Optical Drive and Library

SCSI-2 Command Reference

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	Additional Send Diagnostics Command information
	Additional Inquiry Command information
May 1993	Edition 4
	Added C1716T optical drive information

About This Reference Manual

Table 0-1. Reader's Map

Chapter Section	Title	When to Use
Contents	Table of Contents	Shows the written, graphical, and table contents of each chapter.
1	SCSI Command Overview	Explains SCSI commands and their use with optical drives and libraries. This section does not replace the SCSI-2 Command Specifications.
2	C1716C/T Multifunction Optical Drive SCSI Command Set	Provides a list of all the supported SCSI commands and explains each command's structure.
3	Autochanger SCSI Command Set	Provides a list of all the supported SCSI commands and explains each command's structure.
4	Drive Internal Error Codes	Lists all error codes associated with the optical disk drive.
5	Autochanger Error Codes	Lists all error codes associated with the autochanger or optical disk library system.
Appendix A	FRUs	Lists the field replaceable units by number for the Models 60C/100C, 120T/200T, Models 10C/20C, 20T/40T , and Models 10LC, 20LT.
Appendix B	Programmer's Tips	Provides information that can help you build optical disk and library drivers, utilities, and applications.
Appendix C	Micro/Macro Moves	Lists all micro- and maco-moves for the optical disk libraries.
Glossary	Glossary	Defines terms and acronyms.
Index	Index	Assists you in locating information quickly.

Related Documents

Table 0-2. Other Documents

	Part Number
Models 10LC/20LT Optical Disk Library Systems	
Models 10LC/20LT Service Manual	C1708-90030
Models 10LC/20LT User's Guide	C1708-90099
Models 10C/20C, 20T/40T Optical Disk Library Systems	
Models 10C/20C, 20T/40T Service Manual	C1700-90031
Models 10C/20C, 20T/40T Unpacking Instructions	C1700-90073
Models 10C/20C, 20T/40T Deskside Setup Guide	C1700-90021
Models 10C/20C, 20T/40T Rackmount Setup Guide	C1700-90022
Models 10C/20C, 20T/40T User's Guide	C1700-90040
Models 60C/100C, 120T/200T Optical Disk Library Systems	
Models 60C/100C, 120T/200T Service Manual	C1705-90031
Models 60C/100C, 120T/200T Unpacking Instructions	C1715-90010
Models 60C/100C, 120T/200T Setup Guide	C1705-90020
Models 60C/100C, 120T/200T User's Guide	C1705-90040
Other Materials	
HP Optical Development Software	Call (303) 350-4940

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1

SCSI Command Overview

This chapter gives an overview of SCSI commands as they apply to optical memory devices.

Further information about the Small Computer System Interface - 2 (SCSI-2) can be obtained by writing or calling:

Global Engineering Documents
2805 McGaw
Irvine, CA 92714
(800) 854-7179 or (714) 261-1455

Optical Drive Control Through SCSI

The optical drive can be controlled by the commands described in this document.

This SCSI command set complies with ANSI X3.131-198X standards. The role of the host computer and the target or the address of a disk is defined in the SCSI specifications as follows:

Initiator

The initiator, usually the host, issues the drive control commands.

Target device

The target, usually the drive, receives the command and controls the device.

Addresses

All SCSI commands refer to logical addresses unless otherwise stated.

Drive Control Commands

This section describes all specifications other than command specifications of the target. The "SCSI Commands Used by the Target" are described later in this chapter.

SCSI Bus Phases

The target supports all phases specified in the SCSI standard. The following paragraphs describe each phase.

Arbitration Phase

The arbitration phase allows one SCSI device to gain control of the SCSI bus so that it can initiate or resume an I/0 process.

Selection Phase

The selection phase allows an initiator to select a target for the purpose of initiating some target function such as a read or write command. During the selection phase the I/O signal is negated so that this phase can be distinguished from the reselection phase.

Reselection Phase

The reselection phase allows the target to reconnect to an initiator for the purpose of continuing command operation that was previously started by the initiator but was suspended by the target.

Information Transfer Phase

The command, data, status, and message phases are all grouped together as the information transfer phases because they are all used to transfer data or control information via the data bus.

Data Phase

The data phase encompasses both the "data in" phase and the "data out" phase.

The data in phase allows the target to request that data be sent to the initiator from the target.

The data out phase allows the target to request that data be sent from the initiator to the target.

Command Phase

The command phase allows the target to request command information from the initiator.

Message Phase

The message phase is a term that references either a message in, or a message out phase. Multiple messages may be sent during either phase. The first byte transferred in either of these phases is either a single-byte message or the first byte of a multiple-byte message. Multiple-byte messages are wholly contained within a single message phase.

Message **In** phase allows the target to request that messages be sent to the initiator from the target.

Message **Out** phase allows the target to request that messages be sent from the initiator to the target. The target invokes this phase in response to the attention condition created by the initiator.

See Table 1-1 for a list of supported messages.

Table 1-1. Target-Supported Messages

Code (Hex)	Direction	Description
00H	In[1]	Command Complete
01H,03H,01H	In/Out	Synchronous Data Transfer Request
02H	In	Save Data Pointer
03H	In	Restore Pointers
04H	In	Disconnect
05H	Out[2]	Initiator-Detected Error
06H	Out	Abort
07H	In/Out	Message Reject
08H	Out	No Operation
09H	Out	Message Parity Error
0CH	Out	Bus Device Reset
80H-FFH	In/Out	Identify

1 Target to Initiator

2 Initiator to Target

Command Complete 00H. This message is sent from the target to the initiator to indicate that the execution of a command has terminated and that valid status has been sent to the initiator. After successfully sending this message, the target goes to the Bus Free Phase by releasing BSY (Busy).

Synchronous Data Transfer Request. This message is sent from the initiator to the target to request synchronous data transfer. The synchronous data transfer rate for the optical drive is 5 Mbytes per second.

Save Data Pointer 02H. This message is sent from the target to direct the initiator to save a copy of the present active data pointer for the currently attached logical unit. The target issues this message when it disconnects the SCSI Bus during data transfer.

Restore Pointers 03H. This message is sent from the target to direct the initiator to restore the most recently saved pointers to active state. The target may send this message when a bus error has occurred during the Data In or Status Phase.

Disconnect 04H. This message is sent from the target to inform an initiator that the present physical path is going to be broken, but that a later reconnect is required in order to complete current operation. All commands in this specification support the DISCONNECT message except for:

Table 1-2. Commands That Do Not Support Disconnect

Code (Hex)	Command
00H	Test Unit Ready
03H	Request Sense
12H	Inquiry
16H	Reserve
17H	Release
1AH	Mode Sense
5AH	Mode Sense
1CH	Receive Diagnostic Results
4DH	Log Sense
1EH	Prevent/Allow Medium Removal
25H	Read Capacity

Initiator-Detected Error 05H. When the target receives this message during Data In or Status Phase, it may retry the transfer after sending a Restore Pointers message.

Abort 06H. This message is sent from the initiator to the target to clear the present operation. All pending data and status that was made by the current command is cleared and the target goes to the Bus Free Phase. Pending data and status for other initiators are not cleared. No status or ending message is sent for the operation.

Message Reject 07H. This message is sent from either the initiator or the target to indicate that the last message was inappropriate or has not been implemented.

When the target receives a MESSAGE REJECT message from the initiator, it takes the following action based on which message was rejected.

Command Complete	The target goes to Bus Free Phase and does not consider this as an error.
Disconnect	The target does not disconnect and continues the current command.
Identify	The target goes to the Bus Free Phase and aborts the command. Sense Key/Additional Sense Code is set to Hardware Error/Message Reject Error.
Message Reject	The target terminates the command with Check Condition status and sets the Sense Key/Additional Sense Code to Hardware Error/Message Reject Error.
Restore Pointers	The target goes to the Bus Free Phase and sets the Sense Key/Additional Sense Code according to the error condition.
Save Data Pointers	The target does not disconnect and continues the current command.

No Operation 08H. This message is ignored by the target.

Message Parity Error 09H. When the target receives this message, it retries the operation by resending the original message once. If the message cannot be sent successfully, the target immediately goes to the Bus Free Phase and aborts the current SCSI command. No further reconnection is attempted and no status or COMMAND COMPLETE message is returned for the command. The target sets the Sense Key/Additional Sense Code to Hardware Error/SCSI Interface Parity Error.

Bus Device Reset 0CH. This message is sent from an initiator to reset the target.

Identify 80H-FFH. These messages are sent by either the initiator or the target to establish the physical path connection between initiator and target for a particular logical unit.

Bit 7	This bit is always set to 1.
Bit 6	This bit is set to 1 by the initiator to indicate that the initiator has the ability to accommodate the disconnection and reconnection.
Bit 5-3	Reserved.
Bit 2-0	These bits specify a logical unit number. Only one logical unit number is identified for any one selection sequence.

Status Phase

A status byte is sent from the target to the initiator during the Status Phase at the termination of each command unless the command is cleared by an ABORT message, a BUS DEVICE RESET message, or a RESET condition. The target supports the following status codes.

Table 1-3. Target-Supported Status Codes

Code (Hex)	Status
00H	Good
02H	Check Condition
08H	Busy
18H	Reservation Conflict

Good 00H. This status indicates that the target has successfully completed the command.

Check Condition 02H. Any error, exception, or abnormal condition that causes sense data to be set, causes a Check Condition status. The Request Sense Command should be issued following a CHECK CONDITION status, to determine the nature of the condition.

Busy 08H. A busy status is returned by the target during powerup until all poweron diagnostic tests have been completed. A busy status is also returned when multiple commands are outstanding in the target, and a media access command is received with the DISC PRIV bit cleared in the identify message.

Reservation Conflict 18H. This status is returned when a SCSI device attempts to access a logical unit that is reserved for another initiator.

Conditions

Attention Condition

The Attention Condition allows an initiator to inform the target that the initiator has a message ready. The target gets this message at its convenience by performing a Message Out Phase.

The target goes immediately to the message out phase upon detection of the ATN signal asserted in all cases except when transferring synchronous data in or out. In this case it goes to MESSAGE OUT after the completion of the data transfer phase.

Reset Condition

The target is reset when power is applied, the RST (Reset) signal is asserted, or the BUS DEVICE RESET message is received.

If the target can write to the disk, it finishes writing the data that is in the buffer. Any data that is in the buffer when the reset condition occurs is written to the disk.

If the target is not operating in a cohesive manner (hang encountered—an unrecoverable situation) a poweron reset is performed.

Unit Attention Condition

A unit attention condition for a logical unit begins for each initiator for any of the following conditions:

- Poweron or Reset
- Disk Loaded
- Micro Code Change
- Inquiry Data Change
- Mode Select Data Change

The unit attention condition persists for each initiator until that initiator issues a command to the logical unit other than Request Sense or Inquiry for which the target reports a CHECK CONDITION status. If the next command from that initiator to the logical unit (following the CHECK CONDITION status) is Request Sense, the Unit Attention sense key is returned. (If any command other than Request Sense is received, the unit attention condition is lost.)

If an Inquiry Command is received from an initiator with a pending unit attention condition (before the target reports CHECK CONDITION status), the target performs the Inquiry Command and does not clear the unit attention.

If a Request Sense Command is received from an initiator with a pending unit attention condition (before the target reports a CHECK CONDITION status), the target discards any pending sense data, reports a Unit Attention sense key, and clears the unit attention condition for that initiator.

SCSI Commands Used by the Target

This section describes detailed functions of each program supported in the target. Entries are arranged in order of operation code.

Each entry includes:

1. Command name
2. Operation code
3. Brief description of the command
4. Command descriptor block (CDB)
5. Detailed description of the command

Explanation of the Command Descriptor Block (CDB)

The command descriptor block defines the byte and bit layout for each supported drive command. Chapter 2 contains these specific descriptions.

Byte	7	6	5	4	3	2	1	0
0	Command Name and Code (00H)							
1	Reserved (0)							
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Control Byte (0)							

Figure 1-1. Example Command Descriptor Block

Reserved A Reserved field indicates that the field is reserved and must be set to 0 by the initiator.

The Reserved field for returned data contains 0 as well.

Disk Formats

Two optical disk formats are available. The HP C1716C optical drive can read from and write to 650-Mbyte optical disks. The HP C1716T optical drive can read from and write to both 650-Mbyte and 1.3-Gbyte optical disks. The target's role is to manage the 130mm multifunctional drive and disk as an optical memory device through its SCSI interface. These optical drives support 130mm rewritable optical disks conforming to ISO/IEC 10089 Format A, and write-once optical disks conforming to ISO/IEC DIS 11560, for 650-Mbyte capacity. The C1716T also supports the ECMA 184 standard for 1.3-Gbyte capacity, both rewritable and write-once.

The following sections outline disk layout for both 650-Mbyte and 1.3-Gbyte optical disks. Throughout this section, the sector number is that of a 1024 bytes/sector disk. The value of a 512 bytes/sector disk is written inside parentheses just after the value for the 1024 bytes/sector disk.

Optical Disk Layout - 650-Mbyte Capacity

This section highlights some of the aspects of 650-Mbyte capacity optical disks as outlined by ISO/IEC 10089A and ISO/IEC DIS 11560.

The disk is divided into various zones. In addition to the User Zone, where user data is stored, there are other zones including the PEP and SFP zones. Both the PEP and SFP contain information prerecorded by the media manufacturer and cannot be altered by a drive. They contain information about media parameters that the drive uses to read and write to the optical disk. Consult the ISO standard for more information.

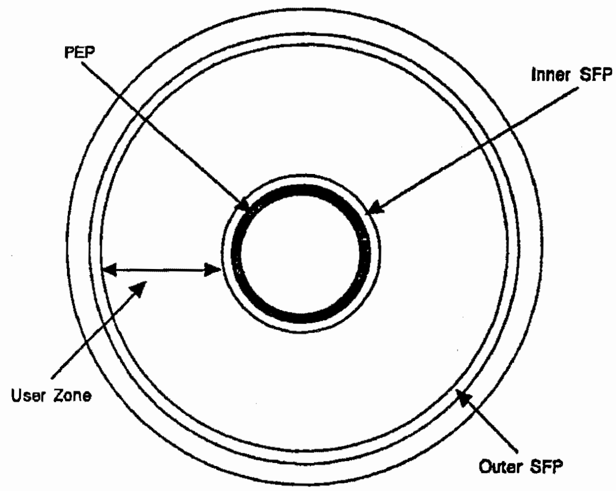


Figure 1-2. Optical Disk Layout

User Zone Layout—650-Mbyte Capacity

The User Zone consists of Defect Management Areas (DMAs), a User Area and a Slipping Area. The DMAs contain information on the organization of the User Area into User Groups and Spare Groups. The DMAs also contain a Primary Defect List (PDL) and a Secondary Defect List (SDL) that provide information on the locations of defects. The drive uses this information to perform defect management.

Although the User Zone consists of tracks and sectors, it is often easier to think of it in terms of a large memory space of consecutive sectors. Figure 1-3 shows the following parts of the User Zone for 650-Mbyte media.

1. Four Defect Management Areas (DMAs) each consisting of a

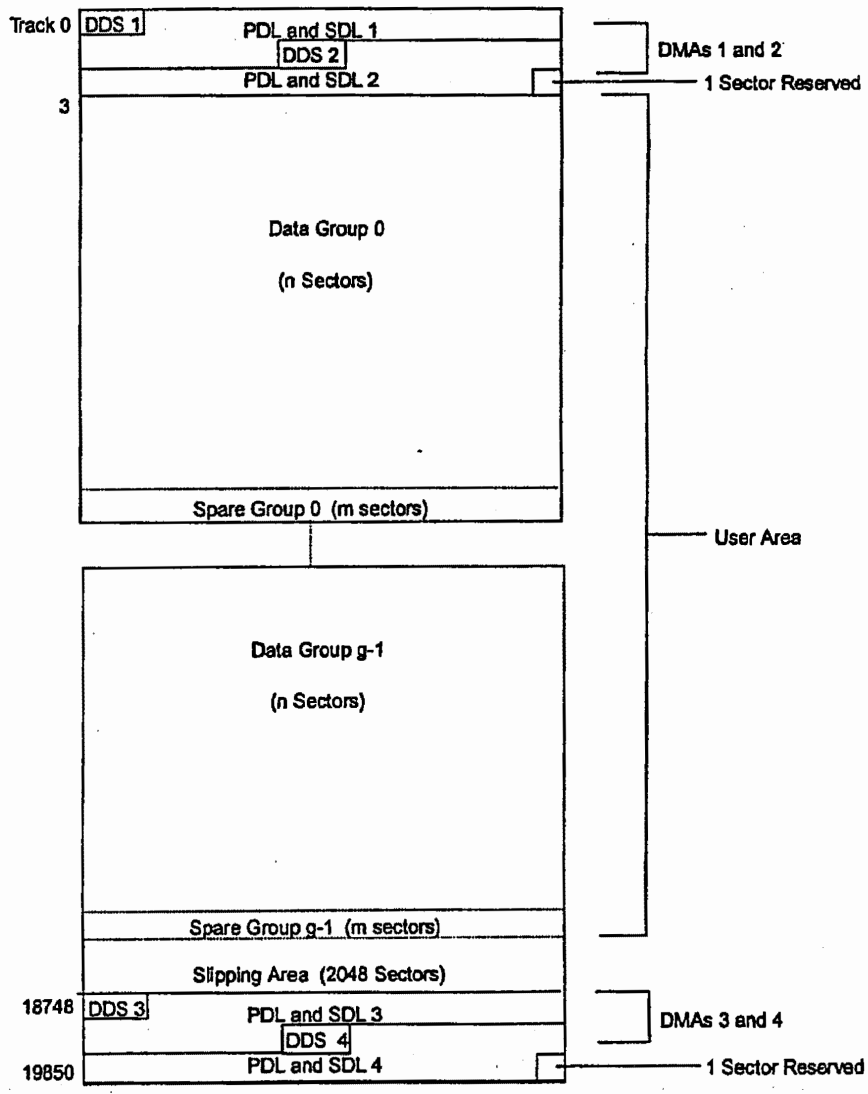
   Disk Definition Structure (DDS)

   Primary Defect List (PDL)

   Secondary Defect List (SDL)

2. Slipping Area
3. User Area consisting of

   g User Groups, of n sectors each
   g Spare Groups, of m sectors each



C1716C Defaults:
g=1 m=2048 n=314569 (576999)

Figure 1-3. User Zone Layout for 650-Mbyte Media

Optical Disk Layout - 1.3-Gbyte Capacity

This section highlights some of the aspects of 1.3-Gbyte Capacity optical disks as outlined by ECMA 184.

The disk is divided into various zones, similar to the 650-Mbyte capacity. See Figure 1-2. In addition to the User Zone, where user data is stored, there are other zones including the PEP and SFP zones. Both the PEP and SFP contain information prerecorded by the media manufacturer and cannot be altered by a drive. They contain information about media parameters that the drive uses to read from and write to the optical disk. Consult the ISO standard for more information.

User Zone Layout - 1.3-Gbyte Capacity

The User Zone consists of Defect Management Areas (DMAs), and User Area. The DMAs contain information about the organization of the User Area into User Groups and Spare Groups. The DMAs also contain a Primary Defect List (PDL) and a Secondary Defect List (SDL) that provide information on the locations of defects. The drive uses this information to perform defect management.

Although the User Zone consists of tracks and sectors, it is often easier to think of it in terms of a large memory space of consecutive sectors. Figure 1-4 shows the following parts of the User Zone for 1.3-Gbyte media.

1. Four Defect Management Areas (DMAs) each consisting of a

   Disk Definition Structure (DDS)

   Primary Defect List (PDL)

   Secondary Defect List (SDL)

2. Slipping Area
3. User Area consisting of

   g User Groups, of n sectors each

   g Spare Groups, of m sectors each

   NOTE: g = 1 or 16

Figures 1-4 and 1-5 show the User Zone Layout for 1.3-Gbyte, for both g=1 and g=16, respectively. It is important to note one significant difference between 650-Mbyte and 1.3-Gbyte media. Both types of media can contain multiple groups, however the start of each group on 650-Mbyte media can "slip out" with any slip spares found prior to that group. 1.3-Gbyte media establishes groups BEFORE accounting for slip spares. (Please refer to the section on Drive Defect Management for more details.)

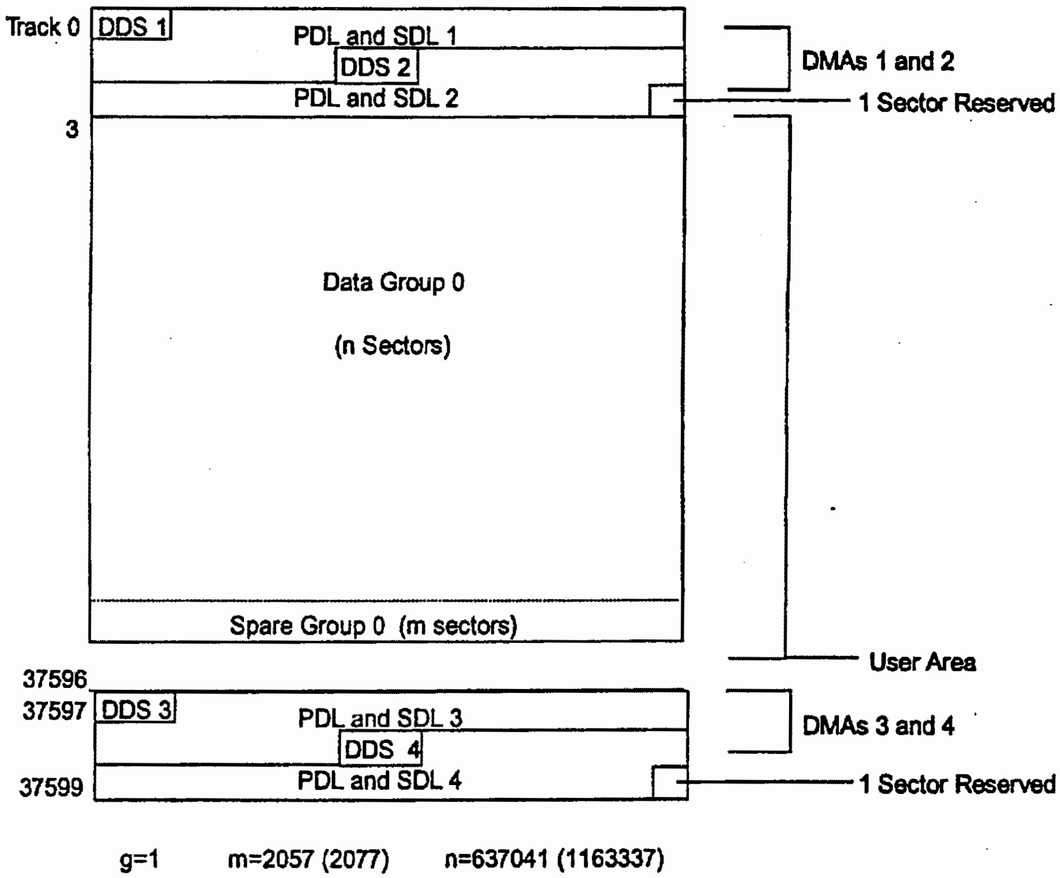


Figure 1-4. User Zone Layout for 1.3-Gbyte Media, g=1

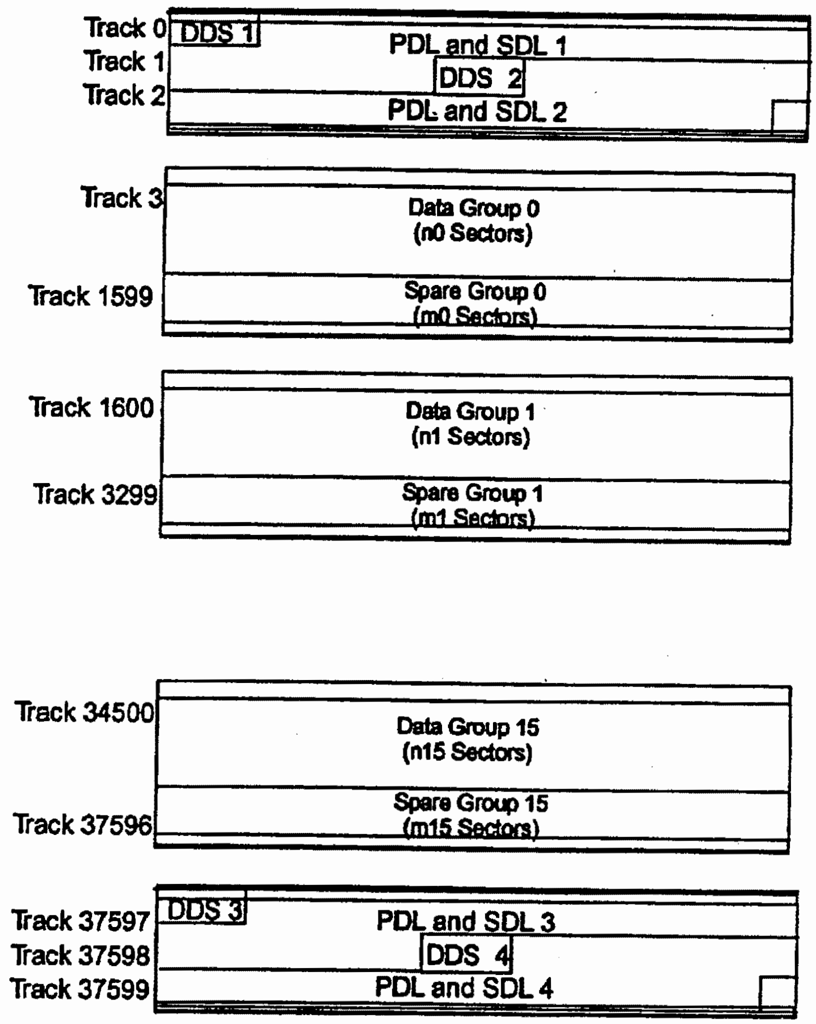


Figure 1-5. User Zone Layout for 1.3-Gbyte, g=16

Table 1-4.
Values for n and m for 1.3-Gbyte with g=16 (1024 media)

Band	n	m
Data Band 0	27064	85
Data Band 1	28815	85
Data Band 2	30498	102
Data Band 3	32198	102
Data Band 4	33898	102
Data Band 5	35581	119
Data Band 6	37281	119
Data Band 7	38981	119
Data Band 8	40664	136
Data Band 9	42364	136
Data Band 10	44064	136
Data Band 11	45747	153
Data Band 12	47447	153
Data Band 13	49147	153
Data Band 14	50830	170
Data Band 15	52462	187

TOTALS 637041 2057

The format of 1.3-Gbyte media is often referred to as a "sliding sector" format. This means that logical tracks do not necessarily align with physical revolutions. The following table details the physical revolution to logical track layout for 1.3-Gbyte media.

Table 1-5. Physical Revolution to Logical Track Layout

Zone or Band	Physical Revolution Range	Logical Track Range
Inner SFP	(-369, -161)	(-369, -161)
Inner Mfg	(-128, -33)	(-128, -33)
Data Band 0	(0, 1349)	(0, 1599)
Data Band 1	(1350, 2699)	(1600, 3299)
Data Band 2	(2700, 4049)	(3300, 5099)
Data Band 3	(4050, 5399)	(5100, 6999)
Data Band 4	(5400, 6749)	(7000, 8999)
Data Band 5	(6750, 8099)	(9000, 11099)
Data Band 6	(8100, 9449)	(11100, 13299)
Data Band 7	(9450, 10799)	(13300, 15599)
Data Band 8	(10800, 12149)	(15600, 17999)
Data Band 9	(12150, 13499)	(18000, 20499)
Data Band 10	(13500, 14849)	(20500, 23099)
Data Band 11	(14850, 16199)	(23100, 25799)
Data Band 12	(16200, 17549)	(25800, 28599)
Data Band 13	(17550, 18899)	(28600, 31499)
Data Band 14	(18900, 20249)	(31500, 34499)
Data Band 15	(20250, 21599)	(34500, 37599)
Outer Mfg	(21600, 22949)	(37600, 37785)
Outer SFP	(22950, 24299)	(37786, 38046)

Drive Defect Management

The C1716C/T drives support the defect management scheme specified by ISO 10089A and ISO DIS 11560, and ECMA 184. Each DMA consists of a

disk definition structure (DDS)

primary defect list (PDL)

secondary defect list (SDL).

The DDS contains information on how the disk is organized into user and spare groups. There are three important parameters; the variables g, n, and m are used in the ISO standard, and are used here for consistency:

g - number of groups

n - number of sectors in a User Group

m - number of sectors in a Spare Group

User data is stored initially in the sectors of the User Group, while the Spare Groups are reserved sectors for the linear replacement sparing algorithm. The values of g, n, and m are generally chosen so that they maximize the number of spare sectors allowed, and maximize the size of the User Area. (The ISO standard for 650-Mbyte media allows for a maximum of 2048 spare sectors total from the PDL and the SDL, while the ECMA standard for 1.3-Gbyte allows for 2057 or 1077, depending on the sector size of 1024 or 512 bytes per sector, respectively.) For 1.3-Gbyte the value for g must be 1 or 16.

In general for 650-Mbyte: $g * (n + m) <=$ (size of User Area)

In general for 1.3-Gbyte: $g = 1$ or 16, (n, m or n0 through n15 and m0 through m15 are predefined based on g).

For more details consult the ISO or ECMA standard.

The PDL contains a list of defective sector addresses as determined by the manufacturer or by a certification of the User Area, i.e. during a SCSI Format Unit Command. Defective sectors listed in the PDL are managed according to the slip sparing algorithm described in this chapter.

The SDL contains a list of defective sectors and corresponding replacement sectors determined during disk use, after certification. Defect/replacement entries in the SDL are managed according to the replacement sparing algorithm described in this chapter.

The Slipping Area is a portion of the User Zone used by the slip sparing algorithm. Defects found during certification are excluded from use. The user accessible space is slipped by a corresponding number of sectors into the slip area. This area is large enough to account for a maximum of 2048 slip spares. Any unused sectors in the slipping area are unavailable for user data.

Note The Slipping Area applies only to 650-Mbyte media.

Slip Sparing Algorithm

The slip sparing algorithm is used to manage the defective sectors listed in the PDL during address translation between logical and physical blocks. During an address translation, the logical blocks are "slipped" past any defective sectors, thus the name slip sparing. As an example, suppose there are defective sectors at physical block addresses 20 and 30, and the user wants the physical address of logical block 40. Since physical addresses 20 and 30 have defective sectors they should be slipped past, so logical block address 20 is now physical block address 21, and logical block address 30 is now physical block address 32, taking into account both physical blocks 20 and 30 being slipped past. This would result in physical block address 42 being the translation for logical block address 40.

This is not a truly accurate example for the following reasons:

1. PDL entries are given in track/sector form, not as block addresses. The final translated address must also be in track/sector form.
2. There is a 3-track offset added to the physical block address, 51 sectors for 1024 bytes/sector media and 93 sectors for 512 bytes/sector media.
3. This example does not take into account the effects of Spare Groups preceding this sector. The User and Spare Groups are determined after slip sparing for 650-Mbyte media, and before slip sparing for 1.3-Gbyte media.

For 650-Mbyte media, slip sparing is always the first step of address translation, followed by User and Spare Grouping, and replacement sparing.

For 1.3-Gbyte media, user and Spare Grouping is always the first step of address translation, followed by Slip sparing, and replacement sparing.

The data structures for slip sparing and User and Spare Grouping (the PDL and DDS respectively) are created or updated only during a certification/format process, such as during a SCSI Format Unit Command. After certification, any additional defect management updating is done through the replacement sparing algorithm.

Replacement Sparing Algorithm

The replacement sparing algorithm is intended to manage defective sectors found after initialization.

As was mentioned earlier, the DDS allows for a number of sectors to be reserved for future use by the replacement sparing algorithm. These "spare sectors" reside in the Spare Groups, and are referred to via entries in the SDL. Each SDL entry consists of a defect and its replacement pair. The defect is always a sector in a User Group, and the replacement is a sector from a Spare Group. Both are given in track/sector form.

During address translation, after the original physical address is found via the slip sparing algorithm, the SDL is checked to see if that physical address was spared through the replacement sparing algorithm. If so, the replacement physical address is substituted for the original physical address.

In the event a sector needs to be replaced, i.e., due to a Reassign Blocks Command or automatic reallocation during a write command, a new defect/replacement pair is added to the SDL (if the new defect is not already in the SDL) or an existing defect/replacement entry is updated if it already exists in the SDL. (Updating an existing defect/replacement pair only occurs on 650-Mbyte media. For 1.3-Gbyte media a new defect/replacement pair is added, thus creating a "chain" of defect/replacement pointers.)

Error Thresholds

Although not directly related to disk format, the various error thresholds are the basis for deciding whether or not to spare a sector. This could happen during the certification process (i.e. the slip sparing algorithm) or auto-reallocation during a SCSI Write command (i.e. the replacement sparing algorithm). These error thresholds are related to the format of a sector in the User Zone.

Each sector in the User Zone consists of a header, user data, and parity bytes for error correction. The first error threshold of importance involves information in the sector header. Each header consists of three copies of the sector's track number, sector number, and a Cyclic Redundancy Check (CRC). The error threshold is determined by the number of sectors found "good."

The other error threshold of interest pertains to the degree of error correction required on the data. The error correction code (ECC) used causes parity bytes to be written following the user data. During a data recovery operation, these bytes are used to detect and correct up to 8 defective bytes in an interleave. Each sector has 10 (5) interleaves with 120 (122) bytes in each interleave. The actual number of bytes per interleave requiring correction is used as an error threshold. Consult the ISO standard for more details.

Table 1-6 shows the error thresholds for the C1716T optical drive. The sector IDs column refers to the minimum number of sector IDs that must be read correctly for the corresponding operation to be deemed successful. The ECC level column refers to the maximum number of bytes per interleave that require correction in order for the corresponding operation to be deemed successful.

Table 1-6. Error Thresholds

Operation	Sector IDs	ECC Level
Format	2	3
Write	2	-
Erase	2	-
Verify	2	4
Read (Recovered)	1	7
Read	1	8

2

Multifunction Optical Drive SCSI-2 Command Set

Numerical List of Commands

The following tables list the SCSI-2 commands numerically, by group. See Table 2-1 for an alphabetical list of all commands.

Group 0 Commands (6-byte command)

Hex Code	Name	Description	Page
00H	Test Unit Ready	Provides a means to check if the logical unit is ready	2-8
01H	Rezero Unit	Moves the optical head to its recalibration position	2-9
03H	Request Sense	Requests the detailed error information	2-10
04H	Format Unit	Initializes the optical disk (done only once for unformatted Write-Once disks)	2-14
07H	Reassign Blocks	Reassigns defective sectors	2-17
08H	Read	Reads data from the specified logical block address	2-19
0AH	Write	Writes data to the specified logical block address	2-20
0BH	Seek	Moves the optical head to the physical track where the specified logical block exists	2-21
12H	Inquiry	Reads the information related to the controller and the drive unit	2-22
15H	Mode Select	Sets optical disk, drive unit, or controller unit parameters	2-27
16H	Reserve	Gains the exclusive control of a specified logical unit	2-46

Group 0 Commands (6-byte command) (continued)

Hex Code	Name	Description	Page
17H	Release	Releases a specified logical unit from the reservation state	2-47
1AH	Mode Sense	Reads optical disk, drive unit, or controller unit parameters	2-48
1BH	Start/Stop Unit	Starts or stops rotating the optical disk, and/or ejects the optical disk from the drive unit	2-71
1CH	Receive Diagnostic Results	Requests analysis data be sent to the initiator	2-73
1DH	Send Diagnostic	Requests the disk controller to perform diagnostic tests	2-76
1EH	Prevent/Allow Medium Removal	Prevents or allows removal of the optical disk in the logical unit	2-85

Group 1 and 2 Commands (10-byte command)

Hex Code	Name	Description	Page Number
25H	Read Capacity	Reads the capacity of the optical disk	2-86
28H	Read	Reads data from the specified logical block address	2-88
2AH	Write	Writes data to the specified logical block address	2-90
2BH	Seek	Moves the optical head to the physical track where the specified logical block exists	2-92
2CH	Erase	Executes erase operation from the specified logical block address on rewritable disks only	2-93
2EH	Write and Verify	Writes data to the optical disk and then verifies the written data by checking the error correction code	2-95
2FH	Verify	Verifies the data starting from the specified logical block address by checking the error correction code	2-97
35H	*-Synchronize Cache	Initiates the writing of all cached write data to the optical disk	2-99
37H	Read Defect Data	Reads the optical disk defect information	2-100

*-Indicates a new command that is not supported on the C1716A/M drive.

3BH	Write Buffer	Writes data to the controller data buffer.	2-104
3CH	Read Buffer	Reads data from the controller data buffer	2-107
3EH	Read Long	Reads data from the specified logical block address including ECC data	2-110
3FH	Write Long	Writes data to the specified logical block address without using the ECC generation circuitry	2-112
4CH	*-Log Select	Clears drive resident logs and odometers	2-114
4DH	*-Log Sense	Reads drive resident logs and odometers	2-116
55H	*-Mode Select	Sets optical disk, drive unit, or controller unit parameters	2-127
5AH	*-Mode Sense	Reads optical disk, drive unit, or controller unit parameters	2-147

Group 5 Commands (12-byte command)

Hex Code	Name	Description	Page Number
A8H	*-Read	Reads data from the specified logical block address	2-170
AAH	*-Write	Writes data to the specified logical block address	2-172
ACH	*-Erase	Executes erase operation from the specified logical block address on rewritable disks only	2-174
AEH	*-Write and Verify	Writes data to the optical disk and then verifies the written data by checking the error correction code	2-176
AFH	*-Verify	Verifies the data starting from the specified logical block address by checking the error correction code	2-178
B7H	*-Read Defect Data	Reads the optical disk defect information	2-180

*-Indicates a new command that is not supported on the C1716A/M drive.

Alphabetical List of Commands

The following table lists all the SCSI-2 commands in alphabetical order. A numerical list begins on page 1 of this chapter.

Table 2-1. Alphabetical List of Commands

Name	Hex	Group	Description	Page
Erase	2CH	1	Executes erase operation from the specified logical block address on rewritable disks only	2-93
*-Erase	ACH	5	Executes erase operation from the specified logical block address on rewritable disks only	2-174
Format Unit	04H	0	Initializes the optical disk (done only once for uninitialized Write-Once disks)	2-14
Inquiry	12H	0	Reads the information related to the controller and the drive unit	2-22
*-Log Select	4CH	2	Clears drive resident logs and odometers	2-114
*-Log Sense	4DH	2	Reads drive resident logs and odometers	2-116
Mode Select	15H	0	Sets optical disk, drive unit, or controller unit parameters	2-27
*-Mode Select	55H	2	Sets optical disk, drive unit, or controller unit parameters	2-127
Mode Sense	1AH	0	Reads optical disk, drive unit, or controller unit parameters	2-48
*-Mode Sense	5AH	2	Reads optical disk, drive unit, or controller unit parameters	2-147
Prevent/Allow Medium Removal	1EH	0	Prevents or allows removal of the optical disk in the logical unit	2-85

Table 2-1. Alphabetical List of Commands (continued)

Name	Hex	Group	Description	Page
Read	08H	0	Reads data from the specified logical block address	2-19
Read	28H	1	Reads data from the specified logical block address	2-88
*-Read	A8H	5	Reads data from the specified logical block address	2-170
Read Buffer	3CH	1	Reads data from the controller data buffer	2-107
Read Capacity	25H	1	Rads the capacity of the optical disk	2-86
Read Defect Data	37H	1	Reads the optical disk defect information	2-100
*-Read Defect Data	B7H	5	Reads the optical disk defect information	2-180
Read Long	3EH	1	Reads data from the specified logical block address including ECC data	2-110
Reassign Blocks	07H	0	Reassigns defective sectors	2-17
Receive Diagnostic Results	1CH	0	Requests analysis data be sent to the initiator	2-73
Release	17H	0	Releases a specified logical unit from the reservation state	2-47
Request Sense	03H	0	Requests the detailed error information	2-10
Reserve	16H	0	Gains the exclusive control of a specified logical unit	2-46
Rezero Unit	01H	0	Moves the optical head to its recalibration position	2-9
Seek	0BH	0	Moves the optical head to the physical track where the specified logical block exists	2-21
Seek	2BH	1	Moves the optical head to the physical track where the specified logical block exists	2-92
Send Diagnostic	1DH	0	Requests the disk controller to perform diagnostic tests	2-76

Table 2-1. Alphabetical List of Commands (continued)

Name	Hex	Group	Description	Page
Start/Stop Unit	1BH	0	Starts or stops rotating the optical disk, and/or ejects the optical disk from the drive unit	2-71
*-Synchronize Cache	35H	1	Initiates the writing of all cached write data to the optical disk	2-99
Test Unit Ready	00H	0	Provides a means to check if the logical unit is ready	2-8
Verify	2FH	1	Verifies the data starting from the specified logical block address by checking the error correction code	2-97
*-Verify	AFH	5	Verifies the data starting from the specified logical block address by checking the error correction code	2-178
Write	0AH	0	Writes data to the specified logical block address	2-20
Write	2AH	1	Writes data to the specified logical block address	2-90
*-Write	AAH	5	Writes data to the specified logical block address	2-172
Write and Verify	2EH	1	Writes data to the optical disk and then verifies the written data by checking the error correction code	2-95
*-Write and Verify	AEH	5	Writes data to the optical disk and then verifies the written data by checking the error correction code	2-176
Write Buffer	3BH	1	Writes data to the controller data buffer	2-104
Write Long	3FH	1	Writes data to the specified logical block address without using the ECC generation circuitry	2-112

*-Indicates a new command that is not supported on the C1716A/M drive.

