During a write ID field operation, the DD-60 distributes the logical ID information to the 8 ID fields. After the 8 bytes of information are written to the disk drive, each physical ID field contains 8 bits of the information. Figure 6-3 shows the ID fields for the 8 heads in a head group.

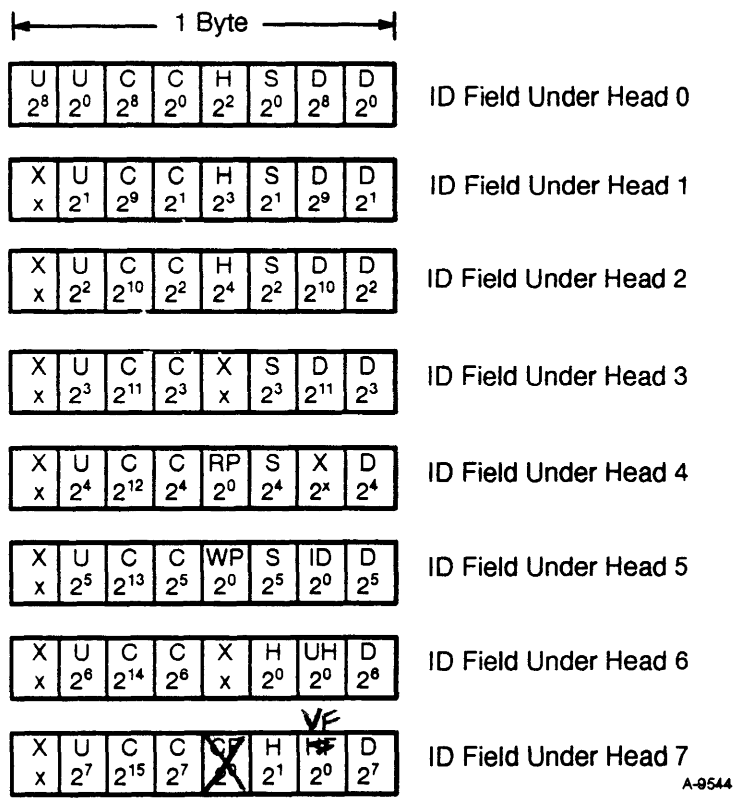

Figure 6-3. DD-60 Physical ID Fields

Media Flaws

A media flaw is a defect on the surface of a platter that does not allow the disk drive to read or write information correctly. Flaws are grouped into two categories, hideable flaws and unhideable flaws.

Hideable Flaws

A hideable flaw is a media defect in the data field that can be effectively covered by an 18-byte defect pad. The DCA2 creates this defect pad when it writes data to the disk drive.

Hiding a Media Flaw

When a media defect is found during surface analysis or from an error report, the cylinder, head, and sector address of the flaw is identified along with a defect parameter. The defect parameter is the byte number in the physical data field where the DCA2 starts to create an 18-byte defect pad.

Values for the defect parameter range from 0_8 to 4004_8 (0 to 2,052). The defect parameter, or location of the first byte of the defect pad, is calculated so that the 18-byte pad is centered over the media flaw. For example, if a media flaw is located at byte 31_8, the defect parameter for this flaw is 21_8 (refer to Figure 6-4).

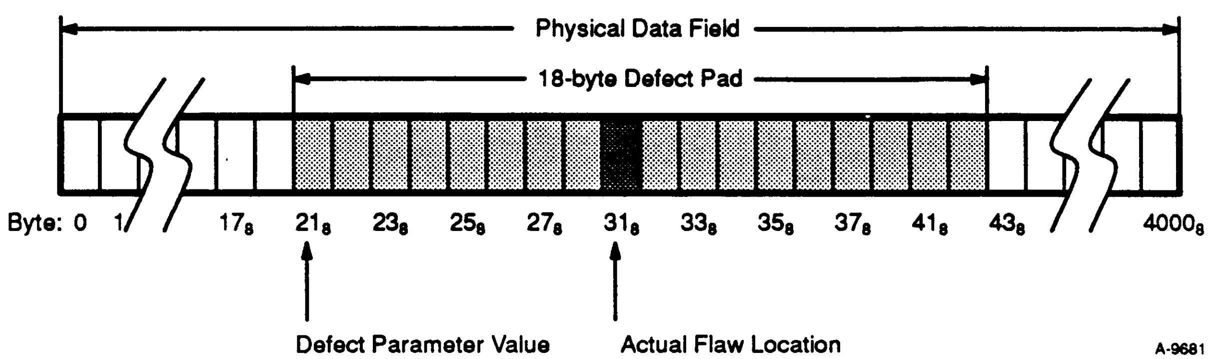

Figure 6-4. Defect Parameter and Actual Flaw Locations in a DD-60 Data Field

Before a write data field operation begins, the defect parameter is read from the sector ID field and transferred to a register in the 3DG option (refer to Figure 3-1). The data parcel counter in 3DG is reset to 0.

The DCA2 uses the parcel counter in the 3DG option to count each parcel of data as it is transferred to the disk drive. To count each 64-bit word (or 4 parcels) of data sent to the disk drive, the 3DG option disregards bits 2^0 and 2^1 of the parcel counter. Since the DD-60 uses 8 parallel heads to write data, one 64-bit word of data sent to the disk drive is equivalent to one byte of data in a physical data field.

When the value of the word count (from the parcel counter) is equivalent to the defect parameter, the DCA2 halts the parcel counter and starts the defect counter in the 3DG option.

While the defect counter is counting, the sequencer signals the 3YC and 3DH options to halt the transfer of data to the 3DF option. Because the 3DF option does not receive new data, it repeatedly transfers the previous parcel of data to the disk drive. This continues until 72 repeated parcels (18 words) of data are sent to the disk drive.

By sending 72 repeated parcels of data to the disk drive, the DCA2 creates an 18-byte defect pad in the same location under each of the 8 parallel heads. Each byte sent to a physical sector/head corresponds to 1 64-bit word sent to the disk drive (refer to Figure 6-5).

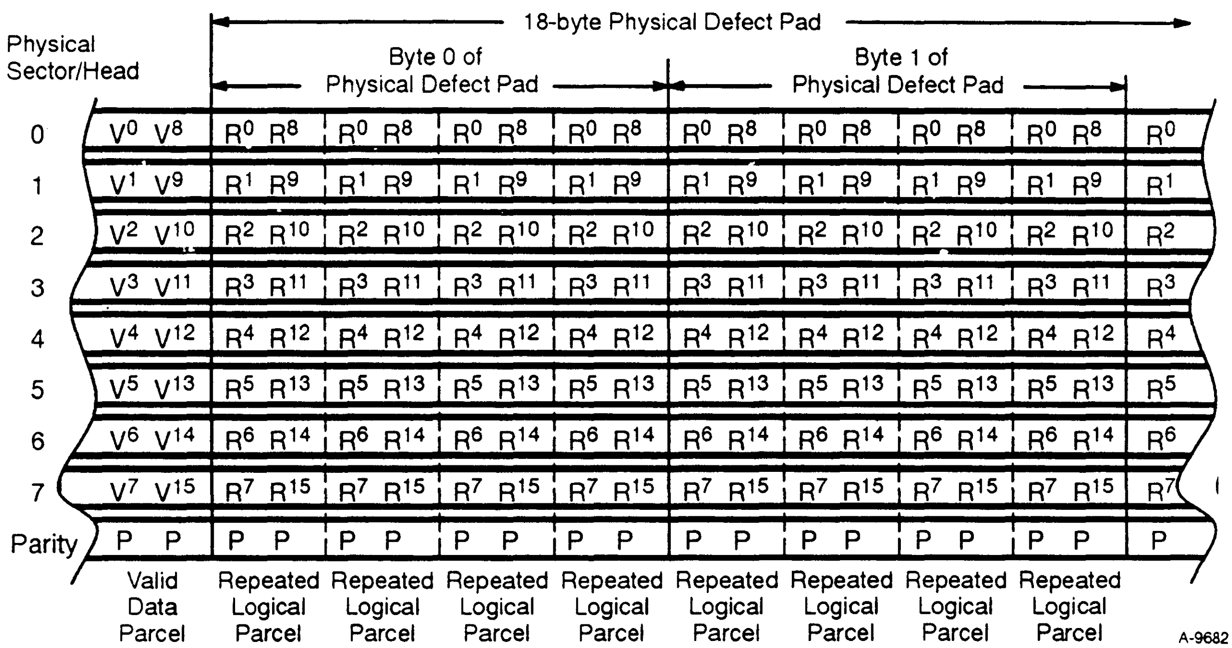

Figure 6-5. Bytes 0 and 1 of the Physical Defect Pads for All Eight Sectors

After creating the defect pads, the sequencer restarts the parcel counter and signals the 3YC and 3DH options to resume the transfer of data to the 3DF option. This continues until all of the data for the logical sector is sent to the disk drive.

Sector Format with a Hideable Flaw

When a defect pad is inserted into a physical sector, the physical length from the start of the data field to the end of the data field increases from 2,048 bytes to 2,066 bytes. To compensate for the increase in size, the DCA2 overwrites the defect swallow with data. Figure 6-6 shows the format of a physical sector that contains a hideable flaw.

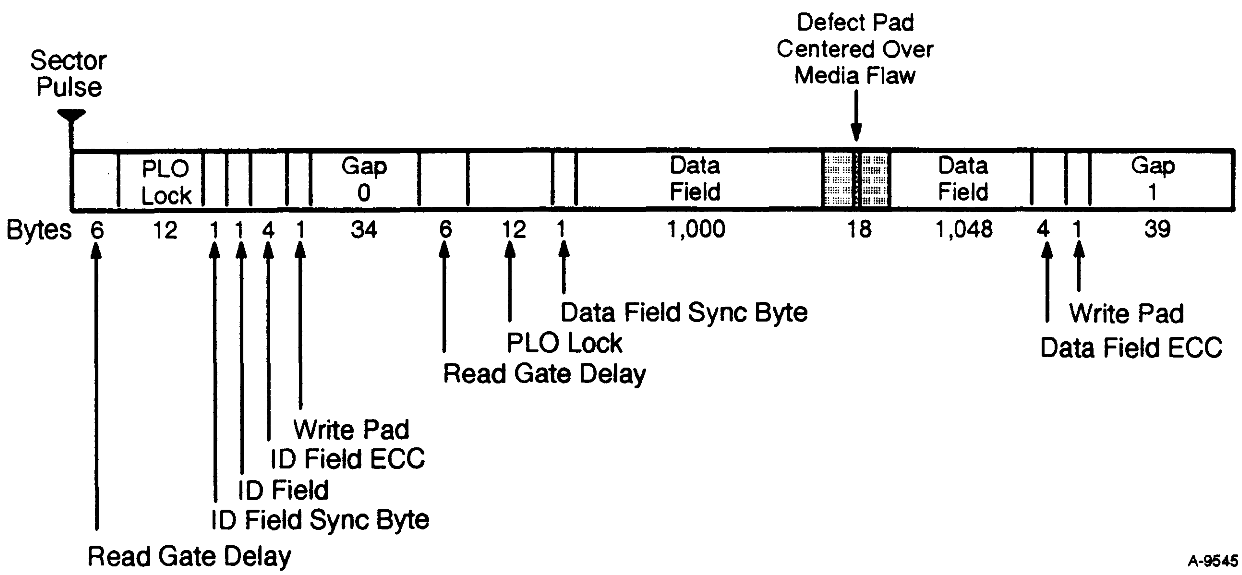

Figure 6-6. DD-60 Physical Sector with a Hideable Flaw

All 8 physical sectors must have a defect pad in the same location as the sector that has a media flaw. Therefore, the logical size of a defect pad is 144 bytes.

Hiding Multiple Media Flaws in One Logical Sector

Two or more flaws on separate physical sectors may be covered by one defect pad. If the combined flaws do not have the properties of an unhideable flaw, the DCA2 can create a defect pad centered over the combined flaws. Figure 6-7 shows one defect pad covering two physical sector flaws.

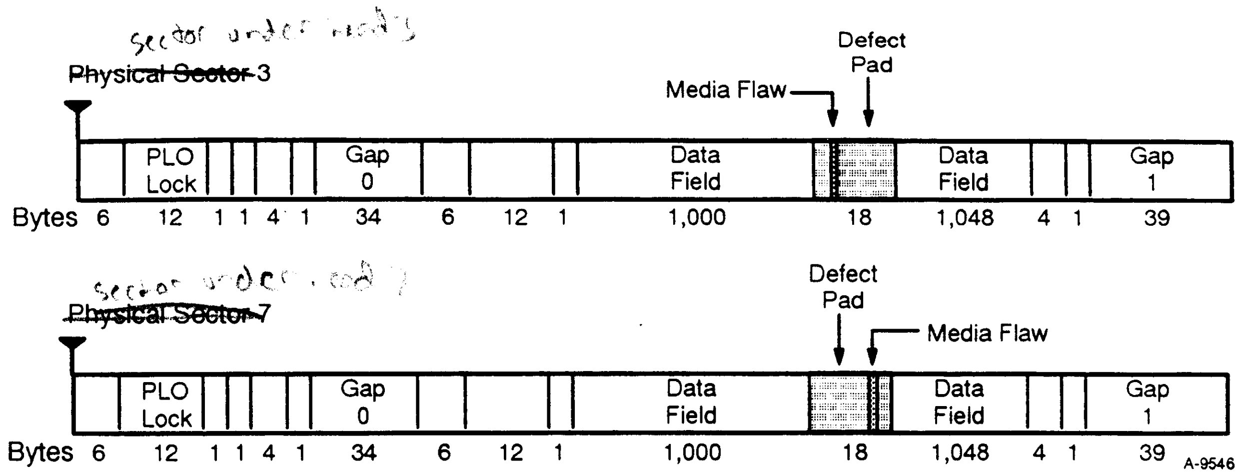

Figure 6-7. Two Physical Sectors with Hideable Flaws Covered by One Defect Pad

Reading a Sector with a Hideable Flaw

Before performing a read data field operation, the DCA2 reads the sector ID field and stores the defect parameter in a register of the 3DG option. The DCA2 then resets the parcel counter in the 3DG option (refer to Figure 3-1).

The DCA2 uses the parcel counter in the 3DG option to count each parcel of data as it is transferred to the disk drive. To count each 64-bit word (or 4 parcels) of data sent to the disk drive, the 3DG option disregards bits 2^0 and 2^1 of the parcel counter. Since the DD-60 uses 8 parallel heads to write data, one 64-bit word of data sent to the disk drive is equivalent to one byte of data in a physical data field.

When the value of the word count (from the parcel counter) is equivalent to the defect parameter, the DCA2 halts the parcel counter and starts the defect counter in the 3DG option.

While the defect counter is counting, the sequencer signals the 3YB option to reject the data parcels coming from the 3DE. This process continues until the 72 repeated logical parcels are transferred from the disk drive to the DCA2.

After all of the repeated data is transferred, the sequencer restarts the parcel counter and signals the 3YB option to resume accepting data parcels from the disk drive. This process continues until the rest of the data field is transferred to the DCA2.

Unhideable Flaws

An unhideable flaw is a media flaw that cannot be hidden by a defect pad. If an unhideable flaw occurs, the entire sector cannot be used to store data. Any sectors that contain an unhideable flaw are marked by the operating system as unusable sectors. The following list describes some of the conditions that create an unhideable flaw.

- A flaw exists in the first 8 bytes of the data field.
- A flaw exists outside of the data field of a sector (such as ID or sync byte fields).
- A flaw is longer than 32 bits.
- Two or more flaws exist under separate heads and the combined flaw cannot be covered by one defect pad.

Flaw Maps and Tables

Flaw maps and tables store the locations of media flaws in the DD-60. The maps and tables include a factory flaw map, a user flaw table, and a UNICOS flaw map.

Factory Flaw Map

even sectors
0 a 2

When Cray Research, Inc. (CRI) purchases a Sabre VI 9HP disk drive, it contains a factory flaw map on the even numbered sectors of cylinder 2,610 (5062_8). The factory flaw map lists the physical locations of all the flaws found during manufacturing checkout. This information is used when the DD-60 is initially formatted.

User Flaw Table

odd sectors
1 a 3

The user flaw table contains a list of all the flaws, hideable and unhideable, including those added since the disk drive was initially formatted. It is located on the odd numbered sectors of cylinder 2,610 (5062_8). Update the user flaw table every time you add a flaw to a sector in the DD-60. Table 6-4 shows the format of the user flaw table.

Table 6-4. User Flaw Table Format

Word	Parcel	Description
0	0	Cray Research, Inc. serial number in ASCII (bits 2^{63} through 2^{48})
	1	Cray Research, Inc. serial number in ASCII (bits 2^{47} through 2^{32})
	2	Cray Research, Inc. serial number in ASCII (bits 2^{31} through 2^{16})
	3	Cray Research, Inc. serial number in ASCII (bits 2^{15} through 2^{0})
1	0	HDA serial number in hexadecimal (bits 2^{31} through 2^{16})
	1	HDA serial number in hexadecimal (bits 2^{15} through 2^{0})
	2	Not used
	3	Date of recording in hexadecimal (bits 2^{15} through 2^{0})
2 through last entry	0	Flaw ID field parcel 0 (refer to Figure 6-2)
	1	Flaw ID field parcel 1 (refer to Figure 6-2)
	2	Flaw ID field parcel 2 (refer to Figure 6-2)
	3	Flaw ID field parcel 3 (refer to Figure 6-2)
Terminator	0	All 1's
	1	All 1's
	2	All 1's
	3	All 1's

UNICOS Flaw Map

The UNICOS flaw map is used by the operating system to locate sectors that contain unhideable flaws. If a sector is unusable, the operating system can remap the logical sector to another location in the DD-60.

SECTION 7
DD-60 DIAGNOSTICS AND UTILITIES

7 DD-60 DIAGNOSTICS AND UTILITIES

The diagnostics and utilities used to test and perform media maintenance on the DD-60 include the online disk diagnostic and maintenance system (DDMS), offline device maintenance environment (DME) utilities, and offline DME diagnostics.

DDMS

The DDMS program runs on Cray Research, Inc. (CRI) computer systems that have an input/output subsystem model E. The DDMS program can be used for the following functions:

- Surface reading, writing, and analysis within a selected range of cylinders, heads, and sectors.
- Verifying the sector ID fields according to the contents of the user flaw table stored in the DD-60.
- Transferring data between a sector and the UNICOS spare map cylinder.
- Reformatting and rewriting sectors that contain a flaw.
- Reading the user flaw table in the DD-60.

For more information on DDMS, refer to the *CRAY Y-MP, CRAY X-MP EA, and CRAY 1 Computer Systems UNICOS On-line Diagnostic Maintenance Manual*, CRI part number SMM-1012.

DME DD-60 Utilities

The offline DD-60 utilities are part of the device maintenance environment (DME) program. They run from Motorola maintenance workstation (MWS) or a Sun maintenance workstation (MWS-E).

Running the DD-60 Utilities

Use the following procedure to start the DME program and select the DD-60 utilities. This procedure uses the keystroke commands in DME; however, you may also use the mouse to select the appropriate commands.

1. Log on to the MWS using the mws login.
2. Type the following command to change to the home directory:

   `cd /u/mws` ↵ (or `/cri/mws` on the MWS-E)

3. Type the following command to initiate DME:

   dme [*channel*] ↵

   The MWS displays the Initial DME menu (refer to Figure 7-1).

```
----------------------------------------------------------------------------
DME1.0        EIOPS:                                    SNAP      QUIT
IOS CLK-U     EIOPS:                            Fri Jun 14 12:33:10 1991



  1. Channel Adapter (DCA-2)              a. Channel Adapter (TCA-1)
  2. DD60 Disk Drive                      b. Round Tape (IBM3420 compatible)
  3. DD61 Disk Drive                      c. Cartridge Tape (IBM3480 compatible)
```

Figure 7-1. Initial DME Menu

4. Press **2** to select `DD60 Disk Drive`. The MWS displays the DME selection menu (refer to Figure 7-2).

```
-------------------------------------------------------------------------------
DME1.0      EIOPS:                                     DD60    SNAP      QUIT
IOS CLK-U   EIOPS:                                     Fri May  3 10:06:53 1991


                              DME SELECTION MENU
                             1. EIOP/CHANNEL SELECTION
                             2. PROGRAM SELECTION
                             3. EIOP CONTROL
                             4. DISPLAYS
                             X. EXIT
```

Figure 7-2. DME Selection Menu

5. Press **1** to select `EIOP/CHANNEL SELECTION`. The MWS displays the DME EIOP selection menu (refer to Figure 7-3).

```
-------------------------------------------------------------------------------
DME1.0      EIOPS:                                             SNAP      QUIT
IOS CLK-U   EIOPS:                                     Thu Feb  7 15:05:41 1991


                           DME EIOP SELECTION MENU
   Enter the EIOPs, channels, and unit addresses(device number) of the devices
   to select or deselect.

   Selection syntax:  sel 'cluster.eiop' 'channels' 'unit addresses'<cr>
   Allowable ranges:  cluster: 0-7  eiop 0-3(* = all 4 eiops)
                      channels: 30, 32, 34, 36 (* = all 4 channel pairs)
                      unit adrs: DD60/61   00-07
                                 tapes     00-FF hexidecimal
   Maximum selection: 8 eiops, 4 channels per eiop, 1 device per channel

   Deselection syntax: dsel 'cluster.eiop'<cr>

   Enter:  X or x to exit this menu

   Example: sel 0.* 32,34 00,01<cr>   This example selects all eiops cluster 0,
   channel pairs 32/33 and 34/35, and unit 00 on 32/33 and 01 for 34/35.
    NOTE: Multiple channel and unit numbers MUST be seperated with commas.

>
-------------------------------------------------------------------------------
```

Figure 7-3. DME EIOP Selection Menu

6. Enter the EIOPs, channels, and unit (logical) addresses of the devices to test. The following commands select cluster 0, EIOP 0, channels 30/31, unit 0 (logical address 0), and exit the display.

   sel 0.0 30 00 ↵

   x ↵

7. The MWS displays the EIOP selections you made and asks whether they are correct. Type the following command if the selections are correct.

   y ↵

   The MWS displays the DME selection menu (refer to NO TAG).

