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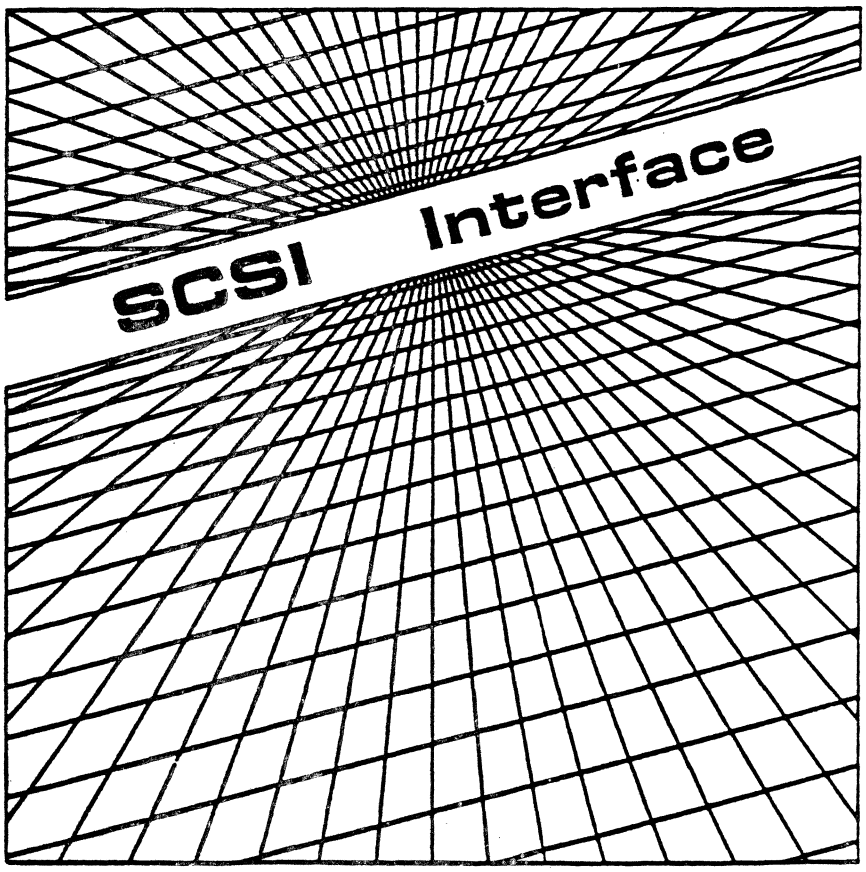
HP C2233/C2234/C2235
3.5-inch Disk Drives

SCSI Interface Technical Reference Manual



HEWLETT PACKARD

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SCSI Interface

Introduction

This chapter describes the implementation of the Small Computer System Interface, SCSI on the HP C2233/C2234/C2235 Disk Drives. The information includes an overview of the SCSI features, options, and commands supported by these products. Any operating characteristics relevant to SCSI implementation are also discussed. In this manual the term Target refers to the HP C2233/C2234/C2235 Disk Drives.

Table 1-1 provides a list of all the commands supported by the Target and identifies which commands are SCSI implementations and which commands are Vendor Unique implementations.

Chapter 2 provides detailed descriptions of the SCSI commands supported by the Target. These descriptions are in alphabetical order and include Command Descriptor Block (CDB) formats, data formats, and all device specific information involved in command execution. For further command specific details, refer to the ANSI SCSI Specification.

Chapter 3 provides descriptions of the Vendor Unique commands supported by the Target. These descriptions include Command Descriptor Block (CDB) formats, data formats, and all device specific information involved in command execution.

Supported Features

The Target support the following features and options:

- **Single-Ended and Differential Drivers.** The standard product supports single-ended drivers. Differential drivers are available, as an option.
- **SCSI Connector.** The Target is equipped with a 50-pin unshielded connector.
- **Arbitration.** Full arbitration is supported.
- **Disconnect.** If allowed, the Target may disconnect after a command is received, and for any significant delay occurring during a data transfer operation.
- **Linked Commands.** Command linking is supported.

- **Power-On.** In response to a Power-on condition, the Target performs the following power-on time sequence:
  - Microprocessor Self Test
  - Microprocessor RAM Test
  - Data Controller Test
  - ECC Verification Test
  - Buffer RAM Test
  - Spinup Motor (if "Auto Spin Up" enabled - see "NOTE" below)
  - Initialize Spare Table
  - Initialize Log
  - Initialize Saved Pages Information
  - R/W Access Test

Note

Motor spinup may take approximately 33 seconds. During this time the drive will respond to all commands with a status byte of CHECK CONDITION and a SENSE KEY CODE of NOT READY in response to a REQUEST SENSE command.

- **Data Head Alignment.** These drives incorporate the capability to perform periodic data head alignments. A full head alignment is executed at power-on. Subsequent head alignments may be executed relative to temperature changes and /or elapsed time since power-on.
- **Bus Reset.** In response to a SCSI bus reset or Bus Device Reset message, the Target will perform the following reset time sequence:
  - Abort Any Command in Progress
  - Controller Initialization
  - Initialize Spare Table
  - Initialize Log
  - Initialize Saved Pages Information

■ **SCSI Messages.** The following SCSI messages are supported:

Code (hex)	Length (bytes)	Message	Direction[1]
00	1	Command Complete	In
01	2[2]	Extended Message to Follow	In/Out
		The following extended message is supported:	
01	3*	Request for SDTR * 3 = added length in bytes	In/Out
02	1	Save Data Pointers	In
04	1	Disconnect	In
05	1	Initiator Detected Error	Out
06	1	Abort	Out
07	1	Message Reject	In/Out
08	1	No Operation	Out
09	1	Message Parity error	Out
0A	1	Linked Command Complete	In
0B	1	Linked Command Complete With Flag	In
0C	1	Bus Device Reset	Out
80-FF	1	Identify	In/Out

Notes:

1. In = Target to Initiator; Out = Initiator to Target.
2. 2nd byte indicates additional length of extended message.

■ **Status Codes.** The following status byte codes are supported:

Code (hex)	Status
00	Good
02	Check Condition
08	Busy
10	Intermediate Good
18	Reservation Conflict

Table 1-1. HP C2233/C2234/C2235 Supported Commands

Command Name	Opcode (hex)	SCSI Command (Chapter 2)	Vendor Unique Command (Chapter 3)
Access Log	F2		*
Execute Data	FE		*
Format Unit	04	*	
Inquiry	12	*	
Interface Control	EF		*
Manage Primary	FD		*
Media Test	F1		*
Mode Select (6-byte)	15	*	
Mode Select (10-byte)	55	*	
Mode Sense (6-byte)	1A	*	
Mode Sense (10-byte)	5A	*	
Read (6-byte)	08	*	
Read (10-byte)	28	*	
Read Buffer	3C	*	
Read Capacity	25	*	
Read Defect Data	37	*	
Read Headers	EE		*
Read Long	3E	*	
Reassign Blocks	07	*	
Reformat Track	ED		*
Release	17	*	
Request Sense	03	*	
Reserve	16	*	
Rezero Unit	01	*	
Seek (6-byte)	0B	*	
Seek (10-byte)	2B	*	
Send Diagnostic	1D	*	
Start/Stop Unit	1B	*	
Test Unit Ready	00	*	
Verify	2F	*	
Write (6-byte)	0A	*	
Write (10-byte)	2A	*	
Write and Verify	2E	*	
Write Buffer	3B	*	
Write Long	3F	*	

Status Byte

A status byte is sent from the Target to the Initiator during the STATUS phase at the termination of each command as specified, unless the command is cleared by an ABORT message, by a BUS DEVICE RESET message, or by a "hard" RESET condition. The status byte format, code values, and code descriptions are shown below.

Status Byte Format

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Reserved	Vendor Unique=0		Status Byte Code				VU=0

Status Byte Code Descriptions

Value				Status	Description
4	3	2	1		
0	0	0	0	Good	Indicates that Target has successfully completed the command.
0	0	0	1	Check Condition	Caused by any error, exception, or abnormal condition that causes sense data to be set. The REQUEST SENSE command should be issued following a CHECK CONDITION status to determine the nature of the condition.
0	1	0	0	Busy	The Target is busy. This status is returned whenever a Target is unable to accept a command from an Initiator. The normal Initiator recovery action is to issue the command again at a later time.
1	0	0	0	Intermediate/ Good	This status is returned for every command in a series of linked commands (except the last GOOD command), unless an error, exception, or abnormal condition causes a CHECK CONDITION status to be set. If this status is not returned, the chain of linked commands is broken; no further commands in the series will be requested.
1	1	0	0	Reservation Conflict	This status is returned whenever a SCSI device attempts to access a logical unit that is reserved to another SCSI device.

SCSI Message Support

The disk drive supports messages received from the Initiator in the following manner:

- Multiple byte message out phases are allowed.
- Any message out may be prefixed with an optional Identify byte.
- An optional number of No-Op message bytes may be embedded in the message out received by the disk drive prior to the final message byte.
- Only one message type (other than the Identify prefix and the optional No-Op bytes) will be accepted per message out phase. If more than one type is received, the message will be treated as an illegal message.
- A maximum of 16-message out bytes will be accepted by the disk drive. if the ATN line is still set after 16 bytes have been received, the disk drive will treat this as an illegal message type, except that the disk drive will always terminate in a BUS FREE state.

The following message types are supported:

Message Parity Error **Initiator Detected Error**	If either of these messages is received from the Initiator, the disk drive will abort the command in process and set the sense key to ABORTED COMMAND with the sense code set to INITIATOR DETECTED ERROR. If a valid LUN has been received in an Identify or CDB, and a status phase has not yet begun, then the command will be terminated with a CHECK CONDITION status; otherwise the Target will go to the BUS FREE phase.
Abort	This message will cause the disk drive to abort the command in process, clear the Initiator's status and go to the BUS FREE state.
Reset	This message will cause the disk drive to abort the command in process, reset to Power On conditions for all Initiators, and go to the BUS FREE state.
No-Op	This message will be treated as an illegal message type if not followed by some legal message byte, except when the No-Op message type is received immediately following a Re-select attempt by the Target. In this case, the Target will attempt to proceed with the interrupted re-select phase.
Message Reject	If a MESSAGE REJECT message is received from the Initiator it will normally be treated like an Illegal Message. Only if the Target is in the MESSAGE IN phase and attempting to send one of the following messages will it be treated differently. **Disconnect Message In, Save Data Pointer Message In.** The Target will not disconnect and will proceed with the command in process. This will not prevent the disk drive from attempting to disconnect from the Initiator at a later time. **Synchronous Data Transfer Message In.** The Target will assume that an asynchronous transfer is expected. This will affect all later data transfer phases.

Extended SDTR Message	The SDTR (Synchronous Data Transfer Request) message type will only be accepted prior to the Command phase, and only prior to the first Command phase in a linked command set. At any other time it will be treated as an illegal message type. If the negotiation process is started by the Initiator, the drive will respond with its SDTR message. If the Initiate SDTR Message Option is enabled, the drive will initiate an SDTR message at Power On and RESET.

Target Error Conditions

Under some error conditions the Target may proceed to the BUS FREE phase without terminating the command (i.e. no DISCONNECT or COMMAND COMPLETE message sent to the host). In this case, the Target will not attempt to re-connect with the Initiator. The Initiator should consider this as a catastrophic error. Information regarding the cause of this abnormal response can be recovered by the Initiator with the REQUEST SENSE command.

Message Out Phase Parity Error

If parity checking is enabled and a message out parity error is detected the disk drive will abort the command in process and set the sense key to ABORTED COMMAND with the sense code set to PARITY ERROR. If a valid LUN has been received in an identify or in the CDB, and status phase has not yet begun, then the command will be terminated with a CHECK CONDITION status; otherwise, the Target will go the the BUS FREE state.

Command or Data Out Phase Parity Error

If parity checking is enabled and a Command or Data Out phase parity error is detected then disk drive will terminate the command in process with a CHECK CONDITION status. The sense information will have the sense key set to ABORTED COMMAND with the sense code set to PARITY ERROR.

Illegal Messages

If an illegal or unexpected message out is received from the Initiator, the disk drive will abort the command in process and set the sense key to ABORTED COMMAND with the sense code set to INAPPROPRIATE/ILLEGAL MESSAGE. If a valid LUN has been received in an identify or in the CDB, and the status phase has not yet begun, then the command will be terminated with a CHECK CONDITION status; otherwise the Target will go to the BUS FREE phase.

Reselection Timeout.

If the Target attempts to reselect the Initiator and the Initiator does not respond within a SELECTION TIMEOUT DELAY, the Target will attempt to reselect a second time. If the second attempt fails, the Target will abort the command in process and make no further attempts to reselect the host. The sense information will be set with a sense key of HARDWARE ERROR and a sense code of SELECT/RESELECT FAILED.

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SCSI Command Descriptions

This chapter provides descriptions of the SCSI commands supported by the Target. Table 2-1 is a list of the SCSI commands supported by the Target with brief descriptions included for each command.

Command Descriptions

Detailed descriptions of the SCSI commands supported by the Target are provided in the following pages. These descriptions include Command Descriptor Block (CDB) formats, data formats, and all device-specific information involved in command execution. For a detailed explanation of the commands, refer to the ANSI SCSI Specification.

Control Byte

A control byte is the last byte of every Command Descriptor Block (CDB).

Control Byte Format

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Last	Vend Unq = 0		Reserved				Flag	Link

Link. This bit is set to one (1) to indicate that the Initiator desires an automatic link to the next command upon successful completion of the current command. Implementation of linked commands is optional. If the LINK bit is one (1), Targets that implement linked commands, upon successful termination of the command, shall return INTERMEDIATE status and shall then send one of the two messages defined by the FLAG bit described below.

Flag. If the LINK bit is set to zero (0), then the FLAG bit shall be set to zero (0). If the LINK bit is set to one (1), and if the command terminates successfully, the Target will send LINKED COMMAND COMPLETE message if the FLAG bit is set to zero (0); and will send LINKED COMMAND COMPLETE (WITH FLAG) message if the FLAG bit is set to one (1). Typically, this bit is used to cause an interrupt in the Initiator between linked commands.