Detailed Description of the SCSI Commands

Note In this chapter, shaded text in the CDB indicates a bit that is supported on the C1716T drive only. Shaded text in the explanation section under the CDB indicates the default setting.

Test Unit Ready Command (00H)

Determines the READY state of a drive. If the drive is in a READY state when it receives this command, it returns a GOOD status. A drive is in the READY state when the optical disk is loaded and spun up, and a read or write operation could complete successfully.

If the drive is not ready when it receives this command, it returns a CHECK CONDITION with a sense key of NOT READY.

Table 2-2. Test Unit Ready Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (00H)							
1	Reserved (0)							
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Control Byte (0)							

Rezero Unit Command (01H)

Recalibrates the optical head by moving the head to a pre-determined location and performing all necessary calibration routines.

Table 2-3. Rezero Unit Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (01H)							
1	Reserved (0)							
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Control Byte (0)							

Request Sense Command (03H)

Determines the specific error condition when a drive fails to complete a command and returns a CHECK CONDITION status. Sense data is preserved for the initiator until retrieved by a Request Sense Command or until the same drive receives another command.

HP Specific Error Codes are used to represent the error condition and can be used to determine what type of error recovery procedure is appropriate

Table 2-4. Request Sense Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (03H)							
1	Reserved (0)							
2	Reserved (0)							
3	Reserved (0)							
4	Allocation Length (Max Bytes=18H, See Table 2-5)							
5	Control Byte (0)							

Table 2-5. Error Code 70H or 71H Sense Data Format

Byte	7	6	5	4	3	2	1	0
0	AV	Error Code (70H or 71H)						
1	Reserved (0)							
2	Reserved(0)		ILI	Rsvd(0)	Sense Key (See Table 4-1)			
3	Information (MSByte)							
4	Information							
5	Information							
6	Information (LSByte)							
7	Additional Sense Length (0AH)							
8	Command Specific Information (MSByte) (reassign blocks only)							
9	Command Specific Information (reassign blocks only)							
10	Command Specific Information (reassign blocks only)							
11	Command Specific Information (LSByte) (reassign blocks only)							
12	Additional Sense Code (See Table 4-2)							
13	Additional Sense Code Qualifier (See Table 4-2)							
14	Reserved (0)							
15	SKSV	Sense Key Specific Information (if Sense Key = 1,3,4,5)						
16	Sense Key Specific Information (See Table 2-6 or Table 2-7)							
17	Sense Key Specific Information							
18	HP-Specific Error Code (See Table 4-3)							
19	HP-Specific Error Code							
20	Reserved (0)							
21	HP-Specific DSP Error Information (MSByte) (See Table 4-4)							
22	HP-Specific DSP Error Information (LSByte) (See Table 4-4)							
23	HP-Specific DSP Status Byte (See Table 4-5)							

AV	A Valid bit of 1 indicates the information field contains valid information. A Valid bit of 0 indicates that the information field does not contain valid data.
ILI	An Incorrect Length Indicator bit of 1 usually indicates that the requested logical block length did not match the logical block length of the data on the medium.
Information	(1) The logical block address associated with the sense key. (2) The difference (residue) of the requested length minus the actual length in either bytes or blocks, as determined by the command, when the ILI bit is set.
Command Specific Information	The logical block address of the first defect descriptor not reassigned is returned in this field. (See Table 2-12.)
SKSV	A Sense Key Specific Valid bit of 1 indicates that the Sense Key Specific Information is valid. A SKSV bit of 0 indicates that there is no sense key specific information.
Sense Key Specific Information	When the Sense Key (Byte 2, Bits 0-3) equals 5-Illegal Request, see Table 2-6. If the Sense Key equals 1, 3, or 4, see Table 2-7. If the Sense Key Specific Information is set to 5-Illegal Request and the SKSV bit is set to 1, the sense key specific field is defined in the following table. The Field Pointer field indicates which illegal parameters in command descriptor blocks or data parameters are in error.

Table 2-6. Field Pointer Types

Byte	7	6	5	4	3	2	1	0
15	SKSV (1)	C/D	Reserved (0)		BPV (1)	Bit Pointer		
16	Field Pointer (MSByte)							
17	Field Pointer (LSByte)							

C/D — A Command Data bit of 1 indicates a bad command.

A C/D bit of 0 indicates bad data.

Field Pointer — The Field Pointer indicates which byte of the command descriptor block or the parameter data was in error. Bytes are numbered starting from 0. When a multiple-byte field is in error, the pointer points to the most-significant byte of the field.

Note — Bytes identified as being in error are not necessarily the bytes that need to be changed to correct the problem.

Table 2-7. Actual Retry Count Bytes

Byte	7	6	5	4	3	2	1	0
15	SKSV (1)	Reserved (0)						
16	Actual Retry Count (MSByte)							
17	Actual Retry Count (LSByte)							

Format Unit Command (04H)

Initializes the optical disk surface. An unformatted Write-Once disk can be formatted only once.

Note The format parameters may be set using the Mode Select Commands (15H or 55H) prior to executing the Format Unit Command.

Table 2-8. Format Unit Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (04H)							
1	Reserved (0)			FmtDta	Reserved (0)			
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Control Byte (0)							

FmtDta — A Format Data bit of 1 indicates that the command includes a Data Out Phase consisting of a 4-byte Defect List Header.

A FmtDta bit of 0 indicates that the command does not include a Data Out Phase.

Note To format an unformatted disk or a previously formatted disk, set the selectable fields to zero. For example:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
04H	00H	00H	00H	00H	00H

When a Format Unit Command executes with all parameters set to zero, default actions take place. The Primary Defect List is developed solely through the results of the certification process.

Note Read "Drive Defect Management" in Chapter 1 for a description and example of drive defect management.

Format Unit Command Defect List

The Format Unit command Defect List consists of the Defect List Header and one multi-byte Defect Descriptor(s).

Table 2-9. Format Unit Defect List Header

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	FOV	Rsvd(0)	DCRT	Reserved (0)			Immed	Rsvd(0)
2	Reserved (0)							
3	Reserved (0)							

Write-Once Byte 1 - Bits 5 through 7 are Reserved (0).

FOV — A Format Options Valid bit of 1 indicates that the DCRT (Disable Certification) and Immed (Immediate) fields contain valid information.

A FOV bit of 0 indicates that the DCRT and Immed fields do not contain valid information.

DCRT — A Disable Certification bit of 1 indicates the drive does not certify the optical disk during the format process.

A DCRT bit of 0 indicates that the drive certifies the optical disk during the format process.

When the FOV bit is set to 0, the DCRT bit must also be set to 0.

DCRT does not apply to Write-Once disks.

Immed — When the Immediate bit is set to 1, it indicates a status of GOOD is returned before the format operation is begun.

An Immed bit of 0 indicates a GOOD status is returned when the format is complete.

Reassign Blocks Command (07H)

Reassigns defective sectors. A defect list containing the Logical Block Addresses to be reassigned is transferred to the drive.

Data in the defective sector is moved to the replacement sector.

Table 2-10. Reassign Blocks Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (07H)							
1	Reserved (0)							
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Control Byte (0)							

Note Read "Drive Defect Management" in Chapter 1 for a description and example of drive defect management.

Reassign Blocks Command Defect List

The Reassign Blocks command defect list is made up of a 4-byte Defect List Header and one or more 4-byte Defect Descriptor blocks.

Table 2-11. Reassign Blocks Command Defect List Header

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Reserved (0)							
2	Defect List Length (MSByte)							
3	Defect List Length (LSByte)							

Defect List Length	The Defect List Length is the total length in bytes of the Defect Descriptors that follow.

Table 2-12. Reassign Blocks Command Defect Descriptor

Byte	7	6	5	4	3	2	1	0
0	Defective Block Logical Address (MSByte)							
1	Defective Block Logical Address							
2	Defective Block Logical Address							
3	Defective Block Logical Address (LSByte)							

Each defective sector is decoded to a physical block address and that physical sector is added to the SDL (Secondary Defect List).

Read (Group 0) Command (08H)

Reads data from the specified logical block address. A maximum length of 256 logical blocks can be read using the Group 0 Read Command. If the number of logical blocks exceeds 256, use the Group 1 Read command.

Note The Mode Select Commands (15H or 55H) impact all read, write, format and erase commands.

Table 2-13. Read (Group 0) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (08H)							
1	Reserved (0)			Starting Logical Block Address (MSByte)				
2	Starting Logical Block Address							
3	Starting Logical Block Address (LSByte)							
4	Transfer Length							
5	PBA	Reserved (0)						

Transfer Length — The Transfer Length field specifies the number of contiguous logical blocks of data to be read. A Transfer Length of 0 specifies that 256 logical blocks are to be read. Any other value specifies the number of logical blocks to be read.

PBA — A Physical Block Address bit of 1 indicates that physical block addressing is used.

A PBA bit of 0 indicates that logical block addressing is used.

Write (Group 0) Command (0AH)

Writes data starting at the specified logical block address. Note that a maximum length of 256 Logical Blocks can be written using the Group 0 Write command. If the number of logical blocks exceeds 256, use the Group 1 Write Command. For Write-Once disks, blank checking is always performed before writes.

Note The Mode Select Commands (15H or 55H) impact all read, write, format and erase commands.

Table 2-14. Write (Group 0) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (0AH)							
1	Reserved (0)			Starting Logical Block Address (MSByte)				
2	Starting Logical Block Address							
3	Starting Logical Block Address (LSByte)							
4	Transfer Length							
5	PBA	Reserved (0)						

Write-Once Byte 5 is Reserved (0).

Transfer Length — The Transfer Length field specifies the number of contiguous logical blocks of data to be written. A Transfer Length of 0 specifies that 256 logical blocks are to be written.

PBA — A Physical Block Address bit of 1 indicates that physical block addressing is used.

A PBA bit of 0 indicates that logical block addressing is used.

Seek (Group 0) Command (0BH)

Seeks the optical head to the physical track where the specified logical block exists.

Table 2-15. Seek (Group 0) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (0BH)							
1	Reserved (0)			Logical Block Address (MSByte)				
2	Logical Block Address							
3	Logical Block Address (LSByte)							
4	Reserved (0)							
5	PBA	Reserved(0)						

PBA — A Physical Block Address bit of 1 indicates that physical block addressing is used.

A PBA bit of 0 indicates that logical block addressing is used.

Inquiry Command (12H)

Sends controller and drive information to the initiator.

Table 2-16. Inquiry Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (12H)							
1	Reserved(0)							EVPD
2	Page Code (See Table 2-18)							
3	Reserved(0)							
4	Allocation Length (Up to 38H) (See Table 2-17)							
5	Control Byte(0)							

EVPD — An Enable Vital Product Data bit of 1 specifies that the target returns the optional vital product data specified by the page code field. See Table 2-18.

AN EVPD bit of 0 specifies that the target returns the standard INQUIRY data. If the page code field is not 0, the target returns a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and an additional sense code of INVALID FIELD IN CDB.

Page Code — Specifies which page of vital product data information is returned.

Table 2-17. Inquiry Command Returned Data

Byte	7	6	5	4	3	2	1	0
0	Peripheral Device Type (07H—Optical Memory(default); 00H—Direct Access)							
1	RMB (1)	Device Type Qualifier (0)						
2	ISO Version		ECMA Version			ANSI-App. Version (2)		
3	Response Data Format (2)							
4	Additional Sense Length (33H)							
5	Reserved (0)							
6	Reserved (0)							
7	Reserved (0)							
8-15	Vendor ID "HP⊔⊔⊔⊔⊔⊔"[1]							
16-31	Product ID "C1716C⊔⊔⊔⊔ ⊔⊔⊔⊔⊔⊔" Product ID "C1716T⊔⊔⊔⊔ ⊔⊔⊔⊔⊔⊔"							
32-35	Engineering Date Code							
36-39	Manufacturing Date Code							
40-55	Hewlett-Packard Specific Information							

1 The ⊔ symbol represents a blank space.

Note A value of 04H is returned in Byte 0 if the DAIR bit in the Vendor Unique Page 21H of the Mode Select Command is set to 1, and a write-once disk is in the drive. If a rewritable disk or no disk is in the drive, 00H is returned.

If the DAIR is set to 0, the value returned in Byte 0 is 07H.

RMB The Removable Media Bit is set to 1 for removable optical disks.

Table 2-18. Vital Product Data Page Codes

Page Code	Description
00H	Supported Vital Product Data Page (See Table 2-19)
80H	Unit Serial Number Page (See Table 2-20)
81H	Implemented Operating Definitions Page (See Table 2-21)
C0H	Device Firmware Page (See Table 2-22)

Table 2-19. Supported Vital Product Data Page (Page Code 00H)

Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type				
1	Page Code (00H)							
2	Reserved (0)							
3	Page Length (n-3)							
4	First Supported VPD Page							
5	Second Supported VPD Page							
6	.							
	.							
n	Last Supported VPD Page							

Table 2-20. VPD Unit Serial Number Page (Page Code 80H)

Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type				
1	Page Code (80H)							
2	Reserved (0)							
3	Page Length (0AH)							
4-13	Product Serial Number (10 ASCII characters)							

Table 2-21.
Implemented Operating Definition Page (Page Code 81H)

Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type				
1	Page Code (81H)							
2	Reserved (0)							
3	Page Length (02H)							
4	Rsvd (0)	Current Operating Definition (03H)						
5	SavImp	Default Operating Definition (03H)						

Table 2-22. Device Firmware Page (Page Code C0H)

Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type				
1	Page Code (C0H)							
2	Reserved (0)							
3	Page Length (10H)							
4-7	Controller Code Revision (x.xx)							
8-11	DSP Code Revision (x.xx)							
12	Reserved							
13-15	Firmware Revision of Head (xxx)							
16-19	Serial Number of Head (xxxx)							

Mode Select Command (15H)

Sets optical disk and drive parameters for read, write, format, and erase commands.

Table 2-23. Mode Select (Group 0) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (15H)							
1	Reserved (0)			PF (1)	Reserved (0)			SP
2	Reserved (0)							
3	Reserved (0)							
4	Parameter List Length (See Table 2-24)							
5	Control Byte (0)							

SP — A Save Pages bit of 1 indicates that the target performs the specified MODE SELECT operation, and saves all the savable pages to non-volatile RAM.

An SP bit of 0 indicates the target performs the specified MODE SELECT operation, and does not save any pages.

Parameter List Length — This byte indicates the number of bytes of parameter data being transferred, including the header.

Table 2-24. Mode Page Codes

Page Code	Parameter List Length	Description
01H	24	Read-Write Error Recovery Page (See Table 2-25)
02H	28	Disconnect-Reconnect Page (See Table 2-26)
06H	16	Optical Memory Page (See Table 2-27)
07H	24	Verify Error Recovery Page (See Table 2-28)
08H	24	Caching Page (See Table 2-29)
0BH	20	Medium Types Supported Page (See Table 2-30)
20H	26	Vendor Unique Format Page (See Table 2-31)
21H	24	Vendor Unique Page (See Table 2-32)

Note

The header (4 bytes) and the block descriptor (8 bytes) are shown as the first 12 bytes on each of the following mode pages.

When sending **multiple** pages, only one header and one block descriptor are sent.

Table 2-25. Read-Write Error Recovery Page 01H

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Medium Type (02H-Optical Write-Once, 03H-Optical Erasable)							
2	Reserved (0)							
3	Block Descriptor Length (08H)							
4	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
5	Number of Blocks (MSByte)							
6	Number of Blocks							
7	Number of Blocks (LSByte)							
8	Reserved (0)							
9	Block Length (MSByte)							
10	Block Length							
11	Block Length (LSByte)							
12	Reserved (0)		Page Code (01H)					
13	Page Length (0AH)							
14	AWRE	Rsvd(0)	TB	Reserved (0)		PER	DTE	DCR
15	Read Retry Count							
16-19	Reserved (0)							
20	Write Retry Count							
21-23	Reserved (0)							

AWRE — An Automatic Write Reallocation Enable bit of 1 enables the automatic reallocation of defective sectors during the write operation of the Write commands (0AH, 2AH, AAH) and Write and Verify commands (2EH, AEH).

For rewritable disks, automatic reallocation of defective sectors occurs during these additional erase operations: Erase 2CH and Erase ACH.

Write-Once AWRE cannot be disabled on Write-Once media.

TB	A Transfer Block bit of 1 indicates that a data block that is not recovered within the recovery limits specified is transferred to the initiator before CHECK CONDITION status is returned. A TB bit of 0 indicates that such a data block is not transferred to the initiator.
PER	A Post Error bit of 1 indicates that the target reports recovered errors. A PER bit of 0 indicates that the target does not report recovered errors.
DTE	A Disable Transfer on Error bit of 1 indicates that the target terminates the data phase upon detection of a recovered error. A DTE bit of 0 indicates that the target does not terminate the data phase upon detection of a recovered error.
DCR	A Disable Correction bit of 1 indicates that error correction codes are not used for data error recovery. A DCR bit of 0 allows the use of error correction codes for data error recovery.
Read Retry Count	The Read Retry Count field specifies the number of times the target attempts recovery of a read operation before reporting an error.
Write Retry Count	The Write Retry Count field specifies the number of times the target attempts recovery of a write operation before reporting an error.

Table 2-26. Disconnect-Reconnect Page 02H

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
2	Reserved (0)							
3	Block Descriptor Length (08H)							
4	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
5	Number of Blocks (MSByte)							
6	Number of Blocks							
7	Number of Blocks (LSByte)							
8	Reserved (0)							
9	Block Length (MSByte)							
10	Block Length							
11	Block Length (LSByte)							
12	Reserved (0)		Page Code (02H)					
13	Page Length (0EH)							
14	Buffer Full Ratio							
15-21	Reserved (0)							
22	Maximum Burst Size (MSByte)							
23	Maximum Burst Size (LSByte)							
24-27	Reserved (0)							

The disconnect-reconnect page provides the initiator the means to tune the performance of the SCSI bus.

Buffer Full Ratio	This field indicates the threshold value which determines when buffer write data is written. The Buffer Full Ratio value is stated as the numerator of a fractional multiplier that has 256 as its denominator. For example, a ratio value of 128 equals 50 percent. A ratio value of 64 equals 25 percent.
Maximum Burst Size	This field indicates the maximum amount of data that the target transfers during a data phase before disconnecting if the initiator has granted the disconnect privilege. This value is expressed in increments of 512 bytes (e.g. a value of one means 512 bytes, two means 1024 bytes, etc.). A value of zero indicates there is no limit on the amount of data transferred per connection.

Table 2-27. Optical Memory Page 06H

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
2	Reserved (0)							
3	Block Descriptor Length (08H)							
4	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
5	Number of Blocks (MSByte)							
6	Number of Blocks							
7	Number of Blocks (LSByte)							
8	Reserved (0)							
9	Block Length (MSByte)							
10	Block Length							
11	Block Length (LSByte)							
12	Reserved (0)		Page Code (06H)					
13	Page Length (02H)							
14	Reserved (0)							
15	Reserved (0)							

The optical memory page defines parameters for control of optical memory devices.

Table 2-28. Verify Error Recovery Page 07H

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
2	Reserved (0)							
3	Block Descriptor Length (08H)							
4	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
5	Number of Blocks (MSByte)							
6	Number of Blocks							
7	Number of Blocks (LSByte)							
8	Reserved (0)							
9	Block Length (MSByte)							
10	Block Length							
11	Block Length (LSByte)							
12	Reserved (0)		Page Code (07H)					
13	Page Length (0AH)							
14	Reserved (0)					PER	Rsvd(0)	DCR
15	Verify Retry Count							
16-23	Reserved (0)							

PER A Post Error bit of 1 indicates that the target reports recovered errors.

A PER bit of 0 indicates that the target does not report recovered errors.

DCR	A Disable Correction bit of 1 indicates that error correction codes are not used for data error recovery. A DCR bit of 0 allows the use of error correction codes for data error recovery.
Verify Retry Count	The Verify Retry Count specifies the number of times the drive attempts its recovery algorithm during a verify operation.

Table 2-29. Caching Page 08H

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	MediumType (02H—Optical Write-Once, 03H—Optical Erasable)							
2	Reserved (0)							
3	Block Descriptor Length (08H)							
4	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
5	Number of Blocks (MSByte)							
6	Number of Blocks							
7	Number of Blocks (LSByte)							
8	Reserved (0)							
9	Block Length (MSByte)							
10	Block Length							
11	Block Length (LSByte)							
12	Reserved (0)		Page Code (08H)					
13	Page Length (0AH)							
14	Reserved (0)					WCE	Rsvd (0)	RCD
15	Reserved (0)							
16	Disable Pre-fetch Transfer Length (MSByte)							
17	Disable Pre-fetch Transfer Length (LSByte)							
18	Minimum Pre-fetch (MSByte)							
19	Minimum Pre-fetch (LSByte)							
20	Maximum Pre-fetch (MSByte)							
21	Maximum Pre-fetch (LSByte)							
22-23	Reserved (0)							

The caching parameters table defines the parameters that affect the use of the cache.

WCE	A Write Cache Enable bit of 1 indicates write caching is enabled. A Write Cache Enable bit of 0 indicates write caching is disabled.
RCD	A Read Cache Disable bit of 1 indicates read ahead is disabled. A Read Cache Disable bit of 0 indicates read ahead is enabled.
Disable Pre-fetch Transfer Length	This field sets the threshold value for pre-fetching data during reads. If the number of blocks to be read is greater than this value, no pre-fetching occurs.
Minimum Pre-fetch	An additional readahead length of the Maximum Pre-fetch is performed when the number of blocks in the Readahead cache is less than this value. (See "Read Performance" in Appendix B)
Maximum Pre-fetch	The maximum number of blocks to be read into the cache at one time. The maximum is 64K. (See "Read Performance" in Appendix B

Note With write caching enabled, data integrity of the information in the buffer is not guaranteed through power cycling.

Table 2-30. Medium Types Supported Page 0BH

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
2	Reserved (0)							
3	Block Descriptor Length (08H)							
4	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
5	Number of Blocks (MSByte)							
6	Number of Blocks							
7	Number of Blocks (LSByte)							
8	Reserved (0)							
9	Block Length (MSByte)							
10	Block Length							
11	Block Length (LSByte)							
12	Reserved (0)		Page Code (0BH)					
13	Page Length (06H)							
14	Reserved (0)							
15	Reserved (0)							
16	Medium Type One Supported (02H—Optical Write-once Medium)							
17	Medium Type Two Supported (03H—Optical Erasable Medium)							
18	Reserved (0)							
19	Reserved (0)							

The medium types supported page contains a list of the medium types implemented by the target for logical units.

The code values for each medium type supported by the target (up to four maximum), as defined in the MODE SELECT command are reported in ascending order.

If only the default medium type is supported, 0 is reported. If less than four medium types are supported, the unused entries are returned as 0.

Table 2-31. Vendor Unique Format Page 20H

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
2	Reserved (0)							
3	Block Descriptor Length (08H)							
4	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
5	Number of Blocks (MSByte)							
6	Number of Blocks							
7	Number of Blocks (LSByte)							
8	Reserved (0)							
9	Block Length (MSByte)							
10	Block Length							
11	Block Length (LSByte)							
12	Reserved (0)		Page Code (20H)					
13	Page Length (0c)							
14	Reserved (0)							
15	Groups per Volume (MSByte)							
16	Groups per Volume (LSByte)							
17	Data Blocks per Group (MSByte)							
18	Data Blocks per Group							
19	Data Blocks per Group (LSByte)							
20	Alternate Blocks per Group (MSByte)							
21	Alternate Blocks per Group							
22	Alternate Blocks per Group (LSByte)							
23	Sectors in Track Zero (17 for 1024 byte-sector disks, 31 for 512 byte-sector disks)							
24-25	Reserved (0)							

Groups per Volume	Groups per Volume indicates the number of user groups for a given surface or volume. (Referred to as g).
Data Blocks per Group	Data Blocks per Group indicates the number of user blocks, or sectors per user group. (Referred to as n).
Alternate Blocks per Group	Indicates the number of alternate or spare blocks (pre-allocated) per user group. (Referred to as m).

Note For 2X media, $g = 1$ or 16, $n = 0$, $m = 0$ (n and m are predefined based on g and vary per zone). Read "Drive Defect Management" in Chapter 1 for a description and example of drive defect management.

Table 2-32. Vendor Unique Page 21H

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
2	Reserved (0)							
3	Block Descriptor Length (08H)							
4	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
5	Number of Blocks (MSByte)							
6	Number of Blocks							
7	Number of Blocks (LSByte)							
8	Reserved (0)							
9	Block Length (MSByte)							
10	Block Length							
11	Block Length (LSByte)							
12	Reserved (0)		Page Code (21H)					
13	Page Length (0AH)							
14	ERR	DSP Log	DM Log	CM Log	Reset	DAS	DTIS	DAIR
15	DWR	Quick Disconnect	Memory Log	Force Verify	DLTW	Q Log	Task Log	Time Stamp
16	Maximum Buffer Latency (MSByte)							
17-18	Maximum Buffer Latency							
19	Maximum Buffer Latency(LSByte)							
20	Drive Retry Count							
21	Autochanger Eject Distance							
22	Phase Retry Count							
23	Reserved (0)							

ERR	An Extended Recovery Reporting bit of 1 indicates that all recovered errors except those requiring ECC are reported. An ERR bit of 0 indicates that error recovery reporting is handled according to Page Code 01H.
DSP Log	A DSP Log bit of 1 indicates DSP logging is enabled. A DSP Log bit of 0 indicates DSP logging is not enabled.
DM Log	A Drive Manager Log bit of 1 indicates drive manager logging is enabled. A DM Log bit of 0 indicates drive manager logging is not enabled.
CM Log	A Correction Manager Log bit of 1 indicates correction manager logging is enabled. A CM Log bit of 0 indicates correction manager logging is not enabled.
Reset	A Reset Configuration bit of 1 indicates a soft reset. A Reset bit of 0 indicates a hard reset.
DAS	A Disable Auto Spinup bit of 1 indicates that the auto spinup is disabled. A DAS bit of 0 indicates that the auto spinup is enabled.
DTIS	A Disable Target Initiated Synchronous bit of 1 indicates that negotiation is disabled. A DTIS bit of 0 indicates target initiated synchronous negotiation is enabled.
DAIR	A Direct Access Inquiry Response bit of 1 indicates the Peripheral Device Type field in the Inquiry Data indicates "Direct Access Device." A DAIR bit of 0 indicates "Optical Memory Device" in the Peripheral Device Type field in the Inquiry Data.

DWR	A Disable Write Reordering bit of 1 indicates write reordering is not enabled. A DWR bit of 0 indicates write reordering is enabled.
Quick Disconnect	A Quick Disconnect bit of 1 enables SCSI bus disconnection before command validation on performance path commands (i.e. reads, writes). A Quick Disconnect bit of 0 disables SCSI bus disconnection before validation on performance path commands (i.e. reads, writes).
Memory Log	A Memory Log bit of 1 indicates Buffer Memory usage logging is enable. A Memory Log bit of 0 indicates Buffer Memory usage logging is not enabled. (C1716T drive only.)
Force Verify	A Force Verify bit of 1 indicates all write operations are verified. The Write 6, 10, and 12-byte commands operate as if they were Write Verify 6, 10, and 12-byte commands. A Force Verify bit of 0 indicates normal operation.
DLTW	A Disable Log Threshold Warning bit of 1 indicates the log threshold warning is not enabled. A DLTW bit of 0 indicates the log threshold warning is enabled.
Q Log	A Priority Queue bit of 1 indicates priority queue logging is enabled. A Q Log bit of 0 indicates priority queue logging is not enabled.
Task Log	A Task Log bit of 1 indicates change logging is enabled. A Task Log bit of 0 indicates change logging is not enabled.

Time Stamp	A Time Stamp bit of 1 indicates that time stamping of Q Log and Task Log is enabled. A TimeStamp bit of 0 indicates that time stamping of Q Log and Task Log is not enabled.
Maximum Buffer Latency	These bytes indicate the maximum time in milliseconds that Immediate Responsed Write Data may remain in the buffer.
Drive Retry Count	This byte indicates the maximum number of retries that should be performed at the drive level.
Autochanger Eject Distance	The Autochanger Eject Distance is the distance the cartridge should be ejected, in tenths of millimeters back from the Standalone Eject position, when the drive is in an autochanger.
Phase Retry Count	This byte indicates the number of times to retry a SCSI phase after an error.

Reserve Command (16H)

Used to reserve the drive for use by a single SCSI initiator if and when the drive is connected to multiple initiators.

Table 2-33. Reserve Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (16H)							
1	Reserved (0)			3rdPty	3rd Party Device ID			Rsvd (0)
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Control Byte (0)							

The reservation is effective until one of the following occurs:

- The Reserve initiator sends another valid Reserve Command
- The Reserve initiator releases using a Release Command
- Any initiator sends a Bus Device Reset message
- A Reset conditions occurs

Once RESERVED, other initiator commands (except Inquiry and Request Sense) for the logical unit are rejected and result in a "Reservation Conflict" status. A Release Command sent by another initiator is ignored.

3rdPty — A 3rd Pty bit of 1 indicates that the drive is reserved for the SCSI device specified in the Third Party Device ID field.

3rd Pty Device ID — 3rd Pty Device ID indicates identification of the SCSI device for which the drive is to be reserved.

Release Command (17H)

Sent by the Reserve Command initiator to release the logical unit for use by other initiators.

Table 2-34. Release Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (17H)							
1	Reserved (0)			3rdPty	3rd Party Device ID			Rsvd (0)
2	Ignored							
3	Ignored							
4	Ignored							
5	Control Byte (0)							

3rdPty — A 3rd Pty bit of 1 indicates that the drive is reserved for the SCSI device specified in the Third Party Device ID field.

3rd Pty Device ID — 3rd Pty Device ID indicates identification of the SCSI device for which the drive is to be reserved.

Mode Sense (Group 0) Command (1AH)

Acquires optical disk, drive and drive controller parameters.

Table 2-35. Mode Sense (Group 0) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (1AH)							
1	Reserved (0)				DBD	Reserved (0)		
2	PC		Page Code (See Table 2-36)					
3	Reserved (0)							
4	Allocation Length							
5	Control Byte (0)							

DBD — A Disable Block Descriptors bit of 1 indicates that no block descriptor is provided.

A DBD bit of 0 indicates that the block descriptor is provided.

PC — Page control defines the type of parameter values to be returned as follows:

0 - Current Values
1 - Changeable Values
2 - Default Values
3 - Saved Values

Page Code — Page code values are the same as for the Mode Select command. See Table 2-36.

Allocation Length — Indicates the number of bytes of parameter data transferred, including the header. Set this value according to Table 2-36.

Table 2-36. Mode Page Codes

Page Code	Parameter List Length	Description
01H	24	Read-Write Error Recovery Page (See Table 2-37)
02H	28	Disconnect-Reconnect Page (See Table 2-38)
06H	16	Optical Memory Page (See Table 2-39)
07H	24	Verify Error Recovery Page (See Table 2-40)
08H	24	Caching Page (See Table 2-41)
0BH	20	Medium Types Supported Page (See Table 2-42)
20H	26	Vendor Unique Format Page (See Table 2-43)
21H	24	Vendor Unique Page (See Table 2-44)
00H,3FH	102	Request for all pages

Note

The header (4 bytes) and the block descriptor (8 bytes) are shown as the first 12 bytes on each of the following mode pages. If the DBD (disable block descriptors) bit is set to 1, bytes 4-11 will not be received.

When requesting **multiple** pages, only one header and one block descriptor are received.

Table 2-37. Read-Write Error Recovery Page 01H

Byte	7	6	5	4	3	2	1	0
0	Mode Data Length							
1	Medium Type (02H-Optical Write-Once, 03H-Optical Erasable)							
2	WP	Reserved (0)		Cache (1)	Reserved (0)			
3	Block Descriptor Length (08H)							
4	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
5	Number of Blocks (MSByte)							
6	Number of Blocks							
7	Number of Blocks (LSByte)							
8	Reserved (0)							
9	Block Length (MSByte)							
10	Block Length							
11	Block Length (LSByte)							
12	PS (1)	Rsvd (0)	Page Code (01H)					
13	Page Length (0AH)							
14	AWRE	Rsvd(0)	TB	Reserved (0)		PER	DTE	DCR
15	Read Retry Count							
16	Reserved (0)							
17	Reserved (0)							
18	Reserved (0)							
19	Reserved (0)							
20	Write Retry Count							
21-23	Reserved (0)							

WP	A Write Protect bit of 1 indicates that the optical disk in the drive is write-protected. A WP bit of 0 indicates that the optical disk in the drive is not write-protected.
Cache	The Cache bit of 1 indicates caching is supported.
PS	The Parameters Savable bit of 1 indicates this parameter page is savable in non-volatile RAM.
AWRE	An Automatic Write Reallocation Enable bit of 1 enables the automatic reallocation of defective sectors during the write operation of the Write commands (0AH, 2AH, AAH) and Write and Verify commands (2EH, AEH). For rewritable disks, automatic reallocation of defective sectors occurs during these additional erase operations: Erase 2CH and Erase ACH. `The AWRE default setting is 1.` An AWRE bit of 0 does not enable automatic reallocation of defective sectors.
TB	A Transfer Block bit of 1 indicates that a data block that is not recovered within the recovery limits specified is transferred to the initiator before CHECK CONDITION status is returned. A TB bit of 0 indicates that such a data block is not transferred to the initiator. `The TB default setting is 0.`
PER	A Post Error bit of 1 indicates that the target reports recovered errors. A PER bit of 0 indicates that the target does not report recovered errors. `The PER default setting is 0.`

DTE — A Disable Transfer on Error (DTE) bit of 1 (default) indicates that the target terminates the data phase upon detection of a recovered error.

A DTE bit of 0 indicates that the target does not terminate the data phase upon detection of a recovered error.

`The DTE default setting is 0.`

DCR — A Disable Correction bit of 1 indicates that error correction codes are not used for data error recovery.

A DCR bit of 0 allows the use of error correction codes for data error recovery.

`The DCR default setting is 0.`

Read Retry Count — The read retry count field specifies the number of times the target attempts recovery of a read operation before reporting an error.

`The Read Retry Count default setting is 5.`

Write Retry Count — The write retry count field specifies the number of times the target attempts recovery of a write operation before reporting an error.

`The Write Retry Count default setting is 2.`

Table 2-38. Disconnect-Reconnect Page 02H

Byte	7	6	5	4	3	2	1	0
0	Mode Data Length							
1	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
2	WP	Reserved (0)		Cache (1)	Reserved (0)			
3	Block Descriptor Length (08H)							
4	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
5	Number of Blocks (MSByte)							
6	Number of Blocks							
7	Number of Blocks (LSByte)							
8	Reserved (0)							
9	Block Length (MSByte)							
10	Block Length							
11	Block Length (LSByte)							
12	PS (1)	Rsvd (0)	Page Code (02H)					
13	Page Length (0EH)							
14	Buffer Full Ratio							
15-21	Reserved (0)							
22	Maximum Burst Size (MSByte)							
23	Maximum Burst Size (LSByte)							
24	Reserved (0)							
25	Reserved (0)							
26	Reserved (0)							
27	Reserved (0)							

The disconnect-reconnect page provides the initiator the means to tune the performance of the SCSI bus.

WP	A Write Protect bit of 1 indicates that the optical disk in the drive is write-protected. A WP bit of 0 indicates that the optical disk in the drive is not write-protected.
Cache	The Cache bit of 1 indicates that caching is supported.
PS	The Parameters Savable bit of 1 indicates this parameter page is savable in non-volatile RAM.
Buffer Full Ratio	This field indicates the threshold value which determines when buffer write data is written. The Buffer Full Ratio value is stated as the numerator of a fractional multiplier that has 256 as its denominator. For example, a ratio value of 128 equals 50 percent. A ratio value of 64 equals 25 percent. The Buffer Full Ratio default setting is 128.
Maximum Burst Size	This field indicates the maximum amount of data that the target transfers during a data phase before disconnecting if the initiator has granted the disconnect privilege. This value is expressed in increments of 512 bytes (e.g. a value of one means 512 bytes, two means 1024 bytes, etc.). A value of zero indicates there is no limit on the amount of data transferred per connection. The Maximum Burst Size default setting is 32.

Table 2-39. Optical Memory Page 06H

Byte	7	6	5	4	3	2	1	0
0	Mode Data Length							
1	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
2	WP	Reserved (0)		Cache (1)	Reserved (0)			
3	Block Descriptor Length (08H)							
4	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
5	Number of Blocks (MSByte)							
6	Number of Blocks							
7	Number of Blocks (LSByte)							
8	Reserved (0)							
9	Block Length (MSByte)							
10	Block Length							
11	Block Length (LSByte)							
12	PS (1)	Rsvd (0)	Page Code (06H)					
13	Page Length (02H)							
14	Reserved (0)							
15	Reserved (0)							

The optical memory page defines parameters for control of optical memory devices.

WP — A Write Protect bit of 1 indicates that the optical disk in the drive is write-protected.

A WP bit of 0 indicates that the optical disk in the drive is not write-protected.

Cache	The Cache bit of 1 indicates that caching is supported.
PS	The Parameters Savable bit of 1 indicates this parameter page is savable in non-volatile RAM.

Table 2-40. Verify Error Recovery Page 07H

Byte	7	6	5	4	3	2	1	0
0	Mode Data Length							
1	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
2	WP	Reserved (0)		Cache (1)	Reserved (0)			
3	Block Descriptor Length							
4	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
5	Number of Blocks (MSByte)							
6	Number of Blocks							
7	Number of Blocks (LSByte)							
8	Reserved (0)							
9	Block Length (MSByte)							
10	Block Length							
11	Block Length (LSByte)							
12	PS (1)	Rsvd (0)	Page Code (07H)					
13	Page Length (0AH)							
14	Reserved (0)					PER	Rsvd(0)	DCR
15	Verify Retry Count							
16-23	Reserved (0)							

WP — A Write Protect bit of 1 indicates that the optical disk in the drive is write-protected.

A WP bit of 0 indicates that the optical disk in the drive is not write-protected.

Cache — The Cache bit of 1 indicates that caching is supported.

PS	The Parameters Savable bit of 1 indicates this parameter page is savable in non-volatile RAM.
PER	A Post Error bit of 1 indicates that the target reports recovered errors. A PER bit of 0 indicates that the target does not report recovered errors. `The PER default setting is 0.`
DCR	A Disable Correction bit of 1 indicates that error correction codes are not used for data error recovery. A DCR bit of 0 allows the use of error correction codes for data error recovery. `The DCR default seting is 0.`
Verify Retry Count	The Verify Retry Count specifies the number of times the drive attempts its recovery algorithm during a verify operation. `The Verify Retry Count default setting is 5.`

Table 2-41. Caching Page 08H

Byte	7	6	5	4	3	2	1	0
0	Mode Data Length							
1	MediumType (02H—Optical Write-Once, 03H—Optical Erasable)							
2	WP	Reserved (0)		Cache (1)	Reserved (0)			
3	Block Descriptor Length (08H)							
4	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
5	Number of Blocks (MSByte)							
6	Number of Blocks							
7	Number of Blocks (LSByte)							
8	Reserved (0)							
9	Block Length (MSByte)							
10	Block Length							
11	Block Length (LSByte)							
12	PS (1)	Rsvd (0)	Page Code (08H)					
13	Page Length (0AH)							
14	Reserved (0)					WCE	Rsvd(0)	RCD
15	Reserved (0)							
16	Disable Pre-fetch Transfer Length (MSByte)							
17	Disable Pre-fetch Transfer Length (LSByte)							
18	Minimum Pre-fetch (MSByte)							
19	Minimum Pre-fetch (LSByte)							
20	Maximum Pre-fetch (MSByte)							
21	Maximum Pre-fetch (LSByte)							
22-23	Reserved (0)							

The caching parameters table defines the parameters that affect the use of the cache.