8. Press 2 to select the `PROGRAM SELECTION` parameter. The MWS displays the DME program selection menu (refer to Figure 7-4).

```
------------------------------------------------------------------------------
DME1.0       EIOPS:0.0                               DD60     SNAP      QUIT
IOS CLK-U    EIOPS:                                  Fri May  3 10:10:20 1991


 DME PROGRAM SELECTION MENU    DIAGNOSTICS             UTILITIES
 1. EIOP  0.0                  a. Channel Adpt test   n. chn troubleshooting
 2. CHANGE PARMETERS           b. ecc test            o. media maintenance
 3. ALL EIOPS                  c. rndm wrt/read       p. drive troubleshoot
 4. LOAD MICRO SEQUENCER       d. rndm read
 X. EXIT                       e. rndm CE cyl wrt/rd
                               f. rndm CE cyl read
                               g. seek sequential
                               h. seek random
                               i. seek full stroke
                               j. seek X to N up
                               k. seek X to N down
```

Figure 7-4. DME Program Selection Menu

9. Press **n**, **o**, or **p** to select the chn troubleshooting, media maintenance, or drive troubleshoot DD-60 utility.

10. Type the following command to exit the DME program selection menu:

    x ↵

    The MWS displays the DME selection menu (refer to Figure 7-2).

11. Press the **4** key to select the `DISPLAYS` parameter. The MWS displays the DME display menu (refer to Figure 7-5).

```
DME1.0      EIOPS:0.0                               DD60     SNAP       QUIT
IOS CLK=U   EIOPS:                                  Fri May  3 10:11:57 1991

                          DME DISPLAY MENU
                          1. RUNNING ALL
                          2. RUNNING EIOP
                          3. LOAD BUFFER
                          4. LOCAL MEMORY
                          X. EXIT
```

Figure 7-5. DME Display Menu

12. Press **2** to select the `RUNNING EIOP` parameter. The MWS displays the chn troubleshooting menu, drive troubleshooting menu, or media maintenance running EIOP display.

Chn Troubleshooting Utility

The chn troubleshooting utility allows you to select an individual channel function to run in the DCA2 and DD-60. This utility should only be used with a thorough understanding of the DCA2 channel functions and their sequences. For more information on the chn troubleshooting utility, refer to the *IOS Model E Offline Diagnostic Reference Manual*, publication number CDM-1018-000. Figure 7-6 shows the chn troubleshooting display.

```
DME0.1      EIOPS:0.0                                         SNAP      QUIT
IOS CLK-U   EIOPS:                                       Thu Feb  7 15:12:49 1991


EIOP0.0     CHANNEL30/31
1. CHAN FUNCTION (  )     (  )     (  )     (  )     (  )     (  )
2. MODE BITS     (  )     (  )     (  )     (  )     (  )     (  )
3. ACCUMULATOR   (      ) (      ) (      ) (      ) (      ) (      )
4. EVEN CHANNEL
5. ODD CHANNEL
6. LOOP COUNT    (      )
7. STATUS
8. EXECUTE
9. CANCEL
X. EXIT
```

Figure 7-6. Chn Troubleshooting Display

Drive Troubleshooting Utility

The drive troubleshooting utility allows you to select individual functions to run in the DD-60. This utility should only be used with a thorough understanding of the DD-60 disk drive functions. Information on the drive troubleshooting utility will be added to the DME section of the *IOS Model E Offline Diagnostic Reference Manual*, publication number CDM-1018-000.

Media Maintenance Utility Description

The media maintenance utility performs several operations used with flaw management. These include transferring flaw table information to and from the disk drive, formatting and verifying the sector ID fields, and reading and writing data to and from the platters to check for media flaws.

When running the media maintenance utility, it may be helpful to refer to the "DD-60 Format and Flaw Management" section of this manual, which contains several figures and tables that can be used as a quick reference when performing media maintenance.

Figure 7-7 shows the DD-60 media maintenance menu. The display is divided into four sections: parameters, disk functions, modifiers, and commands.

```
------------------------------------------------------------------------------
DME1.0       EIOPS:0.0                            DD60    SNAP     QUIT
IOS CLK-U    EIOPS:                               Fri Jun 14 12:36:35 1991

 EIOP0.0            CHANS  A.30 UA-00  B.32         C.34         D.36
                           1.BC-005060 2.EC-005060 3.BH-000000 4.EH-000001
 STATUS:IDLE               5.BS-000000 6.ES-000026 7.PM-177777 8.NP-000001



       a.FACTORY TABLE   d.ID FIELDS
       b.USER TABLE      e.DATA FIELDS
       c.LOADED TABLE                                   r.DISPLAY FLAW TABLE
                                                        s.SURF RESULTS
                                                        t.STATUS
 f.SURFACE ANALYSIS        l.READ FLAW TABLE
             g.SAVE        m.WRITE FLAW TABLE           u.LOAD FLAW TABLE
             h.READ                                     v.SAVE FLAW TABLE
                           n.FORMAT
 i.ADD SURF FLAWS          o.VERIFY
 j.SET CRAY SERIAL NUMBER                               w.EXECUTE
 k.CREATE TABLE WITH IDs                                q.STOP EIOP
                                                        x.EXIT
>
------------------------------------------------------------------------------
```

Figure 7-7. Media Maintenance Menu

Parameters

The parameters display the status of the disk function, the channel and EIOP the function is running on, and the cylinder, head, and sector range the function is operating within. Figure 7-8 highlights the parameters on the media maintenance menu and Table 7-1 describes each of the parameters.

```
------------------------------------------------------------------------------
DME1.0       EIOPS:0.0                              DD60      SNAP       QUIT
IOS CLK=U    EIOPS:                                 Fri Jun 14 12:36:35 1991

  EIOP0.0            CHANS  A.30 UA=00  B.32          C.34          D.36
                            1.BC=005060 2.EC=005060 3.BH=000000 4.EH=000001
  STATUS:IDLE               5.BS=000000 6.ES=000026 7.PH=177777 8.NP=000001


       a.FACTORY TABLE   d.ID FIELDS
       b.USER TABLE      e.DATA FIELDS
       c.LOADED TABLE                                  r.DISPLAY FLAW TABLE
                                                       s.SURF RESULTS
                                                       t.STATUS
  f.SURFACE ANALYSIS        l.READ FLAW TABLE
              g.SAVE        m.WRITE FLAW TABLE         u.LOAD FLAW TABLE
              h.READ                                   v.SAVE FLAW TABLE
                            n.FORMAT
  i.ADD SURF FLAWS          o.VERIFY
  j.SET CRAY SERIAL NUMBER                             w.EXECUTE
  k.CREATE TABLE WITH IDs                              q.STOP EIOP
                                                       x.EXIT
>
------------------------------------------------------------------------------
```

Figure 7-8. Parameters of the Media Maintenance Menu

Table 7-1. Parameter Descriptions

Disk Function	Description
EIOP0.0	The EIOP parameter displays the cluster and EIOP currently selected.
Status	The status parameter displays the current status of the selected disk function. The status must be idle before you execute another disk function.
A through D	Use the A through D parameters to select or deselect the channel and DD-60 to test.

Table 7-1. Parameter Descriptions (continued)

Disk Function	Description
BC	Use the beginning cylinder (BC) parameter to enter the beginning cylinder limit for the disk function. The cylinders range from 0 to 5062_8.
EC	Use the ending cylinder (EC) parameter to enter the ending cylinder limit for the disk function. The cylinders range from 0 to 5062_8.
BH	Use the beginning head (BH) parameter to enter the beginning head group for the disk function. The head groups range from 0 to 1.
EH	Use the ending head (EH) parameter to enter the ending head group for the disk function. The head groups range from 0 to 1.
BS	Use the beginning sector (BS) parameter to enter the beginning sector limit for the disk function. The sectors range from 0 to 26_8.
ES	Use the ending sector (ES) parameter to enter the ending sector limit for the disk function. The sectors range from 0 to 26_8.
PM	Use the pattern mask (PM) parameter to enter a data pattern that is written to each head of a head group in the DD-60 during the surface analysis function. Refer to Table 7-2 for the bit descriptions of the pattern mask.
NP	Use the number of passes (NP) parameter to enter the number of times the selected disk function repeats.

Table 7-2. Pattern Mask Bit Descriptions

Bit	Pattern	Description
2^0	000000_8	A parcel of 0's
2^1	177777_8	A parcel of 1's
2^2	125252_8	A parcel of alternating 1's and 0's
2^3	052525_8	A parcel of alternating 0's and 1's
2^4	123456_8	A parcel of incrementing numbers
2^5	165432_8	A parcel of decrementing numbers
2^6	070707_8	A parcel of alternating 000's and 111's
2^7	107070_8	A parcel of alternating 111's and 000's
2^8	133333_8	A parcel of 011's
2^9	055555_8	A parcel of 101's
2^{10}	066666_8	A parcel of 110's
2^{11}	022222_8	A parcel of 010's
2^{12}	044444_8	A parcel of 100's
2^{13}	111111_8	A parcel of 001's
2^{14}	163471_8 147144_8	Two-parcel worst-case pattern
2^{15}	Random	Generated random bits

Disk Functions

Disk functions perform operations that write to or read from the DD-60. Only one disk function may be selected at a time. Deselect the previous disk function before executing another function. Figure 7-9 highlights the disk functions on the media maintenance menu and Table 7-3 describes each disk function.

```
DME1.0      EIOPS:0.0                                  DD60     SNAP      QUIT
IOS CLK=U   EIOPS:                                     Fri Jun 14 12:36:35 1991

 EIOP0.0            CHANS  A.30 UA=00  B.32        C.34        D.36
                           1.BC=005060 2.EC=005060 3.BH=000000 4.EH=000001
 STATUS:IDLE               5.BS=000000 6.ES=000026 7.PM=177777 8.NP=000001



       a.FACTORY TABLE   d.ID FIELDS
       b.USER TABLE      e.DATA FIELDS
       c.LOADED TABLE                                 r.DISPLAY FLAW TABLE
                                                      s.SURF RESULTS
                                                      t.STATUS
 f.SURFACE ANALYSIS          l.READ FLAW TABLE
                g.SAVE       m.WRITE FLAW TABLE       u.LOAD FLAW TABLE
                h.READ                                v.SAVE FLAW TABLE
                             n.FORMAT
 i.ADD SURF FLAWS            o.VERIFY
 j.SET CRAY SERIAL NUMBER                             w.EXECUTE
 k.CREATE TABLE WITH IDs                              q.STOP EIOP
                                                      x.EXIT
>
```

Figure 7-9. Disk Functions of the Media Maintenance Menu

Table 7-3. Disk Function Descriptions

Disk Function	Description
Surface analysis	The surface analysis function writes and reads the pattern mask (PM) to the DD-60 within the range selected by the parameters. If the pattern read from the DD-60 does not match the pattern written, the surface analysis function calculates the location on the platter(s) that may contain a media flaw.

Table 7-3. Disk Function Descriptions (continued)

Disk Function	Description
Add surf flaws	The add surface analysis flaws function adds the locations of flaws found during surface analysis to the user flaw table. Only flaws that were detected more than once are added to the selected flaw table. Before executing this function, you must select the surface analysis results function. After selecting the function, you must display the surface analysis results in the flaw table format. When finished, the add surface analysis flaws function automatically executes the format and verify functions. No command except STOP EIOP may be executed until this function is finished.
Set Cray serial number	The set Cray serial number function writes the value of the CRI DD-60 serial number to the flaw table loaded in the MWS memory. It also writes the flaw table in MWS memory to the DD-60 user flaw table, and stores the CRI DD-60 serial number in a programmable read only memory (PROM) in the DD-60. The CRI serial number is entered and displayed in decimal.
Create table with IDs	Use the create table with ID function only if the flaw tables are destroyed and a backup does not exist. This function creates a factory or user flaw table from the sector ID fields on the DD-60. After executing this function, perform the following steps: 1. Select display flaw table to make the table resident in the MWS. 2. Execute the write flaw table function to make the created flaw table the new user flaw table.
Read flaw table	The read flaw table function transfers the factory or user flaw table from the DD-60 to the MWS. After executing this function, use the display flaw table command to view the flaw table and load the flaw table into the MWS memory.
Write flaw table	The write flaw table function transfers the flaw table stored in the MWS memory to the DD-60 factory or user flaw table. This transfer overwrites the previous DD-60 factory or user flaw table.
Format	The format function rewrites the sector ID fields in the selected range so they match the user, factory, or previously loaded flaw table stored in MWS memory. When finished, the media maintenance utility automatically performs the verify function.
Verify	The verify function reads the sector ID fields on the DD-60 and compares them to the factory, user, or previously loaded flaw table stored in the MWS memory.

Modifiers

Modifiers select which flaw table or which field the selected disk function writes to or reads from. Figure 7-10 highlights the modifiers in the media maintenance menu and Table 7-4 describes each modifier.

```
DME1.0       EIOPS:0.0                               DD60    SNAP      QUIT
IOS CLK-U    EIOPS:                                  Fri Jun 14 12:36:35 1991

 EIOP0.0              CHANS  A.30 UA-00  B.32         C.34         D.36
                             1.BC-005060 2.EC-005060 3.BH-000000 4.EH-000001
 STATUS:IDLE                 5.BS-000000 6.ES-000026 7.PM-177777 8.NP-000001



      a.FACTORY TABLE   d.ID FIELDS
      b.USER TABLE      e.DATA FIELDS
      c.LOADED TABLE                                    r.DISPLAY FLAW TABLE
                                                        s.SURF RESULTS
                                                        t.STATUS
 f.SURFACE ANALYSIS           l.READ FLAW TABLE
        g.SAVE                m.WRITE FLAW TABLE        u.LOAD FLAW TABLE
        h.READ                                          v.SAVE FLAW TABLE
                              n.FORMAT
 i.ADD SURF FLAWS             o.VERIFY
 j.SET CRAY SERIAL NUMBER                               w.EXECUTE
 k.CREATE TABLE WITH IDs                                q.STOP EIOP
                                                        x.EXIT
>
```

Figure 7-10. Modifiers in the Media Maintenance Menu

Table 7-4. Modifier Descriptions

Disk Function	Description
Factory table	When the factory table modifier is highlighted, the selected disk function performs operations on the DD-60 factory flaw table. For example, if the read flaw table disk function and the factory table modifier are selected, the media maintenance utility transfers the DD-60 factory flaw table to the MWS.
User table	When the user table modifier is highlighted, the selected disk function performs operations on the DD-60 user flaw table. For example, if the write flaw table disk function and the user table modifier are selected, the software writes the flaw table stored in the MWS memory to the DD-60 user flaw table.
Loaded table	When the loaded table modifier is highlighted, the verify or format disk function performs operations using the backup flaw table loaded from the MWS hard drive. For example, if the verify disk function, the ID fields modifier, and the loaded table modifier are selected, the software reads the sector ID fields and compares them to the backup flaw table previously loaded from the MWS hard drive.
ID fields	When the ID fields modifier is highlighted, the verify or format function writes to or reads from the sector ID fields on the DD-60. For example, if the verify disk function, the ID fields modifier, and the user table modifier are selected, the software reads the sector ID fields and compares them to the user flaw table.
Data fields	When the data fields modifier is highlighted, the verify or format function writes to or reads from the sector data fields on the DD-60. Data fields that contain a hideable media flaw have a different format than normal sectors. For more information on sector format and media flaws, refer to the "DD-60 Format and Flaw Management" section.
Save	If the surface analysis function and the save modifier are selected, the software writes any flaws found during surface analysis to the CE cylinder (5060_8) in the DD-60. With this function, surface analysis results may still be read if the EIOP was stopped.
Read	If the surface analysis function and read modifier are selected, the software reads the results of a previous surface analysis function from the CE cylinder (5060_8).

Commands

Commands start and terminate operations performed by the MWS. Figure 7-11 highlights the commands in the media maintenance menu and Table 7-5 describes each command. The status, display flaw table, and surface analysis results each have displays which are described in the following subsections.

```
------------------------------------------------------------------------------
DME1.0      EIOPS:0.0                                  DD60    SNAP      QUIT
IOS CLK=U   EIOPS:                                     Fri Jun 14 12:36:35 1991

 EIOP0.0            CHANS  A.30 UA=00  B.32         C.34        D.36
                           1.BC=005060 2.EC=005060 3.BH=000000 4.EH=000001
 STATUS:IDLE               5.BS=000000 6.ES=000026 7.PM=177777 8.NP=000001



       a.FACTORY TABLE   d.ID FIELDS
       b.USER TABLE      e.DATA FIELDS
       c.LOADED TABLE                                r.DISPLAY FLAW TABLE
                                                     s.SURF RESULTS
                                                     t.STATUS
 f.SURFACE ANALYSIS         l.READ FLAW TABLE
             g.SAVE         m.WRITE FLAW TABLE       u.LOAD FLAW TABLE
             h.READ                                  v.SAVE FLAW TABLE
                            n.FORMAT
 i.ADD SURF FLAWS           o.VERIFY
 j.SET CRAY SERIAL NUMBER                            w.EXECUTE
 k.CREATE TABLE WITH IDs                             q.STOP EIOP
                                                     x.EXIT
>
------------------------------------------------------------------------------
```

Figure 7-11. Commands in the Media Maintenance Menu

Table 7-5. Command Descriptions

Disk Function	Description
Display flaw table	The display flaw table command shows the flaw table in MWS memory. Refer to the "Display Flaw Table" subsection in this section for more information on the display flaw table command.
Surf results	The surface analysis results command shows the results of the previous surface analysis function. Execute this command and the FLAW TABLE FORMAT selection (refer to Figure 7-14) before executing the add surface analysis flaws function. Refer to the "Surface Analysis Results" subsection in this section for more information on the surface analysis results command.

Table 7-5. Command Descriptions (continued)

Disk Function	Description
Status	The status command displays the current execute status of the disk function or the ending status of the completed disk function. Refer to the "Status" subsection in this section for more information on status.
Load flaw table	The load flaw table command loads the backup factory or user flaw table from the MWS hard drive.
Save flaw table	The save flaw table command stores the flaw table in the MWS memory to the MWS hard drive.
Execute	The execute disk function starts the selected disk function. Always deselect the previous function (by selecting the function again) before executing a new one.
Stop EIOP	The stop EIOP command stops the executing disk function and master clears the EIOP.
Exit	The exit command exits the media maintenance utility display.

Status

Figure 7-12 shows the status display. Refer to the "DD-60/61 Disk Systems Status" section for more information on status.

```
--------------------------------------------------------------------------------
DME1.0        EIOPS:0.0                                DD60     SNAP      QUIT
IOS CLK-U     EIOPS:                                   Fri Jun 14 12:37:57 1991

                 CHN 30                                     CHN 31
 BZ  DN          ADPT STATUS- 000000    | BZ  DN          ADPT STATUS- 000000
 ATTENTION IN    SYNDROME -   000000    | ATTENTION IN    SYNDROME -   000000
 SLAVE IN        XFER COUNT - 000000    | SLAVE IN        XFER COUNT-  000000
 SYNC IN         END STATUS - 000000    | SYNC IN         END STATUS - 000000
 SELECT OUT      ID PARM 0 -  000000    | SELECT OUT      ID PARM 0 -  000000
 MASTER OUT      ID PARM 1 -  000000    | MASTER OUT      ID PARM 1 -  000000
 SYNC OUT                                 SYNC OUT
                 DRIVE SERIAL NUMBER:
                 CONDITION BITS: (7X) 000   (6X) 000
                 DRIVE STATUS:       000 000 000 000 000 000 000 000
                 EXTENDED STATUS:    000 000 000 000 000 000 000 000


                 PASS -       000000                      FAIL -       000000
                 ERR CODE -   000000                      B REG -      000000
                 CUR SECT -   000000                      ERL -        000000
                 ACTUAL  -    000000                      EXPECTED -   000000

Enter any key to continue
--------------------------------------------------------------------------------
```

Figure 7-12. Status Display

Display Flaw Table

Figure 7-13 shows a sample flaw table display and Table 7-6 describes the display selections on the bottom of the screen.

```
-----------------------------------------------------------------------------
DME1.0      EIOPS:0.0                              DD60     SNAP      QUIT
IOS CLK-U   EIOPS:                                 Thu Feb  7 15:09:27 1991

CRI Serial #:100A
HDA Serial #:000402AF       DOR:00 00     Total #:2     CRI:2      Unhide:1
FLAW#  CYL ADR   HEAD GRP   SECTOR    HEAD MSK   DEF ADR    V   UH   ID   CRI
1      01260     0          01        004        003027     1   0    0    0
2      01406     1          25        020        003035     1   0    0    1
3      01500     0          07        001        002456     0   1    0    1


 1.FRWRD   2.BKWRD   3.DISPLAY   4.DELETE   5.ADD FLAW   6.CRI SERIAL   x.EXIT
>
-----------------------------------------------------------------------------
```

Figure 7-13. Flaw Table Display

Table 7-6. Flaw Table Display Selections

Selection	Description
1.FRWRD	Move the display one page forward through the flaw table.
2.BKWRD	Move the display one page backward through the flaw table.
3.DISPLAY	Start the display at a given flaw number.
4.DELETE	Delete a given flaw.
5.ADD FLAW	Add a flaw to the flaw table.
6.CRI SERIAL	Adds a new CRI serial number to the flaw table.
x.EXIT	Exit the flaw table display.

