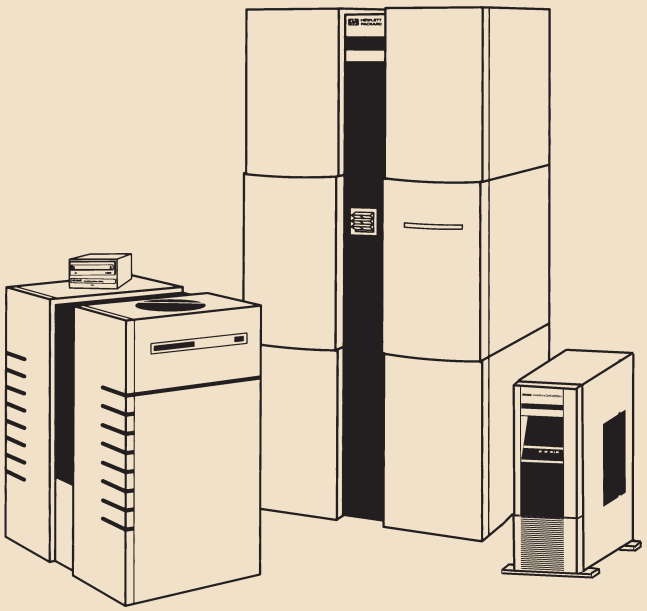
optical drive and library SCSI-2 command reference



for models fx, ex and mx

invent

Optical Drive and Library SCSI-2 Command Reference

For fx, ex and mx Models

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Notice

Revision History

New editions of this manual incorporate all material updated since the previous edition. The manual printing date and part number indicate the current edition. The printing date changes when a new edition is printed. (Minor corrections and updates incorporated at reprint do not change this date.)

Edition 1:. **February 1998**

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Typographical Conventions

The following typographical conventions are used in this manual:

Keycap: Menu choices and screens on the jukebox.

`Computer Output`: Information displayed in the display window and screen menu items that you can select.

NOTE

Notes provide information that can be helpful in understanding the operation of the product.

In This Manual

Chapter 1	**SCSI Command Overview:** Explains SCSI commands and how they are used with optical drives and jukeboxes. This section does not replace the SCSI-2 Command Specifications.
Chapter 2	**SCSI-2 Drive Command Set:** Lists all supported SCSI commands and explains each command's structure.
Chapter 3	**SCSI-2 Jukebox Command Set:** Lists all supported SCSI autochanger commands and explains each command's structure.
Appendix A	**Drive Error Codes:** Lists all error codes associated with the optical disk drive.
Appendix B	**Autochanger Error Codes:** Lists all error codes associated with the autochanger or optical disk jukebox system.
Appendix C	**Field Replaceable Units (FRUs):** Lists all the field replaceable units for optical jukeboxes by part number.
Appendix D	**Micro/Macro-Moves:** Lists all micro- and macro-moves for the optical jukeboxes.
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1 SCSI Command Overview

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 X3.131-1994 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, except command specifications of the target. The “SCSI Commands Used by the Target” are described later in this chapter.

SCSI Bus Phases

The target supports the following phases specified in the SCSI standard.

Arbitration phase

When the drive tries to reconnect to an initiator to continue command operations, it waits for the BUS FREE phase, then enters the ARBITRATION phase.

Selection phase

The selection phase allows an initiator to select a target for the purpose of initiating a 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. The drive examines the DATA BUS to determine the selecting initiator SCSI ID. If it cannot detect the ID, the drive does not respond to the selection.

Reselection phase

The reselection phase allows the target to reconnect to an initiator to continue the command started by the initiator, but 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 to transfer data to and from the drive. Synchronous and asynchronous data transfers are supported.

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 sends the Command Descriptor Block (CDB) from the initiator to the drive.

Message phase

The message phase refers to 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 on page 1-5 for a list of supported messages.