Command Details

The following information applies to all commands:

- The abbreviations "MSB" and "LSB" in the CDB and other descriptor blocks refer to the most significant byte and least significant byte, respectively.
- The Target only supports a single Logical Unit Number (LUN). All commands must be addressed to LUN 0, except an INQUIRY command which may be directed to any LUN.
- All reserved fields in each command must be set to 0.
- All reserved and vendor-unique fields in each command are tested for proper values (normally 0).

Table 2-1. Supported SCSI Commands

Command	Opcode (hex)	Description
Format Unit	04	Formats Target media into Initiator addressable logic blocks. Defect sources include P, D, and G lists (no C list). When formatting, it is recommended that the Initiator not include a D list (FMTDAT=0). However, if the Initiator does include a D list, it must be in the physical sector or bytes from index format. The Target uses an interleave of 1 regardless of the value in Interleave field.
Inquiry	12	Requests that information regarding Target be sent to the Initiator. Target returns 36 bytes of SCSI Standard Product Data. Additional Vital Product Data (VPD) may be supplied if requested by the Initiator.
Mode Select (6-byte) (10-byte)	 15 55	Provides a means for Initiator to specify media, logical unit, or drive parameters to Target. The following values are supported: ■ Media Type: 0 ■ Density Code: 0 ■ Number of Blocks: 0 ■ Block Length: 512, 1024, 2048, or 4096 bytes ■ Page Code (hex): 01, 02, 03, 04, 08, 09, 0C, 25 Use of the following is supported: ■ Disable Correction (DCR) ■ Data Termination on Error (DTE) ■ Post Error (PER) ■ Transfer Block (TB) ■ Retry Count ■ Recovery Limit (converts to Retry Count)

Table 2-1. Supported SCSI Commands (continued)

Command	Opcode (hex)	Description
Mode Sense (6-byte) (10-byte)	 1A 5A	Provides a means for Target to report its media, logical unit, or drive parameters to Initiator. The following CDB values are supported: ■ Page Control Field: **00** (current values); **01** (changeable values); **10** (default values); **11** (saved values) ■ Page Code (hex): 01, 02, 03, 04, 08, 09, 0C, 25, 3F The Target default block size is 512 bytes. Default page parameters are listed in the MODE SENSE command description.
Read (6-byte) (10-byte)	 08 28	Requests Target to transfer data to Initiator. Both 6-byte and 10-byte (extended) command formats are supported. Relative Addressing not supported in extended (10-byte) format (REL=0).
Read Buffer	3C	Used with WRITE BUFFER command to test the Target's data buffer. Recommend executing RESERVE command to guarantee data integrity.
Read Capacity	25	Enables Initiator to request information regarding capacity of logical unit. Use of PMI bit supported. Relative Addressing not supported (REL=0).
Read Defect Data	37	Requests Target to transfer media defect data to Initiator. Target returns P, G, or P+G lists in physical sector or bytes from index format.
Read Long	3E	Requests Target to return the header, data field and ECC bytes of one physical sector.
Reassign Blocks	07	Requests Target to reassign defective logical blocks to an area on logical unit reserved for this purpose. It is recommended that the defect list contain only one defect location per command.
Release	17	Releases previously reserved logical units. Unit and Third-Party Release supported. Extent Release not supported.
Request Sense	03	Only the Extended Sense Data Format is supported. The Bit Pointer and Field Pointer fields are not used.
Reserve	16	Unit and Third-Party Reservations are supported. Extent Reservations are not supported.
Rezero Unit	01	Requests Target to perform a recalibrate and then to seek to logical address 0.

Table 2-1. Supported SCSI Commands (continued)

Command	Opcode (hex)	Description
Seek (6-byte) (10-byte)	 0B 2B	Requests Target to seek to a specified address. Both 6-byte and 10-byte (extended) formats are supported. Target returns GOOD status when seek is complete.
Send Diagnostic	1D	Self-test (Power-On) is supported. If self-test fails, CHECK CONDITION status indicates that results are available via REQUEST SENSE command.
Start/Stop Unit	1B	Both modes are supported. The immediate bit on START is not supported.
Test Unit Ready	00	Checks Target spindle for proper speed. Target returns GOOD status if drive is up to speed.
Verify	2F	Requests Target to verify the data written on the media by performing a selectable ECC check or a byte compare. Relative addressing not supported. (REL=0).
Write (6-byte) (10-byte)	 0A 2A	Requests Target to write the data transferred by the Intitiator to the media. Both 6-byte and 10-byte (extended) formats are supported. Relative Addressing not supported in extended (10-byte) format (REL=0).
Write And Verify	2E	The Target performs a write followed by an ECC verify pass or a byte compare. Relative addressing not supported. (REL=0).
Write Buffer	3B	May be used to test Target's data buffer or download code. To avoid possible data corruption, it is recommended that a RESERVE command be executed prior to the WRITE BUFFER command.
Write Long	3F	Allows Initiator to write one complete physical sector, including header, data, and ECC fields.

Command Use Before Spinup

Table 2-2 provides an overview of the supported SCSI commands and indicates which commands can be used before spinup.

Table 2-2. SCSI Command Overview

SCSI Command	Opcode (hex)	Use Before Spinup
Format Unit	04	No
Inquiry	12	Yes
Mode Select (6-byte)	15	No[1]
Mode Sense (6-byte)	1A	No[1]
Read (6-byte)	08	No
Read (10-byte)	28	No
Read Buffer	3C	No
Read Capacity	25	No
Read Defect Data	37	No
Read Long	3E	No
Reassign Blocks	07	No
Release	17	Yes
Request Sense	03	Yes
Reserve	16	Yes
Rezero Unit	01	No
Seek (6-byte)	0B	No
Seek (10-byte)	2B	No
Send Diagnostic	1D	No
Start/Stop Unit	1B	Yes
Test Unit Ready	00	Yes
Verify	2F	No
Write (6-byte)	0A	No
Write (10-byte)	2A	No
Write and Verify	2E	No
Write Buffer	3B	No
Write Long	3F	No

1. Mode Select and Mode Sense commands that do not involve saved pages may be used before spinup.

Format Unit

The FORMAT UNIT command formats the Target media into Initiator-addressable logical blocks according to Initiator defined options. During execution of the FORMAT UNIT command, the Target may perform a media defect management algorithm (which can be controlled by the Initiator using optional forms of the command). Defect management instructions (if any) are contained in the Defect List supplied to the Target in the Data Out phase of the command.

The FORMAT UNIT command ensures that the media is formatted so that all data blocks can be accessed. Any data residing on the media before this command is issued will be lost. Any log information will be cleared by the format operation. The current Mode Select operating parameters will become the saved values.

Format Unit Command Descriptor Block (CDB)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Opcode = 04H							
01	Logical Unit Number			FMTDTA	CMPLST	Defect List Format		
02	Vendor Unique							
03—04	(MSB=03)			Interleave		(LSB=04)		
05	Control Byte							

There are three possible sources of defect location information during execution of the FORMAT UNIT command.

Primary Defect List (Plist)	This is the list of defects, supplied by the original manufacturer, that are considered as permanent defects. The Plist is located outside of the Initiator-accessible logical block space. The Plist is accessible by the Target (to reference while formatting), but is not normally accessible by the Initiator except through the READ DEFECT command. Once created, the original Plist is not subject to change.
Data Defect List (Dlist)	Supplied by the Initiator in the Data Out phase of the FORMAT UNIT command. This list is added to the Glist.
Grown Defect List (Glist)	Maintained by the Target and includes all defects sent to the Target from the Initiator (the Dlist), any defects identified by the Target during previous and current FORMAT UNIT operations, and any defects identified by a REASSIGN BLOCKS command. The Glist does NOT include the Plist.

FMTDTA (Format Data), CMPLST (Complete List). These bits indicate to the Target what to do with the supplied Dlist information.

The FMTDTA bit indicates whether the Initiator will send additional defect information (Dlist) to the Target. If FMTDTA is set to zero (0), there will be no Data Out phase, the Target will not receive a new Dlist and all previous defect information (Plist and Glist) is retained.

If FMTDTA is set to 1, a new Dlist will be supplied by the Initiator. When FMTDTA is 1, the CMPLST bit determines whether or not existing defects in the Glist will be retained during the format. If CMPLST is set to zero (0), the Glist is retained and the Dlist is appended to it. If CMPLST is set to 1, the existing Glist is deleted and replaced by the new Dlist.

Defect List Format. This field must be set to 5 for physical sector format (recommended), or to 4 for bytes from index format, or if the defect list length is zero, to less than 4 (0XX) for block format.

FORMAT UNIT Defect Sources

FMTDTA	CMPLST	Defect List Format Field	Defect List Supplied	Target Instructions
0*	X	X X X	No	No Data Out Phase. Retain current Plist.
1	0	1 0 1 or 1 0 0 or 0 X X**	Yes	Append new defect list to current Plist. Retain current Glist.
1	1	1 0 1 or 1 0 0 or 0 X X**	Yes	Delete current Plist. Build new Plist with new defect list. Do not retain current Glist.

* The preferred option is FMTDTA = 0.

** Defect list length of zero only.

Interleave. These bytes specify the order in which logical blocks are related to physical blocks. Any interleave value will be accepted, but the Target will always use its default interleave value of (1) so that logical blocks are placed in consecutive physical order.

Defect List Header

The defect list consists of a 4-byte header followed by zero or more 8-byte defect descriptors. Each descriptor consists of an 8-byte physical address or bytes from index address. Each address is bounds-checked by the Target. If any address is out of bounds, an ILLEGAL REQUEST Sense Key is generated, and the format operation is discontinued.

FORMAT UNIT Defect List Header Format

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00	Reserved							
01	FOV	DPRY	DCRT=1	STPF	IP=0	DSP	IMED=0	VU=0 -
02—03	(MSB=02)			Defect List Length		(LSB=03)		

FOV (Format Options Valid). If the FOV bit is set to one (1), the drive will accept a DPRY (Disable Primary), STPF (Stop Format) and/or DSP (Disable Saving Parameter) bit(s) set to one (1). All other options must be set to zero (0).

DPRY (Disable Primary). A DPRY bit of zero (0) indicates that Target will not use portions of the media identified as defective in the Plist for Initiator addressable logic blocks. If the Target cannot locate the Plist or it cannot determine if a Plist exists, it will perform the action specified by the STPF bit.

A DPRY bit of one (1) indicates that the target will not use the Plist to identify defective areas of the media. The Plist is not deleted.

DCRT (Disable Certification). The DCRT bit must be set to one (1), indicating that the target will not perform any vendor-specific media certification process or format verification operation while executing the FORMAT UNIT command.

STPF (Stop Format). The STPF bit controls the behavior of the Target when one of the following events occurs:

1. The Target has requested the use of the Plist (DPRY is set to zero), or the Glist (CMPLST is set to zero) and the Target cannot locate the list or determine whether the list exists.
2. The target has been requested to use the Plist (DPRY is set to zero) or the Glist (CMPLST) is set to zero), and the target encounters an error while accessing the Dlist.

A STPF bit of zero (0) indicates that, if one or both of the above conditions occurs, the Target will continue to execute the FORMAT UNIT command. The Target will return CHECK CONDITION status at the completion of the FORMAT UNIT command. The Sense Key will be set to RECOVERED ERROR and the Additional Sense Code will be set to either DEFECT LIST NOT FOUND if condition 1 described above occurs, or DEFECT LIST ERROR if condition 2 occurs.

A STPF bit of one (1) indicates that, if one or both of the above conditions occurs, the Target will terminate the FORMAT UNIT command with a status of CHECK CONDITION, a Sense Key of MEDIA ERROR, and an Additional Sense Code of either DEFECT LIST NOT FOUND if condition 1 occurred, or DEFECT LIST ERROR if condition 2 occurred.

IP (Initialization Pattern). The IP bit must be set to zero (0), indicating that no Initialization Pattern will be sent. The Target will use its default initialization pattern when it formats the media.

DSP (Disable Saving Parameter). A DSP bit of one (1) specifies that the Target will not save the MODE SELECT parameters.

VU (Vendor Unique). This bit should be set to zero (0).

Defect List Length. This field specifies the total length in bytes of the defect descriptor that follows.

Defect Descriptor Format

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00—02	(MSB=00) Cylinder Number Of Defect (LSB=02)							
03	Head Number Of Defect							
04—07	(MSB=04) Defect Sector Number Or Bytes From Index (LSB=07)							

A sector number of FFFFFFFFH indicates that the entire track will be reallocated.

Inquiry

The INQUIRY command requests that information regarding parameters of the Target be sent to the Initiator.

The INQUIRY command will return a CHECK CONDITION status only when the Target cannot return the requested Inquiry data. Inquiry data will be returned even though the peripheral device may not be ready for other commands. The INQUIRY command will execute even if the drive is reserved to another Initiator.

If an INQUIRY command is received from an Initiator with a pending UNIT ATTENTION condition (before the Target reports CHECK CONDITION status), the Target will execute the INQUIRY command and will not clear the UNIT ATTENTION condition.

Note

An INQUIRY command directed to an invalid LUN ($\neq 0$) will return a Peripheral Device Type of 7FH (Logical Unit Not Present) in byte 0 of the parameter list. This condition is not considered an error. The INQUIRY command will be executed with no error reported even if the Target is reserved by/to a different Initiator.

Inquiry Command Descriptor Block (CDB)

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00	Opcode = 12H							
01	LUN (Logical Unit Number)			Reserved				EVPD
02	VPD Identifier							
03	Reserved							
04	Allocation Length							
05	Control Byte							

EVPD (Enable Vital Product Data) and VPD Identifier. The status of the EVPD bit and the VPD Identifier field determine the information to be returned to the Initiator. The supported combinations are:

EVPD bit	VPD Identifier	Target Will Return:
0	00H	Standard Inquiry Parameter Page
1	00H	Supported VPD Page List
1	80H	Unit Serial Number VPD Page
1	E0H	Manufacturing Information VPD Page

If the EVPD bit is set to zero (0), and the VPD Identifier field is set to one (1), the Target will return a status of CHECK CONDITION, a sense key set to ILLEGAL REQUEST, and an additional sense code of INVALID FIELD IN CDB.

Allocation Length. This field specifies the number of bytes that the Initiator has allocated for returned Inquiry data. An Allocation Length of zero indicates that no INQUIRY data will be transferred. This condition will not be considered as an error. Any other value indicates the maximum number of bytes that will be transferred. The Target will terminate the DATA IN

phase when the specified number of bytes have been transferred or when all available Inquiry data have been transferred to the Initiator, whichever is less.