Surface Analysis Results

Figure 7-14 shows a sample surface analysis results display and Table 7-7 describes the selections on the bottom of the display.

```
---------------------------------------------------------------------------------
DME1.0       EIOPS:0.0                                DD60     SNAP       QUIT
IOS CLK-U    EIOPS:                                   Fri May  3 10:19:36 1991

30/31 Cray Serial Number:
COUNT CYLINDER  HEAD #    HEADGROUP  SECTOR  ID  STARTBIT ENDBIT  PATMSK
3     01260     004       0          01      0   0453     0543    177777











 1.FORWARD   2.BACKWARD    3.FLAW TABLE FORMAT     X.EXIT
>
```

Figure 7-14. Surface Analysis Results Display

Table 7-7. Surface Analysis Results Display Selections

Selection	Description
1.FORWARD	Move the display one page forward through the flaw table.
2.BACKWARD	Move the display one page backward through the flaw table.
3.FLAW TABLE FORMAT	Display flaws that have a count greater than one in flaw table format (refer to Figure 7-13).
X.EXIT	Exits the surface analysis results display.

DME DD-60 Diagnostics

The offline DD-60 diagnostics are part of the DME program, which runs from the Motorola maintenance workstation (MWS) or a Sun maintenance workstation (MWS-E).

Running the DD-60 Diagnostics

Use the following procedure to start the DME program and select the DD-60 diagnostics. This procedure uses the keystroke commands in DME; however, you may also use the mouse to select the appropriate commands.

1. Perform Steps 1 through 7 of the procedure for running the DD-60 utilities in the "DME DD-60 Utilities" subsection in this section.

2. Press **2** to select the `PROGRAM SELECTION` parameter. The MWS displays the DME program selection menu (refer to Figure 7-15).

```
---------------------------------------------------------------------------------
DME1.0       EIOPS:0.0                               DD60    SNAP      QUIT
IOS CLK-U    EIOPS:                                  Fri May  3 10:10:20 1991


 DME PROGRAM SELECTION MENU      DIAGNOSTICS             UTILITIES
 1. EIOP  0.0                    a. Channel Adpt test    n. chn troubleshooting
 2. CHANGE PARMETERS             b. ecc test             o. media maintenance
 3. ALL EIOPS                    c. rndm wrt/read        p. drive troubleshoot
 4. LOAD MICRO SEQUENCER         d. rndm read
 X. EXIT                         e. rndm CE cyl wrt/rd
                                 f. rndm CE cyl read
                                 g. seek sequential
                                 h. seek random
                                 i. seek full stroke
                                 j. seek X to N up
                                 k. seek X to N down
```

Figure 7-15. DME Program Selection Menu

3. Press **a** through **k** to select any or all of the DD-60 diagnostics.

NOTE: The DCA2 diagnostic overwrites the contents of the sequencer random access memories (RAMs); therefore, it may not be run in conjunction with any other diagnostic. Also, the correct microcode must be reloaded when the test completes.

4. Type the following command to exit the DME program selection menu:

   `x` ↵

   The MWS displays the DME selection menu (refer to Figure 7-16).

```
-------------------------------------------------------------------------------
DME1.0       EIOPS:                                  DD60    SNAP     QUIT
IOS CLK-U    EIOPS:                                  Fri May  3 10:06:53 1991


                          DME SELECTION MENU
                         1. EIOP/CHANNEL SELECTION
                         2. PROGRAM SELECTION
                         3. EIOP CONTROL
                         4. DISPLAYS
                         X. EXIT
```

Figure 7-16. DME Selection Menu

5. Press the **4** key to select the `DISPLAYS` parameter. The MWS displays the DME display menu (refer to Figure 7-17).

```
-------------------------------------------------------------------------------
DME1.0       EIOPS:0.0                               DD60    SNAP     QUIT
IOS CLK-U    EIOPS:                                  Fri May  3 10:11:57 1991


                         DME DISPLAY MENU
                         1. RUNNING ALL
                         2. RUNNING EIOP
                         3. LOAD BUFFER
                         4. LOCAL MEMORY
                         X. EXIT
```

Figure 7-17. DME Display Menu

6. Press **2** to select the `RUNNING EIOP` parameter. The MWS displays the running EIOP display.

7. Type the following command to deadstart the diagnostics in the selected EIOPs.

   `ds` ↵

DD-60 Diagnostic Descriptions

Refer to Table 7-8 for a description of each DD-60 diagnostic.

Table 7-8. DD-60 Diagnostic Descriptions

Diagnostic	Description
Channel adpt test	This test verifies the basic operation of the DCA2 channel adapter. Since this test overwrites the contents of the sequencer random access memories (RAMs), it may not be run in conjunction with any other diagnostic. After the test completes, the correct microcode must be reloaded.
rndm wrt/read	This test writes data, then reads and compares the data within the specified beginning and ending cylinder.
rndm read	This test first writes a known pattern to the DD-60 within the specified beginning and ending cylinders. The test then performs random reads to verify the written data.
rndm CE cyl wrt/rd	This test writes data, then reads and compares the data from the diagnostic scratch cylinder (2,608 or 5060_8).
rndm CE cyl read	This test first writes a known pattern to the diagnostic scratch cylinder (2,608 or 5060_8) in the DD-60. The test then performs random reads to verify the written data.
seek sequential	This test performs sequential seeks from the specified beginning cylinder to the ending cylinder.
seek random	This test performs random seeks within the specified beginning and ending cylinders.
seek full stroke	This test performs a seek from the specified beginning cylinder to the ending cylinder.
seek X to N up	This test checks the seek and seek timing step up from the specified beginning to ending cylinder.
seek X to N down	This test checks the seek and seek timing step down from the specified beginning to ending cylinder.
ecc test	This test checks the error correction code (ECC) circuitry.

CONTENTS

8 DD-61 HARDWARE DESCRIPTION

9 DD-61 FORMAT AND FLAW MANAGEMENT

10 DD-61 DIAGNOSTICS AND UTILITIES

FIGURES

SECTION 8
DD-61 HARDWARE DESCRIPTION

8 DD-61 HARDWARE DESCRIPTION

The DD-61 contains hardware that displays status, defines the disk drive format, and tests the internal circuitry. The hardware includes the rear panel, top panel, maintenance panel, and internal components.

Rear Panel

The rear of the DD-61 contains two sets of dual-in-line package (DIP) switches. The vertical rear panel DIP switches set the format of the disk drive. The horizontal set of DIP switches are not used and should be set to the off position. Figure 8-1 shows the locations of the DIP switches.

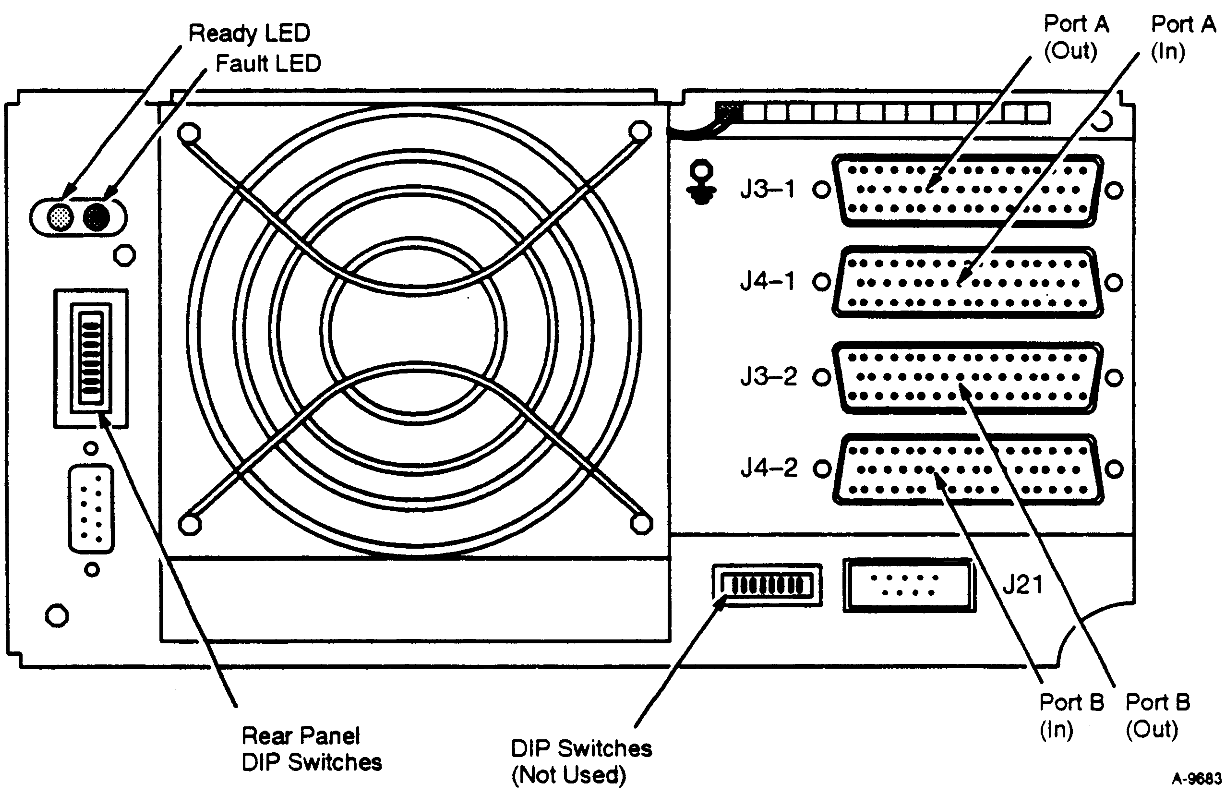

Figure 8-1. Rear Panel of a DD-61 Disk Drive

DIP Switches

The rear panel DIP switches, which are connected to the I/O board in the DD-61, change the modes of input and output operation. The switches are shown in Figure 8-2 below.

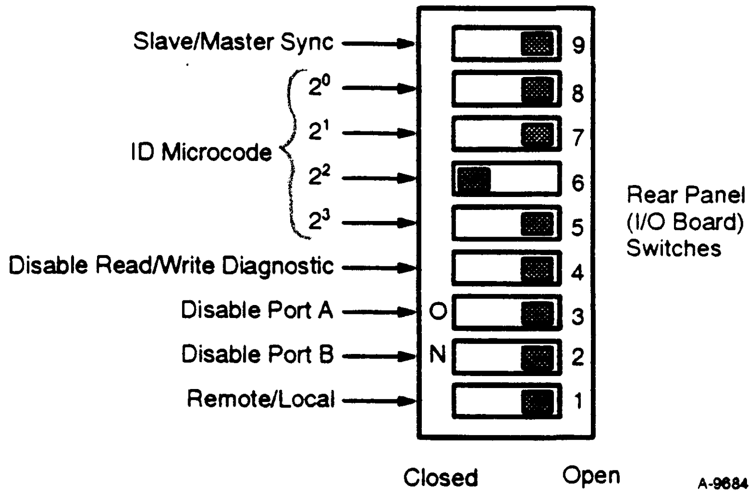

Figure 8-2. Rear Panel (I/O Board) DIP Switches on the DD-61

Slave/Master Sync

Set this switch to the open (off) position to make the disk drive a slave for synchronization. A slave synchronizes its rotation to the signal from a master.

If this switch is in the closed (on) position, the disk drive is the master for synchronization. This option is currently not used by Cray Research, Inc., so the switch should be set to the off position.

ID Microcode

Make sure the ID microcode switches are set as shown in Table 8-1 before powering on the disk drive. Do not reset these switches. If these switches change position, the DD-61 may be reformatted and the stored data overwritten.

Table 8-1. Lower DIP Switch Settings for ID Microcode

Switch 5	Switch 6	Switch 7	Switch 8
Closed	Open	Closed	Closed

The ID microcode switches enable or disable internal disk drive circuitry. This circuitry enables or disables the disk drive internal parity checking.

Disable Read/Write Diagnostic

Set this switch to the open (off) position to enable the internal diagnostic read/write operation to the IPI diagnostic cylinder (5061_8).

Disable Port A

Set this switch to the open (off) position to enable port A. Set this switch to the closed (on) position to disable port A.

Disable Port B

Set this switch to the open (off) position to enable port B. Set this switch to the closed (on) position to disable port B.

Remote/Local

Set this switch to the open (off) position to enable local mode. In local mode, the disk drive spins up when the START/STOP switch is pressed on the maintenance panel. If the disk drive does not have a maintenance panel and it is in local mode, it spins up when DC power is applied.

If this switch is set to the closed (on) position, the remote mode is enabled. In remote mode, the disk drive spins up only after it receives a spin-up command from a host controller.

Top Panel

The top panel of the DD-61 contains two sets of DIP switches, 4 jumpers, and 4 LEDs. They are mounted on the control circuit board in the DD-61. To access the switches, jumpers, and LEDs, remove the plastic protective cover from the hole in the top panel of the DD-61.

Jumpers

The top panel jumpers, which are connected to the control board in the DD-61, change the modes of the sweep cycle and the runt sector pulse (refer to Figure 8-3).

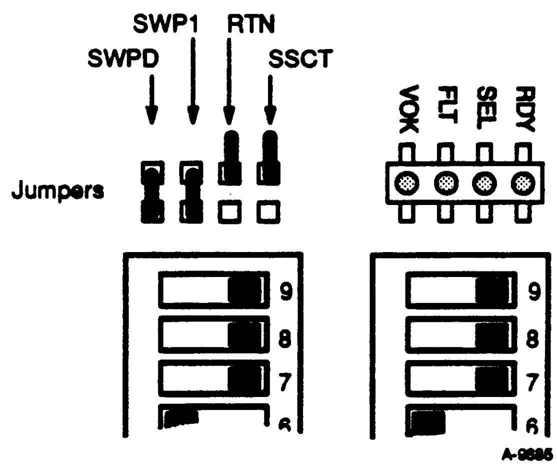

Figure 8-3. Top Panel Jumpers on the DD-61

Table 8-2 describes each of the top panel jumpers.

Table 8-2. Top Panel Jumper Descriptions

Name	Description
SWPD	Connect this jumper to disable the sweep cycle. A sweep cycle moves the heads across the surface of the platter at least once every 12 minutes.
SWP1	Connect this jumper to disable the option for sweep cycle on seeks only.
RTN	Disconnect this jumper to disable the option to return the heads to their original position after a sweep cycle. This is a factory set position. Do not connect this jumper.
SSCT	Disconnect this jumper to enable the detection of runt sector pulses. This jumper is set by the vendor before shipping.

LEDs

The top panel LEDs, which are connected to the control board in the DD-61, display the current condition of the power supply and DD-61 (refer to Figure 8-4).

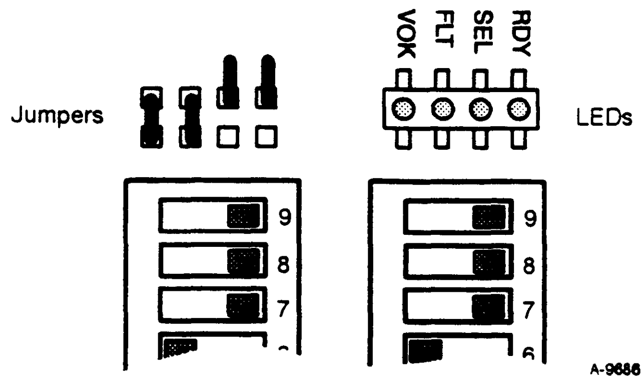

Figure 8-4. Top Panel LEDs on the DD-61

Table 8-3 describes each of the four top panel LEDs.

Table 8-3. Top Panel LED Descriptions

Name	Description
VOK	The voltage (VOK) LED illuminates if the +5 V power supply is working correctly.
FLT	The drive fault (FLT) LED illuminates if a fault condition is detected by the disk drive.
SEL	The drive selected (SEL) LED illuminates when the DD-61 acknowledges a select command.
RDY	The drive ready (RDY) LED illuminates when the platters are up to speed, the heads are positioned over the first cylinder, and the disk drive is ready for use. The RDY LED also flashes during spin-up and spin-down sequences.

DIP Switches

The top panel DIP switches, which are connected to the control board, change the modes of disk drive operation. The switches are shown below in Figure 8-5.

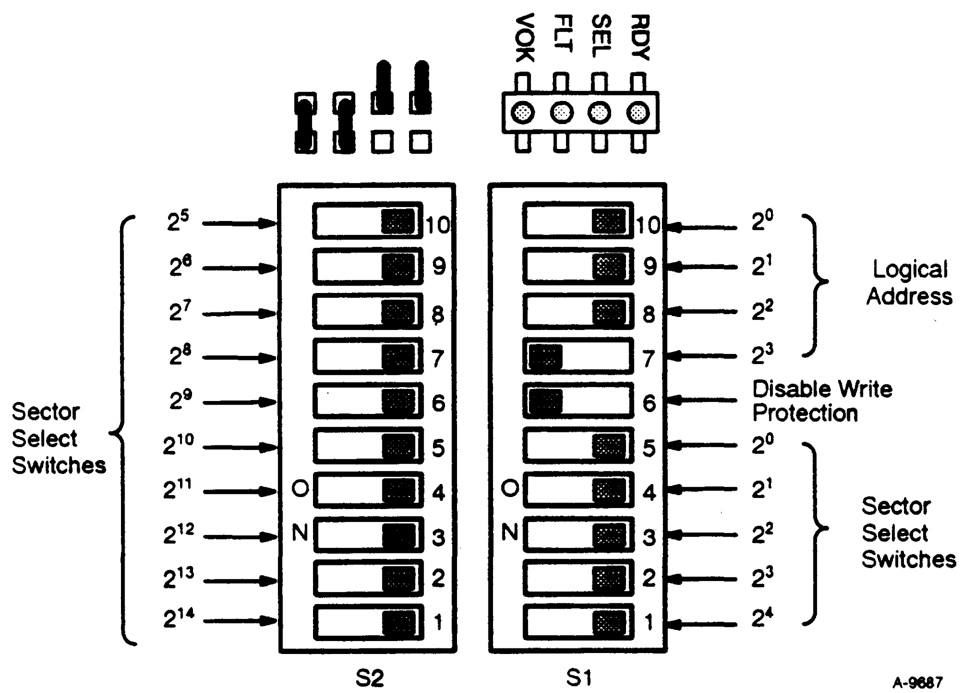

Figure 8-5. Top Panel (Control Board) DIP Switches on the DD-61

Sector Switches

These switches are not used. The settings of these switches have no effect on the DD-61 operation.

Disable Write Protection

Set this switch to the closed (on) position to disable write protection mode. Set this switch to the open (off) position to enable write protection. If the write protection mode is enabled, data can not be written to the disk drive.

Logical Address

Set these switches to the appropriate logical address of the disk drive (refer to Table 8-4). Each disk drive in a daisy chain or alternate-path configuration must have a unique logical address (refer to Figure 8-6).