WP	A Write Protect bit of 1 indicates that the optical disk in the drive is write-protected. A WP bit of 0 indicates that the optical disk in the drive is not write- protected.
Cache	The Cache bit of 1 indicates that caching is supported.
PS	The Parameters Savable bit of 1 indicates this parameter page is savable in non-volatile RAM.
WCE	A Write Cache Enable bit of 1 indicates write caching is enabled. A WCE bit of 0 indicates write caching is disabled. `The WCE default setting is 1.`
RCD	A Read Cache Disable bit of 1 indicates read ahead is disabled. A RCD bit of 0 indicates read ahead is enabled. `The RCD default setting is 0.`
Disable Pre-fetch Transfer Length	This field sets the threshold value for pre-fetching data during reads. If the number of blocks to be read is greater than this value, no pre-fetching occurs. `The Disable Pre-fetch Transfer Length default setting is 65535.`
Minimum Pre-fetch	An additional readahead length of the Maximum Pre-fetch is performed when the number of blocks in the Readahead cache is less than this value. (See "Read Performance" in Appendix B) `The Minimum Pre-fetch default setting is 8.`
Maximum Pre-fetch	The maximum number of blocks to be read into the cache at one time. (See "Read Performance" in Appendix B) `The Maximum Pre-fetch default setting is 8.`

Note With write caching enabled, data integrity of the information in the buffer is not guaranteed through power cycling.

Table 2-42. Medium Types Supported Page 0BH

Byte	7	6	5	4	3	2	1	0
0	Mode Data Length							
1	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
2	WP	Reserved (0)		Cache (1)	Reserved (0)			
3	Block Descriptor Length (08H)							
4	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
5	Number of Blocks (MSByte)							
6	Number of Blocks							
7	Number of Blocks (LSByte)							
8	Reserved (0)							
9	Block Length (MSByte)							
10	Block Length							
11	Block Length (LSByte)							
12	PS (1)	Rsvd (0)	Page Code (0BH)					
13	Page Length (06H)							
14	Reserved (0)							
15	Reserved (0)							
16	Medium Type One Supported (02H—Optical Write- once Medium)							
17	Medium Type Two Supported (03H—Optical Erasable Medium)							
18	Reserved (0)							
19	Reserved (0)							

The medium types supported page contains a list of the medium types implemented by the target for logical units.

The code values for each medium type supported by the target (up to four maximum), as defined in the MODE SELECT command are reported in ascending order.

If only the default medium type is supported, 0 is reported. If less than four medium types are supported, the unused entries are returned as 0.

WP	A Write Protect bit of 1 indicates that the optical disk in the drive is write-protected. A WP bit of 0 indicates that the optical disk in the drive is not write-protected.
Cache	The Cache bit of 1 indicates that caching is supported.
PS	The Parameters Savable bit of 1 indicates this parameter page is savable in non-volatile RAM.

Table 2-43. Vendor Unique Format Page 20H

Byte	7	6	5	4	3	2	1	0
0	Mode Data Length							
1	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
2	WP	Reserved (0)		Cache (1)	Reserved (0)			
3	Block Descriptor Length (08H)							
4	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
5	Number of Blocks (MSByte)							
6	Number of Blocks							
7	Number of Blocks (LSByte)							
8	Reserved (0)							
9	Block Length (MSByte)							
10	Block Length							
11	Block Length (LSByte)							
12	PS (1)	Rsvd (0)	Page Code (20H)					
13	Page Length (0c)							
14	Reserved (0)							
15	Groups per Volume (MSByte)							
16	Groups per Volume (LSByte)							
17	Data Blocks per Group (MSByte)							
18	Data Blocks per Group							
19	Data Blocks per Group (LSByte)							
20	Alternate Blocks per Group (MSByte)							
21	Alternate Blocks per Group							
22	Alternate Blocks per Group (LSByte)							
23	Sectors in Track Zero (17 for 1024 byte-sector disks, 31 for 512 byte-sector disks)							
24-25	Reserved (0)							

WP	A Write Protect bit of 1 indicates that the optical disk in the drive is write-protected. A WP bit of 0 indicates that the optical disk in the drive is not write- protected.
Cache	The Cache bit of 1 indicates that caching is supported.
PS	The Parameters Savable bit of 1 indicates this parameter page is savable in non-volatile RAM.
Groups per Volume	Groups per Volume indicates the number of user groups for a given surface or volume. `The Groups per Volume default setting is 1.`
Data Blocks per Group	Data Blocks per Group indicates the number of user blocks, or sectors per user group. `The Data Blocks per Group default setting is 314569 for 1024 bytes/sector disks and 576999 for 512 bytes/sector disks. (This applies to 650-MB media only.)`
Alternate Blocks per Group	Indicates the number of alternate or spare blocks (pre-allocated) per user group. `The Alternate Blocks per Group default setting is 2048.`

Note Read "Drive Defect Management" in Chapter 1 for a description and example of drive defect management.

Table 2-44. Vendor Unique Page 21H

Byte	7	6	5	4	3	2	1	0
0	Mode Data Length							
1	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
2	WP	Reserved (0)		Cache (1)	Reserved (0)			
3	Block Descriptor Length (08H)							
4	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
5	Number of Blocks (MSByte)							
6	Number of Blocks							
7	Number of Blocks (LSByte)							
8	Reserved (0)							
9	Block Length (MSByte)							
10	Block Length							
11	Block Length (LSByte)							
12	PS (1)	Rsvd (0)	Page Code (21H)					
13	Page Length (0AH)							
14	ERR	DSP Log	DM Log	CM Log	Reset	DAS	DTIS	DAIR
15	DWR	Quick Disconnect)	Memory Log	Force Verify	DLTW	Q Log	Task Log	Time Stamp
16	Maximum Buffer Latency (MSByte)							
17	Maximum Buffer Latency							
18	Maximum Buffer Latency							
19	Maximum Buffer Latency(LSByte)							
20	Drive Retry Count							
21	Autochanger Eject Distance							
22	Phase Retry Count							
23	Reserved (0)							

WP	A Write Protect bit of 1 indicates that the optical disk in the drive is write-protected. A WP bit of 0 indicates that the optical disk in the drive is not write- protected.
Cache	The Cache bit of 1 indicates that caching is supported.
PS	The Parameters Savable bit of 1 indicates this parameter page is savable in non-volatile RAM.
ERR	An Extended Recovery Reporting bit of 1 indicates that all recovered errors except those requiring ECC are reported. An ERR bit of 0 indicates that error recovery reporting is handled according to Page Code 01H. `The ERR default setting is 0.`
DSP Log	A DSP Log bit of 1 indicates DSP logging is enabled. A DSP Log bit of 0 indicates DSP logging is not enabled. `The DSP Log default setting is 0.`
DM Log	A Drive Manager Log bit of 1 indicates drive manager logging is enabled. A DM Log bit of 0 indicates drive manager logging is not enabled. `The DM Log default setting is 0.`
CM Log	A Correction Manager Log bit of 1 indicates correction manager logging is enabled. A CM Log bit of 0 indicates correction manager logging is not enabled. `The CM Log default setting is 0.`
Reset	A Reset Configuration bit of 1 indicates a soft reset. A Reset bit of 0 indicates a hard reset. `The Reset default setting is 0.`

DAS	A Disable Auto Spinup bit of 1 indicates that the auto spinup is disabled. A DAS bit of 0 indicates that the auto spinup is enabled. `The DAS default setting is 0.`
DTIS	A Disable Target Initiated Synchronous bit of 1 indicates that negotiation is disabled. A DTIS bit of 0 indicates target initiated synchronous negotiation is enabled. `The DTIS default setting is 1.`
DAIR	A Direct Access Inquiry Response bit of 1 indicates the Peripheral Device Type field in the Inquiry Data indicates "Direct Access Device." A DAIR bit of 0 indicates "Optical Memory Device" in the Peripheral Device Type field in the Inquiry Data. `The DAIR default setting is 0.`
DWR	A Disable Write Reordering bit of 1 indicates write reordering is not enabled. A DWR bit of 0 indicates write reordering is enabled. `The DWR default setting is 0.`
Quick Disconnect	A Quick Disconnect bit of 1 enables SCSI bus disconnection before command validation on performance path commands (i.e. reads, writes). A Quick Disconnect bit of 0 disables SCSI bus disconnection before validation on performance path commands (i.e. reads, writes). `The Quick Disconnect default setting is 0.`

Memory Log — A Memory Log bit of 1 indicates Buffer Memory usage logging is enabled.

A Memory Log bit of 0 indicates Buffer Memory usage logging is not enabled.

(C1716T drive only.)

`The Memory Log default setting is 0.`

Force Verify — A Force Verify bit of 1 indicates that all write operations will be verified. The Write 6, 10, and 12-byte commands will operate as if they were Write Verify 6, 10, and 12-byte commands.

A Force Verify bit of 0 indicates normal operation.

`The Force Verify default setting is 0.`

DLTW — A Disable Log Threshold Warning bit of 1 indicates the log threshold warning is not enabled.

A DLTW bit of 0 indicates the log threshold warning is enabled.

`The DLTW default setting is 0.`

Q Log — A Priority Queue bit of 1 indicates priority queue logging is enabled.

A Q Log bit of 0 indicates priority queue logging is not enabled.

`The Q Log default setting is 0.`

Task Log — A Task Log bit of 1 indicates change logging is enabled.

A Task Log bit of 0 indicates change logging is not enabled.

`The Task Log default setting is 0.`

Time Stamp
A Time Stamp bit of 1 indicates that time stamping of Q Log and Task Log is enabled.

A Time Stamp bit of 0 indicates that time stamping of Q Log and Task Log is not enabled.

`The Time Stamp default setting is 0.`

Maximum Buffer Latency
These bytes indicate the maximum time in milliseconds that Immediate Responsed Write Data may remain in the buffer.

`The Maximum Buffer Latency default setting is 1000.`

Drive Retry Count
This byte indicates the maximum number of retries that should be performed at the drive level.

`The Drive Retry Count default setting is 2.`

Autochanger Eject Distance
The Autochanger Eject Distance is the distance the cartridge should be ejected, in tenths of millimeters back from the Standalone Eject position, when the drive is in an autochanger.

`The Autochanger Eject Distance default setting is 150.`

Phase Retry Count
This byte indicates the number of times to retry a SCSI phase after an error.

`The Phase Retry Count default setting is 5.`

Start/Stop Unit Command (1BH)

Starts or stops rotation of the optical disk in the drive and/or ejects the optical disk from the drive.

Table 2-45. Start/Stop Unit Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (1BH)							
1	Reserved (0)							Immed
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)						LoEj	Start
5	Control Byte (0)							

Immed — An Immediate bit of 1 indicates that status is returned as soon as the command descriptor block has been validated.

An Immed bit of 0 indicates that status is returned after the operation is completed.

LoEj — A Load Eject bit of 1, and a Start bit of 0, indicates that the drive ejects the media.

A Load Eject bit of 0 and a Start bit of 0 indicates that the drive spins down the media.

When the Start bit is set to 1, this bit is ignored.

Note — This command is affected by the Prevent/Allow Medium Removal command. See Table 2-61.

Do not use LoEj in an autochanger environment.

Start A Start bit of 1 indicates that the drive starts rotating the optical disk.

A Start bit of 0 indicates that the drive stops rotating the optical disk.

Receive Diagnostic Results Command (1CH)

Requests diagnostic test data resulting from the Send Diagnostic Command be sent to the initiator.

Table 2-46. Receive Diagnostic Results Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (1CH)							
1	Reserved (0)							
2	Reserved (0)							
3	Allocation Length (MSByte)							
4	Allocation Length (LSByte)							
5	Control Byte (0)							

Allocation Length — The Allocation Length field specifies the number of bytes allocated for returned diagnostic data. The controller returns the number of bytes specified or all available diagnostic data (20 bytes), whichever is less.

Table 2-47. Supported Diagnostic Pages

Byte	7	6	5	4	3	2	1	0
0	Page Code (00H)							
1	Reserved (0)							
2	Page Length (n-3) (MSByte)							
3	Page Length (n-3) (LSByte)							
4	Supported Page List							
n	Supported Page List							

Table 2-48. Receive Diagnostic Results Page Codes

Page Code	Parameter List Length	Description
40H	14	Translate Address (See Table 2-49)
81H	10	Controller Test (See Table 2-50)

Table 2-49. Translate Address 40H

Byte	7	6	5	4	3	2	1	0
0	Page Code (40H)							
1	Reserved (0)							
2	Page Length (00H) (MSByte)							
3	Page Length (0AH) (LSByte)							
4	Reserved (0)							
5	Reserved (0)							
6	Track Number of Translated Address (MSByte)							
7	Track Number of Translated Address							
8	Track Number of Translated Address (LSByte)							
9	Reserved (0)							
10	Sector Number of Translated Address (MSByte)							
11	Sector Number of Translated Address							
12	Sector Number of Translated Address							
13	Sector Number of Translated Address(LSByte)							

Table 2-50. Controller Test 81H

Byte	7	6	5	4	3	2	1	0
0	Page Code (81H)							
1	Reserved (0)							
2	Page Length (0) (MSByte)							
3	Page Length (6) (LSByte)							
4	Reserved (0)							Success
5	Loop Count Completed							
6	HP-Specific Error Code (MSByte) (See Table 4-4)							
7	HP-Specific Error Code (LSByte)							
8	Test Specific Parameter 1							
9	Test Specific Parameter 2							

Send Diagnostic Command (1DH)

Initiates drive diagnostic tests.

Note Disconnect must be allowed to run diagnostic tests.

Table 2-51. Send Diagnostic Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (1DH)							
1	Reserved (0)			PF (1)	Rsvd (0)	SelfTst	DevOfl	UnitOfl
2	Reserved (0)							
3	Parameter List Length (MSByte)							
4	Parameter List Length (LSByte)							
5	Control Byte (0)							

SelfTst A Self-Test bit of 1 causes the poweron selftest to run. This self-test is equivalent to the execution of test sequence 1, Poweron Sequence. If this bit is 1, the Parameter List Length must be 0.

A Self-Test bit of 0 indicates the test requested in the Parameter List Length (See Table 2-53)

Note A SelfTst bit of 0 should be followed by a Receive Diagnostics Results Command.

A SelfTst bit of 1 should be followed by a Request Sense Command.

DevOfl A Device Offline bit of 1 must be set for proper operation of any test besides self-test.

UnitOfl	A Unit Offline bit of 1 must be set for proper operation of any test besides selftest.
Parameter List Length	Indicates the number of parameter bytes in the Data Out Phase that describe the selected test. This value must be 0 if the SelfTst bit is set to 1.

Table 2-52. Supported Diagnostic Pages

Byte	7	6	5	4	3	2	1	0
0	Page Code (00H)							
1	Reserved (0)							
2	Page Length (n-3) (MSByte)							
3	Page Length (n-3) (LSByte)							
4	Supported Page List							
n	Supported Page List							

Table 2-53. Send Diagnostic Command Page Codes

Page Code	Parameter List Length	Description
40H	14	Translate Address (See Table 2-54)
81H	10	Controller Test (See Table 2-58)

Table 2-54. Translate Address

Byte	7	6	5	4	3	2	1	0
0	Page Code (40H)							
1	Reserved							
2	Page Length (00H) (MSB)							
3	Page Length (0AH) (LSB)							
4	Reserved					Supplied Format (0 or 6)		
5	Reserved					Translate Format (0 or 5)		
6	Address to Translate (MSB)							
7-12	Address to Translate							
13	Address to Translate (LSB)							

Supplied format is the form of the address in bytes 6-13:

0 Block format

6 Vendor-specific format

Translate format is the form of the returned address:

0 Block format

5 Physical format

For block format (0), the address specified is a physical block address. See Table 2-55.

For vendor-specific format (6), the address specified is a logical block address. See Table 2-56.

For physical format (5), the address specified is a track and sector. See Table 2-57.

Table 2-55. Block Format Descriptor

Byte	7	6	5	4	3	2	1	0
0	Defective Block Address (MSByte)							
1	Defective Block Address							
2	Defective Block Address							
3	Defective Block Address (LSByte)							

Table 2-56. Vendor Unique Format Descriptor

Byte	7	6	5	4	3	2	1	0
0	Defective Track (MSByte)							
1	Defective Track							
2	Defective Track (LSByte)							
3	Defective Sector							
4	Replacement Track (MSByte)							
5	Replacement Track							
6	Replacement Track (LSByte)							
7	Replacement Sector							

Table 2-57. Physical Sector Format Descriptor

Byte	7	6	5	4	3	2	1	0
0	Reserved							
1	Physical Track Number of the Defect (MSByte)							
2	Physical Track Number of the Defect (LSByte)							
3	Reserved (0)							
4	Reserved (0)							
5	Reserved (0)							
6	Reserved (0)							
7	Defective Physical Sector Number							

Table 2-58. Controller Test

Byte	7	6	5	4	3	2	1	0
0	Page Code (81H)							
1	Reserved							
2	Page Length (0) (MSB)							
3	Page Length (8) (LSB)							
4	No Break	Test Number (See Table 2-59)						
5	Loop Count							
6	Manager Identification =0x01							
7	Parameter 1							
8	Parameter 2							
9	Parameter 3							
10	Parameter 4							
11	Reserved							

No Break	The No Break bit directs the target not to terminate looping when an error is detected.
Manager Identification	Controller tests are executed by specifying 0x01 in this byte.
Parameters	Parameter 1,2,3 and 4 are not used. Enter a 0 for each parameter.

Table 2-59. Interface Manager Diagnostic Tests

Diagnostic Test Name	Test Number (Hex)
Selftest	0x01
Microprocessor Test	0x02
Non-volatile RAM Test	0x03
ROM Checksum Test	0x04
Microprocessor RAM Test	0x05
SPIFI Chip Test	0x06
EDAC Chip Test	0x07
Sequencer Chip Test	0x08
ENDEC Chip Test	0x09
Active Sector Test	0x0A
Buffer Controller Chip Test	0x0B
Buffer RAM Test	0x0C
SPIFI to Buffer Data Loopback Test	0x0E

Refer to Table 2-60 for a description of each test.

Table 2-60. Controller Diagnostic Tests

Diagnostic Test Name	Description
Selftest	Executes all of the following tests in the order listed below. If any test in the sequence fails, then selftest fails at that point and no further tests are run. Therefore, this is a "run-until-first-failure" type of test. ■ Microprocessor Test ■ ROM Checksum Test ■ Fast Microprocessor RAM Test ■ SPIFI Chip Test ■ EDAC Chip Test ■ Sequencer Chip Test ■ ENDEC Chip Test ■ Active Sector Chip Test ■ Buffer Controller Chip Test ■ Buffer RAM Test ■ SPIFI to Buffer Data Loopback Test
Microprocessor Test	Tests the functionality of the CPU core and the internal non-volatile RAM of the 68332 microprocessor.
Non-Volatile RAM Test	Tests the functionality of the microprocessor's internal RAM by performing a walking 1's and 0's test of the entire RAM space. A checksum is computed before and after this test to insure that the test was non-destructive.
ROM Checksum Test	Tests the validity of the code stored in the ROMs by computing the word checksum of the entire code space and comparing that checksum with the one that was stored in ROM at the time the flash-EEPROMS were programmed.
Microprocessor RAM Test	Tests the functionality of the microprocessor's system RAM by performing a walking 1's and 0's test of the entire RAM space. A checksum is computed before and after this test to insure that the test was non-destructive. This test fails if the checksums do not compare or if the walking 1's/0's test fails.

Table 2-60. Controller Diagnostic Tests (continued)

Diagnostic Test Name	Description
SPIFI Chip Test	Tests the functionality of the SPIFI (1TV3-0342) chip by testing its RAM, all its read/write registers, and by testing some of its state-machine functions. The RAM test and the register test are performed using a walking 1's and 0's test.
EDAC Chip Test	Tests the functionality of the EDAC (85C20) chip by testing its read/write registers using a walking 1's and 0's test.
Sequencer Chip Test	Tests the functionality of the Sequencer (10C00) chip by testing its read/write registers using a walking 1's and 0's test. In addition, the sequencer's control store is also tested.
ENDEC Chip Test	Tests the functionality of the ENDEC (60C31) chip by testing its read/write registers using a walking 1's and 0's test.
Active Sector Chip Test	Tests the functionality of the Active Sector (1821-0074) chip by testing its read/write registers using a walking 1's and 0's test. Also, the chip is held in reset state and all registers are ready to verify that they contain 0's.
Buffer Controller Chip Test	Tests the functionality of the HMAC (52C61) chip by testing its read/write registers using a walking 1's and 0's test. Also, the chip's address and length counters are checked to see if they can be loaded with specific values.
Buffer RAM Test	Tests the functionality of the buffer RAM by performing a toggling 1's and 0's test (write 0xAA, read, write 0x55, read) of the entire buffer RAM space. A checksum is computed before and after this test to insure that the test was non-destructive. This test fails if the checksums do not compare or if the toggling 1's/0's test fails.
SPIFI Data Loopback Test	Tests the functionality of the DMA channel between SPIFI and the buffer by passing data from the buffer to SPIFI and vice versa. This test fails if either data transfered does not compare correctly with the expected data.

Prevent/Allow Medium Removal Command (1EH)

Prevents or allows removal of an optical disk from a drive.

Table 2-61. Prevent/Allow Medium Removal Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (1EH)							
1	Reserved (0)							
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							Prevent
5	Control Byte (0)							

Prevent — A Prevent bit of 1 prevents removal of the optical disk from a drive.

A Prevent bit of 0 allows removal of the optical disk from a drive.

Note — The Start/Stop Unit Command affects this command. See Table 2-45.

Read Capacity Command (25H)

Reads the capacity of the optical disk surface in the drive.

Table 2-62. Read Capacity Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (25H)							
1	Reserved (0)							
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Reserved (0)							
6	Reserved (0)							
7	Reserved (0)							
8	Reserved (0)							PMI
9	Control Byte (0)							

PMI

A Partial Medium Indicator bit of 1 indicates that the returned logical block address and block length in bytes are that of the logical block address after which a substantial delay in data transfer is encountered.

A PMI bit of 0 indicates that the returned logical block address and the block length in bytes are that of the last logical block of the logical unit.

Table 2-63. Read Capacity Command Data

Byte	7	6	5	4	3	2	1	0
0	Logical Block Address (MSByte)							
1	Logical Block Address							
2	Logical Block Address							
3	Logical Block Address (LSByte)							
4	Block Length (MSByte)							
5	Block Length							
6	Block Length							
7	Block Length (LSByte)							

Read (Group 1) Command (28H)

Reads data from the specified logical block address.

Note The Mode Select Commands (15H, 55H) impact read, write, format, and erase commands.

Table 2-64. Read (Group 1) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (28H)							
1	Reserved (0)			DPO	FUA	Reserved (0)		
2	Starting Logical Block Address (MSByte)							
3	Starting Logical Block Address							
4	Starting Logical Block Address							
5	Starting Logical Block Address (LSByte)							
6	Reserved (0)							
7	Transfer Length (MSByte)							
8	Transfer Length (LSByte)							
9	PBA	Reserved (0)						

DPO A Disable Page Out bit of 1 instructs the target not to store readahead data in cache after the read data has been transferred to the initiator.

A DPO bit of 0 instructs the target it may store readahead data in the cache after the read data has been transferred to the initiator.

FUA	A Force Unit Access bit of 1 indicates that data is read directly from the disk. A Force Unit Access bit of 0 indicates that the drive may access the cache memory.
Transfer Length	The Transfer Length field specifies the number of contiguous logical blocks of data to be transferred.
PBA	A Physical Block Address bit of 1 indicates that physical block addressing is used. A PBA bit of 0 indicates that logical block addressing is used.

Write (Group 1) Command (2AH)

Writes data starting at the specified logical block address.

For Write-Once disks, blank checking is always performed before writing.

Note The Mode Select Commands (15H, 55H) impact read, write, format, and erase commands.

Table 2-65. Write (Group 1) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (2AH)							
1	Reserved (0)			DPO	FUA	EBP	Reserved (0)	
2	Starting Logical Block Address (MSByte)							
3	Starting Logical Block Address							
4	Starting Logical Block Address							
5	Starting Logical Block Address (LSByte)							
6	Reserved (0)							
7	Transfer Length (MSByte)							
8	Transfer Length (LSByte)							
9	PBA	Reserved (0)						

Write-Once Byte 9 and Byte 1, Bit 2 are Reserved (0).

DPO A Disable Page Out bit of 1 instructs the target not to store the data in the cache after it has been transferred to the media.

	A DPO bit of 0 instructs the target to store data in the cache after it has been transferred to the media.
	This bit is ignored.
FUA	A Force Unit Access bit of 1 indicates that data is written directly to the disk.
	An FUA bit of 0 indicates that write caching is allowed.
EBP	An Erase By-Pass bit of 0 indicates an erase is automatically performed before writing the data.
	An EBP bit of 1 supresses the erase operation.
Transfer Length	The Transfer Length field specifies the number of contiguous logical blocks of data to be written.
PBA	A Physical Block Address bit of 1 indicates that physical block addressing is used.
	A PBA bit of 0 indicates that logical block addressing is used.

Note If errors are detected during this command, and the AWRE bit of the Mode Select parameters is 1, the data is automatically written to a spare sector.

Seek (Group 1) Command (2BH)

Seeks the optical head to the physical track where the specified logical block exists.

Table 2-66. Seek (Group 1) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (2BH)							
1	Reserved (0)							
2	Logical Block Address (MSByte)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSByte)							
6	Reserved (0)							
7	Reserved (0)							
8	Reserved (0)							
9	PBA	Reserved (0)						

PBA — A Physical Block Address bit of 1 indicates that physical block addressing is used.

A PBA bit of 0 indicates that logical block addressing is used.

Erase (Group 1) Command (2CH)

Erases data from the specified logical block address. This command can only be used with rewritable disks.

Table 2-67. Erase (Group 1) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (2CH)							
1	Reserved (0)					ERA	Reserved (0)	
2	Starting Logical Block Address (MSByte)							
3	Starting Logical Block Address							
4	Starting Logical Block Address							
5	Starting Logical Block Address (LSByte)							
6	Reserved (0)							
7	Transfer Length (MSByte)							
8	Transfer Length (LSByte)							
9	PBA	Reserved (0)						

ERA — An Erase All bit of 1 indicates that all remaining blocks are erased, starting from the logical block address to the end of the disk. The transfer length must be set to 0.

An ERA bit of 0 indicates that all blocks are erased, starting from the logical block address to the end of the specified transfer length.

Transfer Length — The Transfer Length field specifies the number of contiguous logical blocks of data to be erased.

PBA — A Physical Block Address bit of 1 indicates that physical block addressing is used.

A PBA bit of 0 indicates that logical block addressing is used.

Note If errors are detected during this command, and the AWRE bit of the Mode Select parameters is 1, the data is automatically written to a spare sector.

Write and Verify (Group 1) Command (2EH)

Writes data to the optical disk and then verifies the write by reading the written data and checking the error correction code.

For Write-Once disks, blank checking is always performed before writing.

Note The Mode Select Commands (15H, 55H) impact read, write, format, and erase commands.

Table 2-68. Write and Verify (Group 1) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (2EH)							
1	Reserved (0)			DPO	Rsvd (0)	EBP	Reserved (0)	
2	Starting Logical Block Address (MSByte)							
3-4	Starting Logical Block Address							
5	Starting Logical Block Address (LSByte)							
6	Reserved (0)							
7	Transfer Length (MSByte)							
8	Transfer Length (LSByte)							
9	PBA	Reserved (0)						

Write-Once Byte 9 and Byte 1, Bit 2 are Reserved (0).

DPO A Disable Page Out bit of 1 instructs the target not to store the data in the cache after it has been transferred to the optical disk.

A DPO bit of 0 instructs the target to store the data in the cache after it has been transferred to the optical disk.

This bit is ignored.

EBP	An Erase By-Pass bit of 0 indicates an erase automatically performs before writing the data. An EBP bit of 1 supresses the erase operation.
Transfer Length	The Transfer Length field specifies the number of contiguous logical blocks of data to be written.
PBA	A Physical Block Address bit of 1 indicates that physical block addressing is used. A PBA bit of 0 indicates that logical block addressing is used.

Note If errors are detected during this command, and the AWRE bit of the Mode Select parameters is 1, the data is automatically written to a spare sector.

Immediate response and write caching are not available for this command. See Appendix B for additional information.

Verify (Group 1) Command (2FH)

Verifies previously written data integrity starting at the specified Logical Block Address by reading the data and checking the Error Correction Code. The verification threshold is set to approximately half of the error correction capability.

Table 2-69. Verify (Group 1) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (2FH)							
1	Reserved (0)			DPO	Rsvd (0)	BlkVfy	Reserved (0)	
2	Starting Logical Block Address (MSByte)							
3	Starting Logical Block Address							
4	Starting Logical Block Address							
5	Starting Logical Block Address (LSByte)							
6	Reserved (0)							
7	Verification Length (MSByte)							
8	Verification Length (LSByte)							
9	Control Byte (0)							

DPO — A Disable Page Out (DPO) bit of 1 instructs the target not to retain the data in the cache after it has been verified.

A DPO bit of 0 instructs the target to retain the data in the cache after it has been verified.

This bit is ignored.

Blk Vfy	A Blank Verify bit of 1 indicates the drive verifies that sectors are erased. A Blk Vfy bit of 0 indicates the drive verifies written data integrity.
Verification Length	The Verification Length field specifies the number of contiguous logical blocks of data to be verified.

Synchronize Cache (35H)

Initiates the writing of all cached write data to the optical disk. Ensures that logical blocks in the cache memory, within the specified range, have their most recent data value recorded on the optical disk.

Table 2-70. Synchronize Cache Command

Byte	7	6	5	4	3	2	1	0
0	Operation Code (35H)							
1	Reserved (0)						Immed	Rsvd
2	Logical Block Address (MSByte)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSByte)							
6	Reserved (0)							
7	Number of Blocks (MSByte)							
8	Number of Blocks (LSByte)							
9	Control (0)							

Immed — An Immediate bit of 1 indicates that the target returns a status as soon as the command descriptor block is validated.

An Immed bit of 0 indicates that the status is not returned until the operation is completed.

Number of Blocks — The Number of Blocks field specifies the total number of contiguous logical blocks within the range.

A Number of Blocks bit of 0 indicates that all remaining logical blocks on the logical unit are within the range.

A logical block within the specified range that is not in cache memory is not considered an error.

Read Defect Data (Group 1) Command (37H)

Reads optical disk defect information. The data returned starts with a 4-byte header, followed by one or more defect information blocks.

Table 2-71. Read Defect Data (Group 1) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (37H)							
1	Reserved (0)							
2	Reserved (0)			PList	GList	Defect List Format		
3	Reserved (0)							
4	Reserved (0)							
5	Reserved (0)							
6	Reserved (0)							
7	Allocation Length (MSByte)							
8	Allocation Length (LSByte)							
9	Control Byte (0)							

Note Read "Drive Defect Management" in Chapter 1 for a description and example of drive defect management.

PList

A Primary List bit of 1 requests the drive to return the Primary List (PList) of defects. The PList corresponds to the defect list recorded in the Primary Defect List (PDL).

A PList bit of 0 requests that the drive not return the primary list of defects.

GList	A Grown List bit of 1 requests the drive to return the Grown List (GList) of defects. The GList corresponds to the defect list recorded in the SDL (Secondary Defect List). A GList bit of 0 requests that the drive not return the grown defect lists.
Defect List Format	The Physical Sector Format and a Vendor Unique format are available for the Read Defect Data Command. See Table 2-73 and Table 2-74.
Allocation Length	Specifies the number of bytes returned.

Available Read Defect Data Parameters

Table 2-72. Allowed Read Defect Data Combinations (Byte 2)

PList	GList	Defect List Format			Description
(bit 4)	(bit 3)	(bit 2)	(bit 1)	(bit 0)	
1	0	1	0	1	PList sent in physical format
0	1	1	0	1	GList sent in physical format
0	1	1	1	0	GList sent in vendor unique format
1	1	1	0	1	Plist and Glist in physical format
All Other Combinations					Reserved

Table 2-73. Physical Sector Format Defect Descriptor

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Reserved (0)			PList	GList	Defect List Format		
2	Defect List Length (MSByte)							
3	Defect List Length (LSByte)							
4	Reserved							
5	Physical Track Number of the Defect (MSByte)							
6	Physical Track Number of the Defect (LSByte)							
7	Reserved (0)							
8	Reserved (0)							
9	Reserved (0)							
10	Reserved (0)							
11	Defective Physical Sector Number							

PList — A Primary List bit of 1 indicates that the Primary List of defects was returned.

GList — A Grown List bit of 1 indicates that the Grown List of defects was returned.

Defect List Format — Only the Physical Sector Format (indicated by a 5 in this field) or the Vendor Unique Format (indicated by a 6 in this field), are returned. See Table 2-73 or Table 2-74.

Defect List Length — Specifies the number of bytes of defect data returned.

Table 2-74. Vendor Unique Format Defect Descriptor

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Reserved (0)			PList	GList	Defect List Format		
2	Defect List Length (MSByte)							
3	Defect List Length (LSByte)							
4	Defective Track (MSByte)							
5	Defective Track							
6	Defective Track (LSByte)							
7	Defective Sector							
8	Replacement Track (MSByte)							
9	Replacement Track							
10	Replacement Track (LSByte)							
11	Replacement Sector							

Write Buffer Command (3BH)

Writes data to the drive data buffer. The transfer data consists of a 4-byte descriptor followed by the buffer data.

Caution If you write data to the buffer area, you may overwrite valid information that the drive needs for operation.

Write-Once This command is not available when a Write-Once optical disk is in the drive.

Table 2-75. Write Buffer Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (3BH)							
1	Reserved (0)					Mode (See Table 2-76)		
2	Buffer ID (See Table 2-76)							
3	Buffer Offset (MSByte)							
4	Buffer Offset							
5	Buffer Offset (LSByte)							
6	Byte Transfer Length (MSByte) (Maximum=65535)							
7	Byte Transfer Length							
8	Byte Transfer Length (LSByte)							
9	Control Byte (0)							

Mode Indicates which data format is used. Refer to Table 2-76 for valid values.

Buffer ID Indicates which buffer is used. Refer to Table 2-76 for valid values.

Buffer Offset	Indicates at what address the data is written, offset from the beginning of the buffer. Must be set to 0 when using Download Microcode ID.
Byte Transfer Length	Indicates the number of data bytes to be written in the buffer.

Table 2-76. Buffer Access Mode and ID

Buffer Type	Buffer ID	Mode
Buffer RAM	0	0,2
Download Microcode	1	4
NVRAM	2	1
Processor RAM	3	2
Serial Number and Manufacturing Date	4	1
Download DSP Code	5	1
DSP P space	7	2
DSP X space	8	2
DSP Y space	9	2
Register Access	10	2
Customer and Product ID	15	1

Table 2-77. Mode Descriptions

Mode	Description
1	Vendor specific
2	Write data
4	Download microcode
0	Data retained for subsequent read buffer command

Buffer RAM	Indicates the data buffer space used for the movement of data to and from the optical disk.
Processor RAM	Indicates the memory space used for the execution of the firmware by the microprocessor.
NVRAM	Indicates the configuration information stored in non-volatile memory. This data will have a cyclical redundancy check appended to the data.
Download Microcode	Indicates the code the drive uses to operate
Serial Number and Manufacturing Date	Indicates the drive's serial number and date code indicating the week of manufacture.
Download DSP Code	Indicates the microcode the digital signal processor system uses to operate.
DSP P Space	Indicates the segment of RAM where the operable microcode resides
DSP X Space	Indicates a segment of RAM the digital signal processor uses for execution.
DSP Y Space	Indicates a segment of RAM the digital signal processor uses for execution.
Register Access	Indicates direct access to any register on the controller.

Read Buffer Command (3CH)

Reads data from the drive data buffer. The transfer data consists of a 4-byte descriptor followed by the buffer data.

Table 2-78. Read Buffer Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (3CH)							
1	Reserved (0)					Mode		
2	Buffer ID							
3	Buffer Offset (MSByte)							
4	Buffer Offset							
5	Buffer Offset (LSByte)							
6	Byte Transfer Length (MSByte)							
7	Byte Transfer Length							
8	Byte Transfer Length (LSByte)							
9	Control Byte (0)							

Mode	Indicates which data format is to be used. Refer to the following table for valid values.
Buffer ID	Indicates which buffer is to be used. Refer to the following table for valid values.
Buffer Offset	Indicates at what address the data should be written, offset from the beginning of the buffer.
Byte Transfer Length	Indicates the number of data bytes to be read from the buffer (maximum of 65535).

Table 2-79. Read Buffer Descriptor

Byte	7	6	5	4	3	2	1	0
0	Offset Boundary							
1	Buffer Capacity (MSB)							
2	Buffer Capacity							
3	Buffer Capacity (LSB)							

Table 2-80. Buffer Access Mode and ID

Buffer Type	ID	Mode
Buffer RAM	0	0, 2 or 3
NVRAM	2	1 or 3
Processor RAM	3	2 or 3
DSP P space	7	2 or 3
DSP X space	8	2 or 3
DSP Y space	9	2 or 3
Register Access	10	2 or 3
DSP Event Log	11	2 or 3
DSP Diagnostic Log	12	2 or 3
DSP P Block	13	2 or 3
DSP Injection Block	14	2 or 3

Buffer RAM — Indicates the data buffer space used for the movement of data to and from the optical disk.

Processor RAM — Indicates the memory space used for the execution of the firmware by the microprocessor.

NVRAM	Indicates the configuration information stored in non-volatile memory. This data will have a cyclical redundancy check appended to the data.
DSP P Space	Indicates the segment of RAM where the operable microcode resides
DSP X Space	Indicates a segment of RAM the digital signal processor uses for execution.
DSP Y Space	Indicates a segment of RAM the digital signal processor uses for execution.
Register Access	Indicates direct access to any register on the controller.
DSP Event Log	Indicates a log of the last 50 events that occurred in the digital signal processor system.
DSP Diagnostic Log	Indicates a log of diagnostic and internal information from the digital signal processor system.
DSP P Block	Indicates a block of drive operating parameters downloaded to the digital signal processor after the optical disk is spun up.
DSP Injection Block	Indicates a block of parameters downloaded to the digital signal processor for use in error injection code debug.

Read Long Command (3EH)

Reads data starting at the specified Logical Block Address, including ECC data. Read data is not corrected using ECC.

Table 2-81. Read Long Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (3EH)							
1	Reserved (0)							
2	Starting Logical Block Address (MSByte)							
3	Starting Logical Block Address							
4	Starting Logical Block Address							
5	Starting Logical Block Address (LSByte)							
6	Reserved (0)							
7	Transfer Length (MSByte)							
8	Transfer Length (LSByte)							
9	PBA	SC	Reserved (0)					

Transfer Length — The Transfer Length field specifies the number of bytes of data and ECC information to be read:

- 1K media = 1200 bytes (1024 data + 176 ECC)
- 512 media = 610 bytes (512 data + 98 ECC)
- all other numbers are rejected unless SC = 1

PBA — A Physical Block Address bit of 1 indicates that physical block addressing is used.

A PBA bit of 0 indicates that logical block addressing is used.

SC

A Sector Count bit of 1 indicates the transfer length is represented in sectors rather than bytes. A "sector" consists of 1200 bytes for 1K media or 610 bytes for 512 media. (C1716T drive only.)

A Sector Count bit of 0 indicates the transfer length is represented in bytes.

Write Long Command (3FH)

This command applies to rewritable disks only.

Writes data starting at the specified Logical Block Address, without using ECC generation circuitry. The ECC field is also written with data transferred to the drive.

Table 2-82. Write Long Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (3FH)							
1	Reserved (0)							
2	Starting Logical Block Address (MSByte)							
3	Starting Logical Block Address							
4	Starting Logical Block Address							
5	Starting Logical Block Address (LSByte)							
6	Reserved (0)							
7	Transfer Length (MSByte)							
8	Transfer Length (LSByte)							
9	PBA	SC	Reserved (0)					

Transfer Length — The Transfer Length field specifies the number of bytes of data and ECC information to be written.