Table 1-1 Target-Supported Messages

Code (hex.)	Direction	Description
00H	In	Command Complete
01H	In/Out	Extended Message
02H	In	Save Data Pointer
03H	In	Restore Pointers
04H	In	Disconnect
05H	Out	Initiator-Detected Error
06H	Out	Abort
07H	In/Out	Message Reject
08H	Out	No Operation
09H	Out	Message Parity Error
0AH	In	Linked Command Complete
0BH	In	Linked Command Complete (with flag)
0CH	Out	Bus Device Reset
0DH	Out	Abort Tag
0EH	Out	Clear Queue
20H,21H,22H	In/Out	Queue Tag Simple, Head, Ordered
80H-FFH	In/Out	Identify

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).

Extended Message 01H

This message is sent from either the initiator or the drive to indicate that the message is an extended message. The drive supports only the synchronous data transfer request (SDTR) message.

An SDTR message exchange will be initiated by a SCSI device when an arranged data transfer agreement becomes invalid. The agreement becomes invalid after an intermediate status such as:

- Hard reset condition
- BUS DEVICE RESET message
- Wide data transfer message
- Power cycle

The initiator may also initiate a SDTR message exchange when appropriate to negotiate a new data transfer agreement (synchronous or asynchronous).

Table 1-2 Extended Message Format

Byte	7	6	5	4	3	2	1	0
0	Extended Message (01H)							
1	Extended Message Length (03H)							
2	Synchronous Data Transfer Request Code (01H)							
3	Transfer Period Factor (m times 4 nanoseconds)							
4	REQ/ACK Offset (x)							

The transfer period is the minimum time allowed between leading edges of successive REQ pulses and of successive ACK pulses.

The REQ/ACK offset is the maximum number of REQ pulses allowed to be outstanding before the leading edge of its corresponding ACK pulse is received at the target. This value prevents overflow conditions in the device's reception buffer and offset counter. A REQ/ACK offset value of zero indicates asynchronous mode.

The initiator sets its values according to the rules above that permit it to receive data successfully. If the drive can also receive data successfully with these values (or smaller transfer period or larger REQ/ACK offset or both), it returns the same values in its SDTR message.

Synchronous Negotiation Started by the Initiator

If the initiator recognizes that negotiation is required, it asserts the ATN signal and sends a SDTR message to begin the negotiating process. After successfully completing the MESSAGE OUT phase, the drive will respond with the proper SDTR message. If an abnormal condition prevents the drive from returning an appropriate response, both devices will go to asynchronous mode for data transfers between the two devices. The drive responds to each initiator requested transfer period as shown in Table 1-3 on page 1-8.

Table 1-3 Transfer Period Values (For 9.1 and 5.2 Gbyte Drives)

Initiator Requested Transfer Period Factor	Drive Response	Transfer Period
$0 <= m_i <= 25$	$m_t = 25$	100 nsec
$26 <= m_i <= 31$	$m_t = m_i$	125 nsec
$32 <= m_i <= 37$	$m_t = m_i$	150 nsec
$38 <= m_i <= 43$	$m_t = m_i$	175 nsec
$44 <= m_i <= 50$	$m_t = m_i$	200 nsec
$51 <= m_i <= 56$	$m_t = m_i$	225 nsec
$57 <= m_i <= 62$	$m_t = m_i$	250 nsec
$63 <= m_i <= 68$	$m_t = m_i$	275 nsec
$69 <= m_i <= 75$	$m_t = m_i$	300 nsec
$76 <= m_i <= 255$	$m_t = m_i$	Asynchronous (REQ/ACK offset 0)

The drive responds to each initiator requested REQ/ACK offset as show in Table 1-4 on page 1-9.

Table 1-4 Offset Values (For 5.2 and 9.1 Gbyte Drives)

Initiator Requested (REQ/ACK Offset)	Drive Response	(REQ/ACK Offset)
$0 <= x_i <= 15$	$x_t = x_i$	x_t
$0 <= x_i <= 255$	$x_t = 15$	15

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 drive may issue this message when it disconnects from 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 to complete current operation.