Table 8-4. Upper DIP Switch Settings for Logical Address

Logical Address	Switch 7	Switch 8	Switch 9	Switch 10
0	Closed (On)	Closed (On)	Closed (On)	Closed (On)
1	Closed (On)	Closed (On)	Closed (On)	Open (Off)
2	Closed (On)	Closed (On)	Open (Off)	Closed (On)
3	Closed (On)	Closed (On)	Open (Off)	Open (Off)
4	Closed (On)	Open (Off)	Closed (On)	Closed (On)
5	Closed (On)	Open (Off)	Closed (On)	Open (Off)
6	Closed (On)	Open (Off)	Open (Off)	Closed (On)
7	Closed (On)	Open (Off)	Open (Off)	Open (Off)

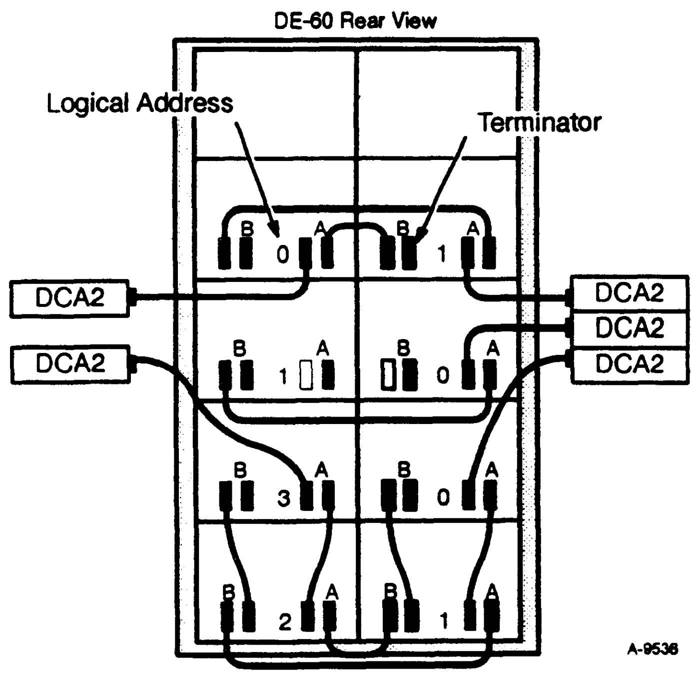

Figure 8-6. Logical Addresses of Disk Drives in a DE-60

If a maintenance panel is connected to the disk drive, the DIP switches do not set the logical address. Refer to the "Maintenance Panel" subsection in this section for information on setting the logical address using the maintenance panel.

Maintenance Panel

Each DE-60 disk enclosure cabinet contains one maintenance panel. When connected to an individual disk drive, the maintenance panel is used to run diagnostic tests or request status.

Switches and Displays

The maintenance panel contains several switches and displays which enable you to power-up or power-down the disk drive, change the logical address, clear fault latches, enable or disable write protection, and run diagnostic tests. Figure 8-7 shows the switches and displays on the maintenance panel.

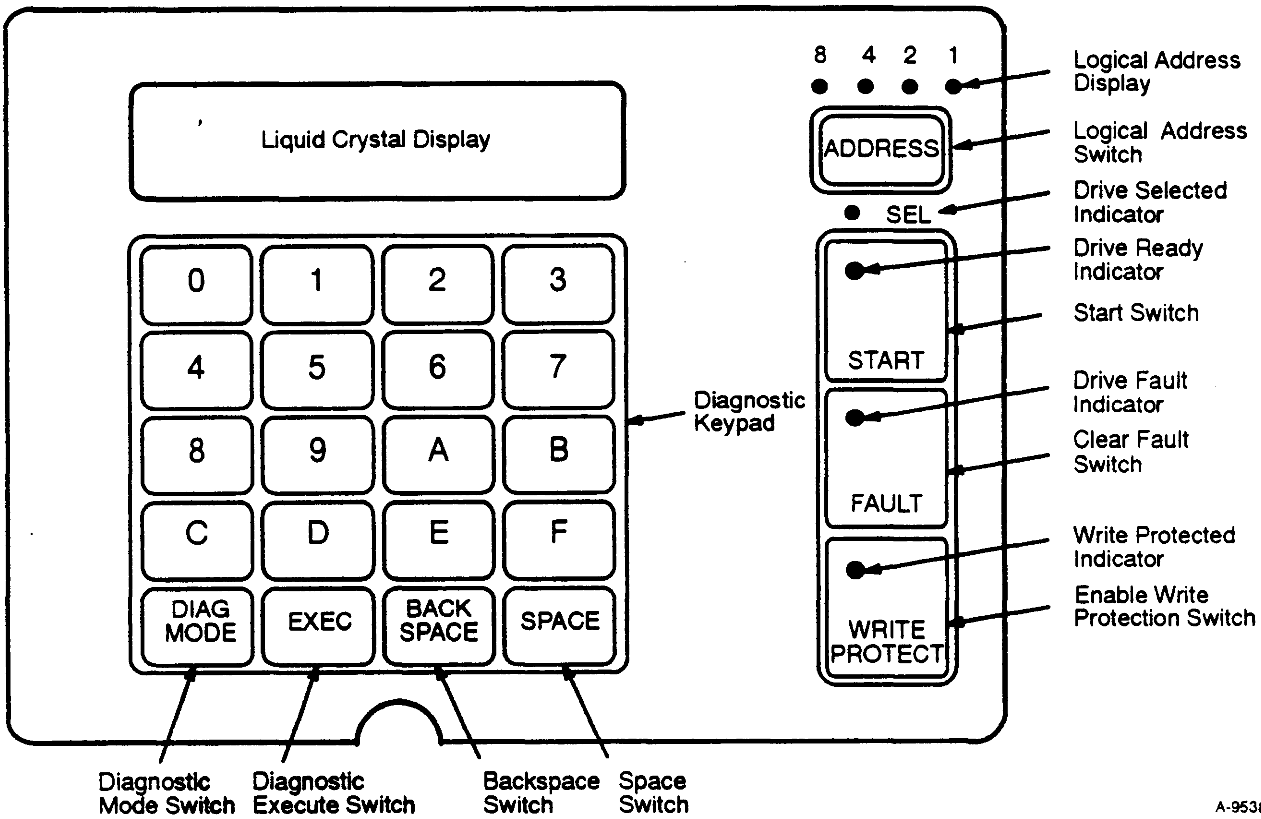

Figure 8-7. Maintenance Panel

Table 8-5 describes each of the switches and displays on the maintenance panel.

Table 8-5. Maintenance Panel Switches and Displays

Switch or Display	Description
Logical Address Display	These LEDs display the logical address of the disk drive. LED number 1 is the least significant bit. LED number 8 is the most significant bit.
Logical Address Switch	Use the ADDRESS switch to enter the logical address. First, press and hold the logical address switch. The display increments through the addresses. When the display shows the correct address, release the logical address switch. When a maintenance panel is installed on a disk drive, the logical address switch overrides the top panel DIP switches.
Drive Selected Indicator	The drive selected indicator (SEL) lights when the DCA2 selects the DD-61 for use by the channel.
Start Switch	Use the START switch to start the power-up sequence or power-down sequence for the disk drive.
Drive Ready Indicator	This drive ready indicator illuminates when the platters are up to speed, the heads are positioned over the first cylinder, and the disk drive is ready for use.
Clear Fault Switch	The FAULT switch clears all fault latches in the disk drive. Seek errors must be cleared with a return-to-zero command.
Drive Fault Indicator	The drive fault indicator illuminates if a fault condition exists on the disk drive.
Enable Write Protection Switch	Use the WRITE PROTECT switch to prevent data from being written to the disk drive.
Write Protected Indicator	The write protected indicator illuminates if the disk drive is in write protected mode.
Space Switch	Use the SPACE switch to add a space in diagnostic mode.
Backspace Switch	Use the BACKSPACE switch to remove the last character entered in diagnostic mode.
Diagnostic Mode Switch	Use the DIAG MODE switch to enter and exit diagnostic mode.
Diagnostic Execute Switch	Use the EXEC switch to start a selected test.
Diagnostic Keypad	Use the diagnostic keypad to enter the hexadecimal codes for diagnostic tests.
Liquid Crystal Display	The liquid crystal display displays the diagnostic tests and results.

Installation and Removal

One maintenance panel display is provided per DE-60. The following procedures describe how to connect the maintenance panel to the disk drives.

CAUTION
Do not remove or install the maintenance panel while the disk drive power supply is on. Severe damage to the maintenance panel may result.

Installation

Use this procedure to connect the maintenance panel to a disk drive:

1. Make sure the disk drive is powered down and the on/standby switch on the front panel of the DD-61 is in the standby position.
2. Connect the maintenance panel cable to the disk drive.
3. Set the on/standby switch on the DD-61 power supply to the on position.
4. Press the START switch on the maintenance panel. The disk drive spins up and the ready indicator temporarily flashes.
5. After the disk drive is ready, enter the correct logical address and power cycle the disk drive. The on/standby switch is located on the front panel of the DD-61.
6. After the disk drive is ready, enter the diagnostic mode, and execute tests 06 and 07 to clear the fault and status registers.

Removal

Use this procedure to disconnect the maintenance panel from a disk drive:

1. Press the START switch on the maintenance panel. The disk drive starts to spin down and the ready indicator on the START switch flashes.
2. After the ready indicator stops flashing, set the on/standby switch on the disk drive power supply to the standby position.

3. Disconnect the maintenance panel cable from the disk drive.

Diagnostic Test Execution

The DD-61 has internal diagnostic tests stored in memory. Perform the following steps on the maintenance panel keypad to select and begin a test:

1. Enter the diagnostic mode by pressing the DIAG MODE switch. The LCD display shows the following message:

   ```
   DIAG TEST XX
   ```

2. Enter the desired two-digit test number on the keypad. (Table 8-6 contains a list of DD-61 Sabre VI tests and their descriptions.)

3. Press the EXEC switch to start the test.

4. To end the test, press the EXEC switch again.

5. To run another test, repeat Steps 2 through 4. When finished, press the DIAG MODE switch to exit the diagnostic mode.

Table 8-6. DD-61 Sabre VI Maintenance Panel Tests

Test	Name
00	Displays the contents of the status/error log.
01	Displays the contents of the fault log or cylinder log.
04	Displays the three internal components most likely to have failed.
05	Performs a servo test.
06	Clears the status/error log.
07	Clears the fault log.
08	Performs a seek to a specific cylinder from cylinder 0.
09	Performs seeks to random cylinders.
0C	Displays the erasable programmable read only memory (EPROM) part number.
0E	Performs a return-to-zero seek.
12	Performs seeks to sequential cylinders.

Internal Components

DD-61 disk drives are Sabre VI 19-head serial disk drives. The Sabre VI 19-head serial disk drive contains three groups of internal components: the circuit boards, head disk assembly (HDA) module, and power supply.

Circuit Boards

The DD-61 contains two circuit boards: a control board and an I/O board.

The control board directly controls most disk drive functions, which include read, write, seek, and spindle synchronization. It mounts to the top of the HDA module and connects to the HDA module through pin connectors under the control board. Figure 8-8 shows the location of the control board relative to the HDA module.

The I/O board controls the disk drive input/output operations, which include selection of the DD-61 and data formatting. Figure 8-8 shows the location of the I/O board relative to the HDA module.

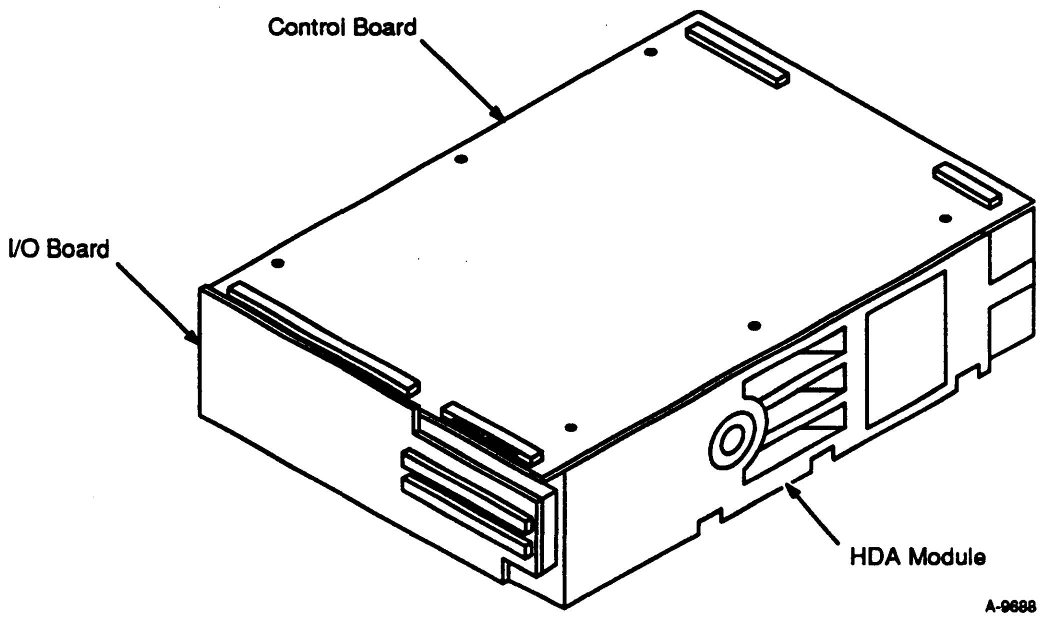

Figure 8-8. DD-61 Circuit Board Locations

HDA Module

The HDA is a sealed module that contains the circuitry and hardware used to store information, including platters, heads, an actuator, a spindle, and a spindle motor.

Platters

The HDA module contains 11 platters that rotate at 3,600 revolutions per minute. Nine of the platters contain two thin film media surfaces for reading or writing data. The top and bottom platter contain only one thin film media surface (refer to Figure 8-9).

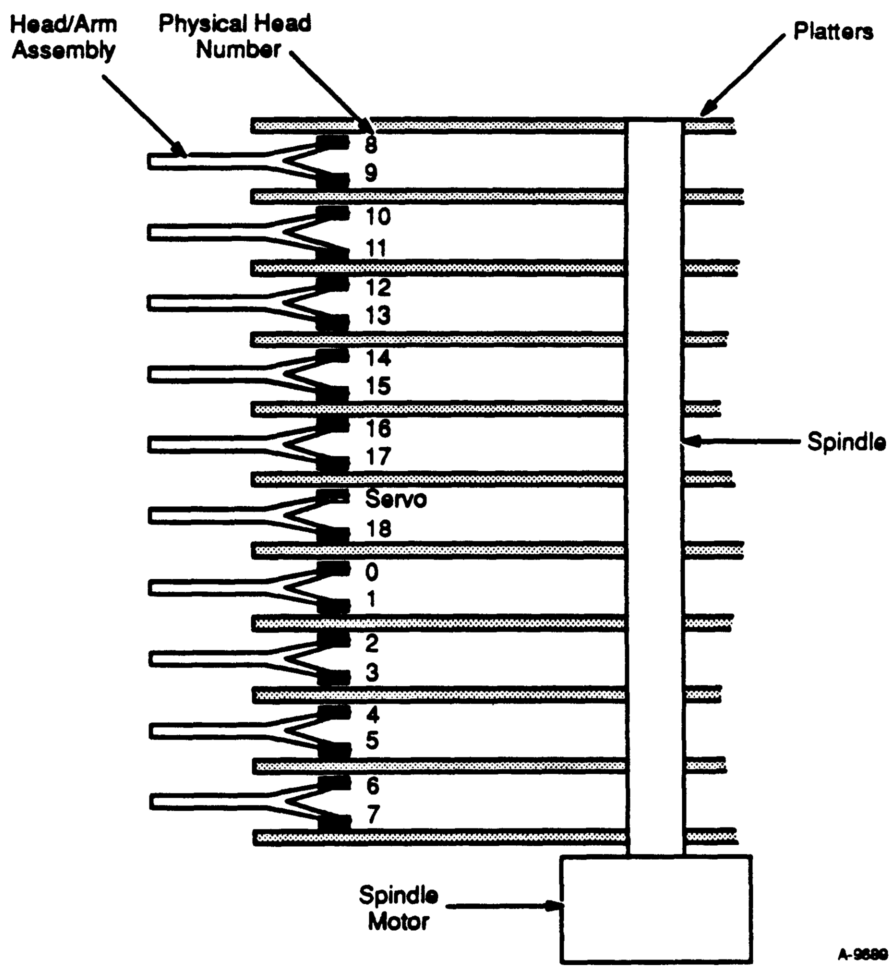

Figure 8-9. DD-61 Physical Head Locations in the HDA

Heads

The heads transfer information to or from the platter media surface. One head transfers servo information, and 19 heads transfer data (refer to Figure 8-9).

Actuator

The actuator positions the heads over any of the 2,611 tracks on the platter surface. The DD-61 has a balanced rotary actuator so the heads move in an arc over the platters.

Spindle

The spindle attaches to the center of all the platters and holds them in place. It is directly connected to the spindle motor (refer to Figure 8-9).

Spindle Motor

The spindle motor is a 3-phase motor that rotates at 3,600 revolutions per minute. It is directly connected to the spindle and platter assembly (refer to Figure 8-9). The spindle motor is controlled by a dedicated motor microprocessor unit on the control board.

Power Supply

The external power supply converts 115 Vac or 230 Vac into DC voltages. All components of the disk drive operate on DC voltage. These voltages are +5 Vdc, –5V dc, +12 Vdc, –12 Vdc, and +24 Vdc.

SECTION 9
DD-61 FORMAT AND FLAW MANAGEMANT

[redacted] [redacted] [redacted]

9 DD-61 FORMAT AND FLAW MANAGEMENT

This section covers format specifications and flaw management properties of the DD-61. This includes cylinder format, sector format, media flaws, and flaw maps and tables.

Cylinder Format

The DD-61 has 2,611 cylinders, including data cylinders, diagnostic cylinders, and a flaw table cylinder. Table 9-1 shows the addresses of these cylinders in decimal and octal.

Table 9-1. DD-61 Cylinder Map

Cylinder Type	Addresses
Data cylinders	0 - 2,607 0 - 5057_8
Diagnostic scratch cylinder	2,608 5060_8
IPI diagnostic cylinder	2,609 5061_8
User flaw table cylinder	2,610 (odd sectors) 5062_8 (odd sectors)
Factory flaw table cylinder	2,610 (even sectors) 5062_8 (even sectors)

Data cylinders store system data. Do not write data patterns to these cylinders unless a problem is narrowed down to a specific data cylinder.

The diagnostic scratch cylinder is reserved for DD-61 diagnostics. Use this cylinder to read and write data patterns without destroying system data.

The IPI diagnostic cylinder is reserved for the disk drive. The internal read/write diagnostics use this cylinder during spin-up of the DD-61.

The flaw table cylinder contains both the factory flaw table and the user flaw table. For more information on flaw tables, refer to the "Flaw Maps and Tables" subsection later in this section.

Sector Format

Figure 9-1 shows the format of a DD-61 sector. Each sector contains five field types. These are timing, ID, data, error correction code (ECC), and defect swallow fields.

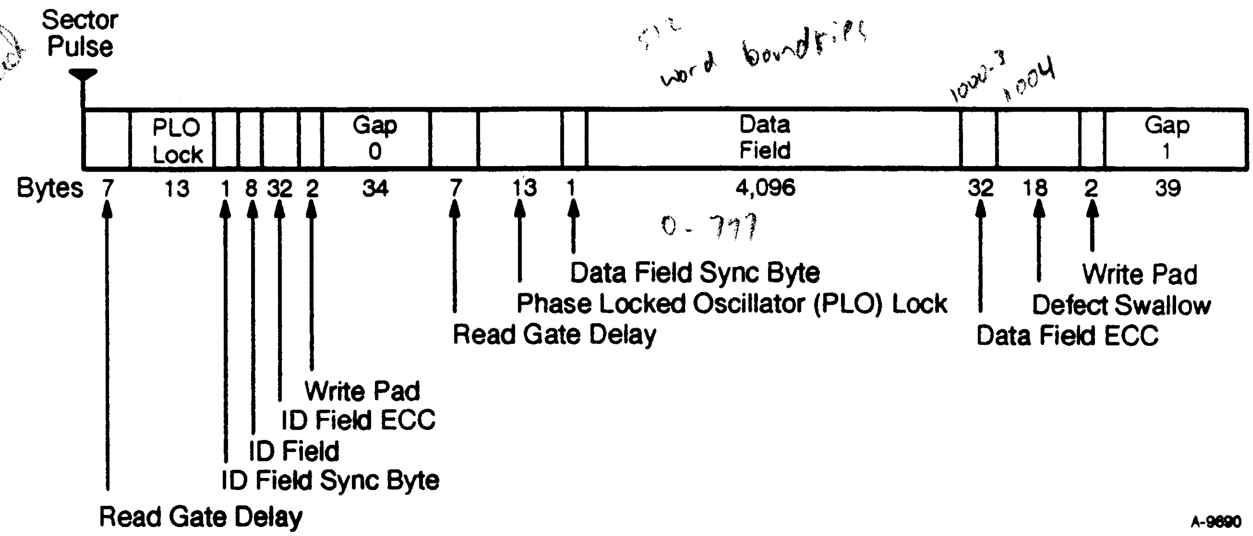

Figure 9-1. DD-61 Sector Format

Timing Fields

Timing fields create time delays for synchronization of the timing circuits during read or write operations. These fields are read gate delay, PLO lock, sync bytes, write pad, gap 0, and gap 1.

For an example of how a timing field is used, gap 0 provides a time delay for the DD-61 to interpret the next command (a read or write data field). Without this delay, the information stored in the data field would be sent to the DCA2 immediately after the ID information.

Data Field

The data field contains 4,096 bytes of system data.

ID Field

The ID field contains 8 bytes of information that identify the sector address and whether the sector contains a flaw. Figure 9-2 shows the format of the ID field and Table 9-2 describes each bit in the ID field.