- 1K media = 1200 bytes (1024 data + 176 ECC)
- 512 media = 610 bytes (512 data + 98 ECC)
- all other numbers are rejected unless SC = 1

PBA — A Physical Block Address bit of 1 indicates that physical block addressing is used.

A PBA bit of 0 indicates that logical block addressing is used.

SC

A Sector Count bit of 1 indicates the transfer length is represented in sectors rather than bytes. A "sector" consists of 1200 bytes for 1K media or 610 bytes 512 media. (C1716T drive only.)

A Sector Count bit of 0 indicates the transfer length is represented in bytes.

Log Select Command (4CH)

Clears drive resident logs.

Table 2-83. Log Select Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (4CH)							
1	Reserved (0)							
2	PC (01H)		Reserved (0)					
3	Reserved (0)							
4	Reserved (0)							
5	Reserved (0)							
6	Reserved (0)							
7	Parameter List Length (MSByte) (0)							
8	Parameter List Length (LSByte) (12) (See Table 2-85)							
9	Control (0)							

Note Initiators should issue LOG SENSE commands prior to issuing LOG SELECT commands to determine supported pages and page lengths.

The ONLY capability the initiator is given via the Log Select command is to reset the cumulative logs. Parameter code and parameter information is listed in Table 2-84.

Table 2-84. Log Select Command

Page Code	Description	Param. Code	Password Parameter Information
2	Write Error Counter Page	8000	4A4F454C
3	Read Error Counter Page	8000	4A6F686E
5	Verify Error Counter Page	8000	45726963
7	Last N error Events Page	1000	53746576
33	Erase Error Counter Page	8000	416C5020
34	Blank Check Counter Page	8000	47657269

Table 2-85.
Parameter List Data for Byte 8 of the Log Select Command

Byte	7	6	5	4	3	2	1	0
0	Page Code							
1	Reserved (0)							
2	Reserved (0)							
3	Page Length (08)							
4	Parameter Code (MSByte)							
5	Parameter Code (LSByte)							
6	Reserved (0)							
7	Password Parameter Length (04)							
8	Password Parameter Information (MSByte)							
9	Password Parameter Information							
10	Password Parameter Information							
11	Password Parameter Information (LSByte)							

Log Sense Command (4DH)

Provides a means for the initiator to manage statistical information maintained by the drive.

Table 2-86. Log Sense CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (4DH)							
1	Reserved (0)							
2	PC (01H)		Page Code (See Table 2-87)					
3	Reserved (0)							
4	Reserved (0)							
5	Parameter Pointer (MSByte) (See Table 2-87)							
6	Parameter Pointer (LSByte)							
7	Allocation Length (MSByte)							
8	Allocation Length (LSByte)							
9	Control (0)							

Allocation Length — The number of parameter bytes, including the Log Page and the parameter structures.

Parameter Pointer — The Parameter Pointer field allows the initiator to request parameter data beginning from a specific parameter code to the maximum allocation length or the maximum parameter code, whichever is less. Log parameters within the specified log page are transferred in ascending order according to parameter code.

Table 2-87. Log Sense Page Codes

Page Code	Description
00H	Supported Log Pages
02H	Error Counter Page for Write Errors (See Table 2-89)
03H	Error Counter Page for Read Errors (See Table 2-91)
05H	Error Counter Page for Verify Errors (See Table 2-93)
07H	Last n Error Events Page (See Table 2-95)
30H	Odometers Page (See Table 2-98)
33H	Error Counter Page for Erase Errors (See Table 2-100)
34H	Error Counter Page for Blank Check Errors (See Table 2-102)

Supported Log Pages 00H

The supported log page returns the list of log pages implemented by the target. Targets that implement the Log Sense command implement this log page.

Table 2-88. Supported Log Pages 00H

Byte	7	6	5	4	3	2	1	0
0	Rsvd (0)		Page Code (00H)					
1	Reserved (0)							
2	Page Length (n-3) (MSByte)							
3	Page Length (n-3) (LSB)							
4	Supported Page List							
n	Supported Page List							

Table 2-89. Error Counter Page for Write Errors 02H

Byte	7	6	5	4	3	2	1	0
0	Rsvd (0)		Page Code (02H)					
1	Reserved (0)							
2	Page Length (n-3) (MSByte)							
3	Page Length (n-3) (LSB)							
4	Parameter Code (MSByte) (See Table 2-90)							
5	Parameter Code (LSB)							
6	Reserved(0)							
7	Parameter Length (n-7)							
8	Parameter Value							
n	Parameter Value							

Table 2-90. Parameter Codes/Structure for Write Errors

Param. Code	Length Bytes	Description
0	12	Sectors Corrected with ECC
1	12	Sectors Corrected with Retries
2	12	Total Number of Retry Attempts
3	12	Total Sectors Corrected
4	12	Total Times ECC was invoked
5	14	Total Bytes Processed
6	12	Total Number of Uncorrectable Sectors
0	62	Request for all pages

Table 2-91. Error Counter Page for Read Errors 03H

Byte	7	6	5	4	3	2	1	0
0	Rsvd (0)		Page Code (03H)					
1	Reserved (0)							
2	Page Length (n-3) (MSByte)							
3	Page Length (n-3) (LSB)							
4	Parameter Code (MSByte) (See Table 2-92)							
5	Parameter Code (LSB)							
6	Reserved(0)							
7	Parameter Length (n-7)							
8	Parameter Value							
n	Parameter Value							

Table 2-92. Parameter Codes/Structure for Read Errors

Param. Code	Length Bytes	Description
0	12	Sectors Corrected with ECC
1	12	Sectors Corrected with Retries
2	12	Total Number of Retry Attempts
3	12	Total Sectors Corrected
4	12	Total Times ECC was invoked
5	14	Total Bytes Processed
6	12	Total Number of Uncorrectable Sectors
0	62	Request for all pages

Table 2-93. Error Counter Page for Verify Errors 05H

Byte	7	6	5	4	3	2	1	0
0	Rsvd (0)		Page Code (05H)					
1	Reserved (0)							
2	Page Length (n-3) (MSByte)							
3	Page Length (n-3) (LSB)							
4	Parameter Code (MSByte) (See Table 2-94)							
5	Parameter Code (LSB)							
6	Reserved(0)							
7	Parameter Length (n-7)							
8	Parameter Value							
n	Parameter Value							

Table 2-94. Parameter Codes/Structure for Verify Errors

Param. Code	Length Bytes	Description
0	12	Sectors Corrected with ECC
1	12	Sectors Corrected with Retries
2	12	Total Number of Retry Attempts
3	12	Total Sectors Corrected
4	12	Total Times ECC was invoked
5	14	Total Bytes Processed
6	12	Total Number of Uncorrectable Sectors
0	62	Request for all pages

Table 2-95. Last n Error Events Page 07H

Byte	7	6	5	4	3	2	1	0
0	Rsvd (0)		Page Code (07H)					
1	Reserved							
2	Page Length (n-3) (MSByte)							
3	Page Length (n-3) (LSB)							
4	Parameter Code (MSByte) (See Table 2-96)							
5	Parameter Code (LSB)							
6	Reserved(0)							
7	Parameter Length (n-7)							
8	Parameter Values							
n	Parameter Values							

Table 2-96.
Parameter Codes/Structure for Last n Error Events Page

Param. Code	Length Bytes	Description
0	10	Number of Events in the Log (Maximum Events = 50)
1	34	Most Recent Error Event Log (See Table 2-97)
2		Next Most Recent Event (See Table 2-97)
.		
.		.
.		.
0	1510	Request for all pages

Table 2-97. Error Event Log

Byte	7	6	5	4	3	2	1	0
0	Log Type (1)							
1	Occurrance Count							
2	Long (1)	Power On Minutes						
3	Half Seconds							
4	Half Seconds Fraction (16 uSec) (MSByte)							
5	Half Seconds Fraction (16 uSec) (LSByte)							
6	Power On Hours (MS Byte)							
7	Power On Hours							
8	Power On Hours							
9	Power On Hours (LSByte)							
10	DSP Status (MSByte)							
11	DSP Status (See Table 4-5)							
12	DSP Status							
13	DSP Status (LSByte)							
14	Error Code (MSByte) (See Table 4-3)							
15	Error Code (LSByte)							
16	Internal Active Sector Status (MSByte) (factory use only)							
17	Internal Active Sector Status (LSByte) (factory use only)							
18	Logical Block Address (MSByte)							
19	Logical Block Address							
20	Logical Block Address							
21	Logical Block Address (LSByte)							
22	Physical Block Address (MSByte)							
23	Physical Block Address							
24	Physical Block Address							
25	Physical Block Address (LSByte)							

Table 2-98. Odometers Page 30H

Byte	7	6	5	4	3	2	1	0
0	Rsvd (0)		Page Code (30H)					
1	Reserved							
2	Page Length (n-3) (MSByte)							
3	Page Length (n-3) (LSByte)							
4	Parameter Code (MSByte) (See Table 2-99)							
5	Parameter Code (LSByte)							
6	Reserved (0)							
7	Parameter Length (n-7)							
8	Parameter Value							
n	Parameter Value							

Table 2-99. Parameter Codes/Structure for Odometers Page

Param. Code	Length Bytes	Description
0	12	Load Odometer
1	12	Poweron Hours Odometer
2	12	Poweron Minutes Odometer
0	28	Request for all odometers

Table 2-100. Error Counter Page for Erase Errors 33H

Byte	7	6	5	4	3	2	1	0
0	Rsvd (0)		Page Code (33H)					
1	Reserved (0)							
2	Page Length (n-3) (MSByte)							
3	Page Length (n-3) (LSB)							
4	Parameter Code (MSByte) (See Table 2-101)							
5	Parameter Code (LSB)							
6	Reserved(0)							
7	Parameter Length (n-7)							
8	Parameter Value							
n	Parameter Value							

Table 2-101. Parameter Codes/Structure for Erase Errors

Param. Code	Length Bytes	Description
0	12	Sectors Corrected with ECC
1	12	Sectors Corrected with Retries
2	12	Total Number of Retry Attempts
3	12	Total Sectors Corrected
4	12	Total Times ECC was invoked
5	14	Total Bytes Processed
6	12	Total Number of Uncorrectable Sectors
0	62	Request for all pages

Table 2-102. Error Counter Page for Blank Check Errors 34H

Byte	7	6	5	4	3	2	1	0
0	Rsvd (0)		Page Code (34H)					
1	Reserved (0)							
2	Page Length (n-3) (MSByte)							
3	Page Length (n-3) (LSByte)							
4	Parameter Code (MSByte) (See Table 2-103)							
5	Parameter Code (LSByte)							
6	Reserved(0)							
7	Parameter Length (n-7)							
8	Parameter Value							
n	Parameter Value							

Table 2-103. Parameter Codes/Structure for Blank Check Errors

Param. Code	Length Bytes	Description
0	12	Sectors Corrected with ECC
1	12	Sectors Corrected with Retries
2	12	Total Number of Retry Attempts
3	12	Total Sectors Corrected
4	12	Total Times ECC was invoked
5	14	Total Bytes Processed
6	12	Total Number of Uncorrectable Sectors
0	62	Request for all pages

Mode Select (Group 2) Command (55H)

Sets optical disk, drive unit, or controller unit parameters.

Table 2-104. Mode Select (Group 2) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (55H)							
1	Reserved (0)			PF 1	Reserved (0)			SP
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Reserved (0)							
6	Reserved (0)							
7	Parameter List Length (MSByte) (See Table 2-105)							
8	Parameter List Length (LSByte)							
9	Control (0)							

SP — A Save Pages bit of 1 indicates that the target performs the specified MODE SELECT operation, and saves all the savable pages to non-volatile RAM.

A Save Pages bit of 0 indicates the target performs the specified MODE SELECT operation, and does not save any pages.

Parameter List Length — The number of bytes of parameter data being transferred, including the header.

Table 2-105. Mode Page Codes

Page Code	Parameter List Length	Description
01H	28	Read-Write Error Recovery Page (See Table 2-106)
02H	32	Disconnect-Reconnect Page (See Table 2-107)
06H	20	Optical Memory Page (See Table 2-108)
07H	28	Verify Error Recovery Page (See Table 2-109)
08H	28	Caching Page (See Table 2-110)
0BH	24	Medium Types Supported Page (See Table 2-111)
20H	30	Vendor Unique Format Page (See Table 2-112)
21H	28	Vendor Unique Page (See Table 2-113)

Note The header (8 bytes) and the block descriptor (8 bytes) are shown as the first 16 bytes on each of the following mode pages.

When sending **multiple** pages, only one header and one block descriptor are received.

Table 2-106. Read-Write Error Recovery Page 01H

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Reserved (0)							
2	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
3-5	Reserved (0)							
6	Block Descriptor Length (MSByte)							
7	Block Descriptor Length (LSByte)							
8	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
9	Number of Blocks (MSByte)							
10	Number of Blocks							
11	Number of Blocks (LSByte)							
12	Reserved (0)							
13	Block Length (MSByte)							
14	Block Length							
15	Block Length (LSByte)							
16	Reserved (0)		Page Code (01H)					
17	Page Length (0AH)							
18	AWRE	Rsvd(0)	TB	Reserved (0)		PER	DTE	DCR
19	Read Retry Count							
20-23	Reserved (0)							
24	Write Retry Count							
25-27	Reserved (0)							

AWRE	An Automatic Write Reallocation Enable bit of 1 enables the automatic reallocation of defective sectors during the write operation of the Write commands (0AH, 2AH, AAH) and Write and Verify commands (2EH, AEH). For rewritable disks, automatic reallocation of defective sectors occurs during these additional erase operations: Erase 2CH and Erase ACH.

Write-Once AWRE cannot be disabled on Write-Once media.

TB	A Transfer Block bit of 1 indicates that a data block that is not recovered within the recovery limits specified is transferred to the initiator before CHECK CONDITION status is returned. A TB bit of 0 indicates that such a data block is not transferred to the initiator.
PER	A Post Error bit of 1 indicates that the target reports recovered errors. A PER bit of 0 indicates that the target does not report recovered errors.
DTE	A Disable Transfer on Error bit of 1 indicates that the target terminates the data phase upon detection of a recovered error. A DTE bit of 0 indicates that the target does not terminate the data phase upon detection of a recovered error.
DCR	A Disable Correction bit of 1 indicates that error correction codes are not used for data error recovery. A DCR bit of 0 allows the use of error correction codes for data error recovery.
Read Retry Count	The Read Retry Count field specifies the number of times the target attempts recovery of a read operation before reporting an error.

Write Retry Count	The Write Retry Count field specifies the number of times the target attempts recovery of a write operation before reporting an error.

Table 2-107. Disconnect-Reconnect Page 02H

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Reserved (0)							
2	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
3-5	Reserved (0)							
6	Block Descriptor Length (MSByte)							
7	Block Descriptor Length (LSByte)							
8	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
9	Number of Blocks (MSByte)							
10	Number of Blocks							
11	Number of Blocks (LSByte)							
12	Reserved (0)							
13	Block Length (MSByte)							
14	Block Length							
15	Block Length (LSByte)							
16	Reserved (0)		Page Code (02H)					
17	Page Length (0EH)							
18	Buffer Full Ratio							
19-25	Reserved (0)							
26	Maximum Burst Size (MSByte)							
27	Maximum Burst Size (LSByte)							
28-31	Reserved (0)							

The disconnect-reconnect page provides the initiator the means to tune the performance of the SCSI bus.

Buffer Full Ratio	This field indicates the threshold value which determines when buffer write data is written. The Buffer Full Ratio value is stated as the numerator of a fractional multiplier that has 256 as its denominator. For example, a ratio value of 128 equals 50 percent. A ratio value of 64 equals 25 percent.
Maximum Burst Size	This field indicates the maximum amount of data that the target transfers during a data phase before disconnecting if the initiator has granted the disconnect privilege. This value is expressed in increments of 512 bytes (e.g. a value of one means 512 bytes, two means 1024 bytes, etc.). A value of zero indicates there is no limit on the amount of data transferred per connection.

Table 2-108. Optical Memory Page 06H

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Reserved (0)							
2	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
3	Reserved (0)							
4	Reserved (0)							
5	Reserved (0)							
6	Block Descriptor Length (MSByte)							
7	Block Descriptor Length (LSByte)							
8	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
9	Number of Blocks (MSByte)							
10	Number of Blocks							
11	Number of Blocks (LSByte)							
12	Reserved (0)							
13	Block Length (MSByte)							
14	Block Length							
15	Block Length (LSByte)							
16	Reserved (0)		Page Code (06H)					
17	Page Length (02H)							
18	Reserved (0)							
19	Reserved (0)							

The optical memory page defines parameters for control of optical memory devices.

Table 2-109. Verify Error Recovery Page 07H

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Reserved (0)							
2	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
3	Reserved (0)							
4	Reserved (0)							
5	Reserved (0)							
6	Block Descriptor Length (MSByte)							
7	Block Descriptor Length (LSByte)							
8	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, OAH-Optical 1.3 GB)							
9	Number of Blocks (MSByte)							
10	Number of Blocks							
11	Number of Blocks (LSByte)							
12	Reserved (0)							
13	Block Length (MSByte)							
14	Block Length							
15	Block Length (LSByte)							
16	Reserved (0)		Page Code (07H)					
17	Page Length (0AH)							
18	Reserved (0)					PER	Rsvd(0)	DCR
19	Verify Retry Count							
20-27	Reserved (0)							

PER	A Post Error bit of 1 indicates that the target reports recovered errors. A PER bit of 0 indicates that the target does not report recovered errors.
DCR	A Disable Correction bit of 1 indicates that error correction codes are not used for data error recovery. A DCR bit of 0 allows the use of error correction codes for data error recovery.
Verify Retry Count	The Verify Retry Count specifies the number of times the drive attempts its recovery algorithm during a verify operation.

Table 2-110. Caching Page 08H

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Reserved (0)							
2	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
3-5	Reserved (0)							
6	Block Descriptor Length (MSByte)							
7	Block Descriptor Length (LSByte)							
8	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
9	Number of Blocks (MSByte)							
10	Number of Blocks							
11	Number of Blocks (LSByte)							
12	Reserved (0)							
13	Block Length (MSByte)							
14	Block Length							
15	Block Length (LSByte)							
16	Reserved (0)		Page Code (08H)					
17	Page Length (0AH)							
18	Reserved (0)					WCE	Rsvd(0)	RCD
19	Reserved (0)							
20	Disable Pre-fetch Transfer Length (MSByte)							
21	Disable Pre-fetch Transfer Length (LSByte)							
22	Minimum Pre-fetch (MSByte)							
23	Minimum Pre-fetch (LSByte)							
24	Maximum Pre-fetch (MSByte)							
25	Maximum Pre-fetch (LSByte)							
26-27	Reserved (0)							

The caching parameters table defines the parameters that affect the use of the cache.

WCE	A Write Cache Enable bit of 1 indicates write caching is enabled. A WCE bit of 0 indicates write caching is disabled.
RCD	A Read Cache Disable bit of 1 indicates read ahead is disabled. An RCD bit of 0 indicates read ahead is enabled.
Disable Pre-fetch Transfer Length	This field sets the threshold value for pre-fetching data during reads. If the number of blocks to be read is greater than this value, no pre-fetching occurs.
Minimum Pre-fetch	An additional readahead length of the Maximum Pre-fetch is performed when the number of blocks in the Readahead cache is less than this value. (See "Read Performance" in Appendix B)
Maximum Pre-fetch	The maximum number of blocks to be read into the cache at one time. The maximum is 64K. (See "Read Performance" in Appendix B)

Note With write caching enabled, data integrity of the information in the buffer is not guaranteed through power cycling.

Table 2-111. Medium Types Supported Page 0BH

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Reserved (0)							
2	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
3-5	Reserved (0)							
6	Reserved (0)							
7	Reserved (0)							
8	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
9	Number of Blocks (MSByte)							
10	Number of Blocks							
11	Number of Blocks (LSByte)							
12	Reserved (0)							
13	Block Length (MSByte)							
14	Block Length							
15	Block Length (LSByte)							
16	Reserved (0)		Page Code (0BH)					
17	Page Length (06H)							
18	Reserved (0)							
19	Reserved (0)							
20	Medium Type One Supported (02H—Optical Write-once Medium)							
21	Medium Type Two Supported (03H—Optical Erasable Medium)							
22-23	Reserved (0)							

The medium types supported page contains a list of the medium types implemented by the target for logical units.

The code values for each medium type supported by the target (up to four maximum), as defined in the MODE SELECT command are reported in ascending order.

If only the default medium type is supported, 0 is reported. If less than four medium types are supported the unused entries are returned as 0.

Table 2-112. Vendor Unique Format Page 20H

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Reserved (0)							
2	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
3-5	Reserved (0)							
6	Block Descriptor Length (MSByte)							
7	Block Descriptor Length (LSByte)							
8	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
9	Number of Blocks (MSByte)							
10	Number of Blocks							
11	Number of Blocks (LSByte)							
12	Reserved (0)							
13	Block Length (MSByte)							
14	Block Length							
15	Block Length (LSByte)							
16	Reserved (0)		Page Code (20H)					
17	Page Length (0c)							
18	Reserved (0)							
19	Groups per Volume (MSByte)							
20	Groups per Volume (LSByte)							
21	Data Blocks per Group (MSByte)							
22	Data Blocks per Group							
23	Data Blocks per Group (LSByte)							
24	Alternate Blocks per Group (MSByte)							
25	Alternate Blocks per Group							
26	Alternate Blocks per Group (LSByte)							
27	Sectors in Track Zero (17 for 1024 byte-sector disks, 31 for 512 byte-sector disks)							
28-29	Reserved (0)							

Groups per Volume	Indicates the number of user groups for a given surface or volume.
Data Blocks per Group	Indicates the number of user blocks, or sectors per user group.
Alternate Blocks per Group	Indicates the number of alternate or spare blocks (pre-allocated) per user group.

Note

For 2X media, g = 1 or 16, n = 0, m = 0 (n and m are predefined based on g and vary per zone).

Read "Drive Defect Management" in Chapter 1 for a description and example of drive defect management.

Table 2-113. Vendor Unique Page 21H

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Reserved (0)							
2	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
3-5	Reserved (0)							
6	Block Descriptor Length (MSByte)							
7	Block Descriptor Length (LSByte)							
8	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
9	Number of Blocks (MSByte)							
10	Number of Blocks							
11	Number of Blocks (LSByte)							
12	Reserved (0)							
13	Block Length (MSByte)							
14	Block Length							
15	Block Length (LSByte)							
16	Reserved (0)		Page Code (21H)					
17	Page Length (0AH)							
18	ERR	DSP Log	DM Log	CM Log	Reset	DAS	DTIS	DAIR
19	DWR	Quick Disconnect	Memory Log	Force Verify	DLTW	Q Log	Task Log	Time Stamp
20	Maximum Buffer Latency (MSByte)							
21-22	Maximum Buffer Latency							
23	Maximum Buffer Latency (LSByte)							
24	Drive Retry Count							
25	Autochanger Eject Distance							
26	Phase Retry Count							
27	Reserved (0)							

ERR	An Extended Recovery Reporting bit of 1 indicates that all recovered errors except those requiring ECC are reported.
	An ERR bit of 0 indicates that error recovery reporting is handled according to Page Code 01H.
DSP Log	A DSP Log bit of 1 indicates DSP logging is enabled.
	A DSP Log bit of 0 indicates DSP logging is not enabled.
DM Log	A Drive Manager Log bit of 1 indicates drive manager logging is enabled.
	A DM Log bit of 0 indicates drive manager logging is not enabled.
CM Log	A Correction Manager Log bit of 1 indicates correction manager logging is enabled.
	A CM Log bit of 0 indicates correction manager logging is not enabled.
Reset	A Reset Configuration bit of 1 indicates a soft reset.
	A Reset bit of 0 indicates a hard reset.
DAS	A Disable Auto Spinup bit of 1 indicates that the auto spinup is disabled.
	A DAS bit of 0 indicates that the auto spinup is enabled.
DTIS	A Disable Target Initiated Synchronous bit of 1 indicates that negotiation is disabled.
	A DTIS bit of 0 indicates target initiated synchronous negotiation is enabled.
DAIR	A Direct Access Inquiry Response bit of 1 indicates the Peripheral Device Type field in the Inquiry Data indicates "Direct Access Device."
	A DAIR bit of 0 indicates "Optical Memory Device" in the Peripheral Device Type field in the Inquiry Data.

DWR	A Disable Write Reordering bit of 1 indicates write reordering is not enabled. A DWR bit of 0 indicates write reordering is enabled.
Quick Disconnect	A Quick Disconnect bit of 1 enables SCSI bus disconnection before command validation on performance path commands (i.e. reads, writes). A Quick Disconnect bit of 0 disables SCSI bus disconnection before validation on performance path commands (i.e. reads, writes).
Memory Log	A Memory Log bit of 1 indicates Buffer Memory usage logging is enabled. A Memory Log bit of 0 indicates Buffer Memory usage logging is not enabled. (C1716T drive only.)
Force Verify	A Force Verify bit of 1 indicates that all write operations will be verified. The Write 6, 10, and 12-byte commands will operate as if they were Write Verify 6, 10, and 12-byte commands. A Force Verify bit of 0 indicates normal operation.
DLTW	A Disable Log Threshold Warning bit of 1 indicates the log threshold warning is not enabled. A DLTW bit of 0 indicates the log threshold warning is enabled.
Q Log	A Priority Queue bit of 1 indicates priority queue logging is enabled. A Q Log bit of 0 indicates priority queue logging is not enabled.
Task Log	A Task Log bit of 1 indicates change logging is enabled. A Task Log bit of 0 indicates change logging is not enabled.

Time Stamp	A Time Stamp bit of 1 indicates that time stamping of Q Log and Task Log is enabled. A TimeStamp bit of 0 indicates that time stamping of Q Log and Task Log is not enabled.
Maximum Buffer Latency	These bytes indicate the maximum time in milliseconds that Immediate Responsed Write data may remain in the buffer.
Drive Retry Count	This byte indicates the maximum number of retries that should be performed at the drive level.
Autochanger Eject Distance	The Autochanger Eject Distance is the distance the cartridge should be ejected, in tenths of millimeters back from the Standalone Eject position, when the drive is in an autochanger.
Phase Retry Count	This byte indicates the number of times to retry a SCSI phase after an error.

Mode Sense (Group 2) Command (5AH)

Table 2-114. Mode Sense (Group 2) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (5AH)							
1	Reserved (0)				DBD	Reserved (0)		
2	PC		Page Code					
3	Reserved (0)							
4	Reserved (0)							
5	Reserved (0)							
6	Reserved (0)							
7	Allocation Length (MSByte)							
8	Allocation Length (LSByte)							
9	Control (0)							

DBD — A disable block descriptors (DBD) bit of 0 (default) indicates that block descriptors are provided.

A disable block descriptors (DBD) bit of 1 indicates that no block descriptors are provided.

PC — Page control defines the type of parameter values to be returned as follows:

0 - Current Values
1 - Changeable Values
2 - Default Values
3 - Saved Values

Page Code — Page code values are the same as for the Mode Select command. If the page code is specified as 00H or 3FH, all the pages are sent to the initiator.

Allocation Length — Indicates the number of bytes of parameter data transferred, including the header. Set this value according to Table 2-115.

Table 2-115. Mode Page Codes

Page Code	Parameter List Length	Description
01H	28	Read-Write Error Recovery Page (See Table 2-116)
02H	30	Disconnect-Reconnect Page (See Table 2-117)
06H	20	Optical Memory Page (See Table 2-118)
07H	28	Verify Error Recovery Page (See Table 2-119)
08H	28	Caching Page (See Table 2-120)
0BH	24	Medium Types Supported Page (See Table 2-121)
20H	30	Vendor Unique Format Page (See Table 2-31)
21H	28	Vendor Unique Page (See Table 2-123)
00H, 3FH	106	Request for all pages

Note

The header (8 bytes) and the block descriptor (8 bytes) are shown as the first 16 bytes on each of the following mode pages. If the DBD (disable block descriptors) bit is set to 1, bytes 8-15 will not be received.

When requesting **multiple** pages, only one header and one block descriptor are received.

Table 2-116. Read-Write Error Recovery Page 01H

Byte	7	6	5	4	3	2	1	0
0	Mode Data Length (MSByte)							
1	Mode Data Length (LSByte)							
2	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
3	WP	Reserved (0)		Cache (1)	Reserved(0)			
4	Reserved (0)							
5	Reserved (0)							
6	Block Descriptor Length (MSByte)							
7	Block Descriptor Length (LSByte)							
8	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
9	Number of Blocks (MSByte)							
10	Number of Blocks							
11	Number of Blocks (LSByte)							
12	Reserved (0)							
13	Block Length (MSByte)							
14	Block Length							
15	Block Length (LSByte)							
16	PS (1)	Rsvd (0)	Page Code (01H)					
17	Page Length (0AH)							
18	AWRE	Rsvd(0)	TB	Reserved (0)		PER	DTE	DCR
19	Read Retry Count							
20-23	Reserved (0)							
24	Write Retry Count							
25-27	Reserved (0)							

WP	A Write Protect bit of 1 indicates that the optical disk in the drive is write-protected.
	A WP bit of 0 indicates that the optical disk in the drive is not write- protected.
Cache	The Cache bit of 1 indicates caching is supported.
PS	The Parameters Savable bit of 1 indicates this parameter page is savable in non-volatile RAM.
AWRE	An Automatic Write Reallocation Enable bit of 1 enables the automatic reallocation of defective sectors during the write operation of the Write commands (0AH, 2AH, AAH) and Write and Verify commands (2EH, AEH).
	For rewritable disks, automatic reallocation of defective sectors occurs during these additional erase operations: Erase 2CH and Erase ACH.
	An AWRE bit of 0 does not enable automatic reallocation of defective sectors.
	The AWRE default setting is 1.
TB	A Transfer Block bit of 1 indicates that a data block that is not recovered within the recovery limits specified is transferred to the initiator before CHECK CONDITION status is returned.
	A TB bit of 0 indicates that such a data block is not transferred to the initiator.
	The TB default setting is 0.
PER	A Post Error bit of 1 indicates that the target reports recovered errors.
	A PER bit of 0 indicates that the target does not report recovered errors.
	The PER default setting is 0.

DTE	A Disable Transfer on Error (DTE) bit of 1 (default) indicates that the target terminates the data phase upon detection of a recovered error. A DTE bit of 0 indicates that the target does not terminate the data phase upon detection of a recovered error. `The DTE default setting is 0.`
DCR	A Disable Correction bit of 1 indicates that error correction codes are not used for data error recovery. A DCR bit of 0 allows the use of error correction codes for data error recovery. `The DCR default setting is 0.`
Read Retry Count	The read retry count field specifies the number of times the target attempts recovery of a read operation before reporting an error. `The Read Retry Count default setting is 5.`
Write Retry Count	The write retry count field specifies the number of times the target attempts recovery of a write operation before reporting an error. `The Write Retry Count default setting is 2.`

Table 2-117. Disconnect-Reconnect Page 02H

Byte	7	6	5	4	3	2	1	0
0	Mode Data Length (MSByte)							
1	Mode Data Length (LSByte)							
2	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
3	WP	Reserved (0)		Cache (1)	Reserved(0)			
4	Reserved (0)							
5	Reserved (0)							
6	Block Descriptor Length (MSByte)							
7	Block Descriptor Length (LSByte)							
8	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
9	Number of Blocks (MSByte)							
10	Number of Blocks							
11	Number of Blocks (LSByte)							
12	Reserved (0)							
13	Block Length (MSByte)							
14	Block Length							
15	Block Length (LSByte)							
16	PS (1)	Rsvd (0)	Page Code (02H)					
17	Page Length (0EH)							
18	Buffer Full Ratio							
19-25	Reserved (0)							
26	Maximum Burst Size (MSByte)							
27	Maximum Burst Size (LSByte)							
28-31	Reserved (0)							

The disconnect-reconnect page provides the initiator the means to tune the performance of the SCSI bus.

WP	A Write Protect bit of 1 indicates that the optical disk in the drive is write protected. A WP bit of 0 indicates that the optical disk in the drive is not write-protected.
Cache	The Cache bit of 1 indicates that caching is supported.
PS	The Parameters Savable bit of 1 indicates this parameter page is savable in non-volatile RAM.
Buffer Full Ratio	This field indicates the threshold value which determines when buffer write data is written. The Buffer Full Ratio value is stated as the numerator of a fractional multiplier that has 256 as its denominator. For example, a ratio value of 128 equals 50 percent. A ratio value of 64 equals 25 percent. The Buffer Full Ratio default setting is 128.
Maximum Burst Size	This field indicates the maximum amount of data that the target transfers during a data phase before disconnecting if the initiator has granted the disconnect privilege. This value is expressed in increments of 512 bytes (e.g. a value of one means 512 bytes, two means 1024 bytes, etc.). A value of zero indicates there is no limit on the amount of data transferred per connection. The Maximum Burst Size default setting is 32.

Table 2-118. Optical Memory Page 06H

Byte	7	6	5	4	3	2	1	0
0	Mode Data Length (MSByte)							
1	Mode Data Length (LSByte)							
2	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
3	WP	Reserved (0)		Cache (1)	Reserved(0)			
4	Reserved (0)							
5	Reserved (0)							
6	Block Descriptor Length (MSByte)							
7	Block Descriptor Length (LSByte)							
8	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
9	Number of Blocks (MSByte)							
10	Number of Blocks							
11	Number of Blocks (LSByte)							
12	Reserved (0)							
13	Block Length (MSByte)							
14	Block Length							
15	Block Length (LSByte)							
16	PS (1)	Rsvd (0)	Page Code (06H)					
17	Page Length (02H)							
18	Reserved (0)							
19	Reserved (0)							

The optical memory page defines parameters for control of optical memory devices.

WP	A Write Protect bit of 1 indicates that the optical disk in the drive is write-protected.
	A WP bit of 0 indicates that the optical disk in the drive is not write-protected.
Cache	The Cache bit of 1 indicates that caching is supported.
PS	The Parameters Savable bit of 1 indicates this parameter page is savable in non-volatile RAM.

Table 2-119. Verify Error Recovery Page 07H

<table>
<tr><th>Byte</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>0</td><td colspan="8">Mode Data Length (MSByte)</td></tr>
<tr><td>1</td><td colspan="8">Mode Data Length (LSByte)</td></tr>
<tr><td>2</td><td colspan="8">Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)</td></tr>
<tr><td>3</td><td>WP</td><td colspan="2">Reserved (0)</td><td>Cache (1)</td><td colspan="4">Reserved 0)</td></tr>
<tr><td>4</td><td colspan="8">Reserved (0)</td></tr>
<tr><td>5</td><td colspan="8">Reserved (0)</td></tr>
<tr><td>6</td><td colspan="8">Block Descriptor Length (MSByte)</td></tr>
<tr><td>7</td><td colspan="8">Block Descriptor Length (LSByte)</td></tr>
<tr><td>8</td><td colspan="8">Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)</td></tr>
<tr><td>9</td><td colspan="8">Number of Blocks (MSByte)</td></tr>
<tr><td>10</td><td colspan="8">Number of Blocks</td></tr>
<tr><td>11</td><td colspan="8">Number of Blocks (LSByte)</td></tr>
<tr><td>12</td><td colspan="8">Reserved (0)</td></tr>
<tr><td>13</td><td colspan="8">Block Length (MSByte)</td></tr>
<tr><td>14</td><td colspan="8">Block Length</td></tr>
<tr><td>15</td><td colspan="8">Block Length (LSByte)</td></tr>
<tr><td>16</td><td>PS (1)</td><td>Rsvd (0)</td><td colspan="6">Page Code (07H)</td></tr>
<tr><td>17</td><td colspan="8">Page Length (0AH)</td></tr>
<tr><td>19</td><td colspan="5">Reserved (0)</td><td>PER</td><td>Rsvd (0)</td><td>DCR</td></tr>
<tr><td>19</td><td colspan="8">Verify Retry Count</td></tr>
<tr><td>20-27</td><td colspan="8">Reserved (0)</td></tr>
</table>

WP	A Write Protect bit of 1 indicates that the optical disk in the drive is write protected. A WP bit of 0 indicates that the optical disk in the drive is not write-protected.
Cache	The Cache bit of 1 indicates that caching is supported.
PS	The Parameters Savable bit of 1 indicates this parameter page is savable in non-volatile RAM.
PER	A Post Error bit of 1 indicates that the target reports recovered errors. A PER bit of 0 indicates that the target does not report recovered errors. `The PER default setting is 0.`
DCR	A Disable Correction (DCR) bit of 1 indicates that error correction codes are not used for data error recovery. A DCR bit of 0 allows the use of error correction codes for data error recovery. `The DCR default setting is 0.`
Verify Retry Count	The Verify Retry Count specifies the number of times the drive attempts its recovery algorithm during a verify operation. `The Verify Retry Count default setting is 5.`

Table 2-120. Caching Page 08H

Byte	7	6	5	4	3	2	1	0
0	Mode Data Length (MSByte)							
1	Mode Data Length (LSByte)							
2	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
3	WP	Reserved (0)		Cache (1)	Reserved(0)			
4-5	Reserved (0)							
6	Block Descriptor Length (MSByte)							
7	Block Descriptor Length (LSByte)							
8	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
9	Number of Blocks (MSByte)							
10	Number of Blocks							
11	Number of Blocks (LSByte)							
12	Reserved (0)							
13	Block Length (MSByte)							
14	Block Length							
15	Block Length (LSByte)							
16	PS (1)	Rsvd (0)	Page Code (08H)					
17	Page Length (0AH)							
18	Reserved (0)					WCE	Rsvd(0)	RCD
19	Reserved (0)							
20	Disable Pre-fetch Transfer Length (MSByte)							
21	Disable Pre-fetch Transfer Length (LSByte)							
22	Minimum Pre-fetch (MSByte)							
23	Minimum Pre-fetch (LSByte)							
24	Maximum Pre-fetch (MSByte)							
25	Maximum Pre-fetch (LSByte)							
26-27	Reserved (0)							

The caching parameters table defines the parameters that affect the use of the cache.

WP	A Write Protect bit of 1 indicates that the optical disk in the drive is write protected. A WP bit of 0 indicates that the optical disk in the drive is not write-protected.
Cache	The Cache bit of 1 indicates caching is supported.
PS	The Parameters Savable bit of 1 indicates this parameter page is savable in non-volatile RAM.
WCE	A write cache bit of 1 indicates that write caching is enabled. A write cache bit of 0 indicates write caching is disabled. `The WCE default setting is 1.`
RCD	A Read Cache Disable bit of 1 indicates that read ahead is disabled. An RCD bit is 0 indicates read ahead is enabled. `The RCD default setting is 0.`
Disable Pre-fetch Transfer Length	This field sets the threshold value for pre-fetching data during reads. If the number of blocks to be read is greater than this value, no pre-fetching occurs. `The Disable Pre-fetch Transfer Length default setting is 65535.`
Minimum Pre-fetch	An additional readahead length of the Maximum Pre-fetch is performed when the number of blocks in the Readahead cache is less than this value. (See "Read Performance" in Appendix B) `The Minimum Pre-fetch default setting is 8.`
Maximum Pre-fetch	The maximum number of blocks to be read into the cache at one time. (See "Read Performance" in Appendix B) `The Maximum Pre-fetch default setting is 8.`

Note With write caching enabled, data integrity of information in the buffer is not guaranteed through power cycling.

Table 2-121. Medium Types Supported Page 0BH

Byte	7	6	5	4	3	2	1	0
0	Mode Data Length (MSByte)							
1	Mode Data Length (LSByte)							
2	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
3	WP	Reserved (0)		Cache (1)	Reserved(0)			
4	Reserved (0)							
5	Reserved (0)							
6	Block Descriptor Length (MSByte)							
7	Block Descriptor Length (LSByte)							
8	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
9	Number of Blocks (MSByte)							
10	Number of Blocks							
11	Number of Blocks (LSByte)							
12	Reserved (0)							
13	Block Length (MSByte)							
14	Block Length							
15	Block Length (LSByte)							
16	PS (1)	Rsvd (0)	Page Code (0BH)					
17	Page Length (06H)							
18	Reserved (0)							
19	Reserved (0)							
20	Medium Type One Supported (02H—Optical Write-once Medium)							
21	Medium Type Two Supported (03H—Optical Erasable Medium)							
22-23	Reserved (0)							

The medium types supported page contains a list of the medium types implemented by the target for logical units.