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.
Linked Command Complete	The target goes to the BUS FREE phase and aborts the command and sets Sense Key/Additional Sense Code to Aborted Command/Message 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.

Linked Command Complete 0AH

This message is sent from the drive to an initiator to indicate the execution of a linked command has been completed and that the status has been sent.

Linked Command Complete (with flag) 0BH

This message is sent from the drive to an initiator to indicate the execution of a linked command (with flag bit set to 1) has been completed and that the status has been sent.

Bus Device Reset 0CH

This message is sent from an initiator to reset the target.

Abort Tag 0DH

The drive goes to the BUS FREE phase following successful receipt of the ABORT TAG message and clears the current I/O process. If the drive already started execution of the I/O process, the execution will be halted. The medium contents may have been modified before the execution was halted.

Clear Queue 0EH

The drive goes to the BUS FREE phase following successful receipt of the CLEAR QUEUE message. The drive clears all I/O processes, from all initiators, in the queue for the specified logical unit from the queue. All active I/O processes are terminated. The medium may have been altered by partially executed commands. All pending status and data for that logical unit for all initiators are cleared. A unit attention condition is generated for all other initiators with I/O processes that either were active or were queued for that logical unit. The additional sense code is set to Command Cleared by Another Initiator.

Queue Tag Messages (20H, 21H, 22H)

The drive supports SIMPLE QUEUE TAG, HEAD OF QUEUE TAG, and ORDERED QUEUE TAG. The Queue Tag Messages consist of two consecutive bytes, Message Code (20H, 21H, or 22H) and Queue Tag (00H-FFH) to distinguish each I/O process. The Queue Tag of each I/O process must be unique for each I/O process, but the numeric value of a queue tag has no effect on the order of execution.

Table 1-5 Simple Queue Tag

Byte	7	6	5	4	3	2	1	0
0	Message Code (20H)							
1	Queue Tag (00H-FFH)							

The Simple Queue Tag message specifies that the I/O process be placed in the logical units command queue. The order of the execution may be altered within the constraints of the queue management algorithm specified in the control mode page.

Table 1-6 Head of Queue Tag

Byte	7	6	5	4	3	2	1	0
0	Message Code (21H)							
1	Queue Tag (00H-FFH)							

The Head of Queue Tag message specifies that the I/O process be placed first in the logical unit's command queue. When the drive receives a subsequent I/O process received with a Head of Queue Tag message, the I/O process that has been already done is not interrupted.

Table 1-7 Ordered Queue Tag

Byte	7	6	5	4	3	2	1	0
0	Message Code (22H)							
1	Queue Tag (00H-FFH)							

The Ordered Queue Tag message specifies that the I/O process be placed in the logical unit's command queue for execution in the order received. All queued I/O processes for the logical unit received prior to this I/O process are executed before this I/O process is executed. All queued I/O processes received after this I/O process are executed after this I/O process, except for I/O processes received with a Head of Queue Tag message.

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 1-8 Target-Supported Status Codes

Code (hex.)	Status
00H	Good
02H	Check Condition
04H	Condition Met
08H	Busy
10H	Intermediate/Good
14H	Intermediate Condition Met
18H	Reservation Conflict
28H	Queue Full

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.

Condition Met 04H

This status or Intermediate-Condition Met is returned when the Pre-Fetch command is satisfied.

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.

Intermediate/Good 10H

Unless an error, exception, or abnormal condition causes a Check Condition status or a Reservation Conflict status, the Intermediate Good status is returned for every command in a series of linked commands, excluding the last command. If this status is not returned, the chain of linked commands is broken; no further commands in the series are executed.

Intermediate Condition Met 14H

This status is the combination of the Condition Met and the Intermediate statuses.