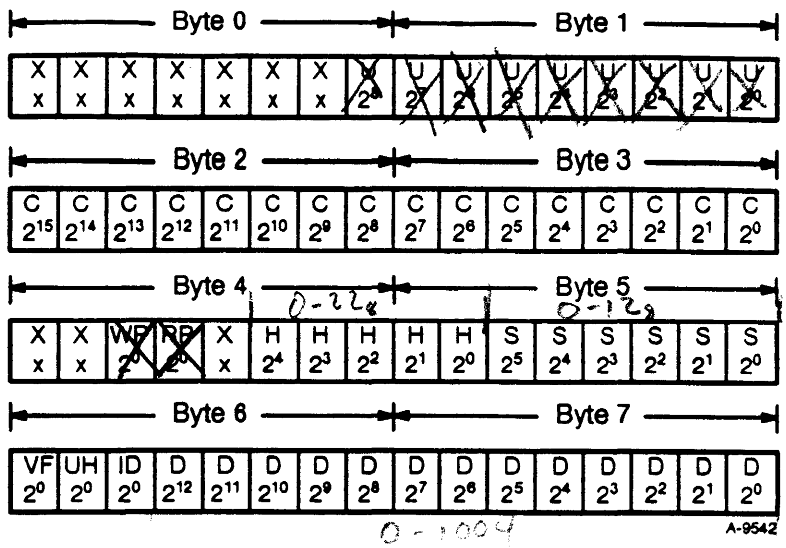

Figure 9-2. DD-61 ID Field Format

Table 9-2. DD-61 Logical ID Information Description

Bit Symbol	Name	Description
X	Not used	This bit is not used.
U	Defective head	When set to 1, this bit indicates that the physical sector corresponding to this head contains a media flaw.
C	Cylinder address	These bits contain the cylinder address of the data (0 - 5062_8).
WP	Write protect	When set to 1, this bit indicates that data cannot be written to the sector unless this bit is also set in the parameter register of the DCA2.
RP	Read protect	When set to 1, this bit indicates that data cannot be read from the sector unless this bit is also set in the parameter register of the DCA2.
H	Head address	These bits contain the logical head address of the data (0 - 22_8).
S	Sector address	These bits contain the sector address of the data (0 - 12_8).
VF	Valid flaw	When set to 1, this bit indicates that the flaw in the sector is a known hideable or unhideable flaw.
UH	Unhideable flaw	When set to 1, this bit indicates that the flaw in the sector is unhideable.
ID	ID field flaw	When set to 1, this bit indicates that the ID field contains a flaw (unhideable).
D	Defect parameter	These bits contain the defect parameter. If the sector does not have a media flaw in the data field, the defect parameter is 1004_8.

Error Correction Code Fields

The ECC field contains ECC generated by the DCA2 during a write data operation. The DCA2 uses this information to correct data errors during a read operation.

During a read data operation, the DCA2 reads the data or ID field and generates new ECCs. The DCA2 then compares the new ECCs to the information read from the sector ECC fields.

If the ID or data field ECCs do not match the generated ECCs, the DCA2 signals the input/output cluster that an error has occurred. If the error occurs in the data field, the DCA2 can determine which bits are incorrect and correct them.

Defect Swallow

The defect swallow allows the data field to expand if a hideable flaw is placed in the sector. For more information on defect swallow and hideable flaws, refer to the "Media Flaws" subsection below.

Media Flaws

A media flaw is a defect on the surface of a platter that does not allow the disk drive to read or write information correctly. Flaws are grouped into two categories: hideable flaws and unhideable flaws.

Hideable Flaws

A hideable flaw is a media defect that can be effectively covered by a physical 18-byte defect pad. The DCA2 creates a defect pad when it writes data to the logical data field.

Hiding a Media Flaw

When a media defect is found during surface analysis or from an error report, the cylinder, head, and sector address of the flaw is identified along with a defect parameter. The defect parameter is the ~~byte~~ word number in the data field where the DCA2 starts to create an 18-byte defect pad.

Values for the defect parameter range from 0 to 1004_8 (0 to 4,100). The defect parameter is calculated so that the 18-byte defect pad starts at the defect parameter value and covers the media flaw. For example, if a media flaw is located at byte 20_8, the defect parameter for this flaw would be 10_8 (refer to Figure 9-3). Although the defect pads that start at byte 0 and byte 20_8 would cover the media flaw, the defect pad that starts at byte 10_8 more effectively covers the media flaw.

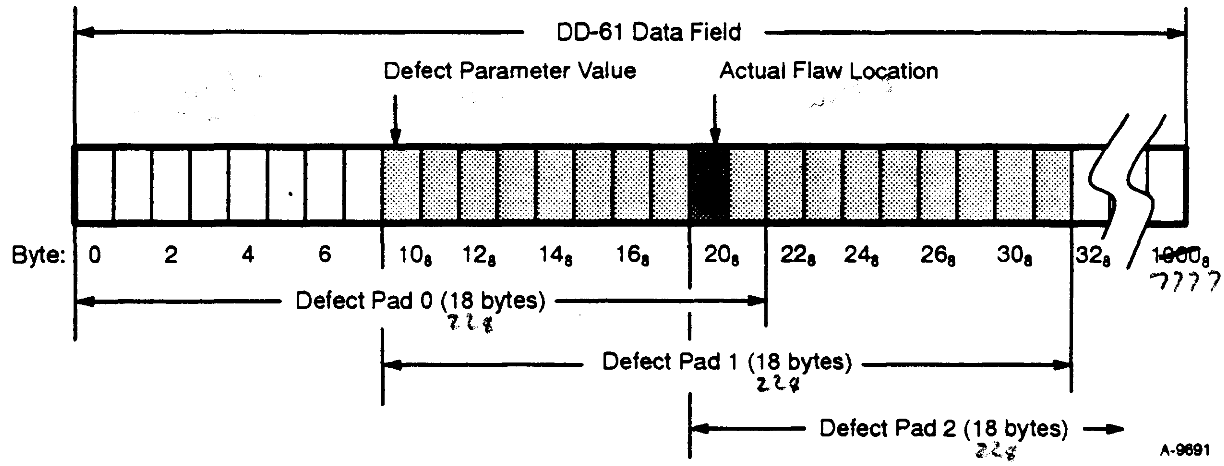

Figure 9-3. Defect Parameter and Actual Flaw Locations in a DD-61 Data Field

Before a write data field operation begins, the defect parameter is read from the sector ID field and transferred to a register in the 3DG option (refer to Figure 3-1). The data parcel counter in the 3DG is reset to 0. The DCA2 uses the parcel counter in the 3DG to count each parcel of data as it is transferred to the disk drive.

When the value of the parcel counter is equivalent to the defect parameter, the DCA2 halts the parcel counter and starts the defect counter. While the defect counter is counting, the sequencer sends a signal to the 3YC and 3DH options which halts the transfer of data to the 3DF option.

Since the 3DF option does not receive new data, it sends the previous logical parcel of data to the disk drive until 9 repeated parcels of data are sent to the disk drive.

After creating the defect pad, the sequencer restarts the parcel counter and signals the 3YC and 3DH options to resume the transfer of data to the 3DF option. This transfer continues until all of the data for the data field has been sent to the disk drive.

Sector Format with a Hideable Flaw

When a defect pad is inserted into a sector, the physical length from the start of the data field to the end of the data field increases from 4,096 bytes to 4,114 bytes. To compensate for the increase in size, the DCA2 overwrites the defect swallow with data. Figure 9-4 shows the format of a sector that contains a hideable flaw.

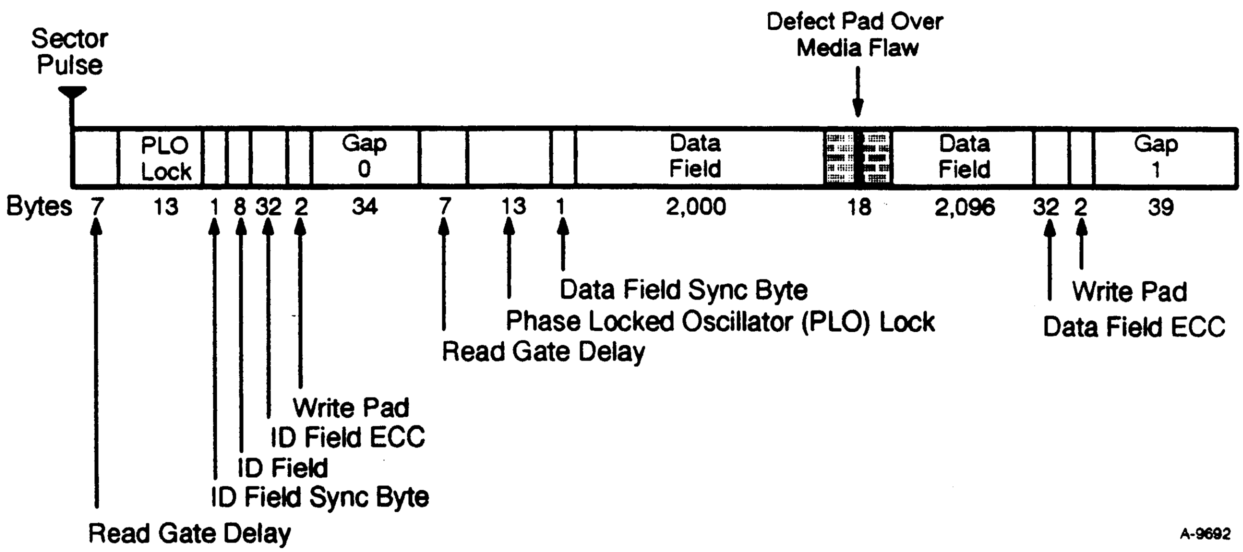

Figure 9-4. DD-61 Sector with a Hideable Flaw

Reading a Sector with a Hideable Flaw

Before performing a read data field operation, the DCA2 reads the sector ID field and stores the defect parameter in a register of the 3DG option. The DCA2 then resets the parcel counter in the 3DG option to 0 (refer to Figure 3-1).

During the read data field operation, the parcel counter counts each parcel of data as it is transferred from the disk drive to the DCA2. When the value of the parcel counter matches the value of the defect parameter, the sequencer stops the parcel counter and starts the defect counter.

While the defect counter is counting, the sequencer signals the 3YB option to not accept the data parcels coming from 3DE until the 9 repeated parcels are transferred from the disk drive to the DCA2.

After all of the repeated data is transferred, the sequencer restarts the parcel counter and signals the 3YB option to resume accepting data parcels from the disk drive until the rest of the data field is transferred to the DCA2.

Unhideable Flaws

An unhideable flaw is a media flaw that cannot be hidden by a defect pad. If an unhideable flaw occurs, the entire sector cannot be used to store data. Any sectors that contain an unhideable flaw are marked by the operating system as unusable sectors. The following list describes some of the conditions that create an unhideable flaw.

- A flaw exists in the first 8 bytes of the data field.
- A flaw exists outside of the data field of a sector (for example, ID or sync byte fields).
- A flaw is longer that 32 bits.

Flaw Maps and Tables

Flaw maps and tables store the locations of media flaws in the DD-61. The maps and tables include a factory flaw map, a user flaw table, and a UNIX Cray operating system (UNICOS) flaw map.

Factory Flaw Map

When Cray Research, Inc. (CRI) purchases a Sabre VI 9HP disk drive, it contains a factory flaw map on the even numbered sectors of cylinder 2,610 (5062_8). The factory flaw map lists the physical locations of all the flaws found during manufacturing checkout. This information is used when the DD-61 is initially formatted.

User Flaw Table

The user flaw table contains a list of all the flaws, hideable and unhideable, including those added since the disk drive was initially formatted. It is located on the odd numbered sectors of cylinder 2,610 (5062_8). Update the user flaw table each time you add a flaw to a sector in the DD-61. Table 9-3 shows the format of the user flaw table.

Table 9-3. User Flaw Table Format

Word	Parcel	Description
0	0	Cray Research, Inc. serial number in ASCII (bits 2^{63} through 2^{48})
	1	Cray Research, Inc. serial number in ASCII (bits 2^{47} through 2^{32})
	2	Cray Research, Inc. serial number in ASCII (bits 2^{31} through 2^{16})
	3	Cray Research, Inc. serial number in ASCII (bits 2^{15} through 2^{0})
1	0	HDA serial number in hexadecimal (bits 2^{31} through 2^{16})
	1	HDA serial number in hexadecimal (bits 2^{15} through 2^{0})
	2	Not used
	3	Date of recording in hexadecimal (bits 2^{15} through 2^{0})
2 through last entry	0	Flaw ID field parcel 0 (refer to Figure 9-2)
	1	Flaw ID field parcel 1 (refer to Figure 9-2)
	2	Flaw ID field parcel 2 (refer to Figure 9-2)
	3	Flaw ID field parcel 3 (refer to Figure 9-2)
Terminator	0	All 1's
	1	All 1's
	2	All 1's
	3	All 1's

UNICOS Flaw Map

The UNICOS flaw map is used by the operating system to locate sectors that contain unhideable flaws. If a sector is unusable, the operating system can remap the logical sector to another location in the DD-61.

SECTION 10
DD-61 DIAGNOSTICS AND UTILITIES

10 DD-61 DIAGNOSTICS AND UTILITIES

The diagnostics and utilities used to test and perform media maintenance on the DD-61 include the online disk diagnostic and maintenance system (DDMS), offline device maintenance environment (DME) utilities, and offline DME diagnostics.

DDMS

The DDMS program runs on Cray Research, Inc. (CRI) computer systems that have an I/O subsystem model E (IOS-E). The DDMS program can be used for the following functions:

- Surface reading, writing, and analysis within a selected range of cylinders, heads, and sectors.
- Verifying the sector ID fields according to the contents of the user flaw table stored in the DD-61.
- Transferring data between a sector and the UNICOS spare map cylinder.
- Reformatting and rewriting sectors that contain a flaw.
- Reading the user flaw table in the DD-61.

For more information on DDMS, refer to the *CRAY Y-MP, CRAY X-MP EA, and CRAY 1 Computer Systems UNICOS On-line Diagnostic Maintenance Manual*, CRI part number SMM-1012.

DME DD-61 Utilities

The offline DD-61 utilities are part of the DME program. They run from the Motorola maintenance workstation (MWS) or a Sun maintenance workstation (MWS-E).

Running the DD-61 Utilities

Use the following procedure to start the DME program and to select the DD-61 utilities. This procedure uses the keystroke commands in DME; you may also use the mouse to select the appropriate commands.

1. Log on to the MWS using the mws login.
2. Type the following command to change to the home directory:

   `cd /u/mws` ↵ (or `/cri/mws` on the MWS-E)

3. Type the following command to initiate DME:

   dme [*channel*] ↵

   The MWS displays the Initial DME menu (refer to Figure 10-1).

```
DME1.0      EIOPS:                                         SNAP        QUIT
IOS CLK=U   EIOPS:                                   Fri Jun 14 12:33:10 1991



  1. Channel Adapter (DCA-2)                  a. Channel Adapter (TCA-1)
  2. DD60 Disk Drive                          b. Round Tape (IBM3420 compatible)
  3. DD61 Disk Drive                          c. Cartridge Tape (IBM3480 compatible)
```

Figure 10-1. Initial DME Menu

4. Press **3** to select `DD61 Disk Drive`. The MWS displays the DME selection menu (refer to Figure 10-2).

```
-------------------------------------------------------------------------------
DME1.0      EIOPS:                                    DD61     SNAP      QUIT
IOS CLK=U   EIOPS:                                    Fri May  3 10:06:53 1991


                          DME SELECTION MENU
                         1. EIOP/CHANNEL SELECTION
                         2. PROGRAM SELECTION
                         3. EIOP CONTROL
                         4. DISPLAYS
                         X. EXIT
```

Figure 10-2. DME Selection Menu

5. Press **1** to select `EIOP/CHANNEL SELECTION`. The MWS displays the DME EIOP selection menu (refer to Figure 10-3).

```
-------------------------------------------------------------------------------
DME1.0      EIOPS:                                             SNAP      QUIT
IOS CLK=U   EIOPS:                                    Thu Feb  7 15:05:41 1991


                          DME EIOP SELECTION MENU
   Enter the EIOPs, channels, and unit addresses(device number) of the devices
   to select or deselect.

   Selection syntax:  sel 'cluster.eiop' 'channels' 'unit addresses'<cr>
   Allowable ranges:  cluster: 0-7  eiop 0-3(* = all 4 eiops)
                      channels: 30, 32, 34, 36 (* = all 4 channel pairs)
                      unit adrs: DD60/61    00-07
                                 tapes      00-FF hexidecimal
   Maximum selection: 8 eiops, 4 channels per eiop, 1 device per channel

   Deselection syntax: dsel 'cluster.eiop'<cr>

   Enter:  X or x to exit this menu

   Example: sel 0.* 32,34 00,01<cr>   This example selects all eiops cluster 0,
   channel pairs 32/33 and 34/35, and unit 00 on 32/33 and 01 for 34/35.
    NOTE: Multiple channel and unit numbers MUST be seperated with commas.

>
-------------------------------------------------------------------------------
```

Figure 10-3. DME EIOP Selection Menu

6. Enter the EIOPs, channels, and unit (logical) addresses of the devices to test. The following line contains commands to select cluster 0, EIOP 0, channels 30/31, unit 0 (logical address 0), and exit the display.

   sel 0.0 30 00 ↵

   x ↵

7. The MWS displays the EIOP selections you made and asks whether the selections are correct. Type the following command if the selections are correct.

   y ↵

   The MWS displays the DME selection menu (refer to Figure 10-2).

8. Press **2** to select the `PROGRAM SELECTION` parameter. The MWS displays the DME program selection menu (refer to Figure 10-4).

```
-------------------------------------------------------------------------------
DME1.0      EIOPS:0.0                                   DD61     SNAP      QUIT
IOS CLK-U   EIOPS:                                      Fri May  3 10:10:20 1991


 DME PROGRAM SELECTION MENU     DIAGNOSTICS              UTILITIES
 1. EIOP  0.0                   a. Channel Adpt test    n. chn troubleshooting
 2. CHANGE PARMETERS            b. ecc test             o. media maintenance
 3. ALL EIOPS                   c. rndm wrt/read        p. drive troubleshoot
 4. LOAD MICRO SEQUENCER        d. rndm read
 X. EXIT                        e. rndm CE cyl wrt/rd
                                f. rndm CE cyl read
                                g. seek sequential
                                h. seek random
                                i. seek full stroke
                                j. seek X to N up
                                k. seek X to N down
```

Figure 10-4. DME Program Selection Menu

9. Press **n**, **o**, or **p** to select the chn troubleshooting, media maintenance, or drive troubleshoot DD-61 utility.

10. Type the following command to exit the DME program selection menu:

    x ↵

    The MWS displays the DME selection menu (refer to Figure 10-2).

11. Press **4** to select the `DISPLAYS` parameter. The MWS displays the DME display menu (refer to Figure 10-5).

```
--------------------------------------------------------------------------------
DME1.0       EIOPS:0.0                                      DD61     SNAP      QUIT
IOS CLK=U    EIOPS:                                         Fri May  3 10:11:57 1991


                                  DME DISPLAY MENU
                                  1. RUNNING ALL
                                  2. RUNNING EIOP
                                  3. LOAD BUFFER
                                  4. LOCAL MEMORY
                                  X. EXIT
```

Figure 10-5. DME Display Menu

12. Press **2** to select the `RUNNING EIOP` parameter. The MWS displays the chn troubleshooting, drive troubleshooting, or media maintenance running EIOP display.

Chn Troubleshooting Utility

The chn troubleshooting utility enables you to select an individual channel function to run in the DCA2 and DD-61. This utility should only be used with a thorough understanding of the DCA2 channel functions and their sequences. For more information on the chn troubleshooting utility, refer to the *IOS Model E Offline Diagnostic Reference Manual*, publication number CDM-1018-000. Figure 10-6 shows the chn troubleshooting display.

```
DME0.1        EIOPS:0.0                                      SNAP      QUIT
IOS CLK=U     EIOPS:                                 Thu Feb  7 15:12:49 1991


EIOP0.0     CHANNEL30/31
1. CHAN FUNCTION (  )      (  )      (  )      (  )      (  )      (  )
2. MODE BITS     (  )      (  )      (  )      (  )      (  )      (  )
3. ACCUMULATOR   (       ) (       ) (       ) (       ) (       ) (       )
4. EVEN CHANNEL
5. ODD CHANNEL
6. LOOP COUNT    (       )
7. STATUS
8. EXECUTE
9. CANCEL
X. EXIT
```

Figure 10-6. Chn Troubleshooting Display

Drive Troubleshooting Utility

The drive troubleshooting utility enables you to select individual functions to run in the DD-61. This utility should only be used with a thorough understanding of the DD-61 disk drive functions. Information on the drive troubleshooting utility will be added to the *IOS Model E Offline Diagnostic Reference Manual*, publication number CDM-1018-000.

Media Maintenance Utility

The media maintenance utility performs several operations used with flaw management. These include transferring flaw table information to and from the disk drive, formatting and verifying the sector ID fields, and reading and writing data to and from the platters to check for media flaws.

When running the media maintenance utility, it may be helpful to refer to the "DD-61 Format and Flaw Management" section, which contains several figures and tables that can be used as a quick reference when performing media maintenance.