The code values for each medium type supported by the target (up to four maximum), as defined in the MODE SELECT command are reported in ascending order.

If only the default medium type is supported, 0 is reported. If less than four medium types are supported the unused entries are returned as 0.

WP	A Write Protect bit of 1 indicates that the optical disk in the drive is write protected. A WP bit of 0 indicates that the optical disk in the drive is not write-protected.
Cache	The Cache bit of 1 indicates caching is supported.
PS	The Parameters Savable bit of 1 indicates this parameter page is savable in non-volatile RAM.

Table 2-122. Vendor Unique Format Page 20H

Byte	7	6	5	4	3	2	1	0
0	Mode Data Length (MSByte)							
1	Mode Data Length (LSByte)							
2	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
3	WP	Reserved (0)		Cache (1)	Reserved(0)			
4-5	Reserved (0)							
6	Block Descriptor Length (MSByte)							
7	Block Descriptor Length (LSByte)							
8	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
9	Number of Blocks (MSByte)							
10	Number of Blocks							
11	Number of Blocks (LSByte)							
12	Reserved (0)							
13	Block Length (MSByte)							
14	Block Length							
15	Block Length (LSByte)							
16	PS (1)	Rsvd (0)	Page Code (20H)					
17	Page Length (0c)							
18	Reserved (0)							
19	Groups per Volume (MSByte)							
20	Groups per Volume (LSByte)							
21	Data Blocks per Group (MSByte)							
22	Data Blocks per Group							
23	Data Blocks per Group (LSByte)							
24	Alternate Blocks per Group (MSByte)							
25	Alternate Blocks per Group							
26	Alternate Blocks per Group (LSByte)							
27	Sectors in Track Zero							
28-29	Reserved (0)							

WP	A Write Protect bit of 1 indicates that the optical disk in the drive is write protected. A WP bit of 0 indicates that the optical disk in the drive is not write-protected.
Cache	The Cache bit of 1 indicates caching is supported.
PS	The Parameters Savable bit of 1 indicates this parameter page is savable in non-volatile RAM.
Groups per Volume	Groups per Volume indicates the number of user groups for a given surface or volume. The Groups per Volume default setting is 1.
Data Blocks per Group	Blocks per Group indicates the number of user blocks, or sectors per user group. The Data Blocks per Group default setting is 314569 for 1024 bytes/sector disks and 576999 for 512 bytes/sector disks. (This applies to 650-Mbyte media only.)
Alternate Blocks per Group	Indicates the number of alternate or spare blocks (pre-allocated) per user group. The Alternate Blocks per Group default setting is 2048.

Note Read "Drive Defect Management" in Chapter 1 for a description and example of drive defect management.

Table 2-123. Vendor Unique Page 21H

Byte	7	6	5	4	3	2	1	0
0	Mode Data Length (MSByte)							
1	Mode Data Length (LSByte)							
2	Medium Type (02H—Optical Write-Once, 03H—Optical Erasable)							
3	WP	Reserved (0)		Cache (1)	Reserved(0)			
4-5	Reserved (0)							
6	Block Descriptor Length (MSByte)							
7	Block Descriptor Length (LSByte)							
8	Density Codes (03H-Optical Erasable 650 MB, 06H-Optical Write-Once 650 MB, 0AH-Optical 1.3 GB)							
9	Number of Blocks (MSByte)							
10	Number of Blocks							
11	Number of Blocks (LSByte)							
12	Reserved (0)							
13	Block Length (MSByte)							
14	Block Length							
15	Block Length (LSByte)							
16	PS (1)	Rsvd (0)	Page Code (21H)					
17	Page Length (0AH)							
18	ERR	DSP Log	DM Log	CM Log	Reset	DAS	DTIS	DAIR
19	DWR	Quick Disconnect	Memory Log	Force Verify	DLTW	Q Log	Task Log	Time Stamp
20	Maximum Buffer Latency (MSByte)							
21-22	Maximum Buffer Latency							
23	Maximum Buffer Latency (LSByte)							
24	Drive Retry Count							
25	Autochanger Eject Distance							
26	Phase Retry Count							
27	Reserved (0)							

WP	A Write Protect bit of 1 indicates that the optical disk in the drive is write protected. A WP bit of 0 indicates that the optical disk in the drive is not write-protected.
Cache	The Cache bit of 1 indicates caching is supported.
PS	The Parameters Savable bit of 1 indicates this parameter page is savable in non-volatile RAM.
ERR	An Extended Recovery Reporting bit of 1 indicates that all recovered errors except those requiring ECC are reported. An ERR bit of 0 indicates that error recovery reporting is handled according to Page Code 01H. `The ERR default setting is 0.`
DSP Log	A DSP Log bit of 1 indicates DSP logging is enabled. A DSP Log bit of 0 indicates DSP logging is not enabled. `The DSP Log default setting is 0.`
DM Log	A Drive Manager Log bit of 1 indicates drive manager logging is enabled. A DM Log bit of 0 indicates drive manager logging is not enabled. `The DM Log default setting is 0.`
CM Log	A Correction Manager Log bit of 1 indicates correction manager logging is enabled. A CM Log bit of 0 indicates correction manager logging is not enabled. `The CM Log default setting is 0.`
Reset	A Reset Configuration bit of 1 indicates a soft reset. A Reset bit of 0 indicates a hard reset. `The Reset default setting is 0.`

DAS	A Disable Auto Spinup bit of 1 indicates that the auto spinup is disabled. A DAS bit of 0 indicates that the auto spinup is enabled. `The DAS default setting is 0.`
DTIS	A Disable Target Initiated Synchronous bit of 1 indicates that negotiation is disabled. A DTIS bit of 0 indicates target initiated synchronous negotiation is enabled. `The DTIS default setting is 1.`
DAIR	A Direct Access Inquiry Response bit of 1 indicates the Peripheral Device Type field in the Inquiry Data indicates "Direct Access Device." A DAIR bit of 0 indicates "Optical Memory Device" in the Peripheral Device Type field in the Inquiry Data. `The DAIR default setting is 0.`
DWR	A Disable Write Reordering bit of 1 indicates write reordering is not enabled. A DWR bit of 0 indicates write reordering is enabled. `The DWR default setting is 0.`
Quick Disconnect	A Quick Disconnect bit of 1 enables SCSI bus disconnection before command validation on performance path commands (i.e. reads, writes). A Quick Disconnect bit of 0 disables SCSI bus disconnection before validation on performance path commands (i.e. reads, writes). `The Quick Disconnect default setting is 0.`

Memory Log

A Memory Log bit of 1 indicates Buffer Memory usage logging is enabled.

A Memory Log bit of 0 indicates Buffer Memory usage logging is not enabled.

(C1716T drive only.)

`The Memory Log default setting is 0.`

Force Verify

A Force Verify bit of 1 indicates that all write operations will be verified. The Write 6, 10, and 12-byte commands will operate as if they were Write Verify 6, 10, and 12-byte commands.

A Force Verify bit of 0 indicates normal operation.

`The Force Verify default setting is 0.`

DLTW

A Disable Log Threshold Warning bit of 1 indicates the log threshold warning is not enabled.

A DLTW bit of 0 indicates the log threshold warning is enabled.

`The DLTW default setting is 0.`

Q Log

A Priority Queue bit of 1 indicates priority queue logging is enabled.

A Q Log bit of 0 indicates priority queue logging is not enabled.

`The Q Log default setting is 0.`

Task Log

A Task Log bit of 1 indicates change logging is enabled.

A Task Log bit of 0 indicates change logging is not enabled.

`The Task Log default setting is 0.`

Time Stamp	A Time Stamp bit of 1 indicates that time stamping of Q Log and Task Log is enabled. A TimeStamp bit of 0 indicates that time stamping of Q Log and Task Log is not enabled. `The Time Stamp default setting is 0.`
Maximum Buffer Latency	These bytes indicate the maximum time in milliseconds that Immediate Responsed Write data may remain in the buffer. `The Maximum Buffer Latency default setting is 1000.`
Drive Retry Count	This byte indicates the maximum number of retries that should be performed at the drive level. `The Drive Retry Count default setting is 2.`
Autochanger Eject Distance	The Autochanger Eject Distance is the distance the cartridge should be ejected, in tenths of millimeters back from the Standalone Eject position, when the drive is in an autochanger. `The Autochanger Eject Distance default setting is 150.`
Phase Retry Count	This byte indicates the number of times to retry a SCSI phase after an error. `The Phase Retry Count default setting is 5.`

Read (Group 5) Command (A8H)

Reads data from the specified logical block address.

Note The Mode Select Commands (15H, 55H) impact read, write, format, and erase commands.

Table 2-124. Read (Group 5) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (A8H)							
1	Reserved (0)			DPO	FUA	Reserved (0)		
2	Starting Logical Block Address (MSByte)							
3	Starting Logical Block Address							
4	Starting Logical Block Address							
5	Starting Logical Block Address (LSByte)							
6	Transfer Length (MSByte)							
7	Transfer Length							
8	Transfer Length							
9	Transfer Length (LSByte)							
10	Reserved (0)							
11	PBA	Reserved (0)						

DPO A Disable Page Out bit of 1 instructs the target not to store readahead data in cache after the read data has been transferred to the initiator.

A DPO bit of 0 instructs the target it may store readahead data in the cache after the read data has been transferred to the initiator.

FUA	A Force Unit Access bit of 1 indicates that the drive reads from the disk. An FUA bit of 0 indicates that data may come from the cache memory.
Transfer Length	The Transfer Length field specifies the number of contiguous logical blocks of data to be transferred.
PBA	A Physical Block Address bit of 1 indicates that physical block addressing is used. A PBA bit of 0 indicates that logical block addressing is used.

Write (Group 5) Command (AAH)

Writes data starting at the specified logical block address.

Note The Mode Select Commands (15H, 55H) impact read, write, format, and erase commands.

Table 2-125. Write (Group 5) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (AAH)							
1	Reserved (0)			DPO	FUA	EBP	Rsvd (0)	
2	Logical Block Address (MSByte)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSByte)							
6	Transfer Length (MSByte)							
7	Transfer Length							
8	Transfer Length							
9	Transfer Length (LSByte)							
10	Reserved (0)							
11	PBA	Reserved (0)						

Write-Once Byte 11 and Byte 1, Bit 2 are Reserved (0).

DPO A Disable Page Out bit of 1 instructs the target not to store the data in the cache after it has been transferred to the media.

	A DPO bit of 0 instructs the target to store the data in the cache after it has been transferred to the media.
	This bit is ignored.
FUA	A Force Unit Access bit of 1 indicates that data is written directly to the disk.
	An FUA bit of 0 indicates that write caching will be allowed.
EBP	If the Erase By-Pass bit is set to 0, an erase is automatically performed before writing the data.
	An EBP bit of 1 suppresses the erase operation.
Transfer Length	The Transfer Length field specifies the number of contiguous logical blocks of data to be written.
PBA	A Physical Block Address bit of 1 indicates that physical block addressing is used.
	A PBA bit of 0 indicates that logical block addressing is used.

Note If errors are detected during this command, and the AWRE bit of the Mode Select parameters is 1, the data is automatically written to a spare sector.

Erase (Group 5) Command (ACH)

Erases data from the specified logical block address. This command can only be used with rewritable disks.

Note The Mode Select Commands (15H, 55H) impact read, write, format, and erase commands.

Table 2-126. Erase (Group 5) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (ACH)							
1	Reserved (0)					ERA	Reserved (0)	
2	Logical Block Address (MSByte)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSByte)							
6	Transfer Length (MSByte)							
7	Transfer Length							
8	Transfer Length							
9	Transfer Length (LSByte)							
10	Reserved (0)							
11	PBA	Reserved (0)						

ERA An Erase All bit of 1 indicates that all remaining blocks are erased, starting from the logical block address to the end of the disk. The transfer length must be set to 0.

An ERA bit of 0 indicates that all blocks are erased, starting from the logical block address to the end of the specified transfer length.

Transfer Length	The Transfer Length field specifies the number of contiguous logical blocks of data to be erased.
PBA	A Physical Block Address bit of 1 indicates that physical block addressing is used. A PBA bit of 0 indicates that logical block addressing is used.

Note If errors are detected during this command, and the AWRE bit of the Mode Select parameters is 1, the data is automatically written to a spare sector.

Write and Verify (Group 5) Command (AEH)

Writes data to the optical disk and then verifies the write by reading the written data and checking the error correction code.

Note The Mode Select Commands (15H, 55H) impact read, write, format, and erase commands.

Table 2-127. Write and Verify (Group 5) CDB

<table>
<tr><th>Byte</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>0</td><td colspan="8">Operation Code (AEH)</td></tr>
<tr><td>1</td><td colspan="3">Reserved (0)</td><td>DPO</td><td>Rsvd (0)</td><td>EBP</td><td colspan="2">Reserved (0)</td></tr>
<tr><td>2</td><td colspan="8">Starting Logical Block Address (MSByte)</td></tr>
<tr><td>3</td><td colspan="8">Starting Logical Block Address</td></tr>
<tr><td>4</td><td colspan="8">Starting Logical Block Address</td></tr>
<tr><td>5</td><td colspan="8">Starting Logical Block Address (LSByte)</td></tr>
<tr><td>6</td><td colspan="8">Transfer Length (MSByte)</td></tr>
<tr><td>7</td><td colspan="8">Transfer Length</td></tr>
<tr><td>8</td><td colspan="8">Transfer Length</td></tr>
<tr><td>9</td><td colspan="8">Transfer Length (LSByte)</td></tr>
<tr><td>10</td><td colspan="8">Reserved (0)</td></tr>
<tr><td>11</td><td>PBA</td><td colspan="7">Reserved (0)</td></tr>
</table>

Write-Once Byte 11 and Byte 1, Bit 2 are Reserved (0).

DPO	A Disable Page Out bit of 1 instructs the target not to store the data in the cache after it has been transferred to the optical disk. A DPO bit of 0 instructs the target to store the data in the cache after it has been transferred to the optical disk. This bit is ignored.
EBP	An Erase By-Pass bit of 0 indicates an erase automatically performs before writing the data. An EBP bit of 1 supresses the erase operation.
Transfer Length	The Transfer Length field specifies the number of contiguous logical blocks of data to be written.
PBA	A Physical Block Address bit of 1 indicates that physical block addressing is used. A PBA bit of 0 indicates that logical block addressing is used.

Note

If errors are detected during this command, and the AWRE bit of the Mode Select parameters is 1, the data is automatically written to a spare sector.

Immediate response and write caching are not available for this command. See Appendix B for additional information.

Verify (Group 5) Command (AFH)

Verifies the data starting from the specified logical block address by checking the error correction code.

This command has two modes of operation depending on the value of the BV bit. If the BV bit is set to 0 it verifies previously written data integrity starting at the specified Logical Block Address by reading the data and checking the Error Correction Code. The verification threshold is set to approximately half of the error correction capability.

Table 2-128. Verify (Group 5) CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (AFH)							
1	Reserved (0)			DPO	Rsvd (0)	BlkVfy	Reserved (0)	
2	Logical Block Address (MSByte)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSByte)							
6	Verification Length (MSByte)							
7	Verification Length							
8	Verification Length							
9	Verification Length (LSByte)							
10	Reserved (0)							
11	Reserved (0)							

DPO	A Disable Page Out bit of 1 instructs the target not to retain the data in the cache after it has been verified. A DPO bit of 0 instructs the target to retain the data in the cache after it has been transferred to the initiator. This bit is ignored.
Blk Vfy	A Blank Verify bit of 1 indicates the drive verifies that sectors are erased. A Blk Vfy bit of 0 indicates the drive verifies written data integrity.
Verification Length	Specifies the number of contiguous logical blocks of data to be verified.

Read Defect Data (Group 5) Command (B7H)

Reads optical disk defect information. The data returned starts with an 8-byte header, followed by one or more defect information blocks.

Note The Mode Select Commands (15H, 55H) impact read, write, format, and erase commands.

Table 2-129. Read Defect Data (Group 5) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (B7H)							
1	Reserved (0)			PList	GList	Defect List Format		
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Reserved (0)							
6	Allocation Length (MSByte)							
7	Allocation Length							
8	Allocation Length							
9	Allocation Length (LSByte)							
10	Reserved (0)							
11	Control Byte (0)							

Note Read "Drive Defect Management" in Chapter 1 for a description and example of drive defect management.

PList A Primary List bit of 1 requests the drive to return the Primary List (PList) of defects. The PList corresponds to the defect list recorded in the Primary Defect List (PDL).

GList	A Grown List bit of 1 requests the drive to return the Grown List (GList) of defects. The GList corresponds to the defect list recorded in the SDL (Secondary Defect List).
Defect List Format	The Physical Sector Format and a Vendor Unique format are available for the Read Defect Data Command. See Table 2-131 and Table 2-132.
Allocation Length	Specifies the number of bytes to be returned.

Available Read Defect Data Parameters

Table 2-130. Allowed Read Defect Data Combinations (Byte 1)

PList	GList	Defect List Format			Description
(bit 4)	(bit 3)	(bit 2)	(bit 1)	(bit 0)	
1	0	1	0	1	PList sent in physical format
0	1	1	0	1	GList sent in physical format
0	1	1	1	0	GList sent in vendor unique format
1	1	1	0	1	Plist and Glist in physical format
All Other Combinations					Reserved

PList	If set to 1, this bit indicates that the Primary List of defects was returned.
GList	If set to 1, this bit indicates that the Grown List of defects was returned.
Defect List Format	Only the Physical Sector Format (indicated by a 5 in this field) or the Vendor Unique Format (indicated by a 6 in this field), are returned. See Table 2-131 or Table 2-132.
Defect List Length	Specifies the number of bytes of defect data returned.

Table 2-131. Physical Sector Format Defect Descriptor

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Reserved (0)			PList	GList	Defect List Format		
2	Reserved (0)							
3	Reserved (0)							
4	Defect List Length (MSByte)							
5	Defect List Length							
6	Defect List Length							
7	Defect List Length (LSByte)							
8	Reserved							
9	Physical Track Number of the Defect (MSByte)							
10	Physical Track Number of the Defect (LSByte)							
11	Reserved (0)							
12	Reserved (0)							
13	Reserved (0)							
14	Reserved (0)							
15	Defective Physical Sector Number							

Table 2-132. Vendor Unique Format Defect Descriptor

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Reserved (0)			PList	GList	Defect List Format		
2	Reserved (0)							
3	Reserved (0)							
4	Defect List Length (MSByte)							
5	Defect List Length							
6	Defect List Length							
7	Defect List Length (LSByte)							
8	Defective Track (MSByte)							
9	Defective Track							
10	Defective Track (LSByte)							
11	Defective Sector							
12	Replacement Track (MSByte)							
13	Replacement Track							
14	Replacement Track (LSByte)							
15	Replacement Sector							

3

Autochanger SCSI-2 Command Set

Numerical List of Commands

Hex Code	Name	Description	Page Number
00H	Test Unit Ready	Checks to determine if the optical library is ready.	3-5
01H	Rezero Unit	Sets the library to a specific predefined state.	3-6
03H	Request Sense	Determines a specific error condition when the library fails to successfully complete a command.	3-7
07H	Initialize Element Status	Checks all elements for optical disks.	3-11
16H	Reserve	Reserves the library for use by a single SCSI initiator.	3-12
17H	Release	Releases the library for use by multiple SCSI initiators.	3-14
1AH	Mode Sense	Determines element parameter information.	3-15
0CH	Rotate Mailslot Command	Controls mailslot rotation.	3-23
1CH	Receive Diagnostic Results	Retrieves diagnostic test information resulting from the Send Diagnostic Command.	3-24

Hex Code	Name	Description	Page Number
1DH	Send Diagnostic	Causes the library to perform predefined diagnostic test/exerciser routines.	3-26
1EH	Prevent/Allow Medium Removal	Prevents or allows the manual insertion or removal of optical disk through the mailslot.	3-28
2BH	Position To Element	Positions the specified transport element in front of the specified destination element.	3-29
3BH	Write Buffer Command	Writes data to the autochanger	3-30
4DH	Log Sense	Retrieves statistical information about the library.	3-32
A5H	Move Medium	Moves the optical disk cartridges between library elements.	3-50
B8H	Read Element Status	Determines the status of the storage slots, mailslot, drives, and picker.	3-51
12H	Inquiry	Provides vendor, product, and revision information.	3-62
A6H	Exchange Medium	Exchanges the optical disk at the source element address with the destination element address.	3-65

Alphabetical List of Commands

Hex Code	Name	Description	Page Number
A6H	Exchange Medium	Exchanges the optical disk at the source element address with the destination element address.	3-65
07H	Initialize Element Status	Checks all elements for optical disks.	3-11
12H	Inquiry	Provides vendor, product, and revision information.	3-62
4DH	Log Sense	Retrieves statistical information about the library.	3-32
1AH	Mode Sense	Determines element parameter information.	3-15
A5H	Move Medium	Moves the optical disk cartridges between library elements.	3-50
2BH	Position To Element	Positions the specified transport element in front of the specified destination element.	3-29
1EH	Prevent/Allow Medium Removal	Prevents or allows the manual insertion or removal of optical disk through the mailslot.	3-28
B8H	Read Element Status	Determines the status of the storage slots, mailslot, drives, and picker.	3-51
1CH	Receive Diagnostic Results	Retrieves diagnostic test information resulting from the Send Diagnostic Command.	3-24

Hex Code	Name	Description	Page Number
17H	Release	Releases the library for use by multiple SCSI initiators.	3-14
03H	Request Sense	Determines a specific error condition when the library fails to successfully complete a command.	3-7
16H	Reserve	Reserves the library for use by a single SCSI initiator.	3-12
01H	Rezero Unit	Sets the library to a specific predefined state.	3-6
0CH	Rotate Mailslot Command	Controls mailslot rotation.	3-23
1DH	Send Diagnostic	Causes the library to perform predefined diagnostic test/exerciser routines.	3-26
00H	Test Unit Ready	Checks to determine if the Optical Library is ready.	3-5
3BH	Write Buffer Command	Writes data to the autochanger	3-30

Note Throughout this section, a Control Byte (0) is vendor unique and should always be set to 0.

Detailed Description of the SCSI Commands

Test Unit Ready Command (00H)

Determines the Ready state of the library. If the library is in a Ready state when it receives this command, it returns a Good status. If the library is not ready when it receives the Test Unit Ready Command, it returns a Check Condition with a sense key of Not Ready.

Table 3-1. Test Unit Ready Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (00H)							
1-4	Reserved (0)							
5	Control Byte (0)							

Rezero Unit Command (01H)

Recalibrates the mechanical system and sets the library to a specific predefined state.

Table 3-2. Rezero Unit Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (01H)							
1-4	Reserved (0)							
5	Control Byte (0)							

Request Sense Command (03H)

Determines the specific error condition when the library fails to successfully complete a command. Codes are used to represent the error condition and this information can be used to determine what type of error recovery procedure is appropriate.

Table 3-3. Request Sense Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (03H)							
1-3	Reserved (0)							
4	Allocation Length							
5	Control Byte (0)							

Allocation Length — This field contains the number of data bytes to be returned.

Table 3-4. Request Sense Data Parameter Block Format

Byte	7	6	5	4	3	2	1	0
0	Valid (0)	Error Code (70H or 71H)						
1	Reserved (0)							
2	Reserved (0)				Sense Key (Table 3-5)			
3-6	Reserved (0)							
7	Additional Sense Length (Table 3-5)							
8-11	Reserved (0)							
12	Additional Sense Code (Table 5-2)							
13	Additional Sense Code Qualifier (Table 5-2)							
14	Reserved (0)							
15	SKSV	Sense Key Specific (Table 3-6)						
16-17	Sense Key Specific							
18-77	Additional Sense Bytes (Table 5-5)							

Error Code — Either 70H (current error) or 71H (deferred error).

Sense Key and Additional Sense Length

Table 3-5. Sense Key - Additional Sense Length Values

Sense Key	Description	Additional Sense Length
0H	No Sense	10
1H	Recovered Error	70
2H	Not Ready	10
4H	Hardware Error	70
5H	Illegal Request	10
6H	Unit Attention	10
BH	Aborted Command	10

Additional Sense Code — The Additional Sense Code specifies detailed information related to the error reported in the Sense Key field. See Table 5-2.

Additional Sense Code Qualifier — The Additional Sense Code Qualifier specifies detailed information related to the Additional Sense Code. See Table 5-2.

SKSV — When set to 1, the Sense Key Specific bytes contains valid data. When set to 0, Bytes 15, 16, and 17 are null.

Sense Key Specific — When the Sense Key field is set to Illegal Request (05H) and SKSV is 1, the Sense Key Specific fields are defined as shown in Table 3-6.

Additional Sense Bytes — This field may contain information when the Additional Sense Length field contains a value greater than 10. See "Additional Sense Data Format for Error Recovery" in Chapter 5.

Table 3-6.
Sense Key Field = Illegal Request (05H) and SKSV Bit = 1

Byte	7	6	5	4	3	2	1	0
15	SKSV (1)	C/D	Reserved (0)		BPV	Bit Pointer		
16	Field Pointer (MSByte)							
17	Field Pointer (LSByte)							

C/D 1 = Illegal Parameter is in Command Descriptor Block.
0 = Illegal Parameter is in Data Out Phase.

BPV 1 = Bit pointer field is valid.
0 = Bit pointer field is invalid.

Bit Pointer Specifies which bit is in error.

Field Pointer Specifies which byte is in error.

Initialize Element Status Command (07H)

Checks all elements for optical disks and for relevant status. This information is retained and can be accessed through the Read Element Status Command (B8H). Refer to Table 3-47.

Table 3-7. Initialize Element Status Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (07H)							
1-4	Reserved (0)							
5	Control Byte (0)							

Note This command takes a few minutes to complete.

Reserve Command (16H)

Reserves the library for use by a single SCSI initiator when the library is connected to multiple initiators.

Table 3-8. Reserve Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (16H)							
1	Reserved (0)			3rdPty	Third Party Device ID			Element
2	Reservation Identification							
3	Element List Length (MSByte)							
4	Element List Length (LSByte)							
5	Control Byte (0)							

3rdPty	When set to 1, the library is reserved for the SCSI device specified in the Third Party Device ID field.
Element	When set to 1, any valid element identified in the element list is reserved for the initiator making the request. When set to 0, all elements are reserved.
Reservation Identification	Identifies each element reservation.
Element List Length	Defines the size of the element list.

Reserve Command Element List Descriptors

Each element list consists of zero or more descriptors. The element list descriptor defines a series of elements beginning at the specified element address for the specified number of elements.

If the number of elements is zero, the element list begins at the specified element address and continues through the last element address on the unit. However, if the Element Address is less than ten, a status of `Check Condition`, Sense Key = `Illegal Request` is returned.

Table 3-9. Reserve Command Element List Descriptors

Byte	7	6	5	4	3	2	1	0
0-1	Reserved (0)							
2	Number of Elements (MSByte)							
3	Number of Elements (LSByte)							
4	Element Address (MSByte)							
5	Element Address (LSByte)							

Release Command (17H)

Releases the library or element for use by another initiator.

Table 3-10. Release Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (17H)							
1	Reserved (0)			3rdPty	Third Party Device ID			Element
2	Reservation Identification							
3-4	Reserved (0)							
5	Control Byte (0)							

3rdPty — When set to 1, the element or unit is released from a previous reserve which had been made using a third party reservation.

Element — When set to 1, any reservation from the requesting initiator with a matching reservation identification is terminated. All other reservations remain intact.

When this bit is set to 0, the target terminates all element and unit reservations.

Reservation Identification — Identifies each element reservation.

Mode Sense Command (1AH)

Acquires element parameter information about the library. This information includes, but is not limited to, the following:

- First storage slot element address and number of storage slots.
- First input/output (mailslot) element address and number of input/output elements.
- First medium transport element (picker) address and number of medium transport elements.
- First optical drive element address and number of drives.
- Characteristics of the various element types.

Table 3-11. Mode Sense Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (1AH)							
1	Reserved (0)							
2	Reserved (0)		Page Code					
3	Reserved (0)							
4	Allocation Length (Table 3-12)							
5	Control Byte (0)							

Page Code — Valid Page Code values are:

1DH - Element Address Assignment Page (Table 3-13)

1EH - Transport Element Parameters Page (Table 3-15)

1FH - Device Capabilities Page (Table 3-16)

3FH - All Pages

Allocation Length The number of bytes returned for each page code are shown below:

Table 3-12. Mode Sense Allocation Lengths

# of Return Bytes	Page #	Description	Table
24	1DH	Element Address Assignment	Table 3-13
8	1EH	Transport Element Parameters	Table 3-15
24	1FH	Device Capabilities	Table 3-16
56	3FH	All Pages	

Element Address

Table 3-13. Mode Sense Element Address Assignment Page (1DH) Format

Byte	7	6	5	4	3	2	1	0
0	Sense Data Length (23)							
1-3	Reserved (0)							
4	Reserved (0)		Page Code (1DH)					
5	Parameter Length (12H)							
6	First Medium Transport Element Address (MSByte) (0)							
7	First Medium Transport Element Address (LSByte) (0)							
8	Number Of Medium Transport Elements (MSByte) (0)							
9	Number Of Medium Transport Elements (LSByte) (1)							
10	First Storage Element Address (MSByte) (0)							
11	First Storage Element Address (LSByte) (11)							
12	Number Of Storage Elements (MSByte) (0)							
13	Number Of Storage Elements (LSByte) (Table 3-14)							
14	First Import/Export Element Address (MSByte) (0)							
15	First Import/Export Element Address (LSByte) (10)							
16	Number Of Import/Export Elements (MSByte) (0)							
17	Number Of Import/Export Elements (LSByte) (1)							
18	First Data Transfer Element Address (MSByte) (0)							
19	First Data Transfer Element Address (LSByte) (1)							
20	Number Of Data Transfer Elements (MSByte) (0)							
21	Number Of Data Transfer Elements (LSByte) (Table 3-14)							
22-23	Reserved (0)							

Table 3-14. Number of Data Transfer Elements

Model	Storage Elements	Data Transfer Elements
10	16	1
10LC	16	1
20	32	2
60	88	2 or 4
100	144	2 or 4

Transport Element (Picker)

Table 3-15.
Mode Sense Transport Element Parameter Page (1EH) Format

Byte	7	6	5	4	3	2	1	0
0	Sense Data Length (7)							
1-3	Reserved (0)							
4	Reserved (0)		Page Code (1EH)					
5	Parameter Length (02H)							
6	Reserved (0)							Rotate (1)
7	Member Number In Transport Element Set (0)							

Parameter Length — Number of bytes which describe each transport element (picker).

Rotate — When set to 1, this bit indicates that the medium transport element (picker) supports flipping double-sided optical disks.

Device Capabilities

The Device Capability Page provides information about library element storage, Move Medium, and Exchange Medium capabilities.

In the field names below, these abbreviations are used:

- MT - Medium transport element (picker)
- ST - Storage element
- IE - Import/Export element (mailslot)
- DT - Data Transport element (drive)

Table 3-16. Mode Sense Device Capabilities Page (1FH) Format

Byte	7	6	5	4	3	2	1	0
0	Sense Data Length (23)							
1-3	Reserved (0)							
4	Reserved (0)		Page Code (1FH)					
5	Parameter Length (12H)							
6	Reserved (0)				StorDT (0)	StorIE (1)	StorST (1)	StorMT (0)
7	Reserved (0)							
8	Reserved (0)				MT->DT (1)	MT->IE (0)	MT->ST (1)	MT ->MT (1)
9	Reserved (0)				ST->DT (1)	ST->IE (1)	ST->ST (1)	ST->MT (1)
10	Reserved (0)				IE->DT (1)	IE->IE (0)	IE->ST (1)	IE->MT (0)
11	Reserved (0)				DT->DT (1)	DT->IE (1)	DT->ST (1)	DT->MT (1)
12-15	Reserved (0)							
16	Reserved (0)				MT<>DT (0)	MT<>IE (0)	MT<>ST (0)	MT<>MT (0)
17	Reserved (0)				ST<>DT (0)	ST<>IE (0)	ST<>ST (0)	ST<>MT (0)
18	Reserved (0)				IE<>DT (0)	IE<>IE (0)	IE<>ST (0)	IE<>MT (0)
19	Reserved (0)				DT<>DT (0)	DT<>IE (0)	DT<>ST (0)	DT<>MT (0)
20-23	Reserved (0)							

In the descriptions below, XX and YY are abbreviations of the element types such as MT or ST.

StorXX

When this bit is set to 1, the XX element type provides independent storage for a cartridge.

If the StorXX bit is set to 0, it indicates that elements of that type provide virtual sources or destinations, and the storage location of the cartridge is provided by an element of some other type.

XX->YY - Move Medium

A returned bit value of 1 indicates that the library supports Move Medium commands from the XX (source) element to the YY (destination) element. See Table 3-46 for additional information on the Move Medium command.

A returned bit value of 0 indicates that Move Medium commands from the XX element to the YY element are not supported and will be rejected, with `Illegal Request`.

XX<>YY - Exchange Medium

A returned bit value of 1 indicates that the library supports Exchange Medium commands where the source is element type XX and destination 1 is element type YY, and destination 2 is of the same type as the source element.

An XX<>YY field returned bit value of 0 indicates that these Exchange Medium commands will be rejected with `Illegal Request`. See Table 3-57 for additional information on the Exchange Medium Command.

Rotate Mailslot Command (0CH)

The host system may send this SCSI vendor-unique command to the optical disk library to control mailslot rotation.

This command can only be used when the front panel Configuration 32 is set to `ON`. If this command is sent when Configuration 32 is `OFF`, a `Check Condition` followed by a Sense Key of Illegal Request is returned.

Table 3-17. Rotate Mailslot Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (0CH)							
1-3	Reserved (0)							
4	Reserved (0)							Open
5	Control Byte (0)							

Open — An Open value of 1 causes the mailslot to rotate out. An Open value of 0 causes the mailslot to rotate in.

There are three exceptions:

- If another device, including the front panel, already has the mailslot prevented or reserved.
- If there is an optical disk already in the transport element (picker).
- If the optical disk library is full.

Receive Diagnostic Results Command (1CH)

Retrieves the results of a library diagnostic test performed using the Send Diagnostic Command (Table 3-20). The diagnostic test number and parameters, error codes, and FRU information are provided.

Note The following tables provide information which can help with troubleshooting failed components in a unit. The FRUs returned should be considered pointers to the best area within the unit to check for the fault. Simply changing the FRU listed may or may not fix the associated problem.

Table 3-18. Receive Diagnostic Results Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (1CH)							
1	Reserved (0)							
2	Reserved (0)							
3	Allocation Length (MSByte)							
4	Allocation Length (LSByte)							
5	Control Byte (0)							

Allocation Length — The maximum number of parameter bytes that may be sent in the Data In Phase to describe the results of the test.

Table 3-19. Receive Diagnostic Results Parameter List

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Hardware Error Code (Table 5-6)							
2	FRU 1 (Appendix A)							
3	FRU 2 (Appendix A)							
4	FRU 3 (Appendix A)							
5	Number of the Test that Failed (Table 5-9)							
6-13	Parameters							

Hardware Error Code	Code is generated only if an unrecoverable error occurs.
FRU 1	The FRU most likely to be at fault. (See Appendix A.)
FRU 2	The second most likely FRU to be at fault. (See Appendix A.)
FRU 3	The third most likely FRU to be at fault. (See Appendix A.)
Test Number	The diagnostic test number. This will not be a sequence number, but the specific test that failed. Refer to Table 5-9 for a list of the autochanger diagnostic tests.
Parameters	Additional parameters as defined for individual tests (tests 18, 44, 153 require additional information).

There may be several like components in a unit (e.g. 4 optical sensors in the home position calibration system). These components may have a common FRU number. When it is possible to detect which of these FRUs may be at fault, the error code field reflects the one to check.

Send Diagnostic Command (1DH)

Causes the library to perform certain predefined diagnostic test/exercise routines.

The Request Sense (Table 3-3) and the Receive Diagnostic Results (Table 3-18) commands can be used to get the results of a test.

Table 3-20. Send Diagnostic Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (1DH)							
1	Reserved (0)					SelfTst	DevOfL	UnitOfl
2	Reserved (0)							
3	Parameter List Length (MSByte)							
4	Parameter List Length (LSByte)							
5	Control Byte (0)							

SelfTst — When set to 1, the Poweron Selftest runs. This selftest is equivalent to running Test Sequence 1, the Poweron Sequence. The parameter list length must be 0.

When set to 0, the diagnostic specified in the parameter list is run.

DevOfL — Must be set to 1 for any test other than Selftest.

UnitOfl — Must be set to 1 for any test other than Selftest.

Parameter List Length — The number of parameter bytes in the Data Out Phase that describes the test to be run. The valid range is between 2 and 10, although this value must be 0 if the Selftest bit is set to 1. See Table 3-21.

Send Diagnostic Command Data

Table 3-21. Send Diagnostic Command Parameter List

Byte	7	6	5	4	3	2	1	0
0	Test Number (Table 5-9)							
1	Break	Loop Count Identifier						
2-9	Parameters							

Test Number — Diagnostic test number. See Table 5-9 for a list of the autochanger diagnostic tests.

Break — Indicates how to terminate the loop count if an error occurs.

0 - Break on first error

1 - Do not break on error

Loop Count Identifier — The number of times the test will be repeated before the test is terminated and status is returned.

1H - Run 1 time

2H - Run 10 times

3H - Run 100 times

4H - Run 1000 times

Parameters — Parameters associated with the specified tests 18, 44, and 153.

Prevent/Allow Medium Removal Command (1EH)

Either prevents or allows users to insert or remove optical disks using the mailslot.

Table 3-22. Prevent/Allow Medium Removal Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (1EH)							
1-3	Reserved (0)							
4	Reserved (0)							Prevent
5	Control Byte (0)							

Prevent — A Prevent bit of 1 prevents removal of an optical disk. A prevent bit of 0 allows removal of an optical disk. Default is 0.

Position To Element Command (2BH)

Positions the specified transport element in front of the specified destination element.

Table 3-23. Position To Element Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (2BH)							
1	Reserved (0)							
2	Transport Element Address (MSByte) (0)							
3	Transport Element Address (LSByte) (0)							
4	Destination Element Address (MSByte)							
5	Destination Element Address (LSByte)							
6-7	Reserved (0)							
8	Reserved (0)							Invert
9	Control Byte (0)							

Destination Element Address	See Table 3-13 in the description of the Mode Sense Command for more information about addressing.
Invert	An Invert bit value of 1 requests the transport element be inverted (flipped) before being placed in front of the destination element.

Write Buffer Command (3BH)

Writes data to the autochanger.

Caution If you send this command, you may overwrite valid information that the autochanger needs for operation.

Table 3-24. Write Buffer Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (3BH)							
1	Reserved (0)					Mode (See Table 3-25)		
2	Buffer ID (See Table 3-25)							
3	Buffer Offset (MSByte)							
4	Buffer Offset							
5	Buffer Offset (LSByte)							
6	Byte Transfer Length (MSByte)							
7	Byte Transfer Length							
8	Byte Transfer Length (LSByte)							
9	Control Byte (0)							

Mode — Indicates which data format is used. Refer to Table 2-76 for valid values.

Buffer ID — Indicates which buffer is used. Refer to Table 2-76 for valid values.

Buffer Offset — Indicates at what address the data is written, offset from the beginning of the buffer. Must be set to 0 when using Download Microcode ID.

Byte Transfer Length — Indicates the number of data bytes to be written in the buffer.

Table 3-25. Buffer Access Mode and ID

Buffer Type	Buffer ID	Mode
Download Microcode (FLASH EPROM)	1	4, 5
Customer and Product ID (NVRAM)	15	1

Table 3-26. Mode Descriptions

Mode	Description
1	Vendor specific
4	Download microcode
5	Download microcode

Log Sense Command (4DH)

Retrieves statistical library information maintained by the library.

Table 3-27. Log Sense Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (4DH)							
1	Reserved (0)							
2	Reserved (0)		Page Code (Table 3-28)					
3-4	Reserved (0)							
5	Parameter Pointer (MSByte) (0)							
6	Parameter Pointer (LSByte) (0)							
7	Allocation Length (MSByte)							
8	Allocation Length (LSByte)							
9	Control Byte (0)							

Allocation Length	The number of parameter bytes, including the Log Page Descriptor Block and the parameter structures. Refer to Table 3-28.