Reservation Conflict 18H

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

Queue Full 28H

This status is returned when a Simple Queue Tag, Ordered Queue Tag, or a Head of Queue Tag message is received and the command queue of the drive is full. The I/O process is not placed in the command queue. The drive can handle 32 I/O processes at a time.

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 as follows:

1. If the ATN signal becomes true during a COMMAND phase, the drive enters the MESSAGE OUT phase after transferring part or all of the command descriptor block bytes.
2. If the ATN signal becomes true during a DATA phase, the drive enters the MESSAGE OUT phase at the drives earliest convenience. The initiator will continue REQ/ACK handshakes until it detects the phase change.
3. If the ATN signal becomes true during a STATUS phase, the drive enters the MESSAGE OUT phase after the status byte has been acknowledged by the initiator.
4. If the ATN signal becomes true during a MESSAGE IN phase, the drive enters the MESSAGE OUT phase before it sends another message.
5. If the ATN signal becomes true during a SELECTION phase and before the initiator releases the BSY signal, the drive enters the MESSAGE OUT phase immediately after that SELECTION phase.
6. If the ATN signal becomes true during a RESELECTION phase, the drive enters the MESSAGE OUT phase after sending its IDENTIFY message for that RESELECTION phase.

Reset Condition

The drive implements the hard reset alternative, upon detection of the RESET condition. When the drive creates the reset conditions, it clears all I/O processes including queued I/O processes, releases all reservations, returns any SCSI device operating modes (MODE SELECT, PREVENT/ALLOW MEDIUM REMOVAL commands, etc.) to their initial conditions, and generates UNIT ATTENTION condition.

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.

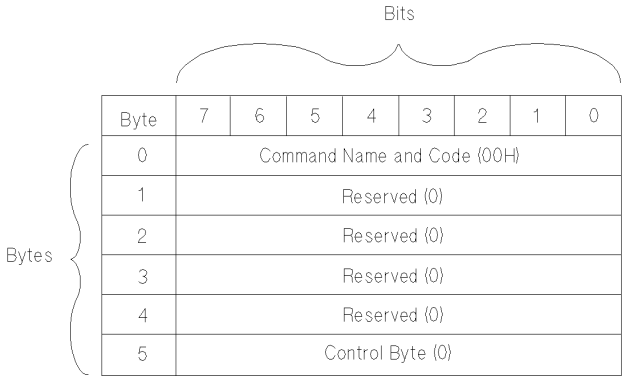
Each entry includes:

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.

Figure 1-1 Example Command Descriptor Block



NOTE 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.

2 SCSI-2 Drive Command Set

Numerical List of Commands

The following tables list the SCSI-2 commands numerically, by group.

Table 2-1 Group 0 Commands (6-byte command)

Code (hex.)	Name	Description	Page Number
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)	2-15
07H	Reassign Blocks	Reassigns defective sectors	2-19
08H	Read	Reads data from the specified logical block address	2-21
0AH	Write	Writes data to the specified logical block address	2-23
0BH	Seek	Moves the optical head to the physical track where the specified logical block exists	2-25
12H	Inquiry	Reads the information related to the controller and the drive unit	2-26
15H	Mode Select	Sets optical disk, drive unit, or controller unit parameters	2-31
16H	Reserve	Gains the exclusive control of a specified logical unit	2-52

Table 2-1 Group 0 Commands (6-byte command)

Code (hex.)	Name	Description	Page Number
17H	Release	Releases a specified logical unit from the reservation state	2-53
1AH	Mode Sense	Reads optical disk, drive unit, or controller unit parameters	2-54
1BH	Start/Stop Unit	Starts or stops rotating the optical disk, and/or ejects the optical disk from the drive unit	2-73
1CH	Receive Diagnostic Results	Requests analysis data be sent to the initiator	2-74
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	2-79

Table 2-2 Group 1 and 2 Commands (10-byte command)