Standard Inquiry Parameter Page Format

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00	Peripheral Qualifier (bits 7 - 5) / Peripheral Device Type (bits 4 - 0) all zero's = requested LUN is supported 7FH = requested LUN is not supported							
01	RMB=0	Reserved						
02	ISO VER = 0		ECMA VER = 0			ANSI VER = 2		
03	AENC	Reserved			Response Data Format = 2			
04	Additional Parameter Length (n=4)							
05—06	Reserved							
07	RELADR = 0	WBUS32 = 0	WBUS16 = 0	SYNC = 1	LINKED = 1	CACHE = 0	CMDQUE = 0	SOFTR = 0
08—15	Vendor Identification Bytes (ASCII)							
08	= H (ASCII)							
09	= P (ASCII)							
10-15	= ASCII Spaces							
16—31	Product Identification Bytes (ASCII)							
16	= C (ASCII)							
17	= 2 (ASCII)							
18	= 2 (ASCII)							
19	= 3 (ASCII)							
20	C2233: = 3 (ASCII) C2234: = 4 (ASCII) C2235: = 5 (ASCII)							
21	Product ID (ASCII)							
22	Product ID (ASCII)							
23	Product ID (ASCII)							
24	Product ID (ASCII)							
25-31	= ASCII Spaces							
32—35	(MSB=32) Product Revision Number (ASCII) (LSB=35) (4-digit date code)							

Page Code 00H: Supported VPD Page List Format

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Peripheral Qualifier (bits 7 - 5) / Peripheral Device Type (bits 4 - 0) all zero's = requested LUN is supported 7FH = requested LUN is not supported							
01	Page Code = 00H							
02	Reserved							
03	Page Length = 3							
04	Page Code 00H, Supported VPD Page List							
05	Page Code 80H, Unit Serial Number							
06	Page Code E0H, Manufacturing Information							

Page Code 80H: Unit Serial Number VPD Page Format

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Peripheral Qualifier = 0			Peripheral Device Qualifier = 0				
01—04	Reserved							
05	VPD Identifier = 80H							
06	Reserved							
07	VPD ASCII Data Length = 0AH							
08—17	Product Serial Number (ASCII)							

Page Code E0H: Manufacturing Information VPD Page Format

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Peripheral Qualifier = 0			Peripheral Device Type = 0				
01—04	Reserved							
05	VPD Identifier = E0H							
06	Reserved							
07	VPD ASCII Data Length = 50H							
08—17	Manufacturing Product Code							
08	= C (ASCII)							
09	= 2 (ASCII)							
10	= 2 (ASCII)							
11	= 3 (ASCII)							
12	C2233: = 3 (ASCII) C2234: = 4 (ASCII) C2235: = 5 (ASCII)							
13	Product ID (ASCII)							
14—16	Option Indicator (ASCII)							
17	ASCI Space							
18—27	HDA Serial Number							
28—37	SCSI Firmware Revision Number							
38—47	DSP Firmware Revision Number							
48—57	Option Pin-set Configurations (0 = open; 1 = shorted)							
48	pin-set 3 (Unit Attention)							
49	pin-set 4 (SDTR)							
50	pin-set 5 (Parity)							
51	pin-set 6 (Auto Spin Up)							

52—54	SCSI Address
	byte 52 = pin-set 7 (bit 2);
	byte 53 = pin-set 8 (bit 1);
	byte 54 = pin-set 9 (bit 0);							

55—57	ASCII Spaces							
58—87	ASCII Spaces							

Mode Select, Mode Sense

The MODE SELECT command provides a means for the Initiator to specify media, logical unit, or peripheral device parameters to the Target.

The MODE SENSE command provides a means for a Target to report its media, logical unit, or peripheral device parameters to the Initiator. It is a complementary command to the MODE SELECT command.

Mode Select Command Description

If a MODE SELECT modifies operating parameters that are common to other Initiators, the Target will report CHECK CONDITION status and UNIT ATTENTION Sense Key with Additional Sense Code of MODIFIED PARAMETERS when next accessed by other Initiators but not by the Initiator issuing the MODE SELECT command. This rule does NOT override the normal first access rule for each Initiator, nor does it override the normal rules for INQUIRY and REQUEST SENSE.

Mode Select (6-Byte) Command Descriptor Block (CDB)

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00	Opcode = 15H							
01	Logical Unit Number			PF	Reserved			SP
02—03	(MSB=02)			Reserved	(LSB=03)			
04	Parameter List Length							
05	Control Byte							

Mode Select (10-Byte) Command Descriptor Block (CDB)

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00	Opcode = 55H							
01	Logical Unit Number			PF	Reserved			SP
02—06	(MSB=02)			Reserved	(LSB=06)			
07—08	(MSB=07)			Parameter List Length			(LSB=08)	
09	Control Byte							

PF (Page Format) A PF bit set to one (1) indicates that the data is sent in the SCSI-2 page format. When set to zero (0), the data is sent in the vendor unique format. For this product both formats are the same and the PF bit is ignored.

SP (Save Page) This bit indicates that the Target should save any savable pages sent with this command. If the SP bit is set to one (1), the current block size will also be saved.

Parameter List Length This field specifies the length in bytes of the MODE SELECT parameter list that will be transferred during the DATA OUT phase. A parameter list length of zero indicates that no data will be transferred. This condition is not considered as an error. If non-zero, the parameter length must contain a header and optionally a Block Descriptor (if Block Descriptor Length is 8) and optional Parameter Pages.

The currently supported Parameter Pages are:

Page Codes	Parameter Pages
01H	Read Write Error Recovery Parameters
02H	Device Disconnect/Reconnect Parameters
03H	Direct Access Device Format Parameters
04H	Rigid Disk Drive Geometry Parameters
08H	Cache Control Parameters
09H	Peripheral Device Parameters
0CH	Notch and Partition Page
25H	VPD Initialization Parameters

The minimum page length accepted is 2 bytes (page code plus length). The Page Length field must exactly match the values supplied in the Mode Sense data. Illegal parameter lengths will result in a CHECK CONDITION status with a Sense Key of ILLEGAL REQUEST.

Mode Sense Command Description

Mode Sense (6-Byte) Command Descriptor Block (CDB)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Opcode = 1AH							
01	Logical Unit Number			Reserved	DBD	Reserved		
02	PC		Page Code					
03	Reserved							
04	Allocation Length							
05	Control Byte							

Mode Sense (10-Byte) Command Descriptor Block (CDB)

	Bit							
byte	7	6	5	4	3	2	1	0
00	Opcode = 5AH							
01	Logical Unit Number			Reserved	DBD	Reserved		
02	PC		Page Code					
03—06	Reserved							
07—08	(MSB=07)		Allocation Length			(LSB=08)		
09	Control Byte							

DBD (Disable Block Descriptors). This field indicates whether or not the target will return any block descriptors. A DBD bit of zero (0) indicates that zero or more block descriptors will be returned. A DBD bit of one (1) indicates that no block descriptors will be returned.

PC (Page Control). This field defines the Parameter Page type to be returned. The supported values for this field are:

00 = Report Current Values	Returns the parameters set in the last successful MODE SELECT command; or the saved values if a MODE SELECT command has not been executed since the last Power On, Hard Reset, or Bus Device Reset; or the default values if saved values are not available.
01 = Report Changeable Values	The changeable values are listed in the Parameter Values table that follows each of the page format tables.
10 = Report Default Values	The default values are listed in the Parameter Values table that follows each of the page format tables.
11 = Report Saved Values	Returns the saved values of the requested Parameter Pages. (Savable Pages are indicated in the following table and in the title block for each page format table.) The Save Block size is reported in the Block Length field of the Block Descriptor.

Page Code. This field specifies which page(s) are to be returned to the initiator. The target supports the following page codes:

Page Code	Description	Saveable
00H	Return No Pages	n/a
01H	Error Recovery Parameters	Yes
02H	Device Disconnect/Reconnect Parameters	Yes
03H	Direct Access Device Format Parameters	Yes
04H	Rigid Disk Drive Geometry Parameters	No
08H	Cache Control Parameters	Yes
09H	Peripheral Device Parameters	Yes
0CH	Notch and Partition Page	No
3FH	Return All Pages	n/a
25H	VPD Initialization Parameters	Yes

Allocation Length. This field specifies the number of bytes that the initiator has allocated for returned MODE SENSE data. An Allocation Length of zero indicates that no MODE SENSE data will be transferred. This condition is not considered an error. Any other value indicates the maximum number of bytes that will be transferred. The target will terminate the Data In phase when the specified number of bytes have been transferred or when all available MODE SENSE data have been transferred to the initiator, whichever is less.

The Allocation Length field is also used by the Target to Auto-Configure to the SCSI Interface version in use by the Initiator.

Six-Byte Parameter Formats

The 6-byte parameter formats contains a 4-byte header followed by an optional Block Descriptor, followed by the requested page.

6-Byte Parameter List Header Format

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Sense Data Length							
01	Media Type = 0							
02	Device Specific Parameters = 0							
03	Block Descriptor Length							

6-Byte Block Descriptor Format (Optional)

	Bit							
Byte	7	6	5	4	3	2	1	0
04	Density Code = 0							
05—07	(MSB=05) Number Of Blocks = 0 (LSB=07)							
08	Reserved							
09—11	(MSB=09) Block Length (LSB=11)							

Parameter List Page Format

	Bit							
Byte	7	6	5	4	3	2	1	0
00	PS [1]	Reserved	Page Code					
01	Page Length in Bytes							
02—nn	Page Parameters Refer to the Parameter Specification Tables that follow.							

Notes:

1. PS bit valid for Mode Sense only; must be zero (0) for Mode Select.

Ten-Byte Parameter Formats

The 10-byte parameter formats contains an 8-byte header followed by an optional Block Descriptor, followed by the requested page.

10-Byte Parameter List Header Format

	Bit							
Byte	7	6	5	4	3	2	1	0
00—01	(MSB=00) Sense Data Length (LSB=01)							
02	Media Type = 0							
03	Device Specific Parameters = 0							
04—05	Reserved							
06—07	(MSB=06) Block Descriptor Length (LSB=07)							

10-Byte Block Descriptor Format (Optional)

	Bit							
Byte	7	6	5	4	3	2	1	0
08	Density Code = 0							
09—11	(MSB=09) Number Of Blocks = 0 (LSB=11)							
12	Reserved							
13—15	(MSB=13) Block Length (LSB=15)							

Parameter List Page Format

	Bit							
Byte	7	6	5	4	3	2	1	0
00	PS [1]	Reserved	Page Code					
01	Page Length in Bytes							
02—nn	Page Parameters Refer to the Parameter Specification Tables that follow.							

Notes:

1. PS bit valid for Mode Sense only; must be zero (0) for Mode Select.

Sense Data Length. This field specifies the length in bytes of the page data to be returned during the Data In phase. The Sense Data Length field does not include itself nor does it include the block description length.

Media Type. Set to all zeros to indicate fixed disk.

Device Specific Parameters. Not used. Set to all zeros.

Block Descriptor Length. This field specifies the length in bytes of the Block Descriptor, and does not include the Parameter Pages. The block descriptor length will be either 0 or 8.

The Block Descriptor specifies the media characteristics for the entire Logical Unit. The Density Code field is 0 (zero), and the Number of Blocks field is 0 (zero), indicating the entire media has the block length returned.

Density Code. Not used. Set to zeros.

Number of Blocks. Set to all zeros indicating that all blocks are set to same size.

Block Length. Indicates logical block size. Set to user configuration.

PS (Page Save). Indicates saveable Mode Sense page when set to one (1). Invalid for Mode Select: must be set to zero (0).

Page Length. Indicates number of bytes remaining in specified page after Page Length field. Used in Mode Select to Auto-Configure to Initiator SCSI interface version.

Parameter Specifications for Supported Pages

The following tables list the parameter formats for all supported pages, their respective default values, and indicates whether the field values are changeable or non-changeable with the Mode Select command. If a field is changeable, the allowable range is given. In addition, the title block for each page indicates whether the page is saveable.

Page Code 01H, Read/Write Error Recovery Parameters (Saveable Page)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	PS [1]	Reserved	Page Code = 01H					
01	Page Length in Bytes: SCSI (CCS) = 06; SCSI-2 = 0A							
02	AWRE	ARRE	TB	RC	EEC	PER	DTE	DCR
03	Read Retry Count							
04	Correction Span							
05	Head Offset Count							
06	Data Strobe Offset Count							
07	SCSI (CCS): Recovery Time Limit (last byte)							
07—11	SCSI-2 Bytes Follow							
07	Reserved							
08	Write Retry Count							
09	Reserved							
10—11	(MSB=10)		Recovery Time Limit			(LSB=11)		

Notes:

1. PS bit valid for Mode Sense only; must be zero (0) for Mode Select.

Page 01H Parameter Values

Parameter	Default Values (hex)	Changeable Values	Allowable Ranges
AWRE (Automatic Write Reallocation)	0	No	n/a
ARRE (Automatic Read Allocation)	0	No	n/a
TB (Transfer Block)	0	Yes	0 = Disable; 1 = Enable transfer of errored data
RC (Read Continous)	0	No	n/a
EEC (Enable Early Correction)	0	Yes	Ignored; may be set to either 0 or 1
PER (Post Error)	1	Yes	0 = Disable; 1 = Enable Posting recovered errors
DTE (Disable Transfer on Error)	0	Yes	1 = Disable; 0 = Enable transfer on recovered errors
DCR (Disable Correction)	0	Yes	1 = Disable; 0 = Enable error correction
Read Retry Count	08	Yes	Maximum allowable retrys = 255 (FFH)
Correction Span (Bits per Sector)	48	Yes	Rounded up to nearest integer multiple of 24: 0, 24 (18H), 48 (30H), 72 (48H)
Head Offset Count	00	No	n/a
Data Strobe Offset Count	00	No	n/a
Write Retry Count (SCSI-2 only)	00	No	n/a
Recovery Time Limit: SCSI (CCS) Recovery Time Limit: SCSI-2	FF FFFF	Yes	In 1 msec increments; 0 = no retrys allowed; FFH = maximum number of retrys allowed

Page Code 02H, Disconnect/Reconnect Parameters (Saveable Page)