Log Sense Parameter Data

Parameter data returned by the Log Sense Command is organized into pages. The parameter data available in each page is as follows:

Table 3-28. Log Sense Parameter Data Available in Each Page

Page Code	Length Bytes	Description
0	16	List of supported pages
30H	510	Error log (Table 3-29)
31H	72	Move Success log (Table 3-31)
32H	300	Force log (Table 3-33)
33H	406	Recovery log (Table 3-34)
35H	14-44	Drive log[1] (Table 3-37)
36H	6	Byte 0 = Version #; Byte 1 = Revision #
37H	24	The Odometer log (Table 3-39)
38H	116	Run-Time log (Table 3-40)
39H	108	Retry log (Table 3-42)
3AH	84	Move History log (Table 3-44)

1 The length of the drive log depends on the number of drives in the unit. Ten bytes per drive are available.

All log pages are preceded by a 4-byte header containing the page number, a reserved byte, and the length of the data to follow the header.

Error Logs Table Format

This table is accessed using the Log Sense Command (4DH), Table 3-27 with page code 30H. It records errors that occur during diagnostic and poweron testing. No entries are made in this log during normal operation of the autochanger (except poweron testing).

This log may be initialized before error rate or wellness sequences are run. This allows you to accumulate data related to the test at hand. When you initialize the cumulative log, all data accumulated is lost.

This log does not have error rate information. That information is found in the Move Success Log Table 3-31.

Table 3-29. Error Logs Table Format

Byte #	Description
0	Page Code 30H
1	Reserved = 0
2 - 3	Number of bytes to follow.
4 - 5	Current entry number. (range 1-50)
6 - 7	Number of entries in log.
8 - 9	Log entry currently being displayed.
10 -509	Array of 50 log entries. (10 bytes each) (See Table 3-30)

Error Log Entry Format

Table 3-30. Error Log Entry Format

Byte	7	6	5	4	3	2	1	0
0	Diagnostic User Number							
1	Hardware Error Code (Table 5-6)							
2	FRU 1 (Appendix A)							
3	FRU 2 (Appendix A)							
4	FRU 3 (Appendix A)							
5	Test Number (Table 5-9)							
6	Time Stamp (MSByte)							
7	Time Stamp							
8	Time Stamp							
9	Time Stamp (LSByte)							

Diagnostic User Number
: 0 - Poweron
1 - Front Panel
2 - SCSI Bus
3 - FRU Isolation
4 - Error Recovery
5 - SCSI Reset
6 - SCSI Abort

FRU 1
: The FRU most likely to be at fault. (See Appendix A.)

FRU 2
: The second most likely FRU to be at fault. (See Appendix A.)

FRU 3
: The third most likely FRU to be at fault. (See Appendix A.)

Test Number
: The Diagnostic test number. See Table 5-9 for a list of the autochanger diagnostic tests.

Time Stamp
: Indicates when the error occurred (measured in hours since the odometer was initialized).

Note The FRUs returned in the Error Log should be considered as the best area within the unit to check for the fault. Simply changing the FRU listed may or may not fix the associated problem.

Move Success Log Table Format

This table can be accessed via the Log Sense Command (4DH), Table 3-27 with page code 31H. The Move Success Log is intended for use during normal autochanger operation, not diagnostic operation.

Move totals and the ten most recent hard errors are recorded.

Table 3-31. Move Success Log Table Format

Byte #	Description
0	Page Code 31H
1	Reserved = 0.
2 - 3	Number of bytes to follow.
4	Current entry number (range 1-10).
5	Number of entries in log.
6-9	Total number of good moves since last hard error.
10-11	Total number of soft errors since last hard error.
12-71	Array of 10 entries, one entry per hard error. (See Table 3-32.)

Note

Hard errors are unrecoverable and generate a hardware error code. Refer to Table 3-3 for additional information on error conditions.

Soft errors are recoverable and normal operation continues after recovery.

Table 3-32. Move Success Logs Entry Format

Byte #	Description
0-3	Current Good Move Count at time of hard error.
4-5	Current Recovery Count at time of hard error.

Force Log Data Format

This table can be accessed via the Log Sense Command (4DH), Table 3-27 with page code 32H. Each cartridge move is actually a sequence of many small moves called Micro-Moves. Each Micro-Move has an associated ID number. For each Micro-Move ID, the log reflects the highest force seen for that Micro-Move ID.

Table 3-33. Force Entry Data Format

Byte #	Description
0	Page Code 32H
1	Reserved = 0.
2 - 3	Number of bytes to follow.
4-5	Y-axis maximum force for the Micro-Move ID (Table C-1,Table C-2, or Table C-3)
6-7	Z-axis maximum force for the Micro-Move ID (Table C-1,Table C-2, or Table C-3)

Recovery Log Data Format

This table can be accessed via the Log Sense Command (4DH), Table 3-27 with page code 33H. It records soft errors and related information on error recovery method and success.

It is reset to 0 before any autochanger move. Any error that occurs during a move, or during the subsequent error recovery, is logged. The information is only valid for the most recent move.

Table 3-34. Recovery Log Data Format

Byte #	Description
0	Page Code 33H
1	Reserved = 0.
2 - 3	Number of bytes to follow.
4-5	Current entry number (range 1-20).
6-405	20 recovery log entries, 20 bytes each. (Table 3-35)

Table 3-35. Recovery Log Entry Format

Byte #	Description
0	Macro-Move ID (Table C-4)
1	Error Recovery State (Table 3-36)
2	Micro-Move ID (Table C-1,Table C-2, or Table C-3)
3	Micro-Move Error Code (Table 5-8)
4-7	Y-input position from the encoder.
8-11	Expected Y-input position from the encoder.
12-15	Z-input position from the encoder.
16-19	Expected Z-input position from the encoder.

Table 3-36. Error Recovery State Table

State	Description
0	First retry attempt failed.
1	Second retry attempt failed.
2	Third retry attempt failed.
20	First restore attempt failed.
21	Second restore attempt failed.
22	Third restore attempt failed.
97	Maximum number of retries exceeded.
98	Maximum number of restores exceeded.
99	Find Home failed.
127	Initial entry for this failure.

Drive Log Data Format

This table can be accessed via the Log Sense Command (4DH), Table 3-27 with page code 35H. It records the number of times a drive is used by the autochanger.

Table 3-37. Drive Log Data Format

Byte #	Description
0	Page Code 35H
1	Reserved = 0.
2-3	Number of bytes to follow.
4-13	Log entry for Drive #1.
14-23	Log entry for Drive #2. (Model dependent - See Table 3-14)
24-33	Log entry for Drive #3. (Model dependent - See Table 3-14)
34-43	Log entry for Drive #4. (Model dependent - See Table 3-14)

Table 3-38. Drive Log Entry Format

Byte #	Description
0-3	Count of optical disk insertions for this drive.
4-5	Media source for last move to this drive.
6	Media flipped bit for last move to this drive.
7	ID/LUN Valid bits for this drive.
8	SCSI ID for this drive.
9	SCSI LUN for this drive. (0)

Odometer Log Data Format

This table can be accessed via the Log Sense Command (4DH), Table 3-27 with page code 37H. It counts the number of times various types of moves are completed. An exchange is counted as two moves.

Table 3-39. Odometer Log Data Format

Byte #	Description
0	Page Code 37H
1	Reserved = 0.
2 - 3	Number of bytes to follow.
4-7	Move Odometer.
8-11	Flip Odometer.
12-15	Translate Odometer. (Not used in Model 10LC.)
16-19	Mailslot Rotate Odometer.
20-23	Poweron Hours.

Run-Time Log Data Format

This table can be accessed via the Log Sense Command (4DH), Table 3-27 with page code 38H. It keeps a record of error recovery activity. An entry is added to the Run-Time Log when a move fails or when any type of error recovery is required. Only the last ten entries are saved.

The log header holds information that is put into the log entries when a recovery attempt occurs.

Table 3-40. Run-Time Log Data Format

Byte #	Description
0	Page Code 38H
1	Reserved = 0.
2-3	Number of bytes to follow.
4-7	Number of Macro-Move IDs since this log was reset.
8-9	Number of retries done since this log was reset.
10-11	Number of inline recoveries since this log was reset.
12-13	Number of fatal errors since this log was reset.
14	Number of entries in this log.
15	Number of the most current entry.
16-115	10 Run-time Log entries, 10 bytes each. (Table 3-41)

Note All Micro-Move Errors of Type # 0H-7EH are counted as inline recoveries. These failures of Type # 90H-FFH are counted as retries. See (Table 5-8 for a description of these micro-move error codes.

Table 3-41. Run-Time Log Entry Format

Byte #	Description
0-3	Number of Macro-Move IDs since this log was reset
4	Macro-Move ID (Table C-4)
5	Number of entries in Recovery Log when the entry was made
6	First Micro-Move ID in the Recovery Log (Table C-1, Table C-2, or Table C-3)
7	First Micro-Move Error Code in the Recovery Log (See Table 5-8)
8	Second Micro-Move ID in Recovery Log (Table C-1, Table C-2, or Table C-3)
9	Second Micro-Move Error Code in Recovery Log (Table 5-8)

Retry Log Data Format

This table can be accessed via the Log Sense Command (4DH), Table 3-27 with page code 39H.

Each retry algorithm code byte triggers a specific retry algorithm on the preceding move command. The byte order is the same order in which the retry algorithms were run.

Table 3-42. Retry Log Data Format

Byte #	Description
0	Page Code 39H
1	Reserved = 0.
2-3	Number of bytes to follow.
4-103	Retry Algorithm Code (Table 3-43)
104-105	Number of Inline Retries
106-107	Number of Major Retries

The last four bytes may be organized as two 16 bit words. The first word is the cumulative number of Inline Retries (since the autochanger was built), and the second word is the cumulative number of Major Retries (since the autochanger was built). Inline Retries are attempts to move again from the error position. Major Retries are attempts to move again after a Find Home command has re-zeroed the unit.

Table 3-43. Retry Algorithm Codes

Number	Algorithm Name	Type
01H	Find Home and Calibrate	Major
03H	Z-axis Home	Major
04H	FRU Isolation	Major
81H	Mailslot	Inline
91H	Drive 1 Eject	Inline
92H	Drive 2 Eject	Inline
93H	Drive 3 Eject	Inline
94H	Drive 4 Eject	Inline
A1H	Drive 1 Insert	Inline
A2H	Drive 2 Insert	Inline
A3H	Drive 3 Insert	Inline
A4H	Drive 4 Insert	Inline

The number of drives within a unit is model dependent. Refer to Table 3-14 for the actual number of drives within a particular library.

Move History Log Data Format

This table can be accessed via the Log Sense Command (4DH), Table 3-27 with page code 3AH.

Table 3-44. Move History Log Data Format

Byte #	Description
0	Page Code 3AH
1	Reserved = 0.
2-3	Number of bytes to follow.
4-83	10 History Log entries, 8 bytes each (Table 3-45)

Table 3-45. Move History Log Entry Format

Byte #	Description
0	Least Recent Micro-Move ID (Table C-1,Table C-2, or Table C-3)
1	Next Recent Micro-Move ID (Table C-1,Table C-2, or Table C-3)
2	Next Recent Micro-Move ID (Table C-1,Table C-2, or Table C-3)
3	Next Recent Micro-Move ID (Table C-1,Table C-2, or Table C-3)
4	Next Recent Micro-Move ID (Table C-1,Table C-2, or Table C-3)
5	Failed Micro-Move ID (Table C-1,Table C-2, or Table C-3)
16	Micro-Move Error Code (Table 5-8)
7	Reserved (0)

Micro-move IDs are the last moves prior to failure, associated with Bytes 5 and 6.

Move Medium Command (A5H)

Moves optical disks between library elements.

Table 3-46. Move Medium Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (A5H)							
1	Reserved (0)							
2	Transport Element Address (MSByte) (0)							
3	Transport Element Address (LSByte) (0)							
4	Source Element Address (MSByte)							
5	Source Element Address (LSByte)							
6	Destination Element Address (MSByte)							
7	Destination Element Address (LSByte)							
8-9	Reserved (0)							
10	Reserved (0)							Invert
11	Control Byte (0)							

Source/ Destination Element Address — See Table 3-13 in the description of the Mode Sense Command for more information about addressing.

Invert — An Invert bit value of 1 requests the transport element be inverted (flipped) before putting the optical disk into the destination element.

Read Element Status Command (B8H)

Gives the exact status of the various elements (individual storage slots, mailslot, optical drives, and picker mechanism) within the library.

Table 3-47. Read Element Status Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (B8H)							
1	Reserved (0)					Element Type Code		
2	Starting Element Address (MSByte)							
3	Starting Element Address (LSByte)							
4	Number Of Elements (MSByte)							
5	Number Of Elements (LSByte)							
6	Reserved (0)							
7	Allocation Length (MSByte)							
8	Allocation Length (Middle Byte)							
9	Allocation Length (LSByte)							
10	Reserved (0)							
11	Control Byte (0)							

Element Type Code — Specifies the element types(s) to report.

- 0H - All element types reported (CDB only)
- 1H - Medium Transport Element (picker)
- 2H - Storage Element
- 3H - Import/Export Element (mailslot)
- 4H - Data Transfer Element (drive)

Starting Element Address — Specifies the minimum element address to report.

Number Of Elements — Maximum number of elements to report.

Allocation Length | The number of bytes of element status to return. The data consists of an 8-byte Element Status Page Header followed by one or more Element Status pages.

Read Element Status Data

Read Element Status Data consists of a data header, followed by one or more Element Status pages.

Table 3-48. Read Element Status Data Header

Byte	7	6	5	4	3	2	1	0
0	First Element Address Reported (MSByte)							
1	First Element Address Reported (LSByte)							
2	Number of Elements Reported (MSByte)							
3	Number of Elements Reported (LSByte)							
4	Reserved (0)							
5	Byte Count Of Report Available (MSByte)							
6	Byte Count of Report Available (Middle Byte)							
7	Byte Count of Report Available (LSByte)							

Byte Count of Report Available — The number of bytes of element status page data available.

Element Type Code 1H - Picker

Table 3-49. Medium Transport Element Descriptor Block

Byte	7	6	5	4	3	2	1	0
0	Element Type Code (1H)							
1	Reserved (0)							
2	Element Descriptor Length (MSByte)							
3	Element Descriptor Length (LSByte)							
4	Reserved (0)							
5	Byte Count Of Descriptor Data Available (MSByte)							
6	Byte Count of Descriptor Data Available (Middle Byte)							
7	Byte Count of Descriptor Data Available (LSByte)							
8	Element Address (MSByte)							
9	Element Address (LSByte)							
10	Reserved (0)					Except	Reserved (0)	Full
11	Reserved (0)							

Element Descriptor Length	The number of bytes in each Element Descriptor Block
Byte Count of Descriptor Data Available	Element Descriptor Length for X Number of Elements of the type shown in byte 0.
Element Address	The address of the element being reported by this descriptor block.

Except	When set to 1, the element is in an abnormal state. Information about the abnormal state is available in the Additional Sense Code and Additional Sense Code Qualifier bytes. (See Table 5-2.)
Full	When set to 1, the element contains a cartridge.

Element Type Code 2H - Storage Slot

Table 3-50.
Read Element Status Storage Element Descriptor Block

Byte	7	6	5	4	3	2	1	0
0	Element Type Code (2H)							
1	Reserved (0)							
2	Element Descriptor Length (MSByte)							
3	Element Descriptor Length (LSByte)							
4	Reserved (0)							
5	Byte Count Of Descriptor Data Available (MSByte)							
6	Byte Count of Descriptor Data Available (Middle Byte)							
7	Byte Count of Descriptor Data Available (LSByte)							
8	Element Address (MSByte)							
9	Element Address (LSByte)							
10	Reserved (0)				Access	Except	Reserved (0)	Full
11	Reserved (0)							

Element Descriptor Length	The number of bytes in each Element Descriptor Block
Byte Count of Descriptor Data Available	Element Descriptor Length for X Number of Elements of the type shown in byte 0.
Element Address	The address of the element being reported by this descriptor block.
Access	When set to 1, access to the element by the Medium Transport Element is allowed.

Except	When set to 1, the element is in an abnormal state. Information about the abnormal state is available in the Additional Sense Code and Additional Sense Code Qualifier bytes. (See Table 5-2.)
Full	When set to 1, the element contains a cartridge.

Element Type Code 3H - Mailslot

Table 3-51.
Read Element Status Import/Export Element Descriptor Block

Byte	7	6	5	4	3	2	1	0
0	Element Type Code (3H)							
1	Reserved (0)							
2	Element Descriptor Length (MSByte)							
3	Element Descriptor Length (LSByte)							
4	Reserved (0)							
5	Byte Count Of Descriptor Data Available (MSByte)							
6	Byte Count of Descriptor Data Available (Middle Byte)							
7	Byte Count of Descriptor Data Available (LSByte)							
8	Element Address (MSByte)							
9	Element Address (LSByte)							
10	Reserved (0)		In- Enab	Ex- Enab	Access	Except	Imp/Exp	Full
11	Reserved (0)							

Element Descriptor Length	The number of bytes in each Element Descriptor Block
Byte Count of Descriptor Data Available	Element Descriptor Length for X Number of Elements of the type shown in byte 0.
Element Address	The address of the element being reported by this descriptor block.
InEnab	When set to 1, Import to the autochanger is enabled.
ExEnab	When set to 1, Export from the autochanger is enabled.

Access	When set to 1, access to the element by the Medium Transport Element is allowed.
Except	When set to 1, the element is in an abnormal state. Information about the abnormal state is available in the Additional Sense Code and Additional Sense Code Qualifier bytes. (See Table 5-2.)
Imp/Exp	When set to 1, the operator inserted the cartridge into the mailslot.
	When set to 0, the autochanger mechanism put the cartridge in the mailslot.
Full	When set to 1, the element contains a cartridge.

Element Type Code 4H - Drive

Table 3-52.
Read Element Status Data Transfer Element Descriptor Block

<table>
<tr><th>Byte</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>0</td><td colspan="8">Element Type Code (4H)</td></tr>
<tr><td>1</td><td colspan="8">Reserved (0)</td></tr>
<tr><td>2</td><td colspan="8">Element Descriptor Length (MSByte)</td></tr>
<tr><td>3</td><td colspan="8">Element Descriptor Length (LSByte)</td></tr>
<tr><td>4</td><td colspan="8">Reserved (0)</td></tr>
<tr><td>5</td><td colspan="8">Byte Count Of Descriptor Data Available (MSByte)</td></tr>
<tr><td>6</td><td colspan="8">Byte Count of Descriptor Data Available (Middle Byte)</td></tr>
<tr><td>7</td><td colspan="8">Byte Count of Descriptor Data Available (LSByte)</td></tr>
<tr><td>8</td><td colspan="8">Element Address (MSByte)</td></tr>
<tr><td>9</td><td colspan="8">Element Address (LSByte)</td></tr>
<tr><td>10</td><td colspan="4">Reserved (0)</td><td>Access</td><td>Except</td><td>Reserved (0)</td><td>Full</td></tr>
<tr><td>11</td><td colspan="8">Reserved (0)</td></tr>
<tr><td>12</td><td colspan="8">Additional Sense Code (See Table 5-2.)</td></tr>
<tr><td>13</td><td colspan="8">Additional Sense Code Qualifier (See Table 5-2.)</td></tr>
<tr><td>14</td><td>Not Bus</td><td>Reserved (0)</td><td>IDValid</td><td>Reserved (0)</td><td>Reserved (0)</td><td colspan="3">Reserved (0)</td></tr>
<tr><td>15</td><td colspan="8">SCSI Bus Address</td></tr>
<tr><td>16</td><td colspan="8">Reserved (0)</td></tr>
<tr><td>17</td><td>SValid</td><td>Invert</td><td colspan="6">Reserved (0)</td></tr>
<tr><td>18</td><td colspan="8">Source Storage Element Address (MSByte)</td></tr>
<tr><td>19</td><td colspan="8">Source Storage Element Address (LSByte)</td></tr>
</table>

Element Descriptor Length	The number of bytes in each Element Descriptor Block
Byte Count of Descriptor Data Available	Element Descriptor Length for X Number of Elements of the type shown in byte 0.
Element Address	The address of the element being reported by this descriptor block.
Access	When set to 1, access to the element by the medium transport element is allowed.
Except	When set to 1, the element is in an abnormal state. Information about the abnormal state is available in the Additional Sense Code and Additional Sense Code Qualifier bytes.
Full	When set to 1, the element contains a cartridge.
Not Bus	When set to 1, the SCSI Bus Address and the Logical Unit value fields are not valid for the SCSI Bus used to select the library.
IDValid	When set to 1, the SCSI Bus Address field contains valid information.
SValid	When set to 1, the source storage element address field and the invert bit information are valid.
Invert	When set to 1, the cartridge in the element was inverted by a move operation since it was last in the source storage element.

Inquiry Command (12H)

Requests information describing the type of SCSI device. This information includes the following:

- vendor ID
- product ID
- product revision

Table 3-53. Inquiry Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (12H)							
1	Reserved (0)							EVPD
2	Reserved (0)							
3	VPD Identifier (0)							
4	Allocation Length (3CH)							
5	Control Byte (0)							

EVPD	A 0 in this bit requests Standard Inquiry Information. A 1 in this bit is not supported.
VPD Identifier	Only page (0) of the vital product data codes is supported.
Allocation Length	The number of bytes reserved for returned data.

Inquiry Command Data

Table 3-54. Standard Inquiry Data Format

<table>
<tr><th>Byte</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>0</td><td colspan="3">Peripheral Qualifier (0)</td><td colspan="5">Peripheral Device Type (08H=Medium Changer)</td></tr>
<tr><td>1</td><td>RMB (1)</td><td colspan="7">Device-Type Qualifier (0)</td></tr>
<tr><td>2</td><td colspan="2">ISO Version (0)</td><td colspan="3">ECMA Version (0)</td><td colspan="3">ANSI-Approved Version (2)</td></tr>
<tr><td>3</td><td>AENC (0)</td><td>TrmIOP (0)</td><td colspan="2">Reserved (0)</td><td colspan="4">Response Data Format (2)</td></tr>
<tr><td>4</td><td colspan="8">Additional Length (1FH)</td></tr>
<tr><td>5-7</td><td colspan="8">Reserved (0)</td></tr>
<tr><td>8-15</td><td colspan="8">Vendor Identification (HP)</td></tr>
<tr><td>16-31</td><td colspan="8">Product Identification (Table 3-55)</td></tr>
<tr><td>32-35</td><td colspan="8">Product Revision Level (Table 3-56)</td></tr>
</table>

RMB	Removable medium bit. When this bit is set to 1, medium is removable.
ANSI and Response Data Format	The Returned values of 2 indicate compliance to X3131-199x.
AENC, TrmIOP	Asynchronous event notification and the terminate I/O process message are not supported.
Response Data Format	Indicates the inquiry data format complies with X3131-199X.
Vendor Identification/Product Identification	All unused bytes are filled with a blank space.

Product Identification

The product numbers are different for each optical disk library size. The following table identifies product numbers for standard autochanger models (bytes 16-31).

Table 3-55. Product Identification Numbers

Market Channel	Model 10C/20T	Model 10LC/20LT	Model 20C/40T	Model 60C/120T	Model 100C/200T
HP Connect Multifunction	N/A	C1708C/T	C1700C/T	C1704C/T	C1705C/T
Distributor and OEM Evaluator Multifunction	C1713C/T	C1718C/T	C1710C/T	C1714C/T	C1715C/T

Table 3-56. Inquiry Command - Product Revision Level

Byte	Ascii Value
32	major version
33	
34	minor version
35	minor version

Exchange Medium Command (A6H)

Exchanges the optical disk at the source element address with the optical disk at the destination element address.

Table 3-57. Exchange Medium Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (A6H)							
1	Reserved (0)							
2	Transport Element Address (MSByte) (0)							
3	Transport Element Address (LSByte) (0)							
4	Source Element Address (MSByte)							
5	Source Element Address (LSByte)							
6	First Destination Element Address (MSByte)							
7	First Destination Element Address (LSByte)							
8	Second Destination Element Address (MSByte)							
9	Second Destination Element Address (LSByte)							
10	Reserved (0)						Inv2	Inv1
11	Control Byte (0)							

Note The optical disk in the source element is moved to the first destination element and the optical disk that previously occupied the first destination element is moved to the second destination element. The second destination element cannot be the same as the source element.

Source/ Destination Element Address — See Table 3-13 in description of Mode Sense Command for more information about addressing.

Inv2 An Inv2 bit value of 1 specifies that the optical disk will be inverted (flipped) prior to being deposited into the second destination element.

Inv1 An Inv1 bit value of 1 specifies that the optical disk will be inverted (flipped) prior to being deposited into the first destination element.

4

Drive Error Codes

This chapter contains the following information:

- Request Sense Command sense key values
- Request Sense Command additional sense code values
- HP-Specific Error Codes
- HP-Specific DSP Error Information

Drive Request Sense Command Values

The Request Sense Command (see "Request Sense Command (03H)" in Chapter 2) returns values for the Sense Key and Additional Sense Code.

Drive Request Sense - Sense Key Values

Byte 2, Bits 3 through 0

Table 4-1. Request Sense - Sense Key Values

Sense Key	Name	Abbrev.	Description
0H	No Sense	NS	The command completed successfully.
1H	Recovered Error	RE	The last command was completed successfully with some recovery action performed by the drive/controller.
2H	Not Ready	NR	The drive cannot be accessed.
3H	Medium Error	ME	The command terminated with an unrecovered error condition that was caused by a optical disk defect.
4H	Hardware Error	HE	The drive/controller detected a hardware error.
5H	Illegal Request	IR	There was an illegal parameter in the command descriptor block or in the additional parameters supplied for some commands.
6H	Unit Attention	UA	The optical disk has been loaded, the unit has been reset, or the Mode Select parameters have been changed.
7H	Data Protect	DP	A command that writes to the optical disk cannot be performed due to the write-protect condition of the optical disk write-protect switch.

Table 4-1. Request Sense - Sense Key Values (continued)

Sense Key	Name	Abbrev.	Description
8H	Blank Check (write-once only)	BC	A blank sector was detected during a Read (Group 0 or 1) or Verify, or a written sector was detected during a Write (Group 0 or 1) or a Write and Verify command.
0BH	Aborted Command	AC	This sense key shall be reported if a target or LUN receives a second command from the same initiator before the previous command from that initiator has completed.

Drive Request Sense - Additional Sense Code Values

Bytes 12 and 13

Table 4-2. Request Sense - Additional Sense Code Values

Sense Code and Qualifer	Sense Key	Description
00 00	0H - NS	No Additional Sense Information
02 00	4H - HE	No ESDI Command Complete
04 01	2H - NR	LUN in Process of Becoming Ready
04 02	2H - NR	LUN Not Ready, Initializing Command Required
04 03	2H - NR	LUN Not Ready, Manual Intervention Needed
04 04	2H - NR	LUN Not Ready, Format in Progress
06 00	4H - HE	No Reference Position Found
09 01	4H - HE	Tracking Servo Failure
09 02	4H - HE	Focus Servo Failure
09 03	4H - HE	Spindle Servo Failure
0C 01	1H - RE	Write Error Recovered with Auto Reallocation
0C 02	3H - ME	Write Error - Auto Reallocation Failed
10 00	4H - HE	ID CRC or ECC Error
11 00	3H - ME	Unrecovered Read Error
11 02	3H - ME	Error Too Long to Correct
11 07	3H - ME	Data Resynchronization Error
11 0B	3H - ME	Uncorrected Read Error - Recommend reassignment
11 0C	3H - ME	Uncorrected Read Error - Recommend rewrite
11 80	3H - ME	Unrecovered error, sparing failed
12 00	3H - ME	Address Mark Not Found for ID Field
13 00	3H - ME	Address Mark Not Found for Data Field
15 01	4H - ME	Mechanical Positioning Error
17 01	1H - RE	Recovered Data With Retries
17 05	1H - RE	Recovered Data Using Previous Sector ID
17 80	1H - RE	Recovered Data With Retries, Data Auto Reallocated
17 81	1H - RE	Recovered data - Auto Reallocate Failed

Table 4-2.
Request Sense - Additional Sense Code Values (continued)

Sense Code and Qualifer	Sense Key	Description
18 00	1H - RE	Recovered Read Data With ECC Procedure
18 01	1H - RE	Recovered Data With ECC/Retries
18 02	1H - RE	Recovered Data With ECC/Retries, Data Auto Reallocated
19 01	3H - ME	Defect List Not Available
19 02	3H - ME	Defect List Error in Primary List
19 03	3H - ME	Defect List Error in Grown List
1A 00	5H - IR	Parameter List Length Error
1C 01	3H - ME	Primary Defect Lists Not Found
1C 02	3H - ME	Grown Defect Lists Not Found
1D 00	3H - ME	Miscompare During Verify Operation
20 00	5H - IR	Invalid Command Operation Code
21 00	5H - IR	Illegal Logical Block Address
22 00	5H - IR	Illegal Function
24 00	5H - IR	Invalid Field In CDB
25 00	5H - IR	Invalid LUN
26 00	5H - IR	Invalid Field In Parameter List
27 00	7H - DP	Write Protected
28 00	6H - UA	Medium Changed
29 00	6H - UA	Power-On, Reset or Bus Device Reset Occurred
29 80	4H - HE	Power-on, Reset or Bus Device Reset Occurred and Selftest Failed
2A 01	6H - UA	Mode Parameters Changed
2F 00	BH - AC	Commands Cleared by Initiator

Table 4-2.
Request Sense - Additional Sense Code Values (continued)

Sense Code and Qualifer	Sense Key	Description
30 01	3H - ME	Cannot Read Medium - Unknown Format
30 02	3H - ME	Cannot Read Medium - Incompatible Format
31 00	3H - ME	Medium Format Corrupted
32 00	3H - ME	No Defect Spare Location Available
32 01	3H - ME	Defect List Update Error
3A 00	2H - NR	Medium Not Present
3D 00	5H - IR	Invalid Bits in Identify Message
3F 01	6H - UA	Microcode Has Been Changed
3F 03	6H - UA	Inquiry Data Has Changed
40 80	4H - HE	Diagnostic Failure in NVRAM Odometers
40 81	4H - HE	Diagnostic Failure in NVRAM Configurations
40 82	4H - HE	Diagnostic Failure in NVRAM Logs
40 83	4H - HE	DSP Poweron Failure
40 84	4H - HE	DM Exception (unexpected flag)
43 00	BH - AC	Message Error
44 00	4H - HE	Internal target failure
47 00	BH - AC	SCSI Parity Error
48 00	BH - AC	Initiator Detected Error
4E 00	BH - AC	Overlapped Commands Attempted
53 00	4H - HE	Media Load/Unload Failed
53 02	5H - IR	Medium Removal Prevented
55 00	2H - NR	System Resource Failure (xaction queue full)
92 00	8H - BC	Overwrite Attempted
93 00	8H - BC	Empty Sector Detected
94 00	8H - BC	Written Sector Detected
95 00	2H NR	Power Interruption Pending

HP-Specific Error Codes

Error codes that are shaded are unique to C1716T.

Table 4-3. HP-Specific Error Codes

Error Code (Hex)	Message
0201	No seek complete
0202	No reference position found
0203	Tracking servo failed
0204	Focus servo failed
0205	Spindle servo failed
0206	Mechanical position error
0207	Load unload failed
0208	DSP download failed
0209	DSP import x failed
020A	DSP import y failed
020B	DSP import p failed
020C	DSP export x failed
020D	DSP export y failed
020E	DSP export p failed
020F	DSP upload log failed
0210	DSP log checksum failed
0211	DSP passthru failed
0212	Fault spinup failed
0213	Recalibrate MO gain failed
0214	DSP log command error
0215	DSP log unsupported
0216	DSP log status error
0220	Active sector SPDET error
0221	Active sector empty sector

Table 4-3. HP-Specific Error Codes (continued)

Error Code (Hex)	Message
0222	Data DMA error
0223	PECC DMA error
0224	EDAC shift register error
0225	ID CRC OR ECC error
0226	Data resync error
0227	Address mark error
0228	Sync mark error
0229	Incompatible format
022A	Active sector ENDEC unexpected
022B	Active sector higain with syncdet error
022C	Active sector syncmark dubbed error
022D	Active sector underflow/overflow error
022E	Active sector not empty
022F	Active sector no DSP status
0230	ENDEC locked on sector
0231	ENDEC locked prearmed
0232	ENDEC locked unexpected
0240	SEQ no transfer started
0241	SEQ unexpected EOHG
0242	SEQ unexpected status
0250	Media recognition failed
0251	Prearmed Watchdog timeout
0260	DM Task bad event
0261	DM mailbox bad event
0262	Next CD bad state
0263	Next operation bad state
0264	DM retry sector operations bad state
0265	Retry drive state bad state

Table 4-3. HP-Specific Error Codes (continued)

Error Code (Hex)	Message
0266	Retry sector operations bad state
0267	DM retry operations, bad operation type
02FF	DM abort transaction
2001	DSP recovery
2002	DSP error
2003	DSP fault
2004	DSP warning
2011	Active sector DSP recovery
2012	Active sector DSP error
2013	Active sector DSP fault
2014	Active sector DSP warning
2021	DSP unsolicited recovery
2022	DSP unsolicited error
2023	DSP unsolicited fault
2024	DSP unsolicited warning
202A	DSP unresponsive
202B	DSP over responsive
202C	DSP poweron failure
3001	SCSI controller kill error
3002	SCSI controller message error
3003	SCSI controller command error
3004	SCSI controller RAM error
3005	SCSI controller register error
3006	SCSI controller FIFO error
3007	SCSI controller target sequence error
3008	SCSI controller command sequence error
3009	SCSI controller STS sequence error
3010	Reselection timeout
4101	Error too long to correct
4102	Data CRC failure

Table 4-3. HP-Specific Error Codes (continued)

Error Code (Hex)	Message
4103	ECC errors in interleave threshold exceeded
4401	DDS sector not found
4402	DDS reserved field not zero
4403	PDL reserved field not zero
4404	SDL reserved field not zero
4405	DDS ID field invalid
4406	PDL indicator field invalid
4407	Number of user groups (G) field invalid
4408	Number of user blocks per group (N) field invalid
4409	Number of spare blocks per group (M) field invalid
440A	User + spare blocks too large for media
440B	PDL sector not found
440C	SDL sector not found
440D	PDL length field invalid
440E	SDL number of sublists field not equal to one
440F	SDL list length field invalid
4410	PDL list incomplete
4411	PDL list not sorted
4412	PDL entry invalid
4413	SDL list incomplete
4414	SDL list not sorted
4415	SDL defect entry invalid
4416	SDL replacement entry invalid
4417	SDL defect entry in a spare group
4418	SDL replacement entry in a user group
4419	Too many defects (PDL + DSL)
441A	DMA length too short for PDL to exist
441B	DMA length too short for SDL to exist
441C	No spare remaining

Table 4-3. HP-Specific Error Codes (continued)

Error Code (Hex)	Message
441D	Number of SDLs greater than total spares allocated
441E	DDS ID invalid for CCW media
441F	CCW media rejected
4420	Certification, erase pass failure
4421	Certification, write pass failure
4422	Certification, verify pass failure
4423	Certification, no defects remain
4424	Certification aborted
4425	NO SD list for certification erase
4426	No maximum SD list for certification erase
4427	No SD list for certification write
4428	No maximum SD list for certification write
4429	No SD list for certification verify
442A	No maximum SD list for certification verify
442B	No write image memory available for certification
442C	No write buffer memory available for certification
442D	No SD list for reassign blocks read
442E	No SD list for reassign blocks write
442F	No SD list for reassign blocks read long
4430	No SD list for reassign blocks write long
4431	Reassign blocks, unexpected CD before read
4432	Reassign blocks, unexpected CD before write
4433	Reassign blocks, unexpected CD before read long
4434	Reassign Blocks, unexpected CD before write long
4435	Reassign blocks, can't move data on CCW
4436	No defect maps found
4437	PDL duplicate entry found
4438	SDL duplicate entry found
4439	SFP not found

Table 4-3. HP-Specific Error Codes (continued)

Error Code (Hex)	Message
443A	SFP format field invalid
443B	SFP modulation field invalid
443C	SFP angular velocity field invalid
443D	SFP ECC code field invalid
443E	SFP sector size differs from detected
443F	SFP sectors in track 0 invalid
4440	SFP medium type invalid
4441	SFP largest track less than or equal to zero, invalid
4442	SFP download P-block failed
4443	DMA write failed all attempts
4444	EWR calibration error, no memory
4445	EWR calibration error, retries failed
4446	Spare retries were exhausted
4447	No memory for next spare table
4448	No working memory for read maps
4449	Retry error after DM error
444A	Sector was spared successfully
444B	No SD list for Reassign Blocks erase
444C	Reassign Blocks, unexpected CD before erase
444D	Format, number of user groups
444E	Format, number of user sectors per group
444F	Format, number of spare sectors per group
4450	Sparing, empty sector following spare attempt
4451	Sparing, overwritten sector following spare attempt
4452	DMA 1 write failed
4453	DMA 2 write failed
4454	DMA 3 write failed

Table 4-3. HP-Specific Error Codes (continued)

Error Code (Hex)	Message
4455	SFP at outer diameter is invalid
4456	SFP at inner diameter is invalid
4457	SFP track pitch is invalid
4458	SFP number of bands is invalid
4459	SFP banding constant is invalid
445A	SFP number revolutions per band is invalid
445B	SFP media type differs
445C	SDL ID is invalid
445D	SDL 2X group kind invalid
445E	Format, no replacement GD available
445F	Too many PDL entries per band
4460	Format, initial erase maps failed
4461	DMA erase during write failed
4462	Blank check during format/certification failed
4463	No SD list for certification blank check
4464	No maximum SD list for certification blank check
8201	Previous sector ID
8401	Recovered data spare failed
C000	Invalid diagnostic test
C001	Register error
C002	RAM test error
C003	Checksum error
C004	CPU test error
C005	Forced test error
C006	NVRAM test error
C007	Microprocessor test error
C008	Microprocessor ROM test error
C009	Microprocessor RAM test error

Table 4-3. HP-Specific Error Codes (continued)

Error Code (Hex)	Message
C00A	EDAC test error
C00B	SEQ test error
C00C	ENDEC test error
C00D	Active sector test error
C00E	HMAC test error
C00F	Buffer RAM test error
C010	Data loopback error
C020	Connector loopback DBO IO error
C021	Connector loopback DB1 CD error
C022	Connector loopback DB2 MSG error
C023	Connector loopback DB3 REQ error
C024	Connector loopback DB4 ACK error
C025	Connector loopback DB5 ATN error
C026	Connector loopback DB6 SEL error
C027	Connector loopback DB7 BSY error
C028	Connector loopback DBP RST error

HP-Specific DSP Error Information

Errors/Faults Byte 21 and 22

Table 4-4. DSP Error Information

Byte 21	Byte 22	Status Description
00	01H	Motor speed fault
00	02H	Laser read power error/fault
00	04H	Laser write power error/fault
00	08H	Laser erase power error/fault
00	10H	Pinning loop error/fault
00	20H	Focus error/fault
00	40H	Tracking error/fault
00	80H	Seek error
01H	00	Command error
02H	00	Initialization fault
04H	00	Cartridge motor fault
08H	00	Header error
10H	00	Bias magnet position error
20H	00	Checksum error
40H	00	Calibration error
80H	00	Active sector error

DSP Status Information

The status byte is an overview of the state of the DSP. It is intended as a quick status check for the DSP. The error/fault bytes (21 and 22) are used to indicate the servo function in error.

Byte 23

Table 4-5. DSP Status Information

	Status Description
01H	Error Recovery-in-Progress
02H	Error
04H	Fault
08H	Warning
80H	Hardware Error

5

Autochanger Error Codes

This chapter contains the following autochanger error code tables:

- Request Sense Codes
- Request Sense Maps
- Hardware Error Codes
- Move Error Codes
- Micro-Move Failure Type Codes
- Diagnostic Tests

An error code can be reported through the Log Sense Command (4DH), Request Sense Command (03H), or through the control panel.

Note See Appendix A for a list of field replaceable units for the Model 10LC/ 20LT, Models 10C/20C, 20T/40T and Models 60C/100C, 120T/200T.

Request Sense Error Codes

This section identifies each of the error responses for the autochanger "Request Sense Command (03H)", Table 3-3.