Code (hex.)	Name	Description	Page Number
25H	Read Capacity	Reads the capacity of the optical disk	2-80
28H	Read	Reads data from the specified logical block address	2-82
2AH	Write	Writes data to the specified logical block address	2-84
2BH	Seek	Moves the optical head to the physical track where the specified logical block exists	2-87
2CH	Erase	Executes erase operation from the specified logical block address on rewritable disks only	2-88
2EH	Write and Verify	Writes data to the optical disk and then verifies the written data by checking the error correction code	2-90
2FH	Verify	Verifies the data starting from the specified logical block address by checking the error correction code	2-92
34H	Pre-Fetch	Transfers the specified number of data blocks starting from the specified logical block address to cache memory	2-94
35H	Synchronize Cache	Initiates the writing of all cached write data to the optical disk	2-95
37H	Read Defect Data	Reads the optical disk defect information	2-96

Table 2-2 Group 1 and 2 Commands (10-byte command)

Code (hex.)	Name	Description	Page Number
3BH	Write Buffer	Writes data to the controller data buffer.	2-99
3CH	Read Buffer	Reads data from the controller data buffer	2-102
3EH	Read Long	Reads data from the specified logical block address including ECC data	2-104
3FH	Write Long	Writes data to the specified logical block address without using the ECC generation circuitry	2-106
4CH	Log Select	Clears drive resident logs and odometers	2-109
4DH	Log Sense	Reads drive resident logs and odometers	2-111
55H	Mode Select	Sets optical disk, drive unit, or controller unit parameters	2-122

Table 2-3 Group 5 Commands (12-byte command)

Code (hex.)	Name	Description	Page
A8H	Read	Reads data from the specified logical block address	2-128
AAH	Write	Writes data to the specified logical block address	2-131
ACH	Erase	Executes erase operation from the specified logical block address on rewritable disks only	2-134
AEH	Write and Verify	Writes data to the optical disk and then verifies the written data by checking the error correction code	2-137
AFH	Verify	Verifies the data starting from the specified logical block address by checking the error correction code	2-140
B7H	Read Defect Data	Reads the optical disk defect information	2-142
DEH	Read Long	Reads data starting at a specified logical block address, including error correction code data	2-145
DFH	Write Long	Writes data starting at the specified logical block address, without using error correction code generation circuitry	2-147

Flag, Link, and RelAdr

Many commands have bits named Flag, Link and RelAdr. The definitions of these bits are:

A Link bit of 1 indicates that the drive links to the next command upon successful completion of the current command. When the command is terminated successfully, the drive returns the INTERMEDIATE/GOOD status and the LINKED COMMAND COMPLETE or the LINKED COMMAND COMPLETE (WITH FLAG) message depending on the state of the Flag bit. The Flag bit may be set to 1 only when the Link bit is 1. If this bit is set to 1 with the Link bit, the drive returns the LINKED COMMAND COMPLETE (WITH FLAG) message upon successful completion of the command. If this bit is set to 0, it returns the LINKED COMMAND COMPLETE message.

The Relative Address (RelAdr) bit is set to 1 to indicate that the logical block address of the command descriptor block is a two's complement displacement. This negative or positive displacement is added to the logical block address last accessed on the drive to form the logical block address for this command.

Test Unit Ready Command (00H)

This command 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 successfully complete.

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

Table 2-4 Test Unit Ready Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (00H)							
1	Logical Unit Number (0)			Reserved (0)				
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Reserved (0)						Flag	Link

Rezero Unit Command (01H)

The Rezero Unit Command is identical to the Test Unit Ready Command (see the previous page).

Table 2-5 Rezero Unit Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (01H)							
1	Logical Unit Number (0)			Reserved (0)				
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Reserved (0)						Flag	Link

Request Sense Command (03H)

This command 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.