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00	PS [1]	Reserved	Page Code = 02H					
01	Page Length in Bytes; **SCSI (CCS):** = 0AH; **SCSI-2:** = 0EH							
02	Buffer Full Ratio							
03	Buffer Empty Ratio							
04—05	(MSB=04) Bus Inactivity Limit (LSB=05)							
06—07	(MSB=06) Disconnect Time Limit (LSB=07)							
08—09	(MSB=08) Connect Time Limit (LSB=09)							
10—11	**SCSI (CCS):** Reserved (last bytes)							
10—15	**SCSI-2 Bytes Follow**							
10—11	(MSB=10) Maximum Burst Rate (LSB=11)							
12	Reserved							DTDC
13—15	Reserved							

Notes:

1. PS bit valid for Mode Sense only; must be zero (0) for Mode Select.

Page 02H Parameter Values

Parameter	Default Values (hex)	Changeable Values	Allowable Range
Buffer Full Ratio	80	Yes	00 to FF
Buffer Empty Ratio	80	Yes	00 to FF
Bus Inactivity Limit	0000	No	Not supported
Disconnect Time Limit	0000	No	Not supported
Connect Time Limit	0000	No	Not supported
Maximum Burst Rate (SCSI-2 only)	0000	No	Not supported
DTDC (SCSI-2 only; Data Transfer Disconnect Control)	00	Yes	■ 00B = Disconnect as controlled by ratios ■ 01B = No disconnect during data transfer ■ 11B = No disconnect during or after data transfer ■ 10B = Reserved

Page Code 03H, Direct Access Device Format (Saveable Page)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	PS [1]	Reserved	Page Code = 03H					
01	Page Length In Bytes: 16H							
02—03	(MSB=02) Tracks per Zone (LSB=03)							
04—05	(MSB=04) Alternate Sectors per Zone (LSB=05)							
06—07	(MSB=06) Alternate Tracks per Zone (LSB=07)							
08—09	(MSB=08) Alternate Tracks per Logical Unit (LSB=09)							
10—11	(MSB=10) Sectors per Track (LSB=11)							
12—13	(MSB=12) Data Bytes per Physical Sector (LSB=13)							
14—15	(MSB=14) Interleave (LSB=15)							
16—17	(MSB=16) Track Skew Factor (LSB=17)							
18—19	(MSB=18) Cylinder Skew Factor (LSB=19)							
20	SSEC	HSEC	RMB	SURF	Reserved			
21—23	Reserved							

Notes:

1. PS bit valid for Mode Sense only; must be zero (0) for Mode Select.

Page 03 Parameter Values [1]

Parameter	Default Value (hex) Notch 0	Notch 1	Notch 2	Notch 3	Changeable Value	Allowable Range
Tracks per Zone	0000	0000	0000	0000	No	n/a
Alternate Sectors per Zone	0000	0000	0000	0000	No	n/a
Alternate Tracks per Zone: C2233	0029	0029	0029	0029	No	n/a
Alternate Tracks per Zone: C2234	0036	0036	0036	0036	No	n/a
Alternate Tracks per Zone: C2235	004D	004D	004D	004D	No	n/a
Alternate Tracks per Logical Unit: C2233	0029	0029	0029	0029	No	n/a
Alternate Tracks per Logical Unit: C2234	0036	0036	0036	0036	No	n/a
Alternate Tracks per Logical Unit: C2235	004D	004D	004D	004D	No	n/a
Sectors per Track	0000	0049	003D	0031	No	n/a
Data Bytes per Physical Sector	0200	0200	0200	0200	Yes	Per customer requirement. From 512 (200H) bytes to 522 (20AH) bytes in increments of 2 bytes.
Interleave	0001	0001	0001	0001	No	n/a
Track Skew Factor	0000	0006	0005	0004	No	n/a
Cylinder Skew Factor	0000	0016	0015	0012	No	n/a
SSEC (Soft Sectored)	00	00	00	00	No	n/a
HSEC (Hard Sectored)	01	01	01	01	No	n/a
RMB (Removable Media)	00	00	00	00	No	n/a
SURF (Surface Mode Addressing)	00	00	00	00	No	n/a

Notes:

1. Default values returned are determined by the Active Notch selected in Parameter Page 0CH.

Page Code 04H, Rigid disk Drive Geometry Parameters (Non-Saveable Page)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	PS [1]	Reserved	Page Code = 04H					
01	Page Length In Bytes: SCSI (CCS) = 12H; SCSI-2 = 16H							
02—04	(MSB=02) Number Of Cylinders (LSB=04)							
05	Number Of Heads							
06—08	(MSB=06) Starting Cylinder, Write Precomp (LSB=08)							
09—11	(MSB=09) Starting Cylinder, Reduced Write Current (LSB=11)							
12—13	(MSB=12) Drive Step Rate (LSB=13)							
14-16	(MSB=14) Landing Zone Cylinder (LSB=16)							
17-19	SCSI (CCS): Reserved (last bytes)							
17-23	SCSI-2 Bytes Follow							
17	Reserved							RPL
18	Rotational Offset							
19	Reserved							
20—21	(MSB=20) Media Rotation Rate (LSB=21)							
22—23	Reserved							

Notes:

1. PS bit valid for Mode Sense only; must be zero (0) for Mode Select.

Page 04H Parameter Values

Parameter	Default Values (hex)	Changeable Values	Allowable Range
Number Of Cylinders	0005E6	No	n/a
Number Of Heads	09	No	n/a
Starting Cylinder: Write Precomp (Not Used)	000000	No	n/a
Starting Cylinder: Reduced Write Current (Not Used)	000000	No	n/a
Drive Step Rate	0000	No	n/a
Landing Zone Cylinder	000000	No	n/a
RPL (SCSI-2 only; Rotational Position Locking)	00	Yes	■ 00 = No locking ■ 01 = Lock on input sync signal (sync spindle pin 2) ■ 10 = Provide output sync signal to pin 2 ■ 11 = Not Supported
Rotational Offset (from input sync signal; SCSI-2 only)	00	Yes	0 - 255 bytes
Media Rotation Rate (SCSI-2 only)	0E10	No	n/a

Page Code 08H, Cache Control Parameters (Saveable Page)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	PS [1]	Reserved	Page Code = 08H					
01	Page Length In Bytes = 0AH							
02	Reserved					WCE	MF	RCD
03	Demand Read Retention Priority				Write Retention Priority			
04—05	(MSB=04) Disable Pre-Fetch Transfer Length (LSB=05)							
06—07	(MSB=06) Minimum Pre-Fetch (LSB=07)							
08—09	(MSB=08) Maximum Pre-Fetch (LSB=09)							
10—11	(MSB=10) Maximum Pre-Fetch Ceiling (LSB=11)							

Notes:

1. PS bit valid for Mode Sense only; must be zero (0) for Mode Select.

Page 08H Parameter Values

Parameter	Default Values (HEX)	Changeable Values	Allowable Range
WCE (Write Cache Enable)	0	No	n/a
MF (Multiplier Factor)	0	No	n/a
RCD (Read Cache Disable)	0	Yes	1 = Disable; 0 = Enable Track Caching
Demand Read Retention Priority	0	No	n/a
Write Retention Priority	0	No	n/a
Disable Pre-Fetch Transfer Length	FFFF	No	n/a
Minimum Pre-Fetch	0000	No	n/a
Maximum Pre-Fetch	TBD	No	n/a
Maximum Pre-Fetch Ceiling	TBD	No	n/a

Page Code 09H, Peripheral Device Parameters (Saveable Page)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	PS [1]	Reserved	Page Code = 09H					
01	Page Length In Bytes = 0AH							
02—03	(MSB=02) Interface Identifier (LSB=03)							
04—07	Reserved							
08—10	(MSB=08) Interface Specific Parameters (LSB=10)							
11	Reserved							

Notes:

1. PS bit valid for Mode Sense only; must be zero (0) for Mode Select.

Page 09H Parameter Values

Parameter	Default Values (HEX)	Changeable Values	Allowable Range
Interface Identifier	8000	Yes	8000 = SCSI; 0002 = ESDI
Interface Specific Parameters		Yes	■ If Interface Identifier = 8000 (SCSI): □ Byte 8, bit 1: 1 = Disable; 0 = Enable Read Out of Order. (Out of Order operation is internal only. All data is transferred in order on the SCSI bus.) □ Byte 8, bit 2: 1 = Disable; 0 = Enable Write Out of Order □ Byte 8, bit 3: 1 = Disable; 0 = Enable Auto-Configuration □ Byte 8, bit 4: 0 = SCSI-2 mode; 1 = SCSI (CCS) mode □ All other bit positions are not used ■ If Interface Identifier = 0002 (ESDI): □ Bytes 8 - 9 = ESDI Command □ Byte 10, bit 0: 0 = Disable; 1 = Enable ESDI status information □ All other bit positions are not used

Page Code 0CH, Notch Page Format (Non-Saveable Page)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	PS [1]	Reserved	Page Code = 0CH					
01	Page Length In Bytes: 16H							
02	ND	LPN	Reserved					
03	Reserved							
04—05	(MSB=04) Maximum Number of Notches (LSB=05)							
06—07	(MSB=06) Active Notch (LSB=07)							
08—11	(MSB=08) Starting Boundary (LSB=11)							
12—15	(MSB=12) Ending Boundary (LSB=15)							
16—23	(MSB=16) Pages Notched (LSB=23)							

Notes:

1. PS bit valid for Mode Sense only; must be zero (0) for Mode Select.

Page 0C Parameter Values

Parameter	Default Value (hex)	Changeable Value	Allowable Range
ND (Notched Drive)	1	No	n/a (1 = Notched Drive)
LPN (Logical or Physical Notch)	0	No	n/a (0 = Physical Parameters)
Maximum Number of Notches	3	No	n/a
Active Notch	0	Yes	0, 1, 2, or 3
Starting Boundary: notch 0	00000000	No	n/a (Bytes 8, 9, and 10 are cylinder number, and byte 11 is head number.)
Starting Boundary: notch 1	00000000	No	
Starting Boundary: notch 2	0001E600	No	
Starting Boundary: notch 3	0003A300	No	
Ending Boundary: notch 0	0005F108	No	n/a (Bytes 12, 13, and 14 are cylinder number, and byte 15 is head number.)
Ending Boundary: notch 1	0001E508	No	
Ending Boundary: notch 2	0003A208	No	
Ending Boundary: notch 3	0005F108	No	
Pages Notched: byte 16	80	No	n/a
Pages Notched: byte 17 - 21	00	No	n/a
Pages Notched: byte 22	10	No	n/a
Pages Notched: byte 23	08	No	n/a

Page Code 25H*, VPD Serialization (Saveable Page)

*** Supported for Mode Select Only**

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Reserved	Reserved	Page Code = 25H					
01	Page Length in Bytes: SCSI-2 = 14H							
02	VPD Identifier							
03	Reserved							
04	Peripheral Device Type							
05—08	Reserved							
09	VPD Identifier							
10	Reserved							
11	ASCII Length							
12—21	Product Serial Number (ASCII format)							

Page 25H Parameter Values

Parameter	Default Values (hex)	Changeable Values	Allowable Ranges
VPD Identifier (Bytes 02 and 04)	80	No	n/a
Peripheral Device Type	00	No	n/a
ASCII Length	0A	No	n/a
Product Serial Number (ASCII format)		Yes	This field is set at the factory and is retrieved with the Inquiry command, VPD page 80H. This page must be saved to have any effect.

Read

The READ command requests that the Target transfer data to the Initiator. The Target accepts both the nonextended (6-byte) and extended (10-byte) CDB formats.

Read (6-Byte) Command Descriptor Block (CDB)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Opcode = 08H							
01	Logical Unit Number			Logical Block Address (MSB)				
02—03	(MSB=02)			Logical Block Address			(LSB=03)	
04	Transfer Length							
05	Control Byte							

Read (10-Byte) Command Descriptor Block (CDB)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Opcode = 28H							
01	Logical Unit Number			Reserved				REL=0
02—05	(MSB=02)			Logical Block Address			(LSB=05)	
06	Reserved							
07—08	(MSB=07)			Transfer Length			(LSB=08)	
09	Control Byte							

Logical Block Address. This field specifies the logical block at which the read operation will begin.

Transfer Length. This field specifies the number of contiguous logical blocks of data to be transferred. When using the nonextended (6-byte) CDB format, a Transfer Length of zero indicates that 256 logical blocks will be transferred. When using the extended (10-byte) CDB format, a Transfer Length of zero indicates that no logical blocks will be transferred. This condition is not considered an error (it is functionally equivalent to a SEEK command).

The most recent data value written in the addressed logical block(s) will be returned.

Read Buffer

The READ BUFFER command is used in conjunction with the WRITE BUFFER command as a diagnostic tool for testing Target memory and the SCSI bus integrity. This command does not alter the media or the buffer.

Read Buffer Command Descriptor Block (CDB)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Opcode = 3CH							
01	Logical Unit Number			Reserved		Mode = 0		
02	Buffer ID = 0							
03—05	(MSB=02)			Buffer Offset		(LSB=05)		
06—08	(MSB=06)			Allocation Length		(LSB=08)		
09	Control Byte							

Mode and Buffer ID These are not supported and should be set to zero (0).

Buffer Offset This field is supported. The value inserted into this field determines the number of bytes into the data buffer to start the transfer of data.

Allocation Length. This field specifies the number of bytes that the initiator has allocated for returned data. An allocation length of zero specifies that no data be transferred and is not considered an error. The target will terminate the Data Phase when the specified number of bytes or when all available buffer data has been transferred, whichever is less.

Read Buffer Header Format

	Bit							
Byte	7	6	5	4	3	2	1	0
00—01	Reserved							
02—03	(MSB=01)			Available Length		(LSB=03)		

The data returned by the READ BUFFER command contains a 4-byte header, followed by the buffer data.

Available Length. This field may contain up to 65,535 bytes, or the Target's maximum data buffer size, whichever is less. An Available Length of zero indicates that no data transfer will take place. If the Allocation Length of the CDB is too small to allow all of the Available Length, the Available Length field is NOT adjusted to reflect the truncation.

The data in the buffer may have been converted since the last WRITE BUFFER command. It is recommended that the Target be placed in reserve or that the WRITE BUFFER command and subsequent READ BUFFER command be linked to ensure that the initiator can reliably test the Target's data buffer.

If any command has been executed by the controller between the execution of the WRITE BUFFER command and the READ BUFFER command, a status of CHECK CONDITION will be returned. In this case, the sense information will have a Sense Key of MISCOMPARE set. The amount of requested buffer data will be returned regardless of the MISCOMPARE error status, but the contents should be set.