Table 5-1.
Request Sense - Sense Key Values—Byte 2, Bits 3 through 0

Sense Key	Name	Abbrev.	Description
0H	No Sense	NS	The command completed successfully.
1H	Recovered Error	RE	The last command was completed successfully with some recovery action performed by the autochanger/controller.
2H	Not Ready	NR	The autochanger cannot be accessed.
3H	Medium Error	ME	The command terminated with an unrecovered error condition that was caused by a optical disk defect.
4H	Hardware Error	HE	The autochanger/controller detected a hardware error.
5H	Illegal Request	IR	There was an illegal parameter in the command descriptor block or in the additional parameters supplied for some commands.
6H	Unit Attention	UA	The optical disk has been loaded, the unit has been reset, or the Mode Select parameters have been changed.
0BH	Aborted Command	AC	This sense key shall be reported if a target or LUN receives a second command from the same initiator before the previous command from that initiator has completed.

Table 5-2. Request Sense Data (Table 3-4, bytes 12 and 13)

Sense Code and Qualifier	Sense Key	Description
00 00	0H-NS	No additional sense information
00 00	1H-RE	Error recovered invoked and completed
04 01	2H-NR	Autochanger becoming ready
04 02	2H-NR	Unit must first initiate element status
04 03	2H-NR	Fatal error - unit must be corrected manually
15 01	4H-HE	Move error (Check additional sense bytes) (Table 5-5)
1A 00	5H-1R	Invalid parameter list length
20 00	5H-1R	Unsupported command
21 01	5H-1R	Invalid address - (Table 5-3)
22 00	5H-1R	Unsupported command
24 00	5H-1R	Illegal field in CDB
25 00	5H-1R	Invalid LUN
26 00	5H-1R	Invalid parameter list=
29 00	6H-UA	Power on sense?
3B 0D	5H-1R	Element full - (Table 5-4)
3B 0E	5H-1R	Source empty - (Table 5-4)
3D 00	5H-1R	Invalid identify message in

Request Se ... 12 and 13) (continued)

Sense Code and Qualifier	Sense K	Description
40 80	4H-HE	
42 00	4H-HE	
43 00	OB-AC	
45 00	0B-AC	r
47 00	0B-AC	
48 00	0B-AC	
4B 00	0B-AC	hase error
4E 00	OB-AC	d command sent early)
81 00	2H-NR	d, initialize element status

Ta ... Sense Code 21

Field Pointer	
00	Invalid ele
02	Invalid tr
04	Invalid sou
06	Invalid de
08	Invalid se

Table 5-4. Element Full/Empty: Sense Code 3B

Field Pointer	
02	Transport full
04	Source empty
06	Destination full/empty
08	Second destination full

Additional Sense Data Format for Error Recovery

Below is a description of the 60 Additional Sense Bytes returned during the Data In Phase of the Request Sense Command (03H), (Table 3-4) from the autochanger. The overall layout of the data is presented first, followed by a description of each byte.

Table 5-5. Request Sense - Additional Sense Data

Byte	7	6	5	4	3	2	1	0
18	Move Error Code (Table 5-7)							
19	Hardware Error Code (Table 5-6)							
20	First FRU (Appendix A)							
21	Second FRU (Appendix A)							
22	Third FRU (Appendix A)							
23	MvCap	Last	Rsvd (0)	PosLost	CartIn	Reserved (0)		
24-25	Reserved (0)							
26	DInRty	DEjRty	PkrRec	CarAssy	Reserved (0)		BFHm	FHR
27	Retry Count							
28-29	Reserved (0)							
30	DInRty	DEjRty	PkrRec	CarAssy	Reserved (0)		BFHm	FHR
31	Recovery Count							
32-34	Reserved (0)							
35	Valid	ErrEn	CartIn	CartEl	UnexpMt	UnexpFl	CartInv	ElRty
36-37	Source Element Number							
38	Valid	ErrEn	CartIn	CartEl	UnexpMt	UnexpFl	CartInv	ElRty
39-40	Destination Element Number							
41	Valid	ErrEn	CartIn	CartEl	UnexpMt	UnexpFl	CartInv	ElRty
42-43	Secondary Source Element Number							
44	Valid	ErrEn	CartIn	CartEl	UnexpMt	UnexpFl	CartInv	ElRty

Table 5-5. Request Sense - Additional Sense Data (continued)

Byte	7	6	5	4	3	2	1	0
45-46	Second Destination Element Number							
47-49	Reserved (0)							
50-54	Micro-Move ID History (Table C-1, Table C-2, Table C-3)							
55	Failed Micro-Move Id (Table C-1, Table C-2, Table C-3)							
56	Micro-Move Error Code (Table 5-8)							
57-60	Vertical Motor Commanded Position							
61-64	Vertical Motor Actual Position							
65-68	Horizontal Motor Commanded Position							
69-72	Horizontal Motor Actual Position							
73-77	Reserved (0)							

Move Error Code — The movement that was being performed when the error occurred. The values of the Move Error Codes are in Table 5-7.

Hardware Error Code — Determined by fault isolation, this error code indicates the cause of the failure. The values of the Hardware Error Codes are in Table 5-6.

First FRU — The most likely Field Replacable Unit to be the cause of the failure. (See Appendix A.)

Second FRU — The second most likely Field Replacable Unit to be the cause of the failure. (See Appendix A.)

Third FRU — The third most likely Field Replacable Unit to be the cause of the failure. (See Appendix A.)

Note The FRUs returned should be considered pointers to the best area within the unit to check for the fault. Simply changing the FRU listed may or may not fix the associated problem.

MvCap	A Move Capable bit of 1 indicates the AC is capable of performing move commands.
LastSCSI	A Last bit of 1 indicates the AC has successfully returned the cartridge to the state they were in before the failed command was executed.
PosLost	A Position Lost bit of 1 indicates the AC cannot calibrate the mechanism and has lost position of the picker.
CartIn	A Cartridge in Transport bit of 1 indicates a cartridge is in the picker mechanism.
DInRty	A Drive Insert Retry bit of 1 indicates that more than one attempt was needed to insert the cartridge into the drive. (For Byte 26, this attempt refers to Retry algorithm and for Byte 30 it refers to Recovery algorithm).
DEjRty	A Drive Eject Retry bit of 1 indicates that more than one attempt was needed to eject the cartridge from the drive. (For Byte 26, this attempt refers to Retry algorithm and for Byte 30 it refers to Recovery algorithm).
PkrRec	A Picker Retracted bit of 1 indicates the picker fingers were fully retracted after a failure. (For Byte 26, this attempt refers to Retry algorithm and for Byte 30 it refers to Recovery algorithm).
CarAssy	A Horizontal Carriage Locked bit of 1 indicates the picker fingers were fully retracted after a failure and the translate pin is engaged. (For Byte 26, this attempt refers to Retry algorithm and for Byte 30 it refers to Recovery algorithm).
BFHm	A Bad Find Home bit of 1 indicates the Find Home algorithm was started while the optical sensors were inoperable. (For Byte 26, this attempt refers to Retry algorithm and for Byte 30 it refers to Recovery algorithm).

FHR	A Find Home d Home algorithm was mechanism (For Byte 26, ry algorithm and for Byte 3 gorithm).
Retry Count	The total num were performed.
Recovery Count	The total num hat were performed.
Valid	A "0" indicates wo bytes contain invalid nd 44 are only set during the and.
ErrEn	An Error Enco an error occurred while this element.
CartEl	A Cartridge in e cartridge associated with
UnexpMt	An Element U indicates this element was u
UnexpFl	An Element Un icates this element was un
CartInv	A Cartridge Inv ne cartridge is inverted from it on began.
ElRty	An Element Re ates an operation in or d one or more retries.
Source Element Number	The Element N e Element Bit Map (Byte 35)
Destination Element Number	The Element N nation Element Bit Map (Byte 3
Secondary Source Element Number	The Element Nu dary Source Element Bit Ma
Second Destination Element Number	The Element Nu d Destination Element Bit Ma

Micro-Move ID History	The last five autochanger Micro-Move IDs for the original movement command prior to the failure. (See Table C-1, Table C-2, Table C-3.)
Failed Micro-Move ID	Actual micro-move that failed. (See Table C-1, Table C-2, Table C-3.)
Micro-Move Error Code	The error code associated with the failed Micro-Move ID. (See Table 5-8.)
Vertical Motor Commanded Position	The position to which the vertical motor was commanded.
Vertical Motor Actual Position	The actual position of the vertical motor.
Horizontal Motor Commanded Position	The position to which the horizontal motor was commanded.
Horizontal Motor Actual Position	The actual position of the horizontal motor.

Hardware Error Codes

Hardware Errors are reported through the Request Sense Command (03H), (Byte 19, Table 5-5), the Log Sense Command (4DH), (Byte 1, Table 3-30), and the Receive Diagnostic Results Command (1CH), (Byte 1, Table 3-19).

If an error is unrecoverable (i.e., something is broken or jammed beyond recovery without manual intervention), the Autochanger will take an additional step of attempting to identify the FRU that is causing the failure.

A routine that performs a process of elimination for various FRUs runs automatically. It attempts to isolate the error to three or less FRUs. If no error can be found (or if error recovery was made), the unit will return a `No Error` status. If an error is found, a Hardware Error Code is returned when the command completes.

Up to three FRUs will be returned to aide service in replacement priority.

Note The FRUs returned should be considered pointers to the best area within the unit to check for the fault. Simply changing the FRU listed may or may not fix the associated problem.

The Hardware Error Codes are listed in the following table. A [1] is placed after every test that is explained further in "Additional Description of Some Hardware Error Codes", following the table.

Table 5-6. Hardware Error Codes

Error Code (hex.)	Failure Description
AUTOCHANGER CONTROLLER PCA ERROR CODES	
00	No error
01	ROM checksum error
03	RAM test error
04	Microprocessor test error
05	Controlled area of RAM checksum error[1]
06	Illegal interrupt encountered by microprocessor
07	Illegal CPU exception encountered by microprocessor
09	Firmware error[1]
SCSI INTERFACE-SPECIFIC ERROR CODES	
0B	SCSI controller register error
0C	SCSI controller IC's RAM failed
0D	SCSI controller message error
0E	SCSI controller command error
0F	SCSI controller kill error
10	SCSI controller FIFO error
11	SCSI controller target sequence error
12	SCSI controller command sequence error
13	SCSI controller status sequence error
LOOPBACK ERROR CODES	
18	SCSI connector loopback error in DBO or I/O
19	SCSI connector loopback error in DB1 or C/D

1 For further explanation, refer to the next section "Additional Descriptions of Hardware Error Codes."

Table 5-6. Hardware Error Codes (continued)

Error Code (hex.)	Failure Description
1A	SCSI connector loopback error in DB2 or MSG
1B	SCSI connector loopback error in DB3 or REQ
1C	SCSI connector loopback error in DB4 or ACK
1D	SCSI connector loopback error in DB5 or ATN
1E	SCSI connector loopback error in DB6 or SEL
1F	SCSI connector loopback error in DB7 or BSY
20	SCSI connector loopback error in DBP or RST
MULTIFUNCTION PERIPHERAL IC ERROR CODES	
29	RS-232 loopback data did not match what was sent (not supported)
2A	Timed out waiting for RS-232 loopback data (not supported)
2B	Timer A did not count down as expected (not supported)
MOTOR CONTROL IC ERROR CODES	
2C	Failed read\write test to Motor control IC
2D	Motor control IC loopback test failed
2E	Motor control IC RAM test failed
POWER SUPPLY ERROR CODES	
33	Low voltage power supply failed
34	High voltage power supply failed
DRIVE CONNECT ERROR CODES	
38	Drive 1 not connected
39	Drive 2 not connected
3A	Drive 3 not connected
3B	Drive 4 not connected

Table 5-6. Hardware Error Codes (continued)

Error Code (hex.)	Failure Description
MECHANISM ERROR CODES	
3CH	Unspecified mechanical failure.
3EH	Unspecified servo failure
40H	Unable to free the Picker fingers in preparation for Carriage motion
41H	Unable to verify that the Picker is at the Home position during Find Home sequence (non-leadscrew side)
42H	Unable to find Home; Cartridge-in-path sensor blocked
43H	Unable to clear Cartridge-in-path sensors by moving Picker fingers back
44H	Carriage motion failure during Find Home sequence[1]
45H	Unable to free the Picker fingers in preparation for translate motion[1]
46H	Carriage motion failed while initializing Home position during Find Home sequence[1]
47H	Translate failed while moving towards non-leadscrew side during Find Home sequence[1]
48H	Carriage motion failed during Carriage/Picker assembly calibration (leadscrew side)[1]
49H	Carriage motion failed during Carriage/Picker assembly calibration (non-leadscrew side)[1]
4AH	Motion error while determining orientation of the Picker
4BH	No sensor found[1] (V4.2 code only)
4CH	Failed flip motion during the Find Home sequence[1] (V4.5 code)
4DH	Motion error while checking for cartridge in the Picker
4EH	Unable to measure height of sensor on left side
4FH	Unable to measure height of sensor on right side

1 For further explanation, refer to the next section "Additional Descriptions of Hardware Error Codes."

Table 5-6. Hardware Error Codes (continued)

Error Code (hex.)	Failure Description
50H	Excessive tilt of the Carriage/Picker assembly (away from the drives)[1]
51H	Excessive tilt of the Carriage/Picker assembly (toward the drives)[1]
52H	Excessive cone angle on Picker[1]
53H	Excessive stack tilt[1]
54H	Unable to complete an interrupted move at power up[1]
EXERCISER TEST ERROR CODES	
55H	Unable to find top of unit
56H	Need to issue Initialize Element Status Command
57H	Invalid test configuration
59H	Exerciser unrecovered error
5AH	Invalid test configuration (elements reserved)
5BH	Initialize Element Status command failed
5CH	Shipping Diagnostic run with cartridges in the mechanism
CALIBRATION SENSOR SYSTEM ERRORS	
60H	Optical sensor failed (leadscrew side - near drives)
61H	Optical sensor failed (non-leadscrew side - near drives)
62H	Optical sensor failed (leadscrew side - near mailslot)
63H	Optical sensor failed (non-leadscrew side - near mailslot)
CARTRIDGE-IN-PATH (CIP) SENSOR SYSTEM ERRORS	
64H	Intermittent CIP sensor beam (leadscrew side)
65H	Intermittent CIP sensor beam (non-leadscrew side)
66H	Path physically blocked (leadscrew side)
67H	Path physically blocked (non-leadscrew side)
6BH	CIP LED failed (leadscrew side)

1 For further explanation, refer to the next section "Additional Descriptions of Hardware Error Codes."

Table 5-6. Hardware Error Codes (continued)

Error Code (hex.)	Failure Description
6CH	CIP LED failed (non-leadscrew side)
6DH	CIP sensor failed (leadscrew side)
6EH	CIP sensor failed (non-leadscrew side)
6FH	CIP sensor system failed
MAILSLOT/STORAGE SLOT ERROR CODES	
B0H	Mailslot will not rotate
B1H	Inside Mailslot sensor failed
B2H	Mailslot will not accept or release cartridge
B3H	Storage slot will not accept or release cartridge
B4H	Outside Mailslot sensor failed

Table 5-6. Hardware Error Codes (continued)

Error Code (hex.)	Failure Description
DRIVE ERROR CODES	
B8H	Drive #1 access error[1]
B9H	Drive #2 access error[1]
BAH	Drive #3 access error[1]
BBH	Drive #4 access error[1]
SOLENOID ERROR CODES	
BCH	Drive #1 access failure; possible solenoid failure
BDH	Drive #2 access failure; possible solenoid failure
BEH	Drive #3 access failure; possible solenoid failure
BFH	Drive #4 access failure; possible solenoid failure
FRU DETECTION TEST ERROR CODES	
C8H	Unable to gain proper servo control of the motors[1]
C9H	Unable to move the Picker motor
CAH	Unable to move the Carriage motor
CBH	Unable to move either motor
CCH	Unable to find a hard stop while turning the Picker motor[1]
CDH	Unable t[illegible] a hard stop while turning the Carriage motor[1]
CEH	Excessi[illegible] required to move the Carriage leadscrew

1 For further explanation, refer to the next section "Additional Descriptions of Hardware Error Codes."

Table 5-6. Hardware Error Codes (continued)

Error Code (hex.)	Failure Description
MISCELLANEOUS ERROR CODES	
FCH	The test can only be run from the Front Panel
FDH	The test can only be run from the SCSI interface
FEH	The test did not run, probably a configuration error
FFH	Invalid test number

Additional Descriptions of Hardware Error Codes

Most of the single-line descriptions of the Hardware Error Code table are self-explanatory. The following Hardware Error Codes require further clarification:

Error Code	Explanation
05H	Controlled area of RAM checksum error All of the RAM on the Autochanger controller board has battery back-up, but not all of it needs to be retained upon power loss. The portion of the RAM that needs to be valid at poweron is referred to as "Controlled RAM." The stored checksum is re-calculated on this area every time the "Controlled RAM" is modified. The checksum is verified by Test #32. Error 05H is returned any time the calculated checksum does not match the stored checksum. To reset the checksum, clear Configuration 16 using the control panel and switch the autochanger off and on again. This error is deemed to be so unacceptable that all autochanger function is halted. The motors are turned off and the SCSI bus is not accessed.
09H	Firmware error There are three conditions where this code is used: 1. Case statement that falls through 2. Stack overflow 3. Divide by zero In case 1, the error code is returned over SCSI to the host. In cases 2 and 3, the motors shut down, and the processor halts.
43H-4CH	See the Service Manual for a thorough explanation of the Find Home test.
50H	Excess upward slant on Picker.
51H	Excess downward slant on Picker.

"Slant" is the distance between where the end of a perfectly perpendicular Picker (in relationship to the Carriage) would be, and where the end of this Picker is MEASURED to be. If the Picker slants down too far, it is not able to engage the mailslot correctly. It first engages the translate pin and moves across, rather than out.

52H Excessive slant on Picker.

If the sum of the upward slant on one side of the Picker plus the downward slant on the other side of the Picker is too great for proper operation, this error is returned.

53H Excessive stack tilt.

The height of each side of the Autochanger, or "stack," is the height of each of the two sensors. Tilt is the measure of the difference of the heights of the sides. If the tilt is too great for proper operation, this error is returned.

54H	At power up, unable to complete an interrupted move. If a move was interrupted by a power failure, at the next poweron the Autochanger will attempt to return the library to the state it was in before that command was issued. This error is returned if all the poweron tests pass, but the Autochanger is unable to put the cartridge(s) back.
B8H - BDH	Drive Errors. If the drive will not eject a cartridge and the Element Status claims that the cartridge exists, the failure will be "Source Unexpectedly Empty." It is not possible to differentiate between a dead drive and an "Unexpectedly Empty" drive. If the Autochanger cannot get a drive to accept a cartridge, the above errors are returned.
C8H	Unable to close the loops on the motors. When this error occurs, the FRU Isolation code has already confirmed that the motors and encoders appear functional. However, the servo system is unable to initiate proper control. This condition is rare.
CCH	Unable to find a hard stop while turning the Picker motor.
CDH	Unable to find a hard stop while turning the Carriage leadscrew motor. The FRU Isolation code checks for the presence of the belts by turning the motors until the mechanical system hits something. These errors are returned if the motors continue to spin longer than the maximum expected distances.

Autochanger Move Error Codes

Move Errors are reported through byte 18 of the Additional Sense Bytes Request Sense Command (03H) in Table 5-5.

Table 5-7. Autochanger Move Error Codes

Error Code (hex)	Failure Description
00	Failure occurred before any servo-controlled motions were attempted during Poweron Selftest.
02	Failure while Picker is not moving.
04	Failure while moving the Carriage/Picker assembly away from drives.
06	Failure while moving the Carriage/Picker assembly toward drives.
08	Failure while flipping the Picker.
0A	Failure while translating the Picker assembly.
0E	Failure while moving the Picker fingers back in preparation to translate.
10	Failure while moving the Picker fingers to engage the cartridge from the source storage element.
12	Failure while moving the Picker fingers back to remove the cartridge from the source storage element.
18	Failure while moving the Picker fingers forwards to insert a cartridge in the destination storage element.

Table 5-7. Autochanger Move Error Codes (continued)

Error Code (hex)	Failure Description
1A	Failure while moving the Picker fingers back after inserting a cartridge in the destination storage slot.
20	Failure while moving the Picker fingers forwards to engage the cartridge ejected from the drive (source).
22	Failure while moving the Picker fingers back to remove the cartridge from the drive (source).
28	Failure while moving the Picker fingers forwards to insert the cartridge into the drive (destination).
2A	Failure while moving the Picker fingers back after inserting a cartridge into the drive (destination).
30	Failure while moving the Picker fingers forward to engage the cartridge in the mailslot (source).
32	Failure while moving the Picker fingers back to remove the cartridge from the mailslot (source).

Table 5-7. Autochanger Move Error Codes (continued)

Error Code (hex)	Failure Description
38	Failure while moving the Picker fingers forward to insert the cartridge in the mailslot (destination).
3A	Failure while moving the Picker fingers back after inserting the cartridge in the mailslot (destination).
40	Failure while rotating the mailslot actuator inward.
42	Failure to ensure that the mailslot rotated inward.
48	Failure while rotating the mailslot actuator outward.
4A	Failure to ensure that the mailslot rotated outward.
50	Failure while the finding the home position.
52	Failure while calibrating the Carriage/Picker assembly.
60	Initializing element status failed while testing an element with a cartridge in the Picker assembly.
80	Failure to remove a cartridge from a source element.
84	Failure to leave a cartridge properly in a destination element.
88	An obstruction was encountered before the cartridge had been inserted the proper distance.
90	Source element unexpectedly empty.
94	Destination element unexpectedly full.
A0	Front mailslot sensor failed.
A2	Inside mailslot sensor failed.
A4	Drive light stuck on.
B0	Door interlock open.

Autochanger Micro-Move Error Codes

Micro-Move Errors are reported through bytes 50-55 in the additional sense bytes (Table 5-5) of the Request Sense Command (03H) and the "Log Sense Command (4DH)" with page code 33H. (See Table 3-35.)

Table 5-8. Autochanger Micro-Move Error Codes

Error Code (hex)	Description
0	No error.
1	Carriage motor drive voltage exceeded limit set by firmware.
2	Carriage motor overcurrent detected by hardware.
3	Carriage motor force exceeded limit set by firmware.
4	Picker motor drive voltage exceeded limit set by firmware.
5	Picker motor overcurrent detected by hardware.
6	Picker motor force exceeded limit set by firmware.
7	Low power supply during motion.
8	High power supply during motion.
9	Move stopped because cartridge-in-path beam blocked.
A	Cartridge not detected by cartridge-in-path beam.
B	Carriage motor not tracking properly.
C	Picker motor not tracking properly.
D	Carriage motor measured voltage less than expected.
E	Picker motor measured voltage less than expected.
10	Find origin failed.
11	Calibrate failed.
12	Diagnose FRU failed.
13	Initial recovery failed.
14	Find home failed.
15	Picker initialization failed.

Table 5-8. Autochanger Micro-Move Error Codes (continued)

Error Code (hex)	Description
16	Cartridge-in-path beams are blocked.
20	Failed to find hard stop at end of flip.
22	Failed to see sensor close at the end of translate.
23	Failed to move to the vertical position needed to engage the translate pin.
24	Failed to see sensor close at the start of translate.
25	Failed to see height sensor re-open after closing at the start of a translate.
28	The translate distance was too long.
29	The translate distance was too short.
31	Failed while checking for cartridge in a drive.
32	Failed to find a hard stop returning cartridge to storage after testing for presence of cartridge.
33	Failed while checking for cartridge in a storage slot.
34	Failed while checking for cartridge in the Picker.
35	Failed while checking for cartridge in the mailslot.
36	Could not free fingers after testing for a cartridge in a drive.
38	Failed to verify that cartridge exists after insert.
40	Failed finding the back of storage slot during retraction.
41	Failed to verify that a disk is in the storage slot on get using cartridge-in-path beams.

Table 5-8. Autochanger Micro-Move Error Codes (continued)

Error Code (hex)	Description
42	Not able to measure the depth of the storage slot.
43	Failed to free fingers from the storage slot.
48	Could not find the back of the storage slot after insert.
49	Failed to verify that a cartridge exists in the storage slot after insert.
4A	Could not free fingers from storage slot after insert.
50	Could not find the back of the mailslot after get.
51	Failed to verify that a disk is in the mailslot on get using cartridge-in-path beams.
52	Not able to measure the depth of the mailslot.
58	Could not find the back of the mailslot after insert.
59	Failed to verify that a cartridge exists in the mailslot after insert.
60	Failed to rotate the mailslot in.
61	Failed to rotate the mailslot out.
70	Exhausted retries while attempting to get the drive to eject the cartridge.
71	Could not verify that the drive ejected the cartridge.
72	Could not free fingers from the drive.
73	No cartridge in drive.
74	No load complete.
75	Drive error signal.
76	Unexpected cartridge in the drive.

Table 5-8. Autochanger Micro-Move Error Codes (continued)

Error Code (hex)	Description
77	Unexpected load complete.
78	Exhausted retries attempting to get drive to accept the cartridge.
79	Could not verify that the drive accepted the cartridge.
7E	Inline recovery attempts exhausted.
	Errors below here are counted in the runtime log as retries.
	Errors above here are counted in the runtime log as in-line.
90	Drive access was disallowed because drive busy signal was active.
91	Drive light stuck off.
94	Outside mailslot sensor failed.
95	Inside mailslot sensor failed.
96	Mailslot rotation failure; possibly caused by operator.
FA	Test drive insert retry.
FB	Timed out waiting for drive to eject when testing for the presence of a cartridge; retry being attempted.
FC	Retry being attempted on drive insert.
FD	Retry being attempted on drive eject.
FE	Mechanism error.

The following tables describe the optical disk library diagnostic tests.

Caution Some diagnostic tests can result in a disk being placed into an improper storage slot. If this happens, the optical disk library file system is no longer accurate.

Note Not all tests are supported on all models.

Table 5-9. Sequence Tests

No.	Test Name	Description
1	Poweron	Checks all digital data paths and normal machine operation. This sequence runs tests that are identical to those run when the optical disk library operation button is switched on. When the test is requested via SCSI, the tests which cannot be executed over SCSI will be skipped. Sequence Order: 3 - Controller Test 41 - Power Supply Test Motor Connection Test 5 - Initialize Mechanism
2	Wellness Test	Checks out the general capability of the Autochanger. Requires one loaded cartridge; drives and mailslot empty. Sequence Order: 1 - Poweron test 11 - Mechanical Exerciser Test
3	Controller Test	This sequence is run by the Autochanger controller when the optical disk library operation switch is switched on to check out all paths, and operation of the servo motor and autochanger circuitry. Sequence Order: 30 - Processor Test 31 - ROM Checksum Test 33 - Non-Destructive RAM Test 32 - RAM Checksum Test 34 - SCSI Interface Controller IC Test 36 - Motor Control IC Test 35 - Multi-Function Peripheral IC Test 37 - Drive Connect Test

Table 5-9. Sequence Tests (continued)

No.	Test Name	Description
5	Initialize Mechanism	Prepares the unit for movement. Sequence Order: Initialize RAM variables to defaults 50 - Find.Home

Exerciser Tests

No.	Test Name	Description
10	Initialize Element Status	Performs the same function as the SCSI INITIALIZE ELEMENT STATUS command. It physically scans the entire unit to determine which storage slots and drives contain disks.
11	Mechanism Exercise Test	Performs a combination of moves with a pass/fail result. This exerciser is actually a sequence of other exerciser tests— 12, 13, 14, 15, 16, and 17. This exerciser returns an error code #57H `Invalid Configuration` if there are no cartridges loaded into the unit, or if any drive is full. Requires one loaded cartridge, drives and mailslot empty.
12	Carriage Move Test	Performs a combination of carriage moves with a pass/fail result. It moves the carriage assembly to the maximum distance away from the sensor on both sides. No cartridges are required.
13	Translate Test (Not [illegible] for the Model 10LC)	Performs a combination of moves with a pass/fail result. It performs several translations from from various starting positions. No cartridges are required.
14	Flip Test	Performs a combination of moves with a pass/fail result. It performs several flips at various locations. No cartridges are required.

Exerciser Tests (continued)

No.	Test Name	Description
15	Storage Slot Test	Performs a combination of moves with a pass/fail result. It moves a cartridge from a randomly-chosen full slot to a randomly-chosen empty slot, with a random flip. It then moves the cartridge back to its original storage slot with its original orientation. This exerciser returns an error code #57H `Invalid Configuration` if there are no cartridges loaded into the unit, or if any drive is full. Requires one loaded cartridge.
16	Drive I/O Test	Performs a combination of moves with a pass/fail result. It moves a cartridge from a randomly-chosen full slot to a drive, with a random flip. It then moves the cartridge back to its original slot with its original orientation. It does this once for each optical drive. Returns an error code #57H `Invalid Configuration` if there are no cartridges loaded into the unit. Requires one loaded cartridge; drives must be empty.
17	Mailslot I/O	Performs a combination of moves with a pass/fail result. It moves a cartridge from the lowest-numbered full slot to the mailslot with a random flip. It then moves the cartridge back to its original slot with its original orientation. Returns an error code #57H `Invalid Configuration` if there are no cartridges loaded into the unit. Requires one loaded cartridge; mailslot must be empty.

Exerciser Tests (continued)

No.	Test Name	Description
18	Speed Factor Setting Utility	Allows the setting of the speed factor as the first parameter given. The speed factor determines how fast the system moves the mechanics. The number provides 1/Parameter speed (e.g. Parameter=3 runs the motors at 1/3 of full speed). **This test can only be run from the SCSI Interface.**
19	Zero Maximum Force Log	The maximum force log is initialized to all zeros.
20	Set Speed Factor to Full Speed	Allows the mechanics to be run at full speed.
21	Set Speed Factor to Half Speed	Allows the mechanics to be run at half speed.
22	Set Speed Factor to Quarter Speed	Allows the mechanics to be run at quarter speed.
23	Shipping	Moves the picker to the appropriate position in preparation for shipping.
24	Fill Picker	Moves a cartridge into the picker from the first full storage slot.
25	Empty Picker	Moves a cartridge from the picker to the first empty storage slot.
26	Zero Runtime Log	The entire runtime log is initialized to all zeros.

Exerciser Tests (continued)

No.	Test Name	Description
27	Set Minimum Retries	This sets the number of retries to 1. This may be set to see if the chosen test is doing what you want it to do. After you are satisfied that the test is what you want, run Test 28 which resets the number of retries to default values.
28	Set to Default Number of Retries	Resets the number of retries to powerup default values. Used after setting retries to 1 by Test 27.
29	Zero Error Log	Sets Information Log 0, Autochanger Error Log back to zero.

Electronic Core Tests

No.	Test Name	Description
30	Microprocessor Operation Test	Performs a functional check of the microprocessor. This test will shut down the servo system; a poweron sequence runs upon completion.
31	ROM Checksum Test	Performs a checksum verification of the ROM.
32	RAM Checksum Test	A checksum of the "Controlled" area of RAM is kept on an ongoing basis. This test verifies that the checksum is still valid.
33	Non-Destructive RAM Test	Tests all of the controller's RAM, checking for data acceptance and retention. The test is non-destructive to RAM unless interrupted by power failure. This test will shut down the servo system; a poweron sequence runs upon completion.
34	SCSI Interface Controller Chip Test	Checks out operations of the SCSI interface controller chip. This test will not be run if initiated via SCSI, it reports PASS.
36	Motor Control Chip Test	Exercises the registers of the motor control IC. In order to perform correctly, this test shuts down the servo system.
37	Drive Connect Test	Checks for expected drive configuration. This is done by polling the drive connect signal on each of the possible drives. This line is grounded at the drive end if a drive is connected. If the drives physically connected do not match the expected configuration then an error is reported.
38	Control Panel Light Show & Button Test	Lights each portion of the display individually and then together. Requires pushing each front panel button to finish the test.

Electronic Core Tests (continued)

No.	Test Name	Description
40	Power Supply Test	Looks at both the 12-Volt and the 24-Volt power supplies to verify that they are within limits. The limits for the 12V supply are 11V and 13V and the 24V supply limits are 23.5V and 25.5V.
41	SCSI Connector Loopback Test (Interactive)	Performs a loopback through SCSI connectors, checking proper operation of the SCSI drivers, receivers, and cables. Requires an external loopback hood with terminator power. Will not run if it was initiated via SCSI; if so, it reports error FCH `Test Did Not Run`.
42	Optical Sensor Test (Interactive if done through the control panel.)	Checks the status of the optical sensors. Also checks the status of the mailslot sensor (see Test 43). "0"s are placed on the control panel display on the left and right of the display. The mark is an open zero if the sensor is not blocked, and a zero filled in with lit segments if a sensor is blocked. No FRU is returned.
43	Mailslot Sensor Test (Interactive if done through the control panel.)	See the description for Test 42.

Electronic Core Tests (continued)

No.	Test Name	Description

44	"Cartridge-in-path" (Infrared beam) Test (Interactive if done through the control panel.)
	(Not valid for Models 10C, 20C, 20T, 40T)
		Displays max/min intensity and ambient readings for the left and right beams. You must enter a parameter to choose the beam to display (0=left, 1=right). Note: The Models 10LC/20LT have one beam.)
		The following is an example of an error message for the right beam and how it is translated:
		
		`F0` is hexadecimal for 240
		`E1` is hexadecimal for 225
		`R` means right beam
		`06` is the maximum ambient reading
		`00` is the minimum ambient reading
		
		`Intensity    L/R    Ambient`
		`Max   Min           Max   Min`
		`240   225    R      6     0`
		
		Press CANCEL to stop.

Mechanism Core Tests

No.	Test Name	Description
50	Find Home Sequence	Moves the picker to a known "home" position. This test assumes nothing about the state of the mechanics. The "home" location is the lower left position of the box. The servo system is initialized to the "home" location. It then automatically runs Test 51.
51	Carriage/Picker Assembly Calibration Test	Runs the portion of the mechanism recalibration related to the optical sensors. It measures sensor offsets and calculates picker tilt and droop. This test assumes that the mechanics and servo system are functional.
60	FRU Isolation Test	Assumes that something has physically failed, either electronic or mechanical. A series of special low-level tests are executed to select the three (or fewer) FRUs which are most likely to be at fault. Tests 30, 31, 33, 35, 36, 40, and 50 are executed as a part of the isolation process.

Mechanism Core Tests (continued)

No.	Test Name	Description
65	Calibrate Magazines	Calculates a min/max clearance for a magazine. (The selected magazine should be empty.) The Autochanger requires a disk in the mailslot. The test passes if clearance is 85 encoder counts (1 mm) up and down. (See Info 23 for actual values.) If this test is run by SCSI command, set Byte 1 to the magazine number. (Models 10LC/20LT, 10C, 20T contain 2 magazines; Models 20C/40T contain 4 magazines; Models 60C/120T have 11 magazines; Model 100C has 18.) The test returns: PASS or FAIL.

Mechanism Core Tests (continued)

No.	Test Name	Description
66	Clear Magazine Min/Max.	Clears the value calculated in Test 65.
67	Calibrate Mailslot	Calculates a min/max clearance for the mailslot. The Autochanger requires a disk in the mailslot. The test passes if clearance is 85 encoder counts (1 mm) up and down. (See Info 23 for actual values.) The test returns: `PASS` or `FAIL`.
68	Clear Mailslot Max/Min.	Clears the value calculated in Test 67.
75	UPS Test	Tests whether or not the UPS is connected properly. The test returns `PASS` if connected properly, `FAIL` if the UPS is not connected properly or if there is no UPS connected.

A

Field Replaceable Units (FRUs)

Table A-1. Optical Disk Library System FRUs

FRU #	Description	Model 10LC/20LT	Model 10C/20C, 20T/40T	Model 60C/100C, 120T/200T
1	Autochanger Controller PCA	X	X	X
2	Sensor Transmit PCA			X
3	Sensor Receive PCA			X
4	Interconnect PCA	X	X	X
20	MO/MF Drive (single-ended)	X	X	X
21	Left Way		X	
22	Display/Front Panel PCA	X	X	X
23	Carriage Motor	1	X	X
24	Front Panel	X	X	X
25	Picker Motor	2	X	X
26	Magazine	X	X	X
27	Picker	2	X	X
28	Power Supply Module	X	X	X
29	Mailslot Assembly	X	X	X
31	Optical Sensor Assembly	X	X	X
32	Carriage Lead Screw	1	X	X

1 Not replaceable individually; all part of leadscrew assembly.

2 Not replaceable individually; all part of carriage assembly.

Table A-1. Optical Disk Library System FRUs (continued)

FRU #	Description	Model 10LC/20LT	Model 10C/20C, 20T/40T	Model 60C/100C, 120T/200T
34	Picker Motor Belt(s)		X	X
35	Carriage Motor Belt	[1]	X	X
36	MO/MF Drive Control ROM	X[2]	X[2]	X[2]
37	Autochanger Controller ROMS	X[2]	X[2]	X
38	Fan Assembly	X	X	X
39	Spring Bearing Block Assembly		X	X
40	Carriage Assembly	[3]	X	X
41	Gate Solenoid Assembly			X
51	MO Drive/Controller Power Cable	X	X	X
52	5/12V Module Power Cable	X	X	X
55	SCSI Cable (internal)	X	X	X
56	Front Panel Address Cable	X	X	X
57	Motor Power/Encoder Cable	X	X	X
58	Motor Cable	X	X	X
59	Interconnect Cable	X	X	X
65	AC/24V Power Cable	X	X	X
66	Line Switch Cable	X	X	X
67	24V Power Cable	X	X	X
71	Mailslot Connector Cable	X	X	X
75	Interface Cable	X	X	X

1 Not replaceable individually; all part of leadscrew assembly.

2 Code is downloadable into flash ROMs.

3 Not replaceable individually; all part of carriage assembly.

B

Programmer's Tips

MO Drive Programmer's Tips

Initial Integration

Sense Key Specific Information During Initial Integration

During initial integration there may be SCSI commands that respond with a Sense Key of ILLEGAL REQUEST and Additional Sense Codes of INVALID FIELD IN CDB (24 00) or INVALID FIELD IN PARAMETER LIST (26 00). The C1716C/T supports the Sense Key Specific field in the Request Sense data to make it easier to find out the cause of the error.

The C/D bit, byte 15 bit 6 of the Request Sense data, will indicate whether the invalid field in question was in the command descriptor bytes or in the data transferred. If this bit is set to 1, the Invalid Field resides in the command descriptor block. If this bit is set to 0, the Invalid Field resides in the data bytes. The Field Pointer, bytes 16 and 17 of the Request Sense data, will indicate which byte in the command descriptor bytes or data contains the invalid field.

If the BPV bit, byte 16 bit 3 of the Request Sense data, is set to 1, the Bit Pointer field, byte 16 bits 2 through 0 of the Request Sense data, will be valid. The Bit Pointer will indicate which bit within the byte indicated by the Field Pointer contains the Invalid Field.

Using this information, the integrator can quickly determine what portion of the command or data sent to the target is causing the problem. For example, if the command descriptor bytes sent from the Initiator were 00 00 00 00 04 00, the drive would recognize this as a Test Unit Ready command with bit 2 of byte 4 set to 1. This bit is reserved and must be set to 0. The drive would return a status of CHECK CONDITION. The following Request Sense

Command would contain a Sense Key of ILLEGAL REQUEST with Addition Sense Codes of INVALID FIELD IN CDB (24 00).

The SKSV (Sense Key Specific Valid) bit would be set to 1 indicating that Sense Key Specific data is available. The C/D bit would be set to 1 indicating that the error is in the command descriptor block. The BPV bit would be set to 1 indicating the Bit Pointer field is valid. The Bit Pointer field would be set to 2, indicating the error is in bit 2. The Field pointer would be 4, indicating the error is in bit 2 of byte 4.

Performance Tuning

The overall performance of the C1716C/T drive can be enhanced by utilizing the buffer memory in the drive for optimized read and write operations.

The buffer memory is used for both the write cache and the readahead cache. If one or the other is enabled, the entire buffer memory is available for the enabled operation. If both are enabled, the buffer memory is shared between the two. However, there is not a distinct allocation to each application. The memory is allocated to the application as it is requested.

For example, if the customer use pattern is many or large writes followed by reads, the writes may utilize all the buffer space as it is available. When the reads start, the tuning parameters described below force a write of the write cached data to the disk to free up buffer memory that can be used for readaheads. After the read operations are finished and the write operations start up again, the operation system frees the readahead cache if buffer space is needed.

Write Performance

The performance of the C1716C/T during write operations is governed by two parameters, the Buffer Full Ratio and the Maximum Buffer Latency. Data stored in the write cache is transferred to the disk when either of the conditions associated with these two parameters is reached. This performance increase is only available when the Immediate Response functionality is enabled.