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

Table 2-6 Request Sense Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (03H)							
1	Logical Unit Number (0)			Reserved (0)				
2	Reserved (0)							
3	Reserved (0)							
4	Allocation Length (Table 2-7 on page 2-11)							
5	Reserved (0)						Flag	Link

The Allocation Length indicates the number of bytes of sense data that the drive transfers to the initiator. This drive has 22 bytes of sense data. If an allocation length specified is less, then the allocated amount is transferred, the remaining sense data is lost, and no error will be reported. If an allocated length specified is greater, then only 22 bytes of sense data are transferred and no error will be reported.

Sense Data Format

Table 2-7 Error Code 70H or 71H Sense Data Format

Byte	7	6	5	4	3	2	1	0
0	Valid	Error Code (70H or 71H)						
1	Reserved (0)							
2	Reserved (0)		ILI	Rsvd (0)	Sense Key			
3	Information (MSByte)							
4	Information Byte							
5	Information Byte							
6	Information (LSByte)							
7	Additional Sense Length (0EH)							
8	Reserved (0)							
9	Reserved (0)							
10	Reserved (0)							
11	Reserved (0)							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Reserved (0)							
15	SKSV	Sense Key Specific Information						
16	Sense Key Specific Information							
17	Sense Key Specific Information							
18	Internal Error Code (MSByte)							
19	Internal Error Code							
20	Internal Error Code							
21	Internal Error Code (LSByte)							

Valid 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.

Error Code An Error Code of 70H indicates that the CHECK CONDITION status returned is the result of an I/O process that returned CHECK CONDITION status.

An Error Code of 71H indicates that the CHECK CONDITION status returned is the result of an error occurring during a previous command that returned GOOD status.

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 If the Valid bit is set to 1, the Information Bytes contain one of the following:

(1) The logical block address associated with the sense key.

(2) The difference (residue) of the requested length minus the actual length in bytes, as determined by the command, when the ILI bit is set.

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 If the Sense Key is set to 5-Illegal Request and the SKSV bit is set to 1, the sense key specific field is defined in Table 2-8 on page 2-13.

If the Sense Key is set to 2-(Not Ready) and the Additional Sense Code/Additional Sense Code Qualifier is set to 04/04-(Logical Unit Not Ready, Format in Progress) and the SKSV bit is set to 1, the sense key specific field is defined in Table 2-9 on page 2-14.

Field Pointer Types

Table 2-8 Sense Key Field Pointer Types

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 A Command Data bit of 1 indicates that the illegal parameter is in the CDB.

A Command Data bit of 0 indicates that the illegal parameter is in the data sent by the initiator during the Data-Out phase.

BPV A Bit Pointer Valid bit of 1 indicates that the Bit Pointer field specifies which bit of the byte designated by the Field Pointer field is in error.

A Bit Pointer Valid bit of 0 indicates that the Bit Pointer field is not valid.

Bit Pointer When the Bit Pointer Valid bit is 1, the Bit Pointer field specifies which bit of the byte designated by the Field Pointer field is in error. When a multiple-bit field is in error, the pointer points to the most significant byte of the field.

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 2-9 Progress Indication Field Bytes

Byte	7	6	5	4	3	2	1	0
15	SKSV (1)	Reserved (0)						
16	Progress Indication (MSByte))							
17	Progress Indication (LSByte)							

Progress Indication The progress indication field value is a percent complete indication in which the returned value is the numerator that has 10000H as its denominator.

Internal Error Code The Internal Error Code provides detailed information about the failure.

Format Unit Command (04H)

This command is used to initialize the optical disk surface.

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

Table 2-10 Format Unit Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (04H)							
1	Reserved (0)			FmtDta	CmpLst	Defect List Format		
2	Reserved (0)						MkCDA	MkPlst
3	Reserved (0)							
4	Reserved (0)							
5	Rsvd	ErsCntl	Reserved (0)				Flag	Link

NOTE The 9.1 and 5.2 Gbyte capacity drives cannot Format, Erase, Write, or Write and Verify 650 Mbyte and 1.3-Gbyte optical disks.