Read Capacity

The READ CAPACITY command provides a means for the Initiator to request information regarding the capacity of the logical unit.

Read Capacity Command Descriptor Block (CDB)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Opcode = 25H							
01	Logical Unit Number			Reserved				REL=0
02—05	(MSB=02)			Logical Block Address			(LSB=05)	
06—07	Reserved							
08	Vend Unq = 0		Reserved					PMI
09	Control Byte							

PMI (Partial Media Indicator). A PMI bit of zero (0) indicates that the information returned in the READ CAPACITY Data phase will be the logical block address and block length (in bytes) of the last logical block of the logical unit. The Logical Block Address field in the CDB should be set to zero for this option.

A PMI bit of one (1) indicates that the information returned in the Data phase will be the logical block address and block length (in bytes) of the last logical block address after which a substantial delay in data transfer will be encountered. This logical block address shall be greater than or equal to the logical block address specified in the CDB. (Implementor's Note: This function is intended to assist storage management software in determining whether there is sufficient space on the current track, cylinder, etc. to contain a frequently accessed data structure such as a file directory or file index. The address returned will normally be the last block on the addressed track.)

Read Capacity Data Format

The format of the information returned by the Target during the Data In phase of the command is as follows:

	Bit							
Byte	7	6	5	4	3	2	1	0
00—03	(MSB=00)			Logical Block Address			(LSB=03)	
04—07	(MSB=04)			Block Length			(LSB=07)	

Read Defect Data

The READ DEFECT DATA command requests that the Target transfer the media defect data to the Initiator.

Read Defect Data Command Descriptor Block (CDB)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Opcode = 37H							
01	Logical Unit Number			Reserved				
02	Reserved			PLIST	GLIST	Defect List Format		
03—06	Reserved							
07—08	(MSB=07)		Allocation Length			(LSB=08)		
09	Control Byte							

PLIST (Primary Defect List), GLIST (Grown Defect List). A PLIST bit of one (1) indicates the the Initiator requests a primary list of defects be returned. A GLIST bit of one (1) indicates that the Initiator requests the grown list of defects. If both bits are one (1), the combination of both lists is requested. If both bits are zero (0), only the header will be returned.

Defect List Format. This field indicates the preferred format for the returned defect list. The bit states are as defined by the FORMAT UNIT command. The Target will return the list in the physical sector format (5) or bytes from index (4) format. If any other format is requested, the list will be returned in the physical sector format and the target will return a CHECK CONDITION status and will set the sense key to RECOVERED ERROR with an additional sense code of DEFECT LIST NOT FOUND.

Allocation Length. This field specifies the number of bytes that the Initiator has allocated for returned data. An Allocation Length of zero indicates that no data should be transferred and should not be considered an error. Any other value indicates the maximum number of bytes that shall be transferred. The Target shall terminate the data phase when either the allocation length or all available READ DEFECT DATA has been sent, whichever is less.

Read Defect Data Defect List Header Format

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Reserved							
01	Reserved			PLIST	GLIST	Defect List Format		
02—03	(MSB=02) Defect List Length (LSB=03)							

Defect List Descriptor Format

	Bit							
Byte	7	6	5	4	3	2	1	0
00—02	(MSB=00) Cylinder Number Of Defect (LSB=02)							
03	Head Number of Defect							
04—07	(MSB=04) Sector Number Of Defect (Physical Sector Format) (LSB=07) Byte Index of Defect (Bytes from Index Format)							

The data returned by the READ DEFECT DATA command contains a four-byte Header, followed by zero or more Defect Descriptors

Defect List Length. This Header field specifies the total length of the following Defect Descriptors in bytes. If the Allocation Length field of the CDB is less than the length of the available defect list data, the Defect List Length is NOT adjusted to reflect the truncation. The defect descriptors are in ascending address order. Ascending address order for physical sector format is defined as cylinder most-significant and sector least-significant. A sector number of all ones (FFFFFFFFH) indicates that the entire track has been spared.

The defect data is supplied in such a manner that the list can be issued in a FORMAT command to restore the current media reassignment mapping without re-ordering.

Read Long

The READ LONG command requests the Target to transfer a specific block of data to the Initiator. The data transferred will include all header, data, and ECC (Error Correction Code) bytes.

Read Long Command Descriptor Block (CDB)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Opcode = 3EH							
01	Logical Unit Number			Reserved			CORRCT	REL=0
02—05	(MSB=02)		Logical Block Address			(LSB=05)		
06	Reserved							
07—08	(MSB=07)		Byte Transfer Length			(LSB=08)		
09	Control Byte							

CORRCT (Corrected). A CORRCT bit of one (1) instructs the Target to correct the data by ECC before transferring it to the Initiator. A CORRCT bit of zero (0) causes the logical block to be read and transferred without any error detection or correction.

Logical Block Address. This field specifies the starting address for the Read Long operation. The operation will continue for the length specified by the Byte Transfer Length field.

Byte Transfer Length. This field should specify exactly the number of bytes available for transfer. The exact value is 4 bytes for the header, 2 bytes for the Header ECC, 512 bytes for data, 18 bytes for the ECC field, and 2 bytes for the data field CRC (Cycled Redundancy Check); a total of 538 bytes. A value of zero in this field indicates that no data bytes will be transferred. This condition is not considered an error.

If the number of bytes specified matches exactly the available data length, the most recent data written in the specified logical block will be transferred. If a requested transfer length value does not match exactly the available data length, the Target will terminate the command with a CHECK CONDITION status and a sense key of ILLEGAL REQUEST and an additional sense key of INVALID FIELD IN CDB. The valid and ILI bits will be set to one and the information bytes will be set to the difference (residue) of the requested transfer length minus the actual length in bytes. Negative values will be transferred in two's complement format.

Reassign Blocks

The REASSIGN BLOCKS command requests the Target to reassign the defective logical blocks to an area on the logical unit reserved for this purpose and to record the defective logical blocks to the Grown Defect list (Glist). More than one physical or logical block may be relocated by each defect descriptor sent by the Initiator. This command does not alter the contents or location of the Primary Defect List (Plist).

Reassign Blocks Command Descriptor Block CDB)

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00	Opcode = 07H							
01	Logical Unit Number			Reserved				
02—04	(MSB=02)			Reserved		(LSB=04)		
05	Control Byte							

The Initiator transfers a defect list that contains the logical block addresses to be reassigned. The Target reassigns the physical media used for each logical block address in the list. The data contained in the logical blocks specified in the defect list will be lost, but the data in all other logical blocks on the media shall be preserved.

A specific logical block address may be reassigned more than once; thus, over the life the media, a logical block can be assigned to multiple physical addresses (until no more spare locations remain on the media).

Note

The REASSIGN BLOCKS command is intended to be used to reassign a single block defect. The provision to handle multiple defects in a single command is made to allow recovery from a situation where multiple defects occur on a single track. Therefore, the maximum length defect list that will be accepted by the Target is 56. Duplicate entries in the defect list result in a single spare operation.

Reassign Blocks Defect List Header Format

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00—01	Reserved							
02—03	(MSB=02)			Defect List Length		(LSB=03)		

The REASSIGN BLOCKS defect list contains a 4-byte header followed by one or more defect descriptors. The length of each defect descriptor is four bytes.

Defect List Length. This field specifies the total length in bytes of the defect descriptors that follow. The Defect List Length is equal to four times the number of defect descriptors and does not include the Defect Header length.

Defect List Descriptor Format

	Bit							
Byte	7	6	5	4	3	2	1	0
00—03	(MSB=00)			Defect Logical Block Address			(LSB=03)	

The Defect Descriptor specifies a 4-byte Defect Logical Block Address that contains the defect. The defect descriptors shall be in ascending order.

If the logical unit has insufficient capacity to reassign all of the logical blocks specified in the defect descriptors, the command shall terminate with a CHECK CONDITION status and the Sense Key shall be set to HARDWARE ERROR. The additional Sense Code will be NO DEFECT SPARE LOCATION AVAILABLE (32H). The logical block address of the first logical block not reassigned shall be returned in the Information Bytes of the sense data.

During a reassign operation, all data residing on the track with the specified defective block(s), except that contained within the defective block(s), is moved to a new physical track. If the Target is unable to recover data from any of these block(s) affected by the operation but *not* contained in the defect descriptor list, the command is terminated with CHECK CONDITION status and a Sense Key of MEDIUM ERROR. The additional Sense Code will be set to UNRECOVERED READ ERROR (11H), and the information bytes will contain the logical block address of the new defect. These additional defect(s) should be added to the reassignment defect list and the command reissued.

All blocks affected by the reassignment operation but *not* included in the defect descriptor list, are verified following the reassignment. If the verification fails, the data will be reassigned to another physical location. If this second reassignment operation fails, the command is terminated with CHECK CONDITION status, a Sense Key of MEDIUM ERROR, and an additional sense code of SPARE OPERATION FAILED. In this case, the media configuration remains as it was prior to the command. The spare track on which the original verify failed is marked as bad. This allows a reissue of the same Reassign Blocks command to step through spare tracks if consecutive spare tracks are defective. Multiple failures of this command probably indicate a hardware failure.

Release

The RELEASE command is used to release previously reserved logical units. It is not an error for an Initiator to attempt to release a reservation that is not currently active. In this case, the Target returns GOOD status without altering any other reservation. A third-party release option for the RELEASE command allows an Initiator to release a logical unit that was previously reserved using the third-party reservation option.

Release Command Descriptor Block (CDB)

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00	Opcode = 17H							
01	Logical Unit Number			3RDPTY	Third Party Device ID			XTNT=0
02	Reservation Identification = 00							
03—04	(MSB=03)		Extent List Length = 00			(LSB=04)		
05	Control Byte							

3RDPTY (Third-Party). If the 3RDPTY bit is set to one (1), the Target shall release the specified logical unit, but only if the reservation was made using the third-party reservation option by the same Initiator for the same SCSI device as specified in the Third-Party Device ID field. If the 3RDPTY bit is set to zero (0), the third-party release option is not requested.

Request Sense

The REQUEST SENSE command requests that the Target transfer sense data to the Initiator. Only the extended sense data format is supported.

Request Sense Command Descriptor Block (CDB)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Opcode = 03H							
01	Logical Unit Number			Reserved				
02—03	Reserved							
04	Allocation Length							
05	Control Byte							

The returned Request Sense data is valid for a CHECK CONDITION status returned on the prior command. This data is preserved by the Target for the Initiator until retrieved by the REQUEST SENSE command or until the receipt of any other command for the same logical unit from the Initiator that issued the command resulting in the CHECK CONDITION status. Sense data is cleared upon receipt of any subsequent command to the logical unit from the Initiator receiving the CHECK CONDITION status. In the case of the single Initiator option, the Target will assume that the REQUEST SENSE command is from the same Initiator. Sense information will be cleared by the REQUEST SENSE command following the transfer of the data.

Allocation Length. This field specifies the number of bytes that the Initiator has allocated for returned sense data. An allocation length of zero (0) indicates that four bytes of sense data will be transferred. Any other value indicates the maximum number of bytes that will be transferred. The Target will terminate the Data In phase when the specified number of bytes have been transferred or when all available sense data has been transferred to the Initiator, whichever is less. The drive will return a maximum of 22 bytes of sense data. Refer to the REQUEST SENSE Extended Data Format descriptions.

The REQUEST SENSE command will return the CHECK CONDITION status only to report fatal errors for the REQUEST SENSE command. The REQUEST SENSE command will be executed even if the drive is reserved to another Initiator.

If any nonfatal error occurs during the execution of the REQUEST SENSE command, the Target will return the sense data with GOOD status. When a fatal error occurs on a REQUEST SENSE command, the returned sense data may be invalid.

After the Sense Data is returned, all conditions are cleared except for a UNIT ATTENTION Sense Key if Power-On verification failed. In this case, the HARDWARE ERROR Sense Key is set by the Target for the first REQUEST SENSE, and UNIT ATTENTION is set for the subsequent command. This is done to insure that diagnostic failures and "Reset Conditions" are observed.

Request Sense Extended Data Format

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Valid	Error Class = 7			Error Code = 0			
01	Segment Number = 0							
02	FM = 0	EOM = 0	ILI	Reserved	Sense Key			
03—06	(MSB=03) Information Bytes (LSB=06)							
07	Additional Sense Length = 20							
08—11	Command Specific Information							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Field Replaceable Unit Code = 0							
15—17	Sense Key Specific							
18	Retry=0	Reassign=0	HRDERR=0	Reserved				
19—23	Reserved							
24—27	(FIRST=24) Device Error (LAST=27)							

Valid. When set to 1, the VALID bit indicates that the Information Bytes field contains valid information. The exact significance of the Information Bytes depends on the status of the Sense Key field.

Error Class, Error Code. These fields are specified as seven-zero (Error Class = 7, Error Code = 0) for extended sense format.

Segment Number. Set to zero (0). Used for Copy and Search commands; not supported in this product.

FM (File Mark), EOM (End of Media), ILI (Incorrect Length Indicator). All set to zero (0).

Sense Key. This field is used to indicate the type of error that has occurred, and the recovery action that should be taken by the initiator. It is the primary piece of information available to the Initiator for making decisions based on errors detected by the Target. The Sense Key codes are listed in a following table.

Additional Sense Code. This field is specific for each sense code and provides additional information about the cause of that particular Sense Key. The Additional Sense Codes are listed in a following table.

Information Bytes. Contain information relative to specific commands and specific devices.

Additional Sense Length. Specifies the number of additional Sense data bytes to follow. Set to fourteen (14) for these products.

Command Specific Information. Contains information dependent upon the command that was executed. Specific details are included in appropriate command explanations.

Failed Field Replaceable Unit (FRU). Refers to the Field Replaceable Unit (FRU) that caused the current error reported in this Sense Key. This field will be set to 0 since FRU specific error detection is not supported.

Device Error. Indicates device unique error codes designed to aid service personnel in more detailed analysis of any drive faults. This information is NOT pertinent to system operation, although it is highly recommended that the system log all sense data including these bytes in cases of drive failures. The status of byte 18 in the Device Error field indicates the content of the bytes that follow. The specific error codes for the Device Error field are described in the tables that follow.