Figure 10-7 shows the DD-61 media maintenance menu. The display is divided into four sections: parameters, disk functions, modifiers, and commands.

```
----------------------------------------------------------------------------------
DME1.0       EIOPS:0.0                                DD61     SNAP       QUIT
IOS CLK=U    EIOPS:                                   Fri Jun 14 12:36:51 1991

 EIOP0.0             CHANS  A.30 UA=00  B.32          C.34          D.36
                            1.BC=005060 2.EC=005060 3.BH=000000 4.EH=000022
 STATUS:IDLE                5.BS=000000 6.ES=000012 7.PM=177777 8.NP=000001



       a.FACTORY TABLE   d.ID FIELDS
       b.USER TABLE      e.DATA FIELDS
       c.LOADED TABLE                                     r.DISPLAY FLAW TABLE
                                                          s.SURF RESULTS
                                                          t.STATUS
 f.SURFACE ANALYSIS         l.READ FLAW TABLE
             g.SAVE         m.WRITE FLAW TABLE            u.LOAD FLAW TABLE
             h.READ                                       v.SAVE FLAW TABLE
                            n.FORMAT
 i.ADD SURF FLAWS           o.VERIFY
 j.SET CRAY SERIAL NUMBER                                 w.EXECUTE
 k.CREATE TABLE WITH IDs        Z.FRMT W/O WTP            q.STOP EIOP
                                                          x.EXIT
>
----------------------------------------------------------------------------------
```

Figure 10-7. Media Maintenance Menu

Parameters

The parameters display the status of the disk function, the channel and EIOP the function is running on, and the cylinder, head, and sector range the function is operating within. Figure 10-8 highlights the parameters on the media maintenance menu and Table 10-1 describes each of the parameters.

```
DME1.0      EIOPS:0.0                            DD61     SNAP      QUIT
IOS CLK=U   EIOPS:                               Fri Jun 14 12:36:51 1991

EIOP0.0            CHANS  A.30 UA=00  B.32          C.34          D.36
                          1.BC=005060 2.EC=005060 3.BH=000000 4.EH=000022
STATUS:IDLE               5.BS=000000 6.ES=000012 7.PM=177777 8.NP=000001


      a.FACTORY TABLE   d.ID FIELDS
      b.USER TABLE      e.DATA FIELDS
      c.LOADED TABLE                                    r.DISPLAY FLAW TABLE
                                                        s.SURF RESULTS
                                                        t.STATUS
f.SURFACE ANALYSIS         l.READ FLAW TABLE
            g.SAVE         m.WRITE FLAW TABLE           u.LOAD FLAW TABLE
            h.READ                                      v.SAVE FLAW TABLE
                           n.FORMAT
i.ADD SURF FLAWS           o.VERIFY
j.SET CRAY SERIAL NUMBER                                w.EXECUTE
k.CREATE TABLE WITH IDs        Z.FRMT W/O WTP           q.STOP EIOP
                                                        x.EXIT
>
```

Figure 10-8. Parameters of the Media Maintenance Menu

Table 10-1. Parameter Descriptions

Disk Function	Description
EIOP0.0	The EIOP parameter displays the cluster and EIOP currently selected.
Status	The status parameter displays the current status of the selected disk function. The status must be idle before you execute another disk function.
A through D	Use the A through D parameters to select or deselect the channel and DD-61 to test.

Table 10-1. Parameter Descriptions (continued)

Disk Function	Description
BC	Use the beginning cylinder (BC) parameter to enter the beginning cylinder limit for the disk function. The cylinders range from 0 to 5062_8.
EC	Use the ending cylinder (EC) parameter to enter the ending cylinder limit for the disk function. The cylinders range from 0 to 5062_8.
BH	Use the beginning head (BH) parameter to enter the beginning head for the disk function. The head groups range from 0 to 22_8.
EH	Use the ending head (EH) parameter to enter the ending head for the disk function. The head groups range from 0 to 22_8.
BS	Use the beginning sector (BS) parameter to enter the beginning sector limit for the disk function. The sectors range from 0 to 12_8.
ES	Use the ending sector (ES) parameter to enter the ending sector limit for the disk function. The sectors range from 0 to 12_8.
PM	Use the pattern mask (PM) parameter to enter one or more data patterns that are written to the selected heads in the DD-61 during the surface analysis function. Refer to Table 10-2 for the bit descriptions of the pattern mask.
NP	Use the number of passes (NP) parameter to enter the number of times the selected disk function repeats.

Table 10-2. Pattern Mask Bit Descriptions

Bit	Pattern	Description
2^0	000000_8	A parcel of 0's
2^1	177777_8	A parcel of 1's
2^2	125252_8	A parcel of alternating 1's and 0's
2^3	052525_8	A parcel of alternating 0's and 1's
2^4	123456_8	A parcel of incrementing numbers
2^5	165432_8	A parcel of decrementing numbers
2^6	070707_8	A parcel of alternating 000's and 111's
2^7	107070_8	A parcel of alternating 111's and 000's
2^8	133333_8	A parcel of 011's
2^9	055555_8	A parcel of 101's
2^{10}	066666_8	A parcel of 110's
2^{11}	022222_8	A parcel of 010's
2^{12}	044444_8	A parcel of 100's
2^{13}	111111_8	A parcel of 001's
2^{14}	163471_8 147144_8	Two-parcel worst-case pattern
2^{15}	Random	Generated random bits

Disk Functions

Disk functions perform operations that write to or read from the DD-61. Only one disk function may be selected at a time. Deselect the previous disk function before executing another function. Figure 10-9 highlights the disk functions on the media maintenance menu and Table 10-3 describes each disk function.

```
DME1.0        EIOPS:0.0                                   DD61       SNAP       QUIT
IOS CLK=U     EIOPS:                                      Fri Jun 14 12:36:51 1991

 EIOP0.0              CHANS  A.30 UA=00  B.32        C.34         D.36
                             1.BC=005060 2.EC=005060 3.BH=000000 4.EH=000022
 STATUS:IDLE                 5.BS=000000 6.ES=000012 7.PM=177777 8.NP=000001


       a.FACTORY TABLE   d.ID FIELDS
       b.USER TABLE      e.DATA FIELDS
       c.LOADED TABLE                                    r.DISPLAY FLAW TABLE
                                                         s.SURF RESULTS
                                                         t.STATUS
 f.SURFACE ANALYSIS          l.READ FLAW TABLE
              g.SAVE         m.WRITE FLAW TABLE          u.LOAD FLAW TABLE
              h.READ                                     v.SAVE FLAW TABLE
                             n.FORMAT
 i.ADD SURF FLAWS            o.VERIFY
 j.SET CRAY SERIAL NUMBER                                w.EXECUTE
 k.CREATE TABLE WITH IDs         z.FRMT W/O WTP          q.STOP EIOP
                                                         x.EXIT
>
```

Figure 10-9. Disk Functions of the Media Maintenance Menu

Table 10-3. Disk Function Descriptions

Disk Function	Description
Surface analysis	The surface analysis function writes and reads the pattern mask (PM) to the DD-60 within the range selected by the parameters. If the pattern read from the DD-60 does not match the pattern written, the surface analysis function calculates the location on the platter(s) that may contain a media flaw.

Table 10-3. Disk Function Descriptions (continued)

Disk Function	Description
Add surf flaws	The add surface analysis flaws function adds the locations of flaws found during surface analysis to the user flaw table. Only flaws that were detected more than once are added to the selected flaw table. Before executing this function, you must select the surface analysis results function. After selecting the function, you must display the surface analysis results in the flaw table format. When finished, the add surface analysis flaws function automatically executes the format and verify functions. No command except STOP EIOP may be executed until this function is finished.
Set Cray serial number	The set Cray serial number function writes the value of the CRI DD-61 serial number to the flaw table loaded in the MWS memory. It also writes the flaw table in MWS memory to the DD-60 user flaw table, and stores the CRI DD-61 serial number in a programmable read only memory (PROM) in the DD-61. The CRI serial number is entered and displayed in decimal.
Create table with IDs	Use the create table with ID function only if the flaw tables are destroyed and a backup does not exist. This function creates a factory or user flaw table from the sector ID fields on the DD-61. After executing this function, perform the following steps: 1. Select display flaw table to make the table resident in the MWS. 2. Execute the write flaw table function to make the created flaw table the new user flaw table.
Read flaw table	The read flaw table function transfers the factory or user flaw table from the DD-61 to the MWS. After executing this function, use the display flaw table command to view the flaw table and load the flaw table into the MWS memory.
Write flaw table	The write flaw table function transfers the flaw table stored in the MWS memory to the DD-61 factory or user flaw table. This transfer overwrites the previous DD-60 factory or user flaw table.
Format	The format function rewrites the sector ID fields in the selected range so they match the user, factory, or previously loaded flaw table stored in MWS memory. When finished, the media maintenance utility automatically performs the verify function.
Verify	The verify function reads the sector ID fields on the DD-61 and compares them to the factory, user, or previously loaded flaw table stored in the MWS memory.

Modifiers

Modifiers select which flaw table or which field the selected disk function writes to or reads from. Figure 10-10 highlights the modifiers in the media maintenance menu and Table 10-4 describes each modifier.

```
DME1.0        EIOPS:0.0                              DD61     SNAP      QUIT
IOS CLK-U     EIOPS:                                 Fri Jun 14 12:36:51 1991

 EIOP0.0             CHANS  A.30 UA-00  B.32        C.34        D.36
                            1.BC-005060 2.EC-005060 3.BH-000000 4.EH-000022
 STATUS:IDLE                5.BS-000000 6.ES-000012 7.PM-177777 8.NP-000001



      a.FACTORY TABLE    d.ID FIELDS
      b.USER TABLE       e.DATA FIELDS
      c.LOADED TABLE                                  r.DISPLAY FLAW TABLE
                                                      s.SURF RESULTS
                                                      t.STATUS
 f.SURFACE ANALYSIS          l.READ FLAW TABLE
           g.SAVE            m.WRITE FLAW TABLE       u.LOAD FLAW TABLE
           h.READ                                     v.SAVE FLAW TABLE
                             n.FORMAT
 i.ADD SURF FLAWS            o.VERIFY
 j.SET CRAY SERIAL NUMBER                             w.EXECUTE
 k.CREATE TABLE WITH IDs       Z.FRMT W/O WTP         q.STOP EIOP
                                                      x.EXIT
>
```

Figure 10-10. Modifiers in the Media Maintenance Menu

Table 10-4. Modifier Descriptions

Disk Function	Description
Factory table	When the factory table modifier is highlighted, the selected disk function performs operations on the DD-61 factory flaw table. For example, if the read flaw table disk function and the factory table modifier are selected, the media maintenance utility transfers the DD-61 factory flaw table to the MWS.
User table	When the user table modifier is highlighted, the selected disk function performs operations on the DD-61 user flaw table. For example, if the write flaw table disk function and the user table modifier are selected, the software writes the flaw table stored in the MWS memory to the DD-61 user flaw table.
Loaded table	When the loaded table modifier is highlighted, the verify or format disk function performs operations using the backup flaw table loaded from the MWS hard drive. For example, if the verify disk function, the ID fields modifier, and the loaded table modifier are selected, the software reads the sector ID fields and compares them to the backup flaw table previously loaded from the MWS hard drive.
ID fields	When the ID fields modifier is highlighted, the verify or format function writes to or reads from the sector ID fields on the DD-61. For example, if the verify disk function, the ID fields modifier, and the user table modifier are selected, the software reads the sector ID fields and compares them to the user flaw table.
Data fields	When the data fields modifier is highlighted, the verify or format function writes to or reads from the sector data fields on the DD-61. Data fields that contain a hideable media flaw have a different format than normal sectors. For more information on sector format and media flaws, refer to the "DD-61 Format and Flaw Management" section.
Save	If the surface analysis function and the save modifier are selected, the software writes any flaws found during surface analysis to the diagnostic scratch cylinder (5060_8) in the DD-61. With this function, surface analysis results may still be read if the EIOP was stopped.
Read	If the surface analysis function and read modifier are selected, the software reads the results of a previous surface analysis function from the diagnostic scratch cylinder (5060_8).

Commands

Commands start and terminate operations performed by the MWS. Figure 10-11 highlights the commands in the media maintenance menu and Table 10-5 describes each command. The status, display flaw table, and surface analysis results each have displays which are described in the following subsections.

```
DME1.0       EIOPS:0.0                                        DD61     SNAP      QUIT
IOS CLK=U    EIOPS:                                           Fri Jun 14 12:36:51 1991

 EIOP0.0              CHANS  A.30 UA=00  B.32         C.34         D.36
                             1.BC=005060 2.EC=005060 3.BH=000000 4.EH=000022
 STATUS:IDLE                 5.BS=000000 6.ES=000012 7.PM=177777 8.NP=000001



       a.FACTORY TABLE   d.ID FIELDS
       b.USER TABLE      e.DATA FIELDS
       c.LOADED TABLE                                         r.DISPLAY FLAW TABLE
                                                              s.SURF RESULTS
                                                              t.STATUS
 f.SURFACE ANALYSIS           l.READ FLAW TABLE
             g.SAVE           m.WRITE FLAW TABLE              u.LOAD FLAW TABLE
             h.READ                                           v.SAVE FLAW TABLE
                              n.FORMAT
 i.ADD SURF FLAWS             o.VERIFY
 j.SET CRAY SERIAL NUMBER                                     w.EXECUTE
 k.CREATE TABLE WITH IDs          Z.FRMT W/O WTP              q.STOP EIOP
                                                              x.EXIT
>
```

Figure 10-11. Commands in the Media Maintenance Menu

Table 10-5. Command Descriptions

Disk Function	Description
Display flaw table	The display flaw table command shows the flaw table in MWS memory. Refer to the "Display Flaw Table" subsection in this section for more information on the display flaw table command.
Surf results	The surface analysis results command shows the results of the previous surface analysis function. Execute this command and the `FLAW TABLE FORMAT` selection (refer to Figure 10-13) before executing the add surface analysis flaws function. Refer to the "Surface Analysis Results" subsection in this section for more information on the surface analysis results command.

Table 10-5. Command Descriptions (continued)

Disk Function	Description
Status	The status command displays the current execute status of the disk function or the ending status of the completed disk function. Refer to the "Status" subsection in this section for more information on status.
Load flaw table	The load flaw table command loads the backup factory or user flaw table from the MWS hard drive.
Save flaw table	The save flaw table command stores the flaw table in the MWS memory to the MWS hard drive.
Execute	The execute disk function starts the selected disk function. Always deselect the previous function (by selecting the function again) before executing a new one.
Stop EIOP	The stop EIOP command stops the executing disk function and master clears the EIOP.
Exit	The exit command exits the media maintenance utility display.

Status

Figure 10-12 shows the status display. Refer to the "DD-60/61 Disk Systems Status" section of this manual for more information on status.

```
--------------------------------------------------------------------------------
DME1.0       EIOPS:0.0                                 DD61     SNAP      QUIT
IOS CLK-U    EIOPS:                                    Fri Jun 14 12:37:33 1991

                 CHN 30                                     CHN 31
 BZ  DN            ADPT STATUS= 000000   | BZ  DN           ADPT STATUS= 000000
 ATTENTION IN      SYNDROME =   000000   | ATTENTION IN     SYNDROME =   000000
 SLAVE IN          XFER COUNT = 000000   | SLAVE IN         XFER COUNT=  000000
 SYNC IN           END STATUS = 000000   | SYNC IN          END STATUS = 000000
 SELECT OUT        ID PARM 0 =  000000   | SELECT OUT       ID PARM 0 =  000000
 MASTER OUT        ID PARM 1 =  000000   | MASTER OUT       ID PARM 1 =  000000
 SYNC OUT                                  SYNC OUT
                   DRIVE SERIAL NUMBER:
                   CONDITION BITS: (7X) 000    (6X) 000
                   DRIVE STATUS:      000 000 000 000 000 000 000 000
                   EXTENDED STATUS:   000 000 000 000 000 000 000 000


                   PASS =       000000                      FAIL =       000000
                   ERR CODE =   000000                      B REG =      000000
                   CUR SECT =   000000                      ERL =        000000
                   ACTUAL  =    000000                      EXPECTED =   000000

Enter any key to continue
--------------------------------------------------------------------------------
```

Figure 10-12. Status Display

Display Flaw Table

Figure 10-13 shows a sample flaw table display and Table 10-6 describes the display selections at the bottom of the screen.

```
-----------------------------------------------------------------------------------
DME1.0       EIOPS:0.0                                  DD61     SNAP       QUIT
IOS CLK=U    EIOPS:                                     Thu Feb  7 15:09:27 1991

CRI Serial #:100B
HDA Serial #:000402AF        DOR:00 00     Total #:2      CRI:2       Unhide:1
FLAW#   CYL ADR    HEAD GRP   SECTOR    HEAD MSK    DEF ADR      V    UH    ID    CRI
1       01260      0          01        000         003027       1    0     0     0
2       01406      1          11        001         003035       1    0     0     1
3       01500      0          07        000         002456       0    1     0     1











 1.FRWRD   2.BKWRD   3.DISPLAY   4.DELETE   5.ADD FLAW   6.CRI SERIAL   x.EXIT
>
-----------------------------------------------------------------------------------
```

Figure 10-13. Flaw Table Display

Table 10-6. Flaw Table Display Selections

Selection	Description
1.FRWRD	Move the display one page forward through the flaw table.
2.BKWRD	Move the display one page backward through the flaw table.
3.DISPLAY	Start the display at a given flaw number.
4.DELETE	Delete a given flaw.
5.ADD FLAW	Add a flaw to the flaw table.
6.CRI SERIAL	Adds a new CRI serial number to the flaw table.
x.EXIT	Exit the flaw table display.

Surface Analysis Results

Figure 10-14 shows a sample surface analysis results display and Table 10-7 describes the selections at the bottom of the screen.

```
DME1.0        EIOPS:0.0                              DD61     SNAP      QUIT
IOS CLK-U     EIOPS:                                 Fri May  3 10:19:36 1991

Cray Serial Number:
COUNT CYLINDER HEAD #    HEADGROUP  SECTOR  ID  STARTBIT ENDBIT  PATMSK
3      01260     000      0          01      0   0453     0543    177777










  1.FORWARD     2.BACKWARD     3.FLAW TABLE FORMAT      X.EXIT
>
```

Figure 10-14. Surface Analysis Results Display

Table 10-7. Surface Analysis Results Display Selections

Selection	Description
1.FORWARD	Move the display one page forward through the flaw table.
2.BACKWARD	Move the display one page backward through the flaw table.
3.FLAW TABLE FORMAT	Display flaws that have a count greater than one in flaw table format (refer to Figure 10-13).
X.EXIT	Exits the surface analysis results display.

DME DD-61 Diagnostics

The offline DD-61 diagnostics are part of the DME program, which run from the Motorola maintenance workstation (MWS) or a Sun maintenance workstation (MWS-E).

Running the DD-61 Diagnostics

Use the following procedure to start the DME program and select the DD-61 diagnostics. This procedure uses the keystroke commands in DME; you may also use the mouse to select the appropriate commands.

1. Perform Steps 1 through 7 of the procedure for running the DD-61 utilities in the "DME DD-61 Utilities" subsection in this section.

2. Press **2** to select the `PROGRAM SELECTION` parameter. The MWS displays the DME program selection menu (refer to Figure 10-15).

```
--------------------------------------------------------------------------------
DME1.0       EIOPS:0.0                                DD61     SNAP      QUIT
IOS CLK=U    EIOPS:                                   Fri May  3 10:10:20 1991


 DME PROGRAM SELECTION MENU     DIAGNOSTICS               UTILITIES
 1. EIOP  0.0                   a. Channel Adpt test     n. chn troubleshooting
 2. CHANGE PARMETERS            b. ecc test              o. media maintenance
 3. ALL EIOPS                   c. rndm wrt/read         p. drive troubleshoot
 4. LOAD MICRO SEQUENCER        d. rndm read
 X. EXIT                        e. rndm CE cyl wrt/rd
                                f. rndm CE cyl read
                                g. seek sequential
                                h. seek random
                                i. seek full stroke
                                j. seek X to N up
                                k. seek X to N down
```

Figure 10-15. DME Program Selection Menu

3. Press **a** through **k** to select any or all of the DD-61 diagnostics.

NOTE: The DCA2 diagnostic overwrites the contents of the sequencer random access memories (RAMs); therefore, it may not be run in conjunction with any other diagnostic. Also, the correct microcode must be reloaded when the test completes.