The 2.6 Gbyte capacity drives cannot Format, Erase, Write, or Write and Verify 650 Mbyte optical disks.

If this command is issued with any of these drive/media combinations, a CHECK CONDITION status will result with the Sense Key/Additional Sense Code set to Data Protect/Write Protected.

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.

CmpLst A Complete List bit of 1 indicates that the previous G-list is not used to make the defect list.

A CmpLst bit of 0 indicates the previous G-list is added to the defect list.

Defect List Format The Defect List Format can be either Block Format (0) or Physical Sector Format (5).

MkCDA Has no effect on the drive.

MkPlst Has no effect on the drive.

ErsCntl An Erase Control bit of 0 indicates that an erase is automatically performed before writing the data when the drive is directed to perform the certify operation by the initiator.

An Erase Control bit of 1 suppresses the erase operation.

NOTE For Write-Once, this command can be executed only once during the lifetime of a disk. When an initiator attempts to execute the Format Unit command more than once for write-once media a CHECK CONDITION status is returned. The Sense Key/Additional Sense Code is set to ILLEGAL REQUEST/Invalid Command Operation Code.

Format Unit Command Defect List

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

Table 2-11 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	Defect List Length (MSByte)							
3	Defect List Length (LSByte)							

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.

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

Table 2-12 Physical Sector Format Defect Descriptor

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

Table 2-13 Block Format Defect Descriptor

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

Reassign Blocks Command (07H)

This command 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 2-14 Reassign Blocks Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (07H)							
1	Logical Unit Number (0)			Reserved (0)				
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Reserved (0)						Flag	Link

Reassign Blocks Command Defect List

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

Table 2-15 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 2-16 Reassign Blocks Command Defect Descriptor

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

This command 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 2-17 Read (Group 0) Command CDB

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

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.

NOTE When this command is used with 512 byte/sector 4X/ 8X/14X media, 1024 byte/sector 8X/14X media, or 2048 14X media, it is not possible to address all logical blocks on the disk because those media types contain $>2^{21}$ logical blocks.

NOTE When this command is used with 14X 512 or 1024 byte/sector media, setting the PBA bit will cause the drive to return a CHECK CONDITION status. The sense key/additional sense code will be set to ILLEGAL REQUEST/INVALID FIELD in CDB.

Write (Group 0) Command (0AH)

This command writes data starting at the specified logical block address.

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

Table 2-18 Write (Group 0) Command CDB

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

NOTE The 9.1 and 5.2 Gbyte capacity drives cannot Format, Erase, Write, or Write and Verify 650 Mbyte and 1.3-Gbyte optical disks.

The 2.6 Gbyte capacity drives cannot Format, Erase, Write, or Write and Verify 650 Mbyte optical disks.

If this command is issued with any of these drive/media combinations, a CHECK CONDITION status will result with the Sense Key/Additional Sense Code set to Data Protect/Write Protected.

NOTE For Write-Once media, byte 5, bit 6 and bit 7 are reserved.

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.

ErsCntl If the Erase Control bit is set to 0, an erase is automatically performed before writing the data.

An Erase Control bit of 1 suppresses the erase operation.

NOTE When this command is used with 512 byte/sector 4X/ 8X/14X media, 1024 byte/sector 8X/14X media, or 2048 14X media, it is not possible to address all logical blocks on the disk because those media types contain $>2^{21}$ logical blocks.

NOTE For write-once optical disks, blank checking is performed before writing data. If a written block is detected during blank checking, the drive will return a CHECK CONDITION status. The sense key/additional sense code will be set to BLANK CHECK/Overwrite Attempted.

NOTE When this command is used with 14X 512 OR 1024 byte/sector media, setting the ErsCntl bit or the PBA bit will cause the drive to return a CHECK CONDITION status. The sense key/additional sense code will be set to ILLEGAL REQUEST/INVALID FIELD in CDB.