- If byte 18 = 80H through FFH, the Device Error field will contain error information returned from the Hard Disk Controller (HDC) chip. This information will normally be returned for RECOVERED ERROR or MEDIUM ERROR Sense Keys.
- If byte 18 = 00H through 3FH, the Device Error field will contain HDA (Head/Disk Assembly) status information. This information may be returned with either the RECOVERED ERROR or HARDWARE ERROR Sense Keys.
- If byte 18 = 40H through 5FH, the Device Error field will contain diagnostic failure information. This information will normally be returned with a HARDWARE ERROR Sense Key after a Power-On, or a SEND DIAGNOSTIC command with self-test bit set.

Sense Key Codes

Value (hex)	Description
0	**No Sense.** Indicates that there is no specific sense key information to be reported for the designated logical unit.
1	**Recovered Error.** Indicates that the last command completed successfully with some recovery action performed by the Target. Details may be determinable by examining the additional sense bytes and the information bytes.
2	**Not Ready.** Indicates that the logical unit addressed cannot be accessed.
3	**Media Error.** Indicates that the command terminated with a nonrecovered error condition that was probably caused by a flaw in the media or an error in the recorded data.
4	**Hardware Error.** Indicates that the Target detected a nonrecoverable hardware failure (for example, controller failure, device failure, parity error, etc.) while performing the command or during a self test.
5	**Illegal Request.** Indicates that there was an illegal parameter in the command descriptor block or in the additional parameters supplied as data for some commands.
6	**Unit Attention.** Indicates that the Target has been reset or there has been a power on.
B	**Aborted Command.** Indicates that the Target aborted the command due to Initiator request/action.
E	**Miscompare.** Indicates data in buffer may have been corrupted between READ BUFFER and WRITE BUFFER commands, or a MISCOMPARE occurred during a VERIFY (with BYTCK enabled).

Additional Sense Codes

Value (hex)	Description
00	No Additional Sense Information
01	No Index/Sector signal
02	No Seek Complete
03	Write Fault
04	Drive Not Ready
08	Logical Unit Communication Failure
10	ID CRC or ECC error
11	Unrecovered Read error of data blocks
14	No record found
15	Seek Positioning error
17	Recovered Read data with Target's Read retries (not with ECC)
18	Recovered Read data with Target's ECC correction (not with retries)
19	Defect List error
1A	Parameter Overrun
1B	Synchronous Transfer error
1D	Compare error
20	Invalid Command Operation Code
21	Illegal Logical Block Address. Address greater than the maximum LBA returned by the READ CAPACITY data with PMI not set.
24	Illegal field in CDB
25	Invalid LUN
26	Invalid field in Parameter List
27	Write Protected
29	Power On or Reset or Bus Device Reset occurred
2A	Mode Select Parameters changed.
31	Media Format Corrupted
32	No Defect Spare Location Available
33	Spare Operation Failed
40	RAM failure
41	Data Path Diagnostic failure
42	Power-On Diagnostic Failure
43	Message Reject Error
44	Internal Controller Error
45	Select/Reselect failed
46	Unsuccessful Soft Reset
47	SCSI Interface Parity Error
48	Initiator Detected Error
49	Inappropriate/Illegal Message

Device Error Field Codes: When Byte 18 = 80H through FFH

Byte	Bit	Description
18	7	Error Detected
	6	Correction Cycle Active
	5	Local Command Busy
	4	Remote Command Busy
	3	Local Request
	2	Header Match Complete
	1	Next Disk Command
	0	Ignore
19	7	Late Interlock
	6	Correction Failed
	5	FIFO Data Lost
	4	No Data Sync
	3	Sector Overrun
	2	Sector Not Found
	1	Data Field Error
	0	Header Failed Although Sector Matched
20		All Zeros
21		Number Of Retrys Attempted

Device Error Field Codes: When Byte 18 = 00H through 3FH

Byte	Bit	Description
18	1	Spindle motor stopped
	0	Reset condition exists
19	7	Command data parity fault
	6	Interface fault
	5	Invalid command fault
	4	Seek fault
	3	Write Gate with track offset fault
	2	Extended status available (byte 21)
	1	Write fault
	0	zero
20		zero
21		Zero if byte 25 bit 2 = zero; If byte 25 bit 2 = 1 then the following ESDI vendor-unique status error codes may be displayed: 00 = Not an error condition. 02 = EEPROM checksum failed (at power on or diagnostics). 03 = Timed out waiting for DSP to complete Power On Self-Test. 04 = After power-on, DSP became Command Ready without Finished being asserted. 05 = DSP status word value was wrong at power-on. 06 = Power-On DSP RAM test failed. 07 = Parity error on command received. 09 = Timed out transferring data to ESDI controller. 0A = Received illegal command. 0B = Address of Seek command was outside legal address space. 0C = An attempt was made to set an illegal EEPROM address. 0D = An attempt was made to access the EEPROM while mechanism was spinning. 0E = Timed out waiting for EEPROM write to complete. 0F = Reserved. 10 = Timed out waiting for DSP to become ready for a short term command. 11 = Timed out waiting for DSP to become ready for a long term command. 12 = A Seek was attempted when the spindle was not spun up and locked. 13 = The DSP did not end up in tracking mode after a Recalibrate command was executed. 14 = Bounds test of Track Offset command failed. 15 = A fault is still set after clearing Gate Array fault flip/flops. 16 = Retries were exhausted while trying to verify position during a Recalibrate. 17 = The DC bias adaptation failed to complete with no Offtrack indication. 18 = Maximum iteration limit reached during head alignment SPES null. 19 = DSP sync lost during head alignment SPES measurement. 1A = The drive has entered the Head Alignment Needed state. 1B = The drive has entered the Head Alignment Critical state. 1C = Reserved. 1D = Reserved. 1E = DSP failed to complete a Read Track Number command in allotted time. 1F = DSP failed to complete a Spin Down command in allotted time.

Device Error Field Codes: When Byte 18 = 00H through 3FH (continued)

Byte	Bit	Description
21		If byte 25 bit 2 = 1 (continued) 20 = Reserved. 21 = DSP failed to complete a Spin Up command in allotted time. 22 = DSP failed to complete a Recalibrate command in allotted time. 23 = DSP failed to complete an Introduce Tracking Offset command in allotted time. 24 = DSP failed to complete a Seek command in allotted time. 25 = DSP failed to complete a Measure Alignment Band command in allotted time. 26 = Reserved. 27 = Write during loss of servo timing sync. 28 = Write during momentary spindle Off-Speed condition. 29 = Write during momentary actuator Off-Track condition. 2A = Write during a Seek operation. 2B = Write after Seek failure. 2C = Write was attempted during drive Power On sequence. 2D = Write was attempted while illegal head was selected. 2E = Write was attempted while head alignment in process. 2F = Write was attempted while ESDI Attention was asserted. 30 = Write was attempted when head alignment was needed, but couldn't be performed. 31 = After power-on, DSP asserted Alert signal. 32 = The long term DSP command completed with Alert signal set in status register. 33 = The DSP Alert signal was set when attempting to send a command to the DSP. 34 = Request Status logged a Servo Fault from the fault register. 80 = No failure detected. 81 = Unsupported command. 82 = Illegal command sequence. 83 = Servo heartbeat time out. 84 = Spindle stuck. 85 = Spindle couldn't reach full speed. 86 = Servo PLL didn't lock 87 = Index pattern fault. 88 = TMR2 Alignment failure 89 = Servo PLL came unlocked. 8A = Bad hard track number. 8B = Settle failure. 8C = Alignment Band AGC voltage not within legal range. 8D = Heroics invoked during spin up. 8E thru BF = Unassigned failure codes. C0 = Track crossing FIFO never got enabled. C1 = PLL came unlocked in Slow Acceleration Phase. C2 = Seek timed out in Slow Acceleration Phase. C3 = Velocity too high in Slow Acceleration Phase. C4 thru C8 = Unassigned seek fault in Slow Acceleration Phase. C9 = PLL came unlocked in Fast Acceleration Phase. CA = Seek timed out in Fast Acceleration Phase. CB = Velocity too high in Fast Acceleration Phase. CC thru D0 = Unassigned seek fault in Fast Acceleration Phase.

Device Error Field Codes: When Byte 18 = 00H through 3FH (continued)

Byte	Bit	Description
21		If byte 25 bit 2 = 1 (continued) D1 = PLL came unlocked in the Coasting Phase. D2 = Seek timed out in the Coasting Phase. D3 = Velocity too high in the Coasting Phase. D4 thru D8 = Unassigned seek fault in the Coasting Phase. D9 = PLL came unlocked in Fast Deceleration Phase. DA = Seek timed out in Fast Deceleration Phase. DB = Velocity too high in Fast Deceleration Phase. DC thru E0 = Unassigned seek fault in Fast Deceleration Phase. E1 = PLL came unlocked in Slow Deceleration Phase E2 = Seek timed out in Slow Deceleration Phase E3 = Velocity too high in Slow Deceleration Phase E4 thru E8 = Unassigned seek fault in Slow Deceleration Phase. E9 = PLL came unlocked in the Flare Phase. EA = Seek timed out in the Flare Phase. EB = Velocity too high in the Flare Phase. EC thru F0 = Unassigned seek fault in the Flare Phase. F1 = PLL came unlocked in the Gross Settle Phase. F2 = Seek timed out in the Gross Settle Phase. F3 = Velocity too high in the Gross Settle Phase. F4 thru F8 = Unassigned seek fault in the Gross Settle Phase. F9 = PLL came unlocked in the Fine Settle Phase. FA = Seek timed out in the Fine Settle Phase. FB = Velocity too high in the Fine Settle Phase. FC thru FF = Unassigned seek fault in the Fine Settle Phase.

Device Error Field Codes: When Byte 18 = 40H through 5FH

Byte	Bit	Description
18/19		**If:** Byte 18 = 41H = Microprocessor failure; **Then:** Byte 19 = 11H = Data Register Failure
18/19		**If:** Byte 18 = 42H = Microprocessor RAM Failure; **Then:** Byte 19 = 30H = RAM failed write/read test 40H = RAM failed address test
18/19		**If:** Byte 18 = 43H = ROM Checksum Failure; **Then:** Byte 19 = zero
18/19		**If:** Byte 18 = 45H = Buffer RAM Failure; **Then:** Byte 19 = 30H = RAM failed write/read test 40H = RAM failed address test
18/19		**If:** Byte 18 = 46H = HDC Chip Failure; **Then:** Byte 19 = 60H = HDC Failed Register Test
18/19		**If:** Byte 18 = 47H = Write/Read Failure; **Then:** Byte 19 = 00H - 7FH = defined same as additional sense code 81H = Buffer compare error
20/21		zero

Reserve

The RESERVE command is used to reserve logical units for the use of the Initiator. With third-party reservation, the logical units may be reserved for another specified SCSI device. The RESERVE and RELEASE commands provide the basic mechanism for contention resolution in multiple-Initiator systems.

Reserve Command Descriptor Block (CDB)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Opcode = 16H							
01	Logical Unit Number			3RDPTY	Third Party Device ID			XTNT = 0
02	Reservation Identification = 00							
03—04	(MSB=03)		Extent List Length = 00			(LSB=04)		
05	Control Byte							

3RDPTY (Third-Party). A 3RDPTY bit set to one (1) indicates that the reservation is being made on behalf of another bus device (the third party). When 3RDPTY is set to zero (0), third-party reservation is not requested.

Third Party Device ID. This field indicates the identity of the third party. The reservation can only be released by the party that made the reservation.

When a third-party reservation is made, the mode parameters of the reserving Initiator will be copied to the mode parameters of the third party. This will cause Unit Attention to the third party with Sense Key UNIT ATTENTION (6) and additional Sense Code of MODE PARAMETER CHANGED (2AH) and additional Sense Code qualifier of 01.

XTNT (Extent Reservation). With the XTNT bit set to zero (0), this command will request that the entire logical unit be reserved for the exclusive use of the Initiator until the reservation is superseded by another valid RESERVE command from the same Initiator that made the reservation or until released by a RELEASE command from the same Initiator, by a BUS DEVICE RESET message from any Initiator, or by a "hard" RESET condition. A logical unit reservation will not be granted if the logical unit is reserved by another Initiator. It will be permissible for an Initiator to reserve a logical unit that is currently reserved by that Initiator. With XTNT set to zero (0), The Reservation Identification and the Extent List Length fields will be ignored.

If the logical unit is reserved for another Initiator, the target will respond by returning a RESERVATION CONFLICT status.

Once a reservation is installed, the reserved logical unit is available only to the Initiator that issued the RESERVE command, or a specified optional third party. If any other Initiator attempts to perform a command on the reserved logical unit the command will be rejected with RESERVATION CONFLICT status. Exceptions are the RELEASE command, which will be ignored by the target, and the INQUIRY command, which will be executed.

Rezero Unit

The REZERO UNIT command causes the Target to perform a recalibrate operation and then seek to logical address zero. The status of the seek is reported as the status of this command. This command is provided for compatibility reasons. Its use is not required for any normal drive operation or error recovery.

Rezero Unit Command Descriptor Block (CDB)

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00	Opcode = 01H							
01	Logical Unit Number			Reserved				
02—04	Reserved							
05	Control Byte							

Seek

The SEEK command requests the logical unit to seek to the specified logical block address. The target accepts both the 6-byte and 10-byte (extended) command formats. Status will be returned as GOOD when the seek is complete. This command will return a CHECK CONDITION status with a Sense Key of HARDWARE ERROR if unable to complete. The NOT READY Sense Key will be returned if the drive has not yet spun up.

Seek (6-Byte) Command Descriptor Block (CDB)

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00	Opcode = OBH							
01	Logical Unit Number			Logical Block Address (MSB)				
02—03	Logical Block Address (LSB=03)							
04	Reserved							
05	Control Byte							

Seek (10-Byte) Command Descriptor Block (CDB)

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00	Opcode = 2BH							
01	Logical Unit Number			Reserved				REL=0
02—05	(MSB=02) Logical Block Address (LSB=05)							
06—08	Reserved							
09	Control Byte							

Logical Block Address. This field specifies the logical block address for the seek.

Send Diagnostic

The SEND DIAGNOSTIC command requests the Target to execute the specified diagnostic test(s) upon itself.

Send Diagnostic Command Descriptor Block (CDB)

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00	Opcode = 1DH							
01	Logical Unit Number			PF = 0	Reserved	S/TEST	DEVOFL	UNTOFL
02	Reserved							
03—04	(MSB=03)		Parameter List Length = 0			(LSB=04)		
05	Control Byte							

Activity Qualifiers. These bits tell the Target what diagnostics are allowed. If the selected diagnostic cannot be executed in its entirety, it will not be executed at all.