4. Type the following command to exit the DME program selection menu:

   x ↵

   The MWS displays the DME selection menu (refer to Figure 10-16).

```
---------------------------------------------------------------------------------
DME1.0       EIOPS:                                       DD61     SNAP      QUIT
IOS CLK=U    EIOPS:                                       Fri May  3 10:06:53 1991


                          DME SELECTION MENU
                         1. EIOP/CHANNEL SELECTION
                         2. PROGRAM SELECTION
                         3. EIOP CONTROL
                         4. DISPLAYS
                         X. EXIT
```

Figure 10-16. DME Selection Menu

5. Press **4** to select the `DISPLAYS` parameter. The MWS displays the DME display menu (refer to Figure 10-17).

```
---------------------------------------------------------------------------------
DME1.0       EIOPS:0.0                                    DD61     SNAP      QUIT
IOS CLK=U    EIOPS:                                       Fri May  3 10:11:57 1991


                         DME DISPLAY MENU
                         1. RUNNING ALL
                         2. RUNNING EIOP
                         3. LOAD BUFFER
                         4. LOCAL MEMORY
                         X. EXIT
```

Figure 10-17. DME Display Menu

6. Press **2** to select the `RUNNING EIOP` parameter. The MWS displays the running EIOP display.

7. Type the following command to deadstart the diagnostics in the selected EIOPs.

   `ds` ↵

DD-61 Diagnostic Descriptions

Refer to Table 10-8 for a description of each DD-61 diagnostic.

Table 10-8. DD-61 Diagnostic Descriptions

Diagnostic	Description
Channel adpt test	This test verifies the basic operation of the DCA2 channel adapter. Since this test overwrites the contents of the sequencer random access memories (RAMs), it may not be run in conjunction with any other diagnostic. After the test completes, the correct microcode must be reloaded.
ecc test	This test checks the error correction code (ECC) circuitry.
rndm wrt/read	This test writes data, then reads and compares the data within the specified beginning and ending cylinder.
rndm read	This test first writes a known pattern to the DD-61 within the specified beginning and ending cylinders. The test then performs random reads to verify the written data.
rndm CE cyl wrt/rd	This test writes data, then reads and compares the data from the diagnostic scratch cylinder (2,608 or 5060_8).
rndm CE cyl read	This test first writes a known pattern to the diagnostic scratch cylinder (2,608 or 5060_8) in the DD-61. The test then performs random reads to verify the written data.
seek sequential	This test performs sequential seeks from the specified beginning cylinder to the ending cylinder.
seek random	This test performs random seeks within the specified beginning and ending cylinders.
seek full stroke	This test performs a seek from the specified beginning cylinder to the ending cylinder.
seek X to N up	This test checks the seek and seek timing step up from the specified beginning cylinder to the specified ending cylinder.
seek X to N down	This test checks the seek and seek timing step down from the specified beginning cylinder to the specified ending cylinder.

CONTENTS

11 DD-60/61 DISK SYSTEMS STATUS

FIGURES

TABLES

SECTION 11
DD-60/61 DISK SYSTEMS STATUS

11 DD-60/61 DISK SYSTEMS STATUS

This section provides status information for DD-60/61 disk systems. This includes DCA2 channel adapter status and DD-60/61 disk drive status information.

Status Cross-references

The statuses for 60 series disk systems are displayed in the device maintenance environment (DME) program and the OLHPA error report.

DME

Figure 11-1 shows the DME program status display. Use Table 11-1 as a cross-reference for the tables in this section that describe each status.

```
------------------------------------------------------------------------------
DME1.0       EIOPS:0.0                                  DD60    SNAP     QUIT
IOS CLK=U    EIOPS:                                     Fri Jun 14 12:37:57 1991

                 CHN 30                                      CHN 31
 BZ  DN          ADPT STATUS= 000000   | BZ  DN          ADPT STATUS= 000000
 ATTENTION IN    SYNDROME =   000000   | ATTENTION IN    SYNDROME =   000000
 SLAVE IN        XFER COUNT = 000000   | SLAVE IN        XFER COUNT=  000000
 SYNC IN         END STATUS = 000000   | SYNC IN         END STATUS = 000000
 SELECT OUT      ID PARM 0 =  000000   | SELECT OUT      ID PARM 0 =  000000
 MASTER OUT      ID PARM 1 =  000000   | MASTER OUT      ID PARM 1 =  000000
 SYNC OUT                                SYNC OUT
                 DRIVE SERIAL NUMBER:
                 CONDITION BITS: (7X) 000   (6X) 000
                 DRIVE STATUS:      000 000 000 000 000 000 000 000
                 EXTENDED STATUS:   000 000 000 000 000 000 000 000


                 PASS =       000000                     FAIL =       000000
                 ERR CODE =   000000                     B REG =      000000
                 CUR SECT =   000000                     ERL =        000000
                 ACTUAL   =   000000                     EXPECTED =   000000
```

Figure 11-1. DME Status Display

OLHPA

Figure 11-2 shows the OLHPA error report for a DD-60 disk drive. Refer to Table 11-1 for a cross-reference to the tables in this section that describe each status.

```
**************************************************************************************
HOST ERROR PACKET
        Device: 60-0-3-34.0  major = 32      minor = 17    I/O Path: 00334.0
        Final Status: Recovered by retrying
        Retry Count:  1              Carriage Offset: normal
        Error location  Cyl: 00556   Head: 000      Sec: 026
        Physical block: 037376       Logical block: 011672
        General status: 100000

DCA2 STATUS PACKET
        Drive ending status:   100200     Adapter status:         000000
        ID parameter 0 status: 000556     Syndrome status:        000000
        ID parameter 1 status: 000026     Transfer count status: 020154
                                          IPI-2Tag status:         000022
        6X Condition Bits:       040      7X Condition Bits:  002
        Head mask bit: 002     Corr Offset: 034114    Defect address: 1004
        Head mask bit: 040     Corr Offset: 034115    Defect address: 1005
        Combined head mask: 042              Flawing defect address: 1004

DRIVE ERROR PACKET
        Status response block (IPI-2bus control 44)
        byte  0      1      2      3      4      5      6      7
             000    000    000    000    000    000    000    000
        Extended status block (IPI-2bus control 48)
        byte  0      1      2      3      4      5      6      7
             000    000    000    000    000    000    000    000
        FRU code 1: FF    Fault code 1: FF   Status code 1: FF    HDA sn: FFFFF
          (Hex)   2: FF      (Hex)   2: FF      (Hex)    2: FF
**************************************************************************************
```

Figure 11-2. OLHPA Error Report

Table 11-1. Status Name Cross-reference Chart

Table	Status Name	Obtained By
Table 11-2	General status	OLHPA software
Table 11-3	6X Condition bits	DCA2:12 channel function
Table 11-4	7X Condition bits	DCA2:12 channel function
Table 11-5	Adapter status	DCA2:12 channel function
Table 11-6	Syndrome status	DCA2:12 channel function
Table 11-7	Transfer count status	DCA2:12 channel function
Table 11-8	Tag status	DCA2:12 channel function
Table 11-9	Drive ending status	DCA2:13 channel function
Table 11-11	ID parameter 0 status	DCA2:13 channel function
Table 11-12	ID parameter 1 status	DCA2:13 channel function
Table 11-13	Exception status (Byte 0)	Bus control command (44_{16})
Table 11-14	Unsolicited exceptions status (Byte 1)	Bus control command (44_{16})
Table 11-15	Bus Control exceptions status (Byte 2)	Bus control command (44_{16})
Table 11-16	Drive exceptions status (Byte 3)	Bus control command (44_{16})
Table 11-17	Drive exceptions status (Byte 4)	Bus control command (44_{16})
Table 11-18	Drive exceptions status (Byte 5)	Bus control command (44_{16})
Table 11-19	Drive exceptions status (Byte 6)	Bus control command (44_{16})
Table 11-20	Drive exceptions status (Byte 7)	Bus control command (44_{16})
Table 11-21	Interface flags status (Byte 0)	Bus control command (48_{16})
Table 11-22	Data received flags status (Byte 1)	Bus control command (48_{16})
Table 11-23	Data control flags status (Byte 2)	Bus control command (48_{16})
Table 11-24	Disk drive status (Byte 3)	Bus control command (48_{16})
Table 11-25	Disk drive alarms status (Byte 4)	Bus control command (48_{16})
Table 11-26	Vendor defined status (Byte 5)	Bus control command (48_{16})
Table 11-27	Vendor defined status (Byte 6)	Bus control command (48_{16})
Table 11-28	Head skew status (Byte 7)	Bus control command (48_{16})
Table 11-29	OLHPA flaw location information	OLHPA software

General Status

General status is a combination of bits from several of the other statuses. It is combined and displayed by the OLHPA software. Table 11-2 describes each bit of the general status.

Table 11-2. General Status

Bit	Name	Description
2^0	Bus A parity error	When set to 1, this bit indicates that the parity bit of bus A was not set to the expected value. This signal is from 3DE.
2^1	Byte 1 parity error	When set to 1, this bit indicates that byte 1 (bus A information) of the data had a parity error. This signal is from 3YB.
2^2	Bus B parity error	When set to 1, this bit indicates that the parity bit of bus B was not set to the expected value. This signal is from 3DE.
2^3	Byte 0 parity error	When set to 1, this bit indicates that byte 0 (bus B information) of the data had a parity error. This signal is from 3YB.
2^4	Voltage fault –4.5 V	When set to 1, this bit indicates the –4.5 V supply is out of range.
2^5	Voltage fault +5.0 V	When set to 1, this bit indicates the +5.0 V supply is out of range.
2^6	Single-bit error	When set to 1, this bit indicates that one of the write data bits was wrong, but was corrected with SECDED circuitry in the 3YC option.
2^7	Double-bit error	When set to 1, this bit indicates that more than one write data bit was wrong and that SECDED circuitry in the 3YC option was unable to correct them.
2^8	Head Select Fault	When set to 1, this bit indicates that the disk drive received an invalid head selection.
2^9	Off Cylinder Fault	When set to 1, this bit indicates that the heads were not positioned over the correct cylinder during a seek, or that the heads moved off cylinder during a data transfer.
2^{10}	Seek Fault	When set to 1, this bit indicates that an error occurred during a seek, read/verify data, or write data bus control operation. Refer to the drive exception status bytes 3 through 7, Table 11-16 through Table 11-20, for more information on which conditions can cause the error.
2^{11}	Spindle Fault	When set to 1, this bit indicates that an error occurred during a spin-up, spin-down, read/verify data, or write data bus control operation. Refer to the drive exception status bytes 3 through 7, Table 11-16 through Table 11-20, for more information on which conditions can cause the error.
2^{12}	Execution Fault	When set to 1, this bit indicates that a disk drive execution fault occurred. Refer to the drive exception status bytes 3 through 7, Table 11-16 through Table 11-20, for more information on which conditions can cause the error.
2^{13}	ID ECC error	When set to 1, this bit indicates that the ID field ECC read from the disk drive did not match the generated ECC from the 3DH options.
2^{14}	ID compare error	When set to 1, this bit indicates that the ID of the sector read from the disk drive did not compare to the expected ID stored in the 3DG option.
2^{15}	Data ECC error	When set to 1, this bit indicates that the data field error correction code (ECC) read from the disk drive did not match the generated ECC from the 3DH options.

DCA2:12 Statuses

The DCA2:12 statuses are transferred to the accumulator by a DCA2:12 channel function. Refer to the "DCA2 Channel Functions" section for more information on the DCA2:12 channel function.

Condition Bits

When the status select bits are both 0 and the sequencer is given a starting address of 36_8, the DCA2:12 channel function transfers the condition bits to the accumulator. There are two types of condition bit statuses: the 6X condition bits and the 7X condition bits.

6X Condition Bits

The 6X condition bits are assembled from information generated by the 3DE option, 3YC option, and voltage sensors on the DCA2. Table 11-3 describes each bit of the 6X condition bits.

Table 11-3. 6X Condition Bits Status

Bit	Name	Description
2^0	Bus A parity error	When set to 1, this bit indicates that the parity bit of bus A was not set to the expected value. This parity is checked by the 3DE option.
2^1	Byte 1 parity error	When set to 1, this bit indicates that byte 1 (bus A information) of the data had a parity error. This parity is checked by the 3YB option.
2^2	Bus B parity error	When set to 1, this bit indicates that the parity bit of bus B was not set to the expected value. This parity is checked by the 3DE option.
2^3	Byte 0 parity error	When set to 1, this bit indicates that byte 0 (bus B information) of the data had a parity error. This parity is checked by the 3YB option.
2^4	–4.5 voltage bad	When set to 1, this bit indicates that the –4.5 voltage setting is out of acceptable range.
2^5	+5.0 voltage good	When set to 0, this bit indicates that the +5.0 voltage setting is out of acceptable range.
2^6	Single-bit error	When set to 1, this bit indicates that one of the write data bits was in error, but was corrected with SECDED circuitry in the 3YC option.
2^7	Double-bit error	When set to 1, this bit indicates that multiple bits were in error and that SECDED circuitry in the 3YC options was unable to correct them.

7X Condition Bits

The 7X condition bits are assembled from information generated by the 3DH options and 3DG option on the DCA2. Table 11-4 describes each bit of the 7X condition bits.

Table 11-4. 7X Condition Bits Status

Bit	Name	Description
2^0	ID compare error	The ID of the sector read from the disk drive did not compare to the expected ID.
2^1	Data ECC error	When set to 1, this bit indicates that the data field error correction code (ECC) read from the disk drive did not match the generated ECC from the 3DH options.
2^2	ID ECC error	When set to 1, this bit indicates that the ID field ECC read from the disk drive did not match the generated ECC from the 3DH options.
2^3	Valid flaw	When set to 1, this bit indicates that the sector contains a hideable flaw.
2^4	Sector flaw	When set to 1, this bit indicates that the sector contains an unhideable flaw.
2^5	ID field flaw	When set to 1, this bit indicates that the sector ID field contains a flaw.
2^6	Read protect	When set to 1, this bit indicates that the read protect bit of the sector ID field is set to 1.
2^7	Write protect	When set to 1, this bit indicates that the write protect bit of the sector ID field is set to 1.

Adapter Status

When the status select bits are both 0, the DCA2:12 channel function transfers the adapter status to the accumulator (refer to Table 11-5).

Table 11-5. Adapter Status

Bit	Name	Description
2^0	DCA2 status bit 2^0	**Bits – Description** 000_8 – No errors were detected by the sequencer. 001_8 – The disk drive did not respond to a request within a set time limit. 002_8 – The interface did not return to the IDLE state within a set time limit. 003_8 – The disk drive did not respond to a select within a set time limit. 004_8 – The expected disk drive did not respond to the select sequence. 005_8 – The disk drive set the busy flag during a select sequence. 006_8 – The disk drive is not selected when the sequencer expected it to be. 007_8 – The disk drive is selected when the sequencer did not expect it to be. 010_8 – During a bus control sequence, the disk drive did not set the Sync In signal to 1 within a set time limit. 011_8 – During a bus control sequence, the disk drive did not reset the Sync In signal to 0 within a set time limit. 012_8 – The bus control sequence failed or an information transfer was not required and the disk drive terminated the sequence. 014_8 – The sequencer terminated an information transfer. 020_8 – The read or write operation was terminated due to ID miscompare, disk drive detected error, or disk drive voltage fault. 021_8 – A parity error occurred on bus A. 022_8 – A parity error occurred on bus B. 024_8 – A parity error occurred on the ending status byte. 040_8 – A parity error occurred on byte 0 of the data. 100_8 – A parity error occurred on byte 1 of the data. 200_8 – An error was detected during the ending status sequence.
2^1	DCA2 status bit 2^1	
2^2	DCA2 status bit 2^2	
2^3	DCA2 status bit 2^3	
2^4	DCA2 status bit 2^4	
2^5	DCA2 status bit 2^5	
2^6	DCA2 status bit 2^6	
2^7	DCA2 status bit 2^7	
2^8	Single-bit error	When set to 1, this bit indicates that the SECDED circuitry in the 3YC option corrected 1 bit of write data.
2^9	Double-bit error	When set to 1, this bit indicates that multiple bits were in error and that SECDED circuitry in the 3YC options was unable to correct them.
2^{10}	Voltage fault –4.5 V	When set to 1, this bit indicates that the –4.5 V supply is out of range.
2^{11}	Voltage fault +5.0 V	When set to 1, this bit indicates that the +5.0 V supply is out of range.
2^{12}	DCA2 parity error bit 2^0	These bits contain the sequencer parity errors. counts how many parity errors 16 max
2^{13}	DCA2 parity error bit 2^1	
2^{14}	DCA2 parity error bit 2^2	
2^{15}	DCA2 parity error bit 2^3	

To decode these, start at bottom and go up. if the ... status byte is valid. only go up as ... into the status ... in the status got satisfied.

ex. 000363

Syndrome Status

When status select bit 2^1 is 0 and bit 2^0 is 1, the DCA2:12 channel function transfers the syndrome status to the accumulator (refer to Table 11-6).

Table 11-6. Syndrome Status

Bit	Name	Description
2^0	Syndrome bit 2^0	These bits contain the syndrome bits from 3YC SECDED circuitry.
2^1	Syndrome bit 2^1	
2^2	Syndrome bit 2^2	
2^3	Syndrome bit 2^3	
2^4	Syndrome bit 2^4	
2^5	Syndrome bit 2^5	
2^6	Syndrome bit 2^6	
2^7	Syndrome bit 2^7	
2^8	Single-bit count bit 2^0	These bits contain the number of times the 3YC option detected a single-bit error.
2^9	Single-bit count bit 2^1	
2^{10}	Single-bit count bit 2^2	
2^{11}	Single-bit count bit 2^3	
2^{12}	Double-bit count bit 2^0	These bits contain the number of times the 3YC option detected a double-bit error.
2^{13}	Double-bit count bit 2^1	
2^{14}	Double-bit count bit 2^2	
2^{15}	Double-bit count bit 2^3	

Transfer Count Status

When status select bit 2^1 is 1 and bit 2^0 is 0, the DCA2:12 channel function transfers the transfer count status to the accumulator (refer to Table 11-7).

Table 11-7. Transfer Count Status

Bits	Name	Description
2^0 through 2^{15}	Transfer count bits 2^0 through 2^{15}	These bits contain the current value of the transfer counter in the 3DI option.

Tag Status

When the status select bits are both 1, the DCA2:12 channel function transfers the tag status to the accumulator (refer to Table 11-8).

Table 11-8. Tag Status

Bit	Name	Description
2^0	Attention In signal	This bit displays the state of the Attention In signal from the 3DE option.
2^1	Slave In signal	This bit displays the state of the Slave In signal from the 3DE option.
2^2	Sync In signal	This bit displays the state of the Sync In signal from the 3DE option.
2^3	Not used	This bit is not used.
2^4	Select Out signal	This bit displays the state of the Select Out signal from the 3DF option.
2^5	Master Out signal	This bit displays the state of the Master Out signal from the 3DF option.
2^6	Sync Out signal	This bit displays the state of the Sync Out signal from the 3DF option.
2^7	Not used	These bits are not used.
2^8	Not used	
2^9	Not used	
2^{10}	Not used	
2^{11}	Not used	
2^{12}	Not used	
2^{13}	Not used	
2^{14}	Not used	
2^{15}	Not used	

DCA2:13 Statuses

The DCA2:13 statuses are transferred to the accumulator by a DCA2:13 channel function. Refer to the "DCA2 Channel Functions" section for more information on the DCA2:13 channel function.

Drive Ending Status

When the status select bits are both 0, the DCA2:13 channel function transfers the drive ending status to the accumulator. The drive ending status contains the drive ending IPI-2 statuses. Refer to Table 11-9 for a description of each bit of the drive ending status.

Table 11-9. Drive Ending Status

Bit	Name	Description
2^0	Initial drive ending status bit 2^0	
2^1	Initial drive ending status bit 2^1	
2^2	Initial drive ending status bit 2^2	
2^3	Initial drive ending status bit 2^3	These bits contain the initial drive ending status.
2^4	Initial drive ending status bit 2^4	
2^5	Initial drive ending status bit 2^5	
2^6	Initial drive ending status bit 2^6	
2^7	Initial drive ending status bit 2^7	
2^8	Final drive ending status bit 2^0	
2^9	Final drive ending status bit 2^1	
2^{10}	Final drive ending status bit 2^2	
2^{11}	Final drive ending status bit 2^3	These bits contain the final drive ending status.
2^{12}	Final drive ending status bit 2^4	
2^{13}	Final drive ending status bit 2^5	
2^{14}	Final drive ending status bit 2^6	
2^{15}	Final drive ending status bit 2^7	

Initial Drive Ending Status

The initial drive ending status contains the first drive ending status on bus B after the first of two ending status sequences. For example, during a write sector of data routine, the sequencer performs two ending status sequences. The first drive ending status received by the DCA2 is stored in the initial drive ending status. The second drive ending status received by the DCA2 is stored in the final drive ending status.

Final Drive Ending Status

The final drive ending status contains the last drive ending status on bus B after an ending status sequence (refer to Table 11-10). For example, during a select unit routine, the sequencer performs one ending status sequence. The drive ending status from this sequence is stored in the final drive ending status.