Immediate Response

Immediate Response means the return of a GOOD status on write operations after all the write data has been transferred from the initiator into the target's data buffer and before the data is transferred to the disk.

Immediate Response greatly improves write performance by allowing the optical drive to perform multiple operations simultaneously. The drive can transfer write data from one command to the disk while it is evaluating/validating another write request and transferring data for the second write request into the write cache.

Immediate Response also allows the optical drive to retain the write data from multiple write requests in the write cache. This provides performance improvements by allowing the data management firmware the ability to merge multiple write operations that are adjacent or within reasonable proximity on the disk. By merging these operations, the number of times the magnet must be flipped, the number of seeks, and the number of additional latencies between write operations is substantially reduced.

It should be noted that write operations are merged in the order they are received by increasing logical block addresses. The write cache will not reorder writes. If a write to a lower logical block address than is presently in the cache is received, the data in the write cache will be written to the disk and the new write data will be kept.

Enabling of Immediate Response is set with the WCE (Write Cache Enable) bit in the Caching Mode Page 08H.

Buffer Full Ratio

The Buffer Full Ratio byte is located in the Disconnect-Reconnect Mode Page 02H. When the total data space consumed in the data buffer exceeds the value indicated in the Buffer Full Ratio, the cached write data is transferred to the disk. The default value for the buffer full ratio is 128, corresponding to 50 percent of the buffer space. Increasing the Buffer Full Ratio allows more data to be stored in the buffer before transferring the data to the disk. This allows the buffer management firmware the opportunity to merge more write operations and therefore increase performance. **The drawback to a larger Buffer Full Ratio is greater exposure to lost data in the event of a power failure.**

Maximum Buffer Latency

The Maximum Buffer Latency bytes are located in the HP Vendor Unique Mode Page 21H. The Maximum Buffer Latency informs the buffer management firmware how long write data may remain in the data buffer before it must be written to the disk. The default value for the Maximum Buffer Latency is 1 second. The larger the Maximum Buffer Latency, the longer the buffer management firmware may hold write data in the buffer, waiting to see if future write data will merge with it. The drawbacks to a larger Maximum Buffer Latency are similar to those of a larger Buffer Full Ratio.

There are other factors that may force the write data to be written to the disk prior to the timer expiring. These include exceeding the Buffer Full Ratio, a write to a logical block address that is not adjacent or within reasonable proximity to the cached data, and a read of the data presently in the write cache.

Read Performance

Readahead

After each read request from the initiator, the C1716C/T reads an additional number of sectors into the readahead cache. When the next read request is received from the initiator, the readahead cache is checked to see if any of the sectors are included in the buffer. If all of the sectors are found in the buffer, the data is transferred to the initiator immediately. If there is only a partial hit, only those sectors that were not found in the buffer are read. Then all the sectors are transferred to the initiator.

Readahead is disabled with the RCD (Read Cache Disable) bit in the Caching Mode Page 08H

The operation of the readahead system is controlled by three parameters: Disable Pre-fetch Transfer Length, Maximum Pre-fetch, and Minimum Pre-fetch.

Disable Pre-fetch Transfer Length

The Disable Pre-fetch Transfer Length indicates when the optical drive should no longer perform a Readahead after the requested Read operation. When the requested Read operation contains more sectors than the Disable Pre-fetch Transfer Length, the data management firmware does not initiate a Readahead.

Maximum Pre-fetch

The Maximum Pre-fetch is the number of sectors that are read into the Readahead cache following the read request. The larger this value, the more sectors of data are available for immediate transfer to the initiator if the following read request is adjacent to or within a reasonable proximity to the previous read request. The larger this value, however, the greater the delay may be before the optical drive can perform subsequent operations if they are not adjacent read requests. Therefore the value of the Maximum Pre-fetch should be selected carefully.

If read operations performed on the optical drive are sequential in nature, a larger Maximum Pre-fetch yields significant performance advantages. If read operations with the optical drive are random in nature, a smaller Maximum Pre-fetch provides the best possible chance for readahead hits with the least impact due to delayed operations.

Minimum Pre-fetch

Once the optical drive places data into the readahead cache, it remains there until different readahead data is obtained, it is transferred to the host on a subsequent read request, or the buffer space is needed for write operations. If readahead data is transferred to the host on a subsequent read request, another readahead operation is initiated by the data management firmware when there are fewer sectors than the Minimum Pre-fetch value remaining in the readahead cache. The larger the Minimum Pre-fetch value, the sooner another readahead operation is started when data is being transferred to the initiator from the readahead cache. The Minimum Pre-fetch must be equal to or less than the Maximum Pre-fetch.

Data Transfer Size

The C1716C/T transfers read and write data to and from the initiator in bursts based on the Maximum Burst Size in the Disconnect-Reconnect Mode Page 02H. The default value for the Maximum Burst Size is 16 Kbytes in a C1716C and is 32 Kbytes in a C1716T. This parameter controls how often the optical drive disconnects and reselects the initiator during large data transfers. If the Maximum Burst Size is smaller, the target transfers data to and from the initiator while simultaneously reading or writing data to the media. If the Maximum Burst Size is larger, the optical drive obtains more data before initiating a write operation, and waits until more data is available before transferring read information to the initiator.

Each time the optical drive disconnects, however, additional SCSI bus time is consumed by the overhead associated with the disconnect and reselect operations. These two factors, the simultaneous transfer of data with media operations and the overhead of the disconnect and reselect process, must be weighed to determine the best performance in the user's system. The C1716C/T is designed with a high-performance integrated SCSI bus controller chip to minimize the overhead of the disconnect and reselect operations, therefore smaller Maximum Burst Size values provide the greatest performance advantages.

Non-Volatile Configuration Values

The configuration values discussed above, along with all other configuration information, are retained in non-volatile storage in the C1716C/T optical drive. The specific values that provide the best performance for the user's system must be configured into the drive only once. This may be done by the user's computer system using the Mode Select command, or written into the non-volatile storage at the factory before shipment to the user.

In many cases, the performance tuning parameters that yield the best performance may vary between different applications. The user may also choose to include the Mode Select operation in the application to update the current operating parameters when the application is invoked.

Error Analysis

The data returned in response to the Request Sense command has six bytes of vendor unique information appended to the ANSI standard data. This information will be very helpful in analyzing the causes of errors. All request sense commands should set the Allocation Length field in the Command Descriptor Block to a value greater than or equal to 24. This will ensure that the additional error information will be available for further analysis by the integrator and/or the optical drive development team.

Autochanger Load Performance

Many optical libraries return SCSI status for a move operation as soon as the optical disk is inserted in the drive. The initiator must then find a way to determine when the disk is spun up and ready for use in the drive. This is typically done by polling the drive with Test Unit Ready commands until a GOOD status is received. Polling consumes both SCSI bus bandwidth as well as initiator processor bandwidth and therefore is not an optimal solution. As the initiator's time between polls is increased, the bandwidth consumed is decreased, yet the average response time is increased. The C1716C/T solves this problem by providing a load completion functionality.

Once the optical library returns a GOOD status for the move operation, the initiator issues a SCSI Start Stop/Unit Command with the Start Bit (byte 4, bit 0) set to 1, effectively requesting the C1716C/T to load and spin up the disk. The C1716C/T disconnects from the initiator immediately, then reselects the initiator as soon as the load and spin up is complete. The SCSI status returned is CHECK CONDITION. The subsequent Request Sense Command receives a Sense Key of UNIT ATTENTION and the additional sense codes are MEDIUM CHANGED (28 00). By taking advantage of this capability, the initiator will not have to consume bandwidth polling, and will receive immediate notification when the optical drive is ready to accept disk access requests.

Determining Media Type Loaded

The C1716T supports four different ISO standard media types. The density code returned in the block descriptor portion of the Mode Sense data defines the density of the media:

03H	Rewritable 650 MB
06H	Write-once 650 MB
OAH	1.3 GB

The medium type field in the mode header specifies the media type.

The combination of these two fields produces a specification of the media installed in the C1716T. The table below depicts the combinations for each of the four types of media.

Table B-1. Media Type Combinations

Media	Density Code	Medium Type
Rewritable 650 MB	03H	03H
Write Once 650 MB	06H	02H
Rewritable 1.3 GB	0AH	03H
Write Once 1.3 GB	0AH	02H

Write and Verify Performance The Write and Verify commands (opcodes 2EH and AEH) do not allow the drive to return Immediate Responsed status as in the Write commands (opcodes 2AH and AAH). This limitation disables the write buffering functionality. For this reason, performance will be significantly reduced when the Write and Verify commands are used.

If data integrity needs to be assured by having the Verify operation performed after each write operation, an alternate approach can be taken to retain the Immediate Response and write buffering functionality, retaining maximum performance. Setting the Force Verify bit in the Vendor Unique Mode Select Page (page 21H) will cause all Write operations to be followed with a Verify operation. By automatically [illegible]cting the Verify operation, the initiator can use the Write command instead of the Write and Verify commands.

SCSI-2 Command Comparison between the HP C1716C/T Drives and the HP C1716A/M Drive

S = Supported Command

NS = Not Supported

b = Functionality is a Subset of the C1716C/T functionality

p = Functionality is a Superset of the C1716C/T functionality

a = Functionality does not adhere to the SCSI-2 standard

Table B-2. Command Comparison

COMMAND	C1716C/T Drive	C1716A/M
Erase 10	S	S b a
Erase 12	S	NS
Format Unit	S	S p
Inquiry	S	S b
Log Sense	S	NS
Log Select	S	NS
Mode Sense 6	S	S b
Mode Sense 10	S	NS

Table B-2. Command Comparison (continued)

COMMAND	C1716C/T Drive	C1716A/M
Mode Select 6	S	S b
Mode Select 10	S	NS
Prevent Allow Medium Removal	S	S
Read 6	S	S
Read 10	S	S b
Read 12	S	NS
Read Buffer	S	S b
Read Capacity	S	S
Read Defect Data 10	S	S
Read Defect Data 12	S	NS
Read Long	S	S a
Reassign Blocks	S	S b
Receive Diagnostic Results	[illegible]	S
Release	S	S
Request Sense	S	S b
Reserve	S	S
Rezero Unit	S	S
Seek 6	S	S
Seek 10	S	S
Send Diagnostic	S	S
Start/Stop Unit	S	S b

Table B-2. Command Comparison (continued)

COMMAND	C1716C/T Drive	C1716A/M
Synchronize Cache	S	NS
Test Unit Ready	S	S
Verify 10	S	S b
Verify 12	S	NS
Write and Verify 10	S	S b
Write and Verify 12	S	NS
Write 6	S	S b
Write 10	S	S b
Write 12	S	NS
Write Buffer	S	S b
Write Long	S	S a

S = Supported Command

NS = Not Supported

b = Functionality is a Subset of the C1716C/T functionality

p = Functionality is a Superset of the C1716C/T functionality

a = Functionality does not adhere to the SCSI-2 standard

Autochanger Specific Programmer's Tips

This section gives you helpful information for developing device drivers or optical library applications.

Optical Drive and Library Performance

This section contains information related to library system performance.

General performance issues that can impact an application such as backup:

- transaction length
- write with erase
- sequential operation
- critical response

Host System Integration

The integration effort required to utilize the rewritable optical products varies by individual software solution and desired feature support.

This section provides hints for the following:

- creating an MO Driver from a SCSI hard disk driver
- modifying the MO Driver to work with an autochanger
- developing an optical disk library application.

Prerequisites

Prior to reading the remaining sections, you should be very familiar with the following:

- SCSI terminology
- SCSI operation
- Winchester disk drivers
- Programming concepts

Modifying the SCSI Driver

When developing an autochanger application for a non-HP system, you must provide a host system driver. A typical approach to this consists of the following:

1. Modifying an existing Winchester disk SCSI driver for the magneto-optical (MO) drive; and
2. Modifying the MO driver for the mechanical picker.

Refer to these materials for supplemental information:

- The American National Standard for Information Systems (ANSI) SCSI-2 documentation available from:

  Global Engineering Documents
  2805 McGaw
  Irvine, CA 92714
  (800) 854-7179 or (714) 261-1455

- Multifunction Optical Drive SCSI-2 Command Set, Chapter 2 of this manual.
- Autochanger SCSI Command Set, Chapter 3 of this manual.

Modifying A SCSI Disk Driver For The Magneto-Optical Disk Drive

One way to develop a driver for the magneto-optical (MO) disk is to modify an existing SCSI Winchester disk driver. With a few modifications to this type of driver, MO integration can be achieved with little difficulty.

Change Considerations

Consider this list of possible changes/issues when modifying a driver for the MO disk.

- Busy Status

  Most Winchester disks will not respond with a status of BUSY. The MO disk will respond with CHECK CONDITION if it is spinning the optical disk up or down. The Winchester driver may have to be modified to handle the busy condition.

- Abort Behavior

  When a command is aborted while the MO drive is logically disconnected from the bus, it will not immediately respond. The abort will be ignored until the MO drive reconnects. At this point, the abort is recognized and the appropriate check condition status returned.

- Sparing

  Many Winchester disks do not automatically handle sector sparing. The MO drive can spare because of the AWRE (Automatic Write Reallocation Enable) behavior. When a sector is spared, the MO drive will notify the host by returning a check condition with the sense key—Recovered Error. The Winchester driver may have to be modified to handle this sense code.

- Removable Media

  Because the optical disk is removable, several unit attention conditions unique to optical drives can be generated:

Table B-3. Unit Attention Conditions

Sense Key	Sense Code	Occurs
Not Ready	No Disk	Media is not loaded or spun up.
Unit Attention	Medium Changed	Each time the autochanger swaps a disk.
	Poweron or Reset	After poweron or reset.
Medium Error	Incompatible Cartridge	Disk not initialized or formatted.
	Medium Format Corrupted	Format is corrupt.
Data Protect	Write Protected	Disk is write protected.
Hardware Error	Load/Unload Failure	Something mechanically impedes the load/unload process.

Additional Considerations

The following commands may be needed depending on the intended application.

Start/Stop	Can be used in conjunction with moving disks in and out of the drives for starting and stopping the drive motor.
Erase	Applications may want to pre-erase all or part of a disk to improve the write performance.
Write and Verify	Can be used for applications that require an extra level of data verification. A second pass is done to reread the disk causing performance degradation.

Modifying the MO Driver for the Autochanger

The driver that interacts with the autochanger can be an extension to the MO driver or it can be a separate driver depending on the architecture of the I/O subsystem.

For autochanger functionality, the following SCSI commands need to be supported by the driver.

Table B-4. Necessary Autochanger SCSI Commands

	Command	Op Code
Must Support	Initialize Element Status	07H
	Inquiry	12H
	Move Medium	A5H
	Read Element Status	B8H
	Request Sense	03H
	Test Unit Ready	00H
Optional	Exchange Medium	A6H
	Mode Sense	1AH
	Position To Element	2BH
	Prevent/Allow Medium Removal	1EH
	Receive Diagnostic Result	1CH
	Release	17H
	Reserve	16H
	Rezero Unit	01H

Disconnect Timeouts

The following commands will cause a SCSI disconnect. It is useful to know what the maximum times for disconnect are so driver timeouts can be set appropriately.

Note In Table B-5 the maximum disconnect time is represented by the nominal number of seconds plus the number of levels of error recovery times 60. You can see the maximum time can be very long. An appropriate timeout may be a compromise between the nominal time and maximum time.

Table B-5.
Timeout Settings for Models 10LC, 20LT, 10C, 20C, 20T, 40T

Command	Nominal Disconnect Time (seconds)	Maximum Disconnect Time	Levels of Error Recovery
Exchange Medium	14	14+(10*60)	10
Initialize Element Status	60	60+(70*60)	70
Move Medium	5	5+(3*60)	3
Position To Element	5	5+(3*60)	3
Prevent/Allow Media Removal	10	10+(5*60)	5
Read Element Status	*60	60+(70*60)	70
Release	10	10+(5*60)	5
Reserve	10	10+(5*60)	5
Rezero Unit	60	60+(3*60)	3
Send Diagnostic	**		

Table B-6. Timeout Settings for Models 60C, 100C, 120T, 200T

Command	Nominal Disconnect Time (seconds)	Maximum Disconnect Time	Levels of Error Recovery
Exchange Medium	14	14+(10*120)	10
Initialize Element Status	120	120+(70*120)	70
Move Medium	5	5+(3*120)	3
Position To Element	5	5+(3*120)	3
Prevent/Allow Media Removal	10	10+(5*120)	5
Read Element Status	*120	120+(70*120)	70
Release	10	10+(5*120)	5
Reserve	10	10+(5*120)	5
Rezero Unit	120	120+(3*120)	3
Send Diagnostic	**		

* If the Read Element Status Command disconnects, it will perform movements identical to that of the Initialize Element Status before sending

the element status data. Therefore, the timeout should be set the same as the Initialize Element Status command.

** The Send Diagnostic Command is different from the other commands in that there are a number of different tests that may be executed. Also, the test may be run in a loop. It is recommended that the host never run a diagnostic test in a loop. Therefore, set the loop count to one and set the timeout to 10 minutes.

Developing Autochanger Manager Software

After developing a magneto-optical and autochanger driver, the driver has the functionality to use SCSI commands for the drive and autochanger mechanism. Additional software (an autochanger manager) is required to use these primitive SCSI commands to provide a solution for data storage. The autochanger manager software can be an extension of the driver or reside as an application running on the host.

Development Considerations

The following issues need to be addressed in the autochanger manager software:

- optical disk moves:
  - into a drive
  - from a drive
  - to and from other elements
- optical disk security
- volume management
- swap scheduling
- error recovery
- error detection

Moving an Optical Disk into a Drive

In order to access data on a given disk, the disk must be moved into a drive and spun up. When a move command is issued to the autochanger where the destination is a drive, it will move the specified optical disk into the drive and initiate a spin up. Once the spin up has been initiated, the autochanger will return the status for the move. Note that this status does not relate to the spin up, only to the move. In fact, the status will be returned before the spin up is complete. Given this information, the following algorithm is recommended to verify that spin up is complete:

```
> send SCSI move command to the autochanger
>
> do {
>     sleep for X seconds
>     send the Test Unit Ready SCSI command to the drive
> } while the status of the test unit ready command is bad
>
> send SCSI commands to read or write data from newly-inserted
optical disk
```

Once the move command has been issued, the drive is polled at regular intervals to check if the drive is spun up. Once spun up, the drive is ready for other SCSI commands.

You must choose a reasonable value for time between polls (X). This table illustrates the trade-offs.

Table B-7. Time Between Polls

Time Between Polls	Result
Small X Value	Shorter wait time between swaps. Longer CPU polling time.
Large X Value	Shorter CPU polling time. Longer wait time between swaps.

A reasonable time for X is between .25 and 1 second.

For instance, if X was chosen as .5 seconds, the average number of polls would be 10 (5.3 second swap time/.5 second), and the swap time would be lengthened by no more than .5 seconds.

Moving an Optical Disk from a Drive

In order to remove optical disk from a drive, the drive must first be spun down and then the optical disk removed. When the autochanger is issued a move command where the source is a drive, it automatically spins the optical disk down and then moves the optical disk to the specified destination element.

Other Moves

For moves that do not involve drives, issue a move command with the appropriate parameters.

Move Summary

In order to move optical disk from one element to another, simply issue the appropriate move command. If the destination is a drive, poll the device to verify that it has spun up.

Physical Security of Optical Disks

One consideration with an autochanger is the unauthorized physical access of optical disk. If an optical disk is "active" in an autochanger, it should not be allowed to be removed via the mailslot. The definition of active will vary with the application. For instance, it may mean that a file on that disk is "open" or that the disk is available for use.

The autochanger provides two levels of physical security that can be controlled by the autochanger manager software.

The most stringent security is provided if the autochanger prevent/ allow media removal is set to prevent. When this is enabled, no optical disk may be inserted or removed through the mailslot. Prevent/Allow media removal can be changed in two ways:

- Set this via the front panel configuration.
- Send the prevent/allow media removal command via the SCSI interface. (See Chapter 2.)

A less stringent level of physical security allows individual disks or surfaces to be controlled. When a storage element is reserved by the host (by using the Reserve SCSI command), optical disk cannot be inserted into or removed from this element via the mailslot. This level of physical security allows some optical disk to be removed from the autochanger while other disks are being used.

Volume Management

Some applications may require that optical disks be cataloged in some manner so that information can be more readily organized. One way to do this is to provide data files as "electronic labels" on each disk. An electronic label is a part of the optical disk where unique information about that optical disk resides. The electronic label gives that application the ability to verify correct optical disk, do quick searches, etc. This electronic label may correspond to a physical label on the optical disk.

Swap Scheduling

One of the main jobs of the autochanger manager software is to control the movement of optical disk from slot to drive and vice versa. This swapping of optical disk may be controlled very simply, e.g. only one process is allowed to use the autochanger at a time; or, any number of processes may be allowed.

In any case, the autochanger manager software must have a policy for swapping optical disk. The policy may be fixed, adaptive, or controlled by the user.

Error Recovery

The optical disk library is an extremely reliable unit, but the possibility of failure must be handled by the autochanger manager software. Depending on the application and user needs, this error recovery can be simple or very complex.

A system with simple error recovery may shut down the optical disk library so that all requests return errors until the system is repaired.

A system with complex error recovery would be able to detect that an element is defective and work around the problem. For instance, if one optical disk drive was not functioning, the swapping algorithm would only use the remaining drive.

Error Detection

The first step in any error recovery is detection. The error codes returned from the SCSI commands will allow the autochanger manager software to know if there is a hardware error.

In general, if a command fails because of a hardware error, there is no need for the autochanger manager software to retry the command. Firmware in the unit takes care of retries and does all it can to succeed before a hardware error is returned.

C

Micro/Macro-Moves

The Micro/Macro-moves for all optical disk libraries are listed in this appendix.

Model 10LC/20LT Micro-Move IDs

Table C-1. Model 10LC, 20LT Micro-Move IDs

Move ID (hex)	Description
0	No motion; no commands pending.
1	Carriage motion; full speed; away from the drives.
2	Carriage motion; full speed; toward the drives.
3	Carriage motion; move fingers forward during full speed; away from the drives.
4	Carriage motion; move fingers forward during full speed; toward the drives.
5	Full speed finger motion.
7	Pull fingers back to depress flip button.
8	Flip.
9	Verify flip complete.
A	Push fingers out to release flip button.
11	Move fingers toward storage slot; with intent to grab cartridge.

Table C-1. Model 10LC, 20LT Micro-Move IDs (continued)

Move ID (hex)	Description
12	Detect cartridge in storage slot before grab, and during Initialize Element Status.
13	Take up the slack in the fingers before retracting all of the way back with cartridge.
14	Pull fingers back from storage slot with cartridge.
15	Move fingers forward to insert cartridge into storage slot.
16	Detect cartridge in storage slot after insert.
17	Pull fingers back from storage slot after releasing cartridge.
18	Move fingers toward drive; prepare to grab cartridge.
19	No motion; waiting for drive to eject the cartridge.
1A	Carriage shake; to assist the cartridge ejected from the drive to slide into the picker.
1B	Move fingers toward drive; with intent to grab cartridge.
1C	Pull fingers back from drive with cartridge.
1D	Insert cartridge into drive, until slider engages.
1E	Insert cartridge into drive, after slider has engaged.
1F	Move fingers with cartridge toward drive using short steps; look for drive to accept the cartridge.
20	Drive failed to accept cartridge, pull fingers back with cartridge.
21	Drive accepted cartridge, release cartridge and pull fingers back.
22	Carriage motion during mailslot access.
23	Move fingers toward mailslot; with intent to grab cartridge.
24	Detect cartridge in mailslot before grab.

Table C-1. Model 10LC, 20LT Micro-Move IDs (continued)

Move ID (hex)	Description
25	Take up the slack in the fingers before retracting all the way back with cartridge.
26	Pull fingers back from mailslot with cartridge.
27	Carriage motion during mailslot access.
28	Move fingers forward to insert cartridge into mailslot.
29	Detect cartridge in mailslot after insert.
2A	Pull fingers back from mailslot after releasing cartridge.
2B	Move leadscrew tab toward mailslot actuator arm before pulling mailslot in.
2C	Carriage motion toward actuator arm where mailslot is engaged before pulling mailslot in.
2D	Move leadscrew tab to mailslot actuator arm before pushing mailslot out.
2E	Carriage motion toward actuator arm where mailslot is engaged before pushing mailslot out.
2F	Rotate the mailslot when rotational position unknown.
30	Release tension on the rotate arm.
31	Release tension on the rotate arm.
32	Rotate the mailslot.
33	Rotate the mailslot.
34	Verify the rotation of the mailslot is complete.
35	Rotate the mailslot when rotational position unknown.

Table C-1. Model 10LC, 20LT Micro-Move IDs (continued)

Move ID (hex)	Description
36	Check for a cartridge in the picker, same motion is used to check for a cartridge in mailslot or storage slot when picker contains a cartridge.
37	Pull fingers back during test for a cartridge.
38	Move fingers at full speed during test for a cartridge.
39	Positioning before and after test for a cartridge in drive.
3A	Check for a cartridge in the drive.
3D	Move carriage to drive bang position.
3E	Verify the presence of a cartridge by pressing cartridge against drive face.
3F	Short carriage motion to check for cartridge sticking out of a storage slot after insertion (toward drives).
40	Short carriage motion to check for cartridge sticking out of a storage slot after insertion (away from drives).
41	Short carriage motion to check for cartridge sticking out of a drive after insertion (toward drives).
42	Short carriage motion to check for cartridge sticking out of a drive after insertion (away from drives).
43	Short carriage motion to check for cartridge sticking out of a drive during error recovery (toward, then away from drives).
46	Short carriage motion after finding leadscrew side of machine (away from drives).
47	Carriage motion toward drives; looking for hard stop in FIND HOME sequence.
48	Release forces after finding hard stop.
49	Carriage motion away from drives; finding room to flip in FIND HOME sequence.

Table C-1. Model 10LC, 20LT Micro-Move IDs (continued)

Move ID (hex)	Description
4A	Fast carriage motion toward drives to flip position.
4B	Carriage motion toward drives finding room to flip in FIND HOME sequence.
4C	Fast carriage motion when flip area found in needed direction.
4D	Slow flips during FIND HOME sequence.
4E	Push fingers slowly out of picker after flips in FIND HOME sequence.
4F	Check for picker belts in FRU isolation tests, or slow finger motions during error recovery.
50	Carriage motion toward drives; looking for hardstop before measuring carriage travel.
51	Verify the maximum required carriage travel from drives.
52	Test for presence of cartridge by pushing against hard stop.
53	Long carriage motion during carriage/picker assembly calibration.
54	Short carriage motion during carriage/picker assembly calibration. (Fine measure)
57	Error occurred while inserting cartridge, push cartridge farther into storage slot.
59	Move fingers toward storage slot; during storage slot recovery.
5A	Pull fingers back from storage slot; during storage slot recovery.
5B	Carriage motion; during drive recovery.
5C	Carriage motion; during storage slot recovery.
5D	Carriage motion; during drive insert recovery.
5E	Slowly push fingers out then in during drive recovery.

Table C-1. Model 10LC, 20LT Micro-Move IDs (continued)

Move ID (hex)	Description
5F	Drive recovery.
60	Drive recovery.
61	Short carriage motions during drive recovery (wiggle motion).
62	Long carriage motion in drive recovery (toward, then away from drives).
64	Pull fingers back into picker during recovery.
65	Pull fingers back from storage slot during storage slot recovery.
66	Carriage motion while testing for cartridge in drive during drive insert recovery.
67	Pull back fingers from drive after releasing cartridge during recovery.
68	Move fingers with cartridge towards drive, using short steps, look for drive to accept the cartridge during recovery.
69	Carriage motion during initial recovery (away from drives).
6A	Carriage motion during initial recovery (toward drives).
6B	Push fingers out of picker during initial recovery.
6C	Pull fingers back into picker during initial recovery.
6D	Carriage motion during initial recovery (away from drives).
6E	Carriage motion during initial recovery (toward drives).
6F	Checking for Carriage motor belt in FRU isolation tests.

Models 10C, 20C, 20T, 40T Micro-Move IDs

Table C-2. Models 10C, 20C, 20T and 40T Micro-Move ID Table

Move ID (hex)	Description
0	No motion; no commands pending
1	Carriage motion; full speed (away from drives)
2	Carriage motion; full speed (toward drives)
3	Carriage motion; move fingers forward during full speed (away from drives)
4	Carriage motion; move fingers forward during full speed (toward drives)
5	Full speed finger motion
7	Pull fingers back to depress flip button
8	Flip
9	Verify flip complete
A	Push fingers out to release flip button
B	Translate picker from non-leadscrew to leadscrew side
C	Translate picker from leadscrew to non-leadscrew side
D	Verify picker translated from non-leadscrew to leadscrew side
E	Verify picker translated from leadscrew to non-leadscrew side
F	Release forces after translating picker from non-leadscrew to leadscrew side
10	Release forces after translating picker from leadscrew to non-leadscrew side
11	Move fingers toward storage slot with intent to grab cartridge
12	Detect cartridge in storage slot before grab, and during Initialize Element Status
13	Take up the slack in the fingers before grabbing the cartridge

Table C-2.
Models 10C, 20C, 20T and 40T Micro-Move ID Table (continued)

Move ID (hex)	Description
14	Pull cartridge back from storage slot
15	Push cartridge forward into storage slot
16	Detect cartridge in storage slot after insert
17	Pull fingers back from the storage slot after releasing the cartridge
18	Move fingers toward drive; prepare to grab cartridge
19	No motion; waiting for drive to eject the cartridge
1A	Carriage shake; to assist the cartridge ejected from the drive to slide into the picker
1B	Move fingers toward drive; with intent to grab cartridge
1C	Pull cartridge back from drive
1D	Insert cartridge into drive, until slider engages
1E	Insert cartridge into drive, after slider has engaged
1F	Push cartridge toward drive using short steps; look for drive to accept the cartridge
20	Drive failed to accept cartridge; pull cartridge back
21	Drive accepted cartridge, release cartridge and pull fingers back
22	Carriage motion during mailslot grab
23	Move fingers toward mailslot; with intent to grab cartridge
24	Detect cartridge in mailslot before grab
25	Take up the slack in the fingers before grabbing the cartridge
26	Pull cartridge back from mailslot

Models 10C, 2 ID Table (continued)

Move ID (hex)	
27	Carriage motio
28	Push cartridge
29	Detect the cart
2A	Pull fingers bac rtridge
2B	Move leadscrew rm before pulling mailslot in
2C	Carriage motio ulling mailslot in
2D	Move leadscrew before pushing mailslot out
2E	Carriage motio mailslot is engaged before pushing mailslo
2F	Rotate the mail unknown
30	Release tension
31	Release tension
32	Rotate the mai
33	Rotate the mail
34	Verify the rotat
35	Rotate the mail nknown
36	Check for a cart on is used to check for a cartridge in mai r contains a cartridge
37	Move cartridge or a cartridge in a storage slot
38	Move fingers in a cartridge in a storage slot
39	Move cartridge for cartridge in the drive

Table C-2.
Models 10C, 20C, 20T and 40T Micro-Move ID Table (continued)

Move ID (hex)	Description
3A	Check for a cartridge in the drive
3D	Move carriage to cartridge test position in front of drive
3E	Verify the presence of a cartridge by pressing cartridge against drive face
3F	Short carriage motion to check for cartridge sticking out of a storage slot after insertion (towards drives)
40	Short carriage motion to check for cartridge sticking out of a storage slot after insertion (away from drives)
41	Short carriage motion to check for cartridge sticking out of a drive after insertion (towards drives)
42	Short carriage motion to check for cartridge sticking out of a drive after insertion (away from drives)
43	Short carriage motion to check for cartridge sticking out of a drive during error recovery (towards, then away from drives)
44	Translate slowly to leadscrew side in FIND HOME sequence
45	Short translate after finding leadscrew side (toward non-leadscrew side)
46	Short carriage motion after finding leadscrew side (away from drives)
47	Carriage motion toward drives; looking for hard stop in FIND HOME sequence
48	Short carriage motion away from drives after hard stop
49	Carriage motion away from drives; finding room to flip in FIND HOME sequence
4A	Fast carriage motion toward sensors to flip position
4B	Carriage motion toward drives finding room to flip in FIND HOME sequence

Table C-2.
Models 10C, 20C, 20T and 40T Micro-Move ID Table (continued)

Move ID (hex)	Description
4C	Fast carriage motion when flip position found in needed direction
4D	Slow flips during FIND HOME sequence
4E	Push fingers slowly out of picker after flips in FIND HOME sequence
4F	Check for picker belts in FRU Isolation tests, or slow finger motions during error recovery
50	Carriage motion toward drives; looking for hard stop before measuring carriage travel
51	Verify the maximum required carriage travel from sensors
52	Test for presence of cartridge in picker by pushing against hard stop
53	Long carriage motion during carriage/picker assembly calibration (Coarse measure)
54	Short carriage motion during carriage/picker assembly calibration (Fine measure)
57	Error occurred while inserting cartridge, push cartridge farther into storage slot
59	Move fingers toward storage slot during storage slot recovery
5A	Pull fingers back from storage slot during storage slot recovery
5B	Carriage motion during drive recovery
5C	Carriage motion during storage slot recovery
5D	Carriage motion during drive insert recovery
5E	Slowly push fingers out then into picker during drive recovery
5F	Drive recovery
60	Drive recovery

Table C-2.
Models 10C, 20C, 20T and 40T Micro-Move ID Table (continued)

Move ID (hex)	Description
61	Short carriage motions during drive recovery (wiggle motion)
62	Long carriage motion in drive recovery (toward, then away from drives)
63	Drive recovery, restore picker home in case of unexpected translate
64	Pull fingers back into picker during recovery.
65	Pull fingers back from storage slot during storage slot recovery
66	Carriage motion while testing for cartridge in drive during drive insert recovery
67	Pull back fingers from drive after releasing cartridge; during recovery
68	Push cartridge towards drive, using short steps, look for drive to accept the cartridge; during recovery
69	Carriage motion; during initial recovery (away from drives)
6A	Carriage motion; during initial recovery (toward drives)
6B	Push fingers out of picker; during initial recovery
6C	Pull fingers back into picker; during initial recovery
6D	Carriage motion; during initial recovery (away from drives)
6E	Carriage motion; during initial recovery (toward drives)
6F	Checking for carriage motor belt in FRU isolation tests

Models 60C, 100C, 120T, 200T Micro-Move IDs

Table C-3.
Models 60C, 100C, 120T and 200T Micro-Move ID Table

Move ID (hex)	Description
0	No motion; no commands pending
1	Carriage motion; full speed (away from drives)
2	Full speed finger motion
3	Carriage motion; full speed (toward the drives)
4	Carriage motion; to seat the translate pin (toward the drives)
5	Carriage motion; to seat translate pin (away from drives)
6	Push fingers toward end of picker; during full speed carriage motion (away from drives)
7	Push fingers toward end of picker; during full speed carriage motion (toward drives)
8	First move in flip sequence (picker leadscrew up)
9	First move in flip sequence (picker leadscrew down)
A	Verify flip complete
C	Flip during carriage motion (away from drives)
D	Flip during carriage motion (toward drives)
E	Translate (at bottom)
10	Prepare for carriage motion after translate (leadscrew side; bottom)
11	Prepare for carriage motion after translate (non-leadscrew side; bottom)
12	Translate (at top)
14	Prepare for carriage motion after translate (leadscrew side; top)
15	Prepare for carriage motion after translate (non-leadscrew side; top)

Table C-3.
Models 60C, 100C, 120T and 200T Micro-Move ID Table
(continued)

Move ID (hex)	Description
16	Move fingers toward storage slot with intent to grab cartridge
17	Detect disk in storage slot before grab and during Initialize Element Status
18	Take up the slack in the fingers before grabbing the cartridge
19	Pull cartridge back from storage slot
1A	Push cartridge forward into storage slot
1B	Detect cartridge in storage slot after insert
1C	Pull fingers back from storage slot after releasing cartridge
21	Move fingers toward drive; prepare to grab cartridge
22	Carriage shake; to assist cartridge ejected from the drive to slide into the picker.
23	Move fingers toward drive with intent to grab cartridge
24	Pull cartridge back from drive
25	Insert cartridge into drive until slider engages
26	Move fingers with cartridge toward drive, determining distance of cartridge in drive. Look for drive to accept cartridge.
27	Drive failed to accept the cartridge; pull cartridge back
28	Drive accepted cartridge; release cartridge and pull fingers back
29	Detect a cartridge in the drive with cartridge in the picker
2A	Move cartridge in and out of the picker during test for cartridge in the drive
2B	No motion; waiting for drive to eject the cartridge
2C	Move fingers toward mailslot; with intent to grab the cartridge
2D	Detect cartridge in the mailslot before grab

Table C-3.
Models 60C, 100C, 120T and 200T Micro-Move ID Table (continued)

Move ID (hex)	Description
2E	Take up the slack in the fingers before grabbing the cartridge
2F	Pull cartridge back from the mailslot
30	Carriage motion during mailslot insert
31	Push cartridge forward into the mailslot
32	Carriage motion; during mailslot insert
33	Detect cartridge in the mailslot after insert
34	Pull fingers back from mailslot after releasing cartridge
35	Carriage motion toward actuator arm before pulling mailslot in
36	Rotate the mailslot inward
37	Rotate the mailslot when rotational position unknown
38	Verify that rotation of the mailslot inward is complete
39	Release tension on the mailslot rotate arm
3A	Move leadscrew tab toward mailslot actuator arm before pulling mailslot in
3B	Carriage motion toward actuator arm where mailslot is engaged before pushing mailslot out
3C	Rotate the mailslot outward
3D	Verify that the rotation of the mailslot outward is complete
3E	Release tension on the mailslot rotate arm
3F	Move leadscrew tab to mailslot actuator arm before pushing mailslot out
41	Move cartridge in or out during test for a cartridge in storage slot
42	Move fingers in our out during test for a cartridge in storage slot

Table C-3.
Models 60C, 100C, 120T and 200T Micro-Move ID Table
(continued)

Move ID (hex)	Description
44	Check for a cartridge in the picker; same motion is used to check for a cartridge in mailslot or storage slot when picker contains a cartridge
45	Insert cartridge into the drive, after slider has engaged
47	Slowly translate at bottom to the non-leadscrew side in the FIND HOME sequence
48	Short carriage motion after finding non-leadscrew side of machine (away from drives)
49	Carriage motion toward drives; looking for hard stop in the FIND HOME sequence
4A	Short carriage motion away from drives after hard stop
4B	Slow carriage motion toward drives; finding room to flip in FIND HOME sequence
4C	Carriage motion away from drives when room to flip is found
4D	Slow carriage motion away from drives; finding room to flip in FIND HOME sequence
4E	Carriage motion toward drives when room to flip is found
4F	Slow flips during FIND HOME sequence
50	Push fingers slowly out of picker after flips in FIND HOME sequence
51	Check for picker short belt in FRU isolation tests
56	Carriage motion away from drives to determine which side of picker faces the top
5C	Slow carriage motion away from drives; measuring distance to the top

Table C-3.
Models 60C, 100C, 120T and 200T Micro-Move ID Table
(continued)

Move ID (hex)	Description
5D	Long carriage motion during height sensor measurements
5E	Short carriage motion during height sensor measurements
60	Short carriage motion toward drives after finding picker finger home position during FIND HOME sequence
62	Slow carriage motion away from drives during error recovery
63	Slow carriage motion toward drives during error recovery
64	Slow carriage motion away from drives during error recovery
65	Slow carriage motion toward drives during error recovery
66	Slow finger or cartridge motion out of picker; used during error recovery
67	Slow finger or cartridge motion into picker; used during error recovery
81	Check for long picker belt in FRU isolation tests
82	No motion; servo-locking the motors

Macro-Move IDs - All Models

Table C-4. Macro-Move ID Table

Type #	Description
0	Move Medium or Exchange Medium commands. Non-leadscrew side of picker facing mailslot end.
1	Initialize element status command. Non-leadscrew side of picker facing mailslot end.
2	Position to element command (Seek). Non-leadscrew side of picker facing mailslot end.
3	Mailslot rotation function. Non-leadscrew side of picker facing mailslot end.
80H	Move Medium or Exchange Medium commands. leadscrew side of picker facing mailslot end.
81H	Initialize element status command. leadscrew side of picker facing mailslot end.
82H	Position to element command (Seek). Leadscrew side of picker facing mailslot end.
83H	Mailslot rotation function. leadscrew side of picker facing mailslot end.

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