- Bit 0 is the Unit Off Line bit. It is ignored by the Target.
- Bit 1 is the Device Off Line bit. It is ignored by the Target.
- Bit 2 is the Self-Test bit. If set to one (1), the Parameter List Length field must be 0, and the Target will execute the Default Self-Test, the Buffer RAM test, and the Full Write/Read Tests. If bit 2 is set to zero (0), the command is treated as a NOP.

When successfully completed, the SEND DIAGNOSTIC command will be terminated with a CHECK CONDITION status. Use the REQUEST SENSE command to determine the cause of failure.

Start/Stop Unit

The START/STOP UNIT command requests the Target to enable or disable the logical unit for further operations.

Start/Stop Unit Command Descriptor Block (CDB)

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00	Opcode = 1BH							
01	Logical Unit Number			Reserved				IMMED = 0
02—03	Reserved							
04	Reserved							Start
05	Control Byte							

IMMED (Immediate). The IMMED bit is not supported.

Start. A START bit of one (1) requests the logical unit be made ready for use. A START bit of zero (0) requests that the logical unit be made Not Ready For Use by stopping the spindle motor until the next START UNIT command is sent.

Test Unit Ready

The TEST UNIT READY command provides a means to check if the logical unit is ready. This is not a request for a self test. If the logical unit is up to speed and ready for media access, this command will return a GOOD status. This does not assure that media access will be successful. If the drive is not up to speed, this command will return a CHECK CONDITION Status with a Sense Key of NOT READY and an Additional Sense Code of DRIVE NOT READY.

Test Unit Ready Command Descriptor Block (CDB)

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00	Opcode = 00H							
01	Logical Unit Number			Reserved				
02—04	Reserved							
05	Control Byte							

Verify

The VERIFY command requests that the Target verify the data written on the media.

Verify Command Descriptor Block (CDB)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Opcode = 2FH							
01	Logical Unit Number			Reserved			BYTCK	REL=0
02—05	(MSB=02)		Logical Block Address			(LSB=05)		
06	Reserved							
07—08	(MSB=07)		Verification Length			(LSB=08)		
09	Control Byte							

BYTCK (Byte Check). If the BYTCK bit is set to zero (0), a media verification is performed with no data comparison. If BYTCK is set to one (1), the drive will request data from the Initiator and do a byte-by-byte comparison of this data with the data read from the media. If the data does not compare with that on the media, a check condition status will be returned. The sense key will be set to MISCOMPARE with a sense code of COMPARE ERROR. If the data cannot be read from the media, a MEDIUM ERROR will be returned.

Logical Block Address. This field specifies the logical block at which the verify operation will begin.

Verification Length. This field specifies the number of contiguous logical blocks of data that will be verified. A length of zero indicates that no logical blocks will be verified. This condition is not considered as an error. Any other value indicates the number of logical blocks that will be verified.

Write

The WRITE command requests that the Target write the data transferred by the Initiator to the media. The Target accepts both the nonextended (6-byte) and extended (10-byte) CDB formats.

Write (6-Byte) Command Descriptor Block (CDB)

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00	Opcode = 0AH							
01	Logical Unit Number			Logical Block Access (MSB)				
02—03	Logical Block Address (LSB=03)							
04	Transfer Length							
05	Control Byte							

Write (10-Byte) Command Descriptor Block (CDB)

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00	Opcode = 2AH							
01	Logical Unit Number			Reserved				REL=0
02—05	(MSB=02) Logical Block Address (LSB=05)							
06	Reserved							
07—08	(MSB=07) Transfer Length (LSB=08)							
09	Control Byte							

Logical Block Address. This field specifies the logical block at which the write operation will begin.

Transfer Length. This field specifies the number of contiguous logical blocks of data to be transferred. When using the nonextended (6-byte) CDB format, a Transfer Length of zero indicates that 256 logical blocks will be transferred. When using the extended (10-byte) CDB format, a Transfer Length of zero indicates that no logical blocks will be transferred. This condition shall not be considered an error (it is functionally equivalent to a SEEK command).

Write And Verify

The WRITE AND VERIFY command requests the Target to write the data transferred by the Initiator to the media, and then do an ECC verify of the data that was written.

Write And Verify Command Descriptor Block (CDB)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Opcode = 2EH							
01	Logical Unit Number			Reserved			BYTCK	REL=0
02—05	(MSB=02)		Logical Block Address			(LSB=05)		
06	RESERVED							
07—08	(MSB=07)		Transfer Length			(LSB=08)		
09	Control Byte							

BYTCK (Byte Check). The byte check option (BYTCK=1) is supported and will cause a byte-by-byte comparison of the data. Note that the verification pass will take additional time over a normal WRITE command.

Logical Block Address. This field specifies the logical block at which the WRITE AND VERIFY operations will begin.

Transfer Length. This field specifies the number of contiguous logical blocks of data to be transferred. A Transfer Length of zero indicates that no logical blocks shall be transferred. This condition shall not be considered an error (it is functionally equivalent to a SEEK command). The drive does an ECC verify pass on the data after it has been written.

Write Buffer

The WRITE BUFFER command allows the initiator to set the contents of the Target's data buffer. When used in conjunction with the READ BUFFER command, it allows the Initiator to test the buffer.

Caution

The WRITE BUFFER download microcode mode command allows the Initiator to execute code that may cause damaging results. It should only be performed when no data retention is required. Use of this command should be restricted to development or other highly controlled environments. Development of the code for this command should be carefully coordinated with the product's support team. Execution of this command with code not approved by Hewlett-Packard may be deemed a violation of warranty.

Write Buffer Command Descriptor Block (CDB)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Opcode = 3BH							
01	Logical Unit Number			Reserved		Mode = 0		
02	Buffer ID = 0							
03—05	(MSB=03)			Buffer Offset		(LSB=05)		
06—08	(MSB=07)			Transfer Length		(LSB=08)		
09	Control Byte							

Mode and Buffer ID These are not supported and should be set to zero (0).

Buffer Offset This field is supported. The value inserted into this field determines the number of bytes into the data buffer to start the transfer of data.

Byte Transfer Length. This field specifies the number of bytes to be transferred to the Target during the data phase. The transfer length includes the number of bytes to be written the data buffer plus four (4) for the header. (The four header bytes are ignored by the Target and not written to the buffer.) A transfer length of zero indicates that no data transfer will take place and will not be considered an error. It is not considered an error to request a transfer length smaller than the Target data buffer size.

If the transfer length is greater than the maximum size of the Target's data buffer, the data phase will not be performed. The Target progresses immediately to the Status phase with CHECK CONDITION, ILLEGAL REQUEST Sense Key.

To avoid the possibility of causing data buffer corruption between a WRITE BUFFER and a subsequent READ BUFFER, it is recommended that the Target be placed in Reserve or that the commands be linked to ensure that the Initiator can reliably test the Target's data buffer.

Write Long

The WRITE LONG command requests the Target to write the data transferred by the Initiator to the media. The data transferred is implementation specific, but will include the header, data bytes, and the ECC bytes. The READ LONG command is usually issued before issuing a WRITE LONG command. The WRITE LONG data should be the same length and in the same order as the data returned by the READ LONG command.

Write Long Command Description Block (CDB)

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00	Opcode = 3FH							
01	Logical Unit Number			Reserved				REL=0
02—05	(MSB=02)		Logical Block Address				(LSB=05)	
06	Reserved							
07—08	(MSB=07)		Byte Transfer Length				(LSB=08)	
09	Control Byte							

Logical Block Address. This field specifies the logical block address where the write operation will begin.

Byte Transfer Length. This field specifies the number of data bytes the Target would return for the READ LONG command. A transfer length of zero indicates that no bytes will be transferred. This condition is not considered an error.

If a non-zero byte transfer length does not exactly match the data length the Target would return for the READ LONG command, the Target will terminate the command with a CHECK CONDITION status and a Sense Key of ILLEGAL REQUEST, and an Additional Sense Code of INVALID FIELD IN CDB. The ILI and VALID bits will be set to one (1), and the information bytes will be set to the difference (residue) of the requested length minus the actual length in bytes. Negative numbers will be indicated by two's complement notation.

If the Byte Transfer Length field matches exactly the length that the Target would return for the READ LONG command, the Target will write the data to the specified address.

3

Vendor Unique Command Desc· · ons

This section provides descriptions of the Vendor Uniqu· .mands supported by the Target. Table 3-1 is al list of the Vendor Unique commands sup ·d by the Target with brief descriptions included for each command.

Command Descriptions

Detailed descriptions of the Vendor Unique commands ·rted by the Target are provided at the end of this chapter. These descriptions include t· ntrol Byte format, Command Descriptor Block (CDB) formats, data formats, and a· ·e-specific information involved in command execution.

Table 3-1. Vendor Unique · nands

Command	Opcode (hex)	· scription
Access Log	F2	Used to retrieve information · he Target's maintenance log.
Execute Data	FE	Executes special code downlo· · via the WRITE BUFFER command.
Interface Control	EF	Allows the ESDI commands · · sent to the disk drive processor.
Manage Primary	FD	Used to manage the primary · ·ct list (P list).
Media Test	F1	Used to test the integrity of · ·isk media.
Read Headers	EE	Requests Target to read all t· · eaders on the addressed track and return the requested number of bytes of · ·der information.
Reformat Track	ED	Formats a single track. If HS · · is 0, then it uses normal default header information. If the HS bit is · · ne supplied header information is used for the track logical address and flag b·res.

Command Use Before Spinup

Table 3-2 provides an overview of the supported Vendor Unique commands.

Table 3-2. Vendor Unique Command Overview

SCSI-2 Command	Opcode (hex)	Use Before Spinup
Access Log	F2	NO
Execute Data	FE	NO
Interface Control	EF	NO
Manage Primary	FD	NO
Media Test	F1	NO
Read Headers	EE	NO
Reformat Track	ED	NO

Access Log

The ACCESS LOG command allows the Initiator to read the entries contained in the disk drive's maintenance log. This information is available for maintenance purposes. The log information is maintained on the disk. There is a small queue in RAM to hold entries enroute to the disk. This queue is initialized on power-on or reset. Queued RAM entries are posted to the disk periodically, or when the logs are accessed. The ACCESS LOG command will always return this information from the disk log. There is always a disk access.

Access Log Command Descriptor Block (CDB)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Opcode = F2H							
01	Logical Unit Number			Reserved			Clear	PHYS
02—06	(MSB=02)			Reserved		(LSB=06)		
07—08	(MSB=07)			Allocation Length		(LSB=08)		
09	Control Byte							

Clear. A CLEAR bit of one (1) allows the Initiator to clear all the current log entries after reading them.

PHYS (Physical Address). A PHYS bit of zero (0) causes all addresses and block counts to be in terms of logical blocks. Any addresses that are outside the user data space are set to addresses higher than the maximum block address when logical block references are requested. If PHYS is set to one (1), all addresses and block counts are in terms of physical sectors.

Allocation Length. This field specifies the number of bytes that the Initiator has allocated for returned ACCESS LOG data. An Allocation Length of zero indicates that no ACCESS LOG data will be transferred. This condition shall not be considered as an error. Any other value indicates the maximum number of bytes that shall be transferred. The Target will terminate the Data In phase when the specified number of bytes have been transferred, or when all available ACCESS LOG data have been transferred to the Initiator, whichever is less.

Access Log Data Header Format

The log information is preceded by a 4-byte header.

	Bit							
Byte	7	6	5	4	3	2	1	0
00—01	Reserved							
02—03	(MSB=02) Available Length (LSB=03)							

Available Length. This field defines the number of bytes following the header. This length does not include the 4-byte header itself. The header is followed by zero or more log entries. Each log entry begins with a 2-byte header identifying the type and length (excluding the header) of the following entry. The log types are defined as follows:

- 00H - No information
- 01H - Usage log entry
- 02H - Data Error log entry
- 03H - Hardware Error log entry

Usage Log Entry

The Usage log entry conveys usage information about the entire device. The length of this entry is 12 bytes.

Usage Log Entry Header Format

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Log Entry Type = 01H							
01	Log Entry Length = 0CH							

Usage Log Entry Data Format

Byte	7	6	5	4	3	2	1	0
02	Reporting Area = FFH							
03	Reserved				Access Count			
04—09	(MSB=04) Blocks Read Count (LSB=09)							
10—11	(MSB=10) First Retry Count (LSB=11)							
12—13	(MSB=12) Multiple Retry Count (LSB=13)							

Reporting Area. This field is set to FFH, indicating that the entry refers to the entire device.

Access Count. This field indicates the number of media positionings since the last hardware error occurred. This field is reset to zero each time a Hardware Error log entry is added to the log. If no Hardware Error log entries are included in the ACCESS LOG data, this field reflects the total number of media accesses. If Hardware Error log entries are included, this field and the values in corresponding Access Count fields in those entries must be combined to yield the total number of media accesses. The number of accesses represented by the Access Count field are as follows:

Access Count Range Values

Value (HEX)	Minimum of Access Range	Maximum of Access Range	Value (HEX)	Minimum of Access Range	Maximum of Access Range
0	No Accesses	No Accesses	8	500,001	1,000,000
1	1	1	9	1,000,001	5,000,000
2	2	10	A	5,000,001	10,000,000
3	11	100	B	10,000,001	50,000,000
4	101	1,000	C	50,000,001	100,000,000
5	1,001	10,000	D	100,000,001	500,000,000
6	10,001	100,000	E	500,000,001	1,000,000,000
7	100,001	500,000	F	1,000,000,001	>1,000,000,001

Blocks Read Count. This field is the count of the blocks read over the entire disk drive. If the PHYS bit in the CDB is set to zero (0), the count represents logical blocks. If PHYS is set to one (1), the count represents physical blocks.

First Retry Count. This field indicates the number of instances when the data error recovery algorithm was forced to perform data read retrys and the data was recovered on the first retry.

Multiple Retry Count. This field indicates the number of times data was not recovered on the first retry. Note that this count is incremented only once per complete recovery action, not once for each retry within one recovery action.

Data Error Log Entry

This 6-byte entry is used to convey data error information about a specific data block.