Table 11-10. Disk Drive Status on Bus B

<table>
<tr><th>Bit</th><th>Name</th><th>Description</th></tr>
<tr><td>2^0</td><td>Operation status bit 2^0</td><td rowspan="4">Bits Description
00_8 – The disk drive executed the bus control command and is available.
01_8 – The disk drive rejected the bus control command and is busy.
04_8 – The disk drive did not detect the address mark.
05_8 – The disk drive did not detect the sync byte.
06_8 – ECC error (not used by CRI)
07_8 – Verify ID miscompare (not used by CRI)
10_8 – An operation exception occurred. The exception status may be read for more information (refer to Table 11-13).
14_8 – An unsolicited exception occurred. The unsolicited exception status must be read before continuing (refer to Table 11-14).</td></tr>
<tr><td>2^1</td><td>Operation status bit 2^1</td></tr>
<tr><td>2^2</td><td>Operation status bit 2^2</td></tr>
<tr><td>2^3</td><td>Operation status bit 2^3</td></tr>
<tr><td>2^4</td><td>Time dependant operation</td><td>When set to 1, this bit indicates that the last command has not been completed by the disk drive. The disk drive will set the Attention In signal when it completes the command.</td></tr>
<tr><td>2^5</td><td>Odd byte transfer</td><td>When set to 1, this bit indicates that the last information transfer contained an odd number of bytes. If set, the last byte transferred on bus B is not valid.</td></tr>
<tr><td>2^6</td><td>Bus parity error</td><td>When set to 1, this bit indicates the disk drive detected a parity error on a bus control command, information transfer, or controller status.</td></tr>
<tr><td>2^7</td><td>Good transfer</td><td>When set to 1, this bit indicates the disk drive did not detect a parity error on a bus control command, information transfer, or controller status.</td></tr>
</table>

ID Parameter 0 Status

When status select bit 2^1 is 0 and bit 2^0 is 1, the DCA2:13 channel function transfers the ID parameter 0 status to the accumulator. Refer to Table 11-11 for a description of each bit of the ID parameter 0 status.

Table 11-11. ID Parameter 0 Status

Bit	Name	Description
2^0 through 2^{15}	Cylinder address (ID parameter 0)	These bits contain the current value of the cylinder register in the 3DG option.

ID Parameter 1 Status

When status select bit 2^1 is 1 and bit 2^0 is 0, the DCA2:13 channel function transfers the ID parameter 1 status to the accumulator. Refer to Table 11-12 for a description of each bit of the ID parameter 1 status.

Table 11-12. ID Parameter 1 Status

Bit	Name	Description
2^0	Sector address bit 2^0	These bits contain the current sector address.
2^1	Sector address bit 2^1	
2^2	Sector address bit 2^2	
2^3	Sector address bit 2^3	
2^4	Sector address bit 2^4	
2^5	Sector address bit 2^5	
2^6	Head address bit 2^0	These bits contain the current head address.
2^7	Head address bit 2^1	
2^8	Head address bit 2^2	
2^9	Head address bit 2^3	
2^{10}	Head address bit 2^4	
2^{11}	Not used	This bit is not used.
2^{12}	Read protection	When set to 1, this bit indicates that data cannot be read from the sector.
2^{13}	Write protection	When set to 1, this bit indicates that data cannot be written to the sector.
2^{14}	Not used	This bit is not used.
2^{15}	Not used	This bit is not used.

Status Response Block

The status response block is 8 bytes of IPI-2 status information transferred from the disk drive to the DCA2. The status response block is read when the sequencer sends a bus control code for read status (44_{16}) to the disk drive over bus A. Tables 11-13 through 11-20 describe each bit in the statuses response block.

Table 11-13. Exception Status (Byte 0)

Bit	Name	Description
2^0	Execution fault	When set to 1, this bit indicates that a disk drive execution fault occurred. Refer to the drive exception status bytes 3 through 7, Tables 11-16 through 11-20, for more information on conditions that can cause the error.
2^1	Spindle fault	When set to 1, this bit indicates that an error occurred during a spin-up, spin-down, read/verify data, or write data bus control operation. Refer to the drive exception status bytes 3 through 7, Tables 11-16 through 11-20, for more information on conditions that can cause the error.
2^2	Seek fault	When set to 1, this bit indicates that an error occurred during a seek, read/verify data, or write data bus control operation. Refer to the drive exception status bytes 3 through 7, Tables 11-16 through 11-20, for more information on conditions that can cause the error.
2^3	Write fault	When set to 1, this bit indicates that an error occurred during a write data bus control operation. Refer to the drive exception status bytes 3 through 7, Tables 11-16 through 11-20, for more information on conditions that can cause the error.
2^4	Read fault	When set to 1, this bit indicates that an error occurred during a read/verify bus control operation. Refer to the drive exception status bytes 3 through 7, Tables 11-16 through 11-20, for more information on conditions that can cause the error.
2^5	Bus control exception	When set to 1, this bit indicates that the disk drive did not accept the last bus control command. Refer to the bus control exception status (byte 2), Table 11-15, for more information on conditions that can cause the error.
2^6	Unsolicited exception	When set to 1, this bit indicates that the disk drive has an unsolicited exception condition. Refer to the unsolicited exceptions status (byte 1), Table 11-14, for more information on conditions that can cause the error.
2^7	Status response	This bit is always set to 0 for a status response.

Table 11-14. Unsolicited Exceptions Status (Byte 1)

Bit	Name	Description
2^0	Media change	When set to 1, this bit indicates that the head disk assembly (HDA) was removed and replaced with another HDA.
2^1	Ready transition	When set to 1, this bit indicates that the disk drive changed from a not ready condition to a ready condition.
2^2	Not Ready transition	When set to 1, this bit indicates that the disk drive changed from a ready condition to a not ready condition.
2^3	Reserved	This bit is not used.
2^4	Alternate port format complete	When set to 1, this bit indicates that the alternate port received the notify alternate port of format completion bus control command.
2^5	Alternate port format change	When set to 1, this bit indicates that the alternate port accepted a new format specification.
2^6	Alternate port priority select	When set to 1, this bit indicates that the alternate port issued a disk drive address with the priority select bit set to 1.
2^7	Reset complete	When set to 1, this bit indicates that the disk drive completed a reset operation.

Table 11-15. Bus Control Exceptions Status (Byte 2)

Bit	Name	Description
2^0	Reserved	This bit is not used.
2^1	Reserved	This bit is not used.
2^2	Reserved	This bit is not used.
2^3	Data bus control late	When set to 1, this bit indicates that the bus control command was valid but the disk drive did not receive the command within a given time limit.
2^4	Bus control context	When set to 1, this bit indicates that the bus control command was valid but it conflicts with the current disk drive operation.
2^5	Unsupported bus control	When set to 1, this bit indicates that the bus control command was valid but the disk drive does not support the command.
2^6	Invalid parameter	When set to 1, this bit indicates that the bus control parameter was not valid.
2^7	Invalid bus control	When set to 1, this bit indicates that the bus control command issued was not valid.

Table 11-16. Drive Exceptions Status (Byte 3)

Bit	Name	Description
2^0	Reserved	This bit is not used.
2^1	Logic temperature fault	When set to 1, this bit indicates that the disk drive detected an over-temperature condition.
2^2	Voltage fault	When set to 1, this bit indicates that the disk drive detected a voltage that was out of range.
2^3	Reserved	This bit is not used.
2^4	Reserved	This bit is not used.
2^5	Head select fault	When set to 1, this bit indicates that the disk drive received an invalid head selection.
2^6	Off cylinder fault	When set to 1, this bit indicates that the heads were not positioned over the correct cylinder during a seek, or that the heads moved off cylinder during a data transfer.
2^7	Speed fault	When set to 1, this bit indicates that the platters did not reach the required rotation speed during spin-up or lost speed during a data transfer.

Table 11-17. Drive Exceptions Status (Byte 4)

Bit	Name	Description
2^0	Reserved	This bit is not used.
2^1	Reserved	This bit is not used.
2^2	Reserved	This bit is not used.
2^3	Data strobe fault	When set to 1, this bit indicates that the early or late data strobe was in effect when the disk drive received a write data bus control command.
2^4	Head offset fault	When set to 1, this bit indicates that the heads were in an offset position when the disk drive received a write data bus control command.
2^5	Write transmission fault	When set to 1, this bit indicates that the disk drive received a write data bus control command but did not receive write data.
2^6	Reserved	This bit is not used.
2^7	Write protected fault	When set to 1, this bit indicates that the disk drive received a write data bus control command but was in write protected mode.

Table 11-18. Drive Exceptions Status (Byte 5)

Bit	Name	Description
2^0	Reserved	This bit is not used.
2^1	Reserved	This bit is not used.
2^2	Reserved	This bit is not used.
2^3	Reserved	This bit is not used.
2^4	Reserved	This bit is not used.
2^5	Write/read diagnostic disable	When set to 1, this bit indicates that the internal read/write disk drive diagnostics are disabled.
2^6	Diagnostic test incomplete	When set to 1, this bit indicates that the disk drive failed to execute an internal diagnostic test.
2^7	Diagnostic status valid	When set to 1, this bit indicates that an error occurred during internal disk drive diagnostics.

Table 11-19. Drive Exceptions Status (Byte 6)

Bit	Name	Description
2^0	Head 0 error	When set to 1, this bit indicates that head 0 of the logical head group cannot write or read data.
2^1	Head 1 error	When set to 1, this bit indicates that head 1 of the logical head group cannot write or read data.
2^2	Head 2 error	When set to 1, this bit indicates that head 2 of the logical head group cannot write or read data.
2^3	Head 3 error	When set to 1, this bit indicates that head 3 of the logical head group cannot write or read data.
2^4	Head 4 error	When set to 1, this bit indicates that head 4 of the logical head group cannot write or read data.
2^5	Head 5 error	When set to 1, this bit indicates that head 5 of the logical head group cannot write or read data.
2^6	Head 6 error	When set to 1, this bit indicates that head 6 of the logical head group cannot write or read data.
2^7	Heads 7 or 8 error	When set to 1, this bit indicates that head 7 of the logical head group cannot write or read data or that head 8 cannot write or read data.

Table 11-20. Drive Exceptions Status (Byte 7)

Bit	Name	Description
2^0	Reserved	This bit is not used.
2^1	Field overrun	When set to 1, this bit indicates that the heads moved past the end of the ID or data field boundary before a write or read data operation finished.
2^2	Sector overrun	When set to 1, this bit indicates that the heads moved past the end of a sector boundary before a write or read data operation finished.
2^3	Track overrun	When set to 1, this bit indicates that the heads moved past the end of the track before a write or read data operation finished.
2^4	Operation fault	When set to 1, this bit indicates that an error occurred during the last disk drive operation.
2^5	Data control late	When set to 1, this bit indicates that the disk drive did not receive the write or read data bus control command in the specified time limit.
2^6	Data control reject Bit 2^0	00 – Normal status. 01 – The write or read data bus control command was not valid. 10 – The write or read data bus control command conflicted with a current disk drive operation. 11 – The disk drive received a write or read data bus control but the rotational position sensing (RPS) was disabled.
2^7	Data control reject Bit 2^1	

Extended Status Block

The extended status block is 8 bytes of additional IPI-2 status information transferred from the disk drive to the DCA2. The extended status block is read when the sequencer sends a bus control code for read status (48_{16}) to the disk drive over bus A. Tables 11-21 through 11-28 describe each bit in the extended status block.

Table 11-21. Interface Flags Status (Byte 0)

Bit	Name	Description
2^0	Format specification present	When set to 1, this bit indicates that a valid format specification has been loaded to the disk drive.
2^1	Status pending interrupt enables	When set to 1, this bit indicates that the status pending interrupts are enabled so the disk drive can use the Attention In signal on the current port.
2^2	RPS interrupt enabled	When set to 1, this bit indicates that the rotational positional sensing (RPS) interrupt is enabled so the disk drive can use the Attention In signal on the current port.
2^3	Command complete interrupt enabled	When set to 1, this bit indicates that the command complete interrupts are enabled so the disk drive can use the Attention In signal on the current port.
2^4	Reserve active	When set to 1, this bit indicates that the disk drive is reserved for use by the current port in use.
2^5	Alternate port enabled	When set to 1, this bit indicates that the alternate port is enabled.
2^6	Port number	When set to 0, this bit indicates that port A is in use. When set to 1, this bit indicates that port B is in use.
2^7	Extended status	This bit is always set to 1.

Table 11-22. Data Received Flags Status (Byte 1)

Bit	Name	Descriptions
2^0	Data ECC enabled	When set to 1, this bit indicates that the disk drive data field error correction code (ECC) circuitry is enabled. This option is not used by Cray Research, Inc. (CRI).
2^1	Header ECC enabled	When set to 1, this bit indicates that the disk drive ID field ECC circuitry is enabled. This option is not used by CRI.
2^2	Reserved	This bit is not used.
2^3	Late data strobe	When set to 1, this bit indicates that the late data strobe is active.
2^4	Early data strobe	When set to 1, this bit indicates that the early data strobe is active.
2^5	Offset magnitude bit 2^0	These bits indicate the magnitude of the head offset operation. If these bits are set to 0, the heads are not offset.
2^6	Offset magnitude bit 2^1	
2^7	Offset direction	When set to 0, this bit indicates that a positive offset of the heads is in effect. When set to 1, this bit indicates that a negative offset of the heads is in effect.

Table 11-23. Data Control Flags Status (Byte 2)

Bit	Name	Description
2^0	Reserved	This bit is not used.
2^1	Reserved	This bit is not used.
2^2	Reserved	This bit is not used.
2^3	Reserved	This bit is not used.
2^4	Reserved	This bit is not used.
2^5	Reserved	This bit is not used.
2^6	Spindle power on	When set to 1, this bit indicates that the disk drive power is on.
2^7	Write protected	When set to 1, this bit indicates that the disk drive is in write protected mode.

Table 11-24. Disk Drive Status (Byte 3)

Bit	Name	Description
2^0	Media present	When set to 1, this bit indicates that the head disk assembly (HDA) is present.
2^1	HDA ready	When set to 1, this bit indicates that the platters are rotating at the correct speed, and that the heads are loaded and positioned on the correct track.
2^2	Reserved	This bit is not used.
2^3	Reserved	This bit is not used.
2^4	Reserved	This bit is not used.
2^5	Reserved	This bit is not used.
2^6	On cylinder	When set to 1, this bit indicates that the heads are over the correct cylinder.
2^7	Speed	When set to 1, this bit indicates that the platters are rotating at the correct speed.

Table 11-25. Disk Drive Alarms Status (Byte 4)

Bit	Name	Description
2^0	Reserved	This bit is not used.
2^1	Logic over temperature	When set to 1, this bit indicates that the disk drive detected an over-temperature condition.
2^2	Voltage range error	When set to 1, this bit indicates that the disk drive detected an out-of-range voltage.
2^3	Reserved	This bit is not used.
2^4	Reserved	This bit is not used.
2^5	Illegal head select	When set to 1, this bit indicates that the disk drive has no heads selected, multiple heads selected, or the wrong head selected.
2^6	Reserved	This bit is not used.
2^7	Reserved	This bit is not used.

Table 11-26. Vendor Defined Status (Byte 5)

Bits	Name	Description
2^0 through 2^1	Reserved	These bits are not used.

Table 11-27. Vendor Defined Status (Byte 6)

Bits	Name	Description
2^0	Spindle type	When set to 0, this bit indicates that the disk drive is a Sabre 9 head parallel disk drive (DD-60). When set to 1, this bit indicates that the disk drive is a Sabre 8 head parallel disk drive (this disk drive is not used by CRI).
2^1 through 2^7	Reserved	These bits are not used.

Table 11-28. Head Skew Status (Byte 7)

Bits	Name	Description
2^0 through 2^7	Head skew bits	These bits contain the value of the head skew.

Flaw Location Information

The flaw location information contains the number of the physical head the flaw was detected under, the location of the flaw in the sector, and the defect parameter of the flaw. It is calculated and displayed by the OLHPA software. Table 11-29 describes each entry of the flaw location information.

Table 11-29. OLHPA Flaw Location Information

Information	Description
Head mask bit	When one of these bits is set to 1, this bit indicates that the sector under the corresponding physical head may have a flaw.
Correction offset	The correction offset contains the physical bit position of the detected flaw.
Defect address	The defect address contains the value for the defect parameter in a physical sector.
Combined head mask	When one or more of these bits are set to 1, these bits indicate that the sectors under the corresponding physical heads may have a flaw.
Flawing defect address	The flawing defect address contains the combined value (from multiple heads) for the defect parameter.

DD-60 Rear Panel Display I/O Status

During normal disk drive operations, the DD-60 rear panel display shows the current I/O status for the disk drive. The I/O status contains information on the state of the disk drive hardware and fault information. Table 11-30 describes each I/O status.

Table 11-30. DD-60 Rear Panel Display I/O Status

Status Display (Hex)	Description
00	Initial state after a power-up or slave reset. Successful completion of the power-up or slave reset diagnostics causes the display to change.
01	Initialization state after power-on diagnostics or slave reset. Also indicates that a not-ready transition was detected.
02	Invalid setting of ID microcode switches.
03	Waiting for first ready (first spin-up after power-up or reset). Also indicates that the ready-to-not ready transition was detected.
04	Timeout waiting for servo test to start.
05	Timeout waiting for servo test to end.

Table 11-30. DD-60 Rear Panel Display I/O Status (continued)

Status Display (Hex)	Description
06	Timeout waiting for drive to respond to I/O board.
07	Waiting for ready transition after spin-up command was issued.
08	Undefined.
09	Successful execution of read and write diagnostics.
0A	Undefined.
0B	Undefined.
0C	A test failed, a logic failure occurred, or the heads moved off cylinder during the read and write diagnostics.
0D	Timeout occurred while waiting for the heads to move over the cylinder.
0E	The On-cylinder signal was active after a seek or return-to-zero (RTZ) command was issued during read and write diagnostics.
0F	Expected active On-cylinder signal during read and write diagnostics.
10	Reserved.
11	A read/write fault occurred.
12	Attempted a read or write with a not on-cylinder fault.
13	Attempted a read or write with a not on-cylinder fault. Also a read/write fault occurred.
14	A first seek fault occurred.
15	A read/write fault and a first seek fault occurred.
16	Attempted a read/write while the heads were not on cylinder. Also a first seek fault occurred.
17	Attempted a read/write while the heads were not on cylinder, and a first seek fault and read/write fault occurred.
18	A write fault occurred.
19	A read/write fault and a write fault occurred.
1A	Attempted a read/write while the heads were not on cylinder, and a write fault occurred.
1B	Attempted a read/write while the heads were not on cylinder, and a read/write fault and a write fault occurred.
1C	A first seek fault and a write fault occurred.
1D	A read/write fault, a first seek fault, and a write fault occurred.
1E	Attempted a read or write while the heads were not on cylinder. A first seek fault and a write fault also occurred.
1F	Attempted a read or write while the heads were not on cylinder. A read/write fault, a first seek fault, and a write fault also occurred.
20	Reserved.
21	Attempted a write while write protected.
22	A head select fault occurred.
23	Attempted a write while write protected, and a head select fault occurred.

Table 11-30. DD-60 Rear Panel Display I/O Status (continued)

Status Display (Hex)	Description
24	A voltage fault occurred.
25	Attempted a write while write protected, and a voltage fault occurred.
26	A head select fault and a voltage fault occurred.
27	Attempted a write while write protected, and a head select fault and voltage fault occurred.
28	A seek error occurred.
29	Attempted a write while write protected and a seek error occurred.
2A	A head select fault and a seek error occurred.
2B	Attempted a write while write protected, and a head select fault with a seek error occurred.
2C	A voltage fault and seek error occurred.
2D	Attempted a write while write protected. A voltage fault with a seek error also occurred.
2E	A head select fault, voltage fault, and seek error occurred.
2F	Attempted a write while write protected and a head select fault, voltage fault, and seek error occurred.
30	The write/read diagnostic failed. The internal components most likely to have caused the failure: 1. Control circuit board 2. IPI-2 logic circuit board 3. Multiple channel read/write failure or the diagnostic cylinder was not formatted 4. HDA module
31	The write/read diagnostic failed. The internal components most likely to have caused the failure: 1. Read/write channel 8 circuit board 2. Multiple channel read/write failure or the diagnostic cylinder was not formatted 3. Control circuit board 4. IPI-2 logic circuit board
32	The write/read diagnostic failed. The internal components most likely to have caused the failure: 1. Read/write channel 0 and 7 circuit board 2. Read/write channel 8 circuit board 3. Control circuit board 4. IPI-2 logic circuit board
33	The write/read diagnostic failed. The internal components most likely to have caused the failure: 1. Read/write channel 0 and 7 circuit board 2. Control circuit board 3. IPI-2 logic circuit board 4. HDA module

Table 11-30. DD-60 Rear Panel Display I/O Status (continued)

Status Display (Hex)	Description
34	The write/read diagnostic failed. The internal components most likely to have caused the failure: 1. Read/write channel 1 and 6 circuit board 2. Control circuit board 3. IPI-2 logic circuit board 4. HDA module
35	The write/read diagnostic failed. The internal components most likely to have caused the failure: 1. Read/write channel 2 and 5 circuit board 2. Control circuit board 3. IPI-2 logic circuit board 4. HDA module
36	The write/read diagnostic failed. The internal components most likely to have caused the failure: 1. Read/write channel 3 and 4 circuit board 2. Control circuit board 3. IPI-2 logic circuit board 4. HDA module
37	The write/read diagnostic failed. The internal components most likely to have caused the failure: 1. Read/write channel 8 circuit board 2. Control circuit board 3. IPI-2 logic circuit board 4. HDA module
38 through 7F	Undefined.
80 through FF	Reserved.

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