Data Error Log Entry Header Format

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Log Entry Type = 02H							
01	Log Entry Length = 06H							

Data Error Log Entry Data Format

Byte	7	6	5	4	3	2	1	0
02—05	(MSB=02) Block Address (LSB=05)							
06	Data Error Code							
07	Occurrence Count							

Block Address. This field contains the block address of the data block that encountered multiple read retrys during one or more data error recovery attempts. If the PHYS bit in the CDB is is set to zero (0), the field contains the logical block address. If PHYS is set to one (1), the field contains the physical block address in the following format:

- Byte 2: Cylinder Address (MSB)
- Byte 3: Cylinder Address (LSB)
- Byte 4: Head Address
- Byte 5: Sector Address

Data Error Code. This byte is bit-significant, and multiple errors at the same location will have their respective bits merged into the reported byte as follows:

- Bit 7: Unclassifiable error
- Bit 6: Error occurred in header field
- Bit 5: Error occurred in data field
- Bit 4: Unrecoverable error
- Bit 3: Error recovered with ECC
- Bit 2: Error recovered with retries
- Bit 1: Write fault
- Bit 0: Reserved

Occurrence Count. This field is incremented each time the specified block is uncorrectable or requires multiple read retrys in a given transaction. This field is incremented only once for each data recovery.

Hardware Error Log Entry

This 8-byte entry conveys hardware fault information.

Hardware Error Log Entry Header Format

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Log Entry Type = 03H							
01	Log Entry Length = 08H							

Hardware Error Log Entry Data Format

Byte	7	6	5	4	3	2	1	0
02—05	(MSB=02) Block Address (LSB=05)							
06	Internal Device Status							
07	Device Error = 0							
08	Field Replaceable Unit (FRU) = 0							
09	Reserved				Access Count			

Block Address. This field contains the block address the disk drive was attempting to access when the error occurred. If the PHYS bit in the CDB is set to zero (0), this is a logical block address. If PHYS is set to one (1), this is a physical block address. The address format is similar to that described for the Data Error Log entry.

Internal Device Status. This byte contains an error code corresponding to the Additional Sense code returned by the REQUEST SENSE command.

Device Error and Field Replaceable Unit (FRU). The code values in these bytes will be returned as zero.

Access Count. This field contains access information as defined in the Usage log entry.

Execute Data

The EXECUTE DATA command allows the Initiator to download special code for the Target to execute, thus providing functions not available in the standard command set. This command causes code bytes, sent by the Initiator to the data buffer via a WRITE BUFFER command, to be executed. It is suggested that each EXECUTE DATA command be immediately preceded by the appropriate WRITE BUFFER command to ensure proper code execution.

Caution

The EXECUTE DATA command allows the Initiator to execute code that may cause damaging results. It should only be performed when no data retention is required. Use of this command should be restricted to development or other highly controlled environments. Development of the code for this command should be carefully coordinated with the product's support team. Execution of this command with code not approved by Hewlett-Packard may be deemed a violation of warranty.

EXECUTE DATA Command Descriptor Block (CDB)

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00	Opcode = FEH							
01	Logical Unit Number			0	0	0	INST	EXE
02—08	(MSB=02)			Parameter Field		(LSB=08)		
09	Control Byte							

INST (Install), EXE (Execute). If the INST bit is set to one (1), the code segment in the buffer will be "permanently" installed in executable RAM but not executed. If the EXT bit is set to one (1) the previously installed command is to be executed and no code is transferred from the data buffer. If both INSTAL and EXE are set to one (1), the code segment will be installed and executed. If both bits are set to zero (0), the command will fail with a status of CHECK CONDITION, a sense key of ILLEGAL REQUEST, and an addiitonal sense code of ILLEGAL FIELD IN CDB.

Execute Data Header

The code segment in the data buffer will consist of an optional 8-byte Execute Data header followed by the executable code. The header consists of four (4) ASCII Rev (revision) bytes, which must be equal to the current ASCII firmware revision (refer to the CAUTION); a 2-byte Checksum calculated over the code length; and a 2-byte Code Length field which does not include the length of the header.

Execute Data Header Format

	Bit							
Byte	7	6	5	4	3	2	1	0
00—03	Byte 1=00			ASCII Rev Bytes		Byte 4=03		
04—05	(MSB=04)			Checksum		(LSB=05)		
06—07	(MSB=06)			Code Length		(LSB=07)		

ASCII Rev Bytes. Current ASCII firmware revision.

Checksum. A checksum verification will be done over the code length for all cases, except when only the EXE bit is set to one (1). If the verification fails, the command will fail with CHECK CONDITION status and ILLEGAL REQUEST sense.

Code Length. A Code Length of zero will be accepted with no error and no code will be executed. In this case, no checksum verification will be performed.

If the Code Length is nonzero and all verification succeeds, execution will begin at the first byte of received code. It is the responsibility of that code to maintain proper firmware integrity and to terminate its function in an acceptable manner.

Interface Control

The INTERFACE COMMAND allows the Initiator to send an ESDI command directly to the disk drive ESDI interface.

Interface Control Command Descriptor Block (CDB)

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00	Opcode = EFH							
01	Logical Unit Number			Reserved				Stat
02—03	(MSB=02)			Command		(LSB=03)		
04—08	(MSB=07)			Reserved		(LSB=08)		
09	Control Byte							

Stat (Status). If this byte is set to one (1), two (2) bytes of ESDI status information will be received from the disk drive and returned to the Initiator in addition to the interface status byte described below.

Note

There is **no** interface timeout on this command. It is the Initiator's responsibility to issue valid commands and to set the STAT bit only for commands which will normally return status information.

A single byte will be returned to the Initiator when the disk controller completes its operation. The byte has the following bit definitions:

- Bit 0 - Disk drive selected
- Bit 1 - Command complete
- Bit 2 - Ready
- Bit 3 - Attention
- Bits 4-7 - Undefined

Command. This field is the ESDI command for the disk drive.

Manage Primary

The MANAGE PRIMARY command is used to manage the Primary Defect list (Plist). the MANAGE PRIMARY command can delete the current Plist, install a new Plist, or append defects to the current Plist. When installing or appending the Plist, this command causes the specified physical blocks to be reassigned as primary defects and added to the Plist. This command is implemented by performing a full device format, which will cause the loss of all user data and log information. Any existing Grown Defect List (Glist) defect information will also be lost. The current operating MODE SELECT parameters will become the saved parameters following this command.

The operation of the MANAGE PRIMARY command is similar to the FORMAT UNIT command.

Caution

The MANAGE PRIMARY command allows the Target to overwrite any or all of the Initiator-addressable data space. This command should be performed only when no data retention is required. Use of this command should be restricted to development or other highly controlled environments. Any use of this command other than at Hewlett-Packard approved sites may be deemed a violation of warranty.

Manage Primary Command Descriptor Format (CDB)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	OPCODE = FDH							
01	Logical Unit Number			FMTDTA	CMPLST	Defect List Format		
02—08	(MSB=02)			Reserved		(LSB=08)		
09	Control Byte							

FMTDTA (Format Data), CMPLST (Complete List). The state of these bits indicate to the Target what to do with the supplied defect information.

The FMTDTA bit is used to indicate if the Initiator will send defect information to the Target. If FMTDTA is set to zero (0), the Initiator will not send a Defect List, consequently no Data Out Phase occurs. If FMTDTA is set to one (1), a defect list will be supplied by the Initiator.

When FMTDTA is set to one (1), the CMPLST bit determines whether or not existing defects in the Plist will be retained. If CMPLST is set to zero (0), the existing Plist is retained and the defect list is appended to it. If CMPLST is set to one (1), the existing Plist is deleted and replaced by the new list from the Initiator. If the append option is selected, only the spare track area of the drive will be reformatted.

Defect List Format. This field must be set to 5 for the physical sector format or 4 for bytes from index format. The Defect List consists of a header indicating the total number of bytes in the set of descriptors to follow. Each descriptor consists of an 8-byte physical sector address. A Defect List Format byte of zero (0) is not considered an error.

Manage Primary Defect Sources

FMTDTA	CMPLST	Defect List Format Field	Defect List Supplied	Target Instructions
0*	X	X X X	No	No Data Out Phase. Do not retain current Plist.
1	0	1 0 1 or 1 0 0 or 0 X X**	Yes	Append new defect list to current Plist. Do not retain current Glist.
1	1	1 0 1 or 1 0 0 or 0 X X**	Yes	Delete current Plist. Build new Plist with new defect list. Do not retain current Glist.

* The preferred option is FMTDTA = 0.

** Defect list length of zero only.

Manage Primary Defect List Header Format

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Reserved							
01	Vendor Unique = 0							
02—03	(MSB=02) Defect List Length (LSB=03)							

Defect Descriptor Format

	Bit							
Byte	7	6	5	4	3	2	1	0
00—02	(MSB=00) Cylinder Number Of Defect (LSB=02)							
03	Head Number Of Defect							
04—07	(MSB=04) Defect Sector Number Or Bytes From Index (LSB=07)							

Media Test

The MEDIA TEST command instructs the Target to automatically perform testing over a specified area of the media.

Media Test Command Descriptor Block (CDB)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Opcode = F1H							
01	Logical Unit Number			WRT	PHYS	INT	RND	RST
02—05	(MSB=02)			Address		(LSB=05)		
06—08	(MSB=06)			Transfer Length		(LSB=08)		
09	Control Byte							

WRT (Write). This bit defines the type of test to be performed on the specified media area. If WRT is set to zero (0), the Target performs a read; if WRT is set to one (1), the Target performs a write operation.

PHYS (Physical Address). If the PHYS bit is set to one (1), the address field is interpreted as a physical address in the following format:

- Byte 2: Physical Cylinder Address (MSB)
- Byte 3: Physical Cylinder Address (LSB)
- Byte 4: Head Address
- Byte 5: Physical Sector Address (Ignored)

If PHYS is set to zero (0), the address is assumed to be a logical address.

INT (Internal Pattern). This bit selects the source of the data pattern used when a write test is selected. If INT is set to one (1), the Target uses an internally generated worst-case data pattern (6DBH). If INT is set to zero (0), the current contents of the first logical block of the Target's data buffer is used for the write pattern. Therefore, immediately preceding a MEDIA TEST command with INT set to zero (0), the Initiator should perform a WRITE BUFFER command (of at least one block length) which loads the desired data pattern into the data buffer. If WRT is set to zero (0), INT must also be set to zero (0).

RND (Random). This bit selects either random or sequential addressing. The media testing begins with the logical block address specified in the CDB. If RND is set to zero (0), the test proceeds sequentially from the specified logical block. Logical block zero follows the last logical block on the media when using sequential addressing. If RND is set to one (1), the next address is generated randomly from any block on the media.

RST (Reset Seed). This bit is used only when RND is set to one (1). When RST is set to one (1), the Target initializes its random number seed using the specified block address. This capability provides a method to enable a repeatable sequence of random addresses for pairs of MEDIA TEST commands (i.e., a write followed by a read). If RND is set to one (1) and RST is set to zero (0), the random number seed is not reset. If RND is set to zero (0), RST must also be set to zero (0).

Address. This field specifies which track to read.

Transfer Length. This field indicates the number of blocks to be tested, unless terminated by an error. An unrecoverable error terminates the MEDIA TEST command and generates CHECK CONDITION status with the appropriate sense information. If only recoverable errors occur, the media test will run to completion and return a CHECK CONDITION status with sense information set for the last recoverable error which occurred. Information on any additional errors can be obtained from the drive error log. A transfer length of zero shall not cause any media transfer to occur and shall not be considered an error.

On a sequential media test, if the Transfer Length is greater than the length remaining from the start address to the maximum block address, the test will continue to run from address zero (0) after the maximum block address is reached. This is not considered an error. This "wrap around" may occur more than once during a long test.

For random tests, only single block operations are performed. The transfer length field indicates the number of these operations to be performed.

Read Headers

The READ HEADERS command will read all the headers on the track specified by the Address field and return the requested number of bytes. The header information will always be returned starting from physical sector 0 of the addressed track regardless of the addressed block or sector.

READ HEADERS Command Descriptor Block (CDB)

	Bit							
Byte	7	6	5	4	3	2	1	0
00	Opcode = EEH							
01	Logical Unit Number			Reserved				PHYS
02—05	(MSB=02) Address (LSB=05)							
06	Reserved							
07—08	(MSB=07) Allocation Length (LSB=08)							
09	Control Byte							

PHYS (Physical Address). If the PHYS bit is set to one (1), the address field is interpreted as a physical address in the following format:

- Byte 2: Physical Cylinder Address (MSB)
- Byte 3: Physical Cylinder Address (LSB)
- Byte 4: Head Address
- Byte 5: Physical Sector Address (Ignored)

If PHYS is set to zero (0), the address is assumed to be a logical address.

Address. This field specifies which track to read.

Allocation Length. A value of zero (0) in this field will cause a seek to the addressed track with the header information read from the disk but no data transfer to the Initiator. The typical allocation length is 4 x 57 = 228 bytes.

Reformat Track

The REFORMAT TRACK command will cause the addressed track on the disk drive to be formatted according to the setting of the Transfer Length field.

Caution

REFORMAT TRACK will cause the loss of all user data on the specified track. Use of this command should be restricted to development or other highly controlled environments. Improper use of this command may cause the reformatted tracks to become unusable, or other user tracks to become inaccessible. Loss of defect information may also result. Any use of this command other than at Hewlett-Packard approved sites and by HP approved methods may be deemed a violation of warranty.

Reformat Track Command Descriptor Block (CDB)

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00	Opcode = EDH							
01	Logical Unit Number			Reserved				
02—05	(MSB=02)			Physical Block Address				(LSB=05)
06	Reserved							
07—08	(MSB=07)			Allocation Length				(LSB=08)
09	Control Byte							

Physical Block Address. This field selects the physical block address of the track to be reformatted. The Address field is defined as follows:

- Byte 2: Cylinder Address (MSB)
- Byte 3: Cylinder Address (LSB)
- Byte 4: Head Address
- Byte 5: Sector Address (Ignored)

Allocation Length. If the Allocation Length field is zero (0), the track will be formatted with the normally correct default header information. If the Transfer Length is equal to the header length (6), the bytes supplied in the Data Out phase will be used as the header bytes to reformat the track.

Reformat Track Data Out Phase

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
00—01	(MSB=00)			Track Address				(LSB=01)
02	Sector (Ignored)							
03	Sector Spare Flag							
04—05	(MSB=04)			Track Spare Flag				(LSB=05)