Seek (Group 0) Command (0BH)

This command seeks the optical head to the physical track where the specified logical block exists.

Table 2-19 Seek (Group 0) Command CDB

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

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 When this command is used with 512 byte/sector 4X/ 8X/14X media, 1024 byte/sector 8X/14X media, or 2048 14X media, it is not possible to address all logical blocks on the disk because those media types contain $>2^{21}$ logical blocks.

NOTE When this command is used with 14X 512 or 1024 byte/sector media, setting the PBA bit will cause the drive to return a CHECK CONDITION status. The sense key/additional sense code will be set to ILLEGAL REQUEST/INVALID FIELD in CDB.

Inquiry Command (12H)

This command sends controller and drive information to the initiator.

Table 2-20 Inquiry Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (12H)							
1	Logical Unit Number (0)			Reserved (0)				EVPD
2	VPD Identifier							
3	Reserved (0)							
4	Allocation Length							
5	Reserved (0)						Flag	Link

EVPD ***(8X and 14X only).*** An enable vital product data bit of 1 specifies that the drive shall return the optional vital product data specified by the page code field. An enable vital product data bit of 0 specifies that the drive shall return the standard INQUIRY data.

Page Code The page code field specifies which page of vital product data information the drive shall return (Table 2-21).

Allocation Length This field specifies the number of bytes that the initiator has allocated for the return data. An Allocation Length of 0 is not an error and indicates that no data will be returned. The initiator will terminate the data in phase when all available inquiry data has been returned or when allocation length bytes have been returned, whichever is less.

If an inquiry command is received from an initiator with a pending UNIT ATTENTION (before the drive reports CHECK CONDITION status), the drive performs the INQUIRY command and does not clear the UNIT ATTENTION condition.

Table 2-21 Vital Product Data Page Codes

Page Code	Description
00H	Supported Vital Product Data Pages
80H	Unit Serial Number Page
C1H	Unique Media ID (UMID) Page

Table 2-22 Supported Vital Product Data Pages (00H)

Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (00H)							
2	Reserved (0)							
3	Page Length (03H)							
4	First Supported VPD Page (00H)							
5	Second Supported VPD Page (80H)							
6	Third Supported VPD Page (C1H)							

Table 2-23 Unit Serial Number Page (80H)

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

Table 2-24 Unique Media ID Page (C1H)

Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (C1H)							
2	Reserved (0)							
3	Page Length (08H)							
4-5	Unique Media ID Bytes 1-2							
6-8	Unique Media ID Bytes 3-5							
9-11	Unique Media ID Bytes 6-8							

The Unique Media ID Bytes 1-2 field is “HP” in ASCII.

The Unique Media ID Bytes 3-5 field is a three-byte binary representation of the serial number of the drive which wrote the UMID on the media.

The Unique Media ID Bytes 6-8 field is a three-byte random number.

Table 2-25 Inquiry Command Returned Data

Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	RMB (1)	Device Type Modifier (0)						
2	ISO Version (0)		ECMA Version (0)			ANSI-Approved Version (2)		
3	Response Data Format (2)							
4	Additional Sense Length (33H)[a]							
5-6	Reserved (0)							
7	RelAdr (1)	WBus32 (0)	WBus16 (0)	Sync (1)	Linked (1)	Rsvd (0)	Cmd Que (1)	SftRe (0)
8-15	Vendor Identification “HP~~~~~~” (ASCII)[b]							
16-31	Product Identification “C1113J~~~~~~~~~~” (ASCII)[b] (“C1113F~~~~~~~~~~” for 2.6 Gbyte capacity drives)							
32-35	Product Revision Level (Current firmware version in ASCII)							
36-39	Manufacturing Date Code (Current ASCII data)							
40-49	Serial Number (Current ASCII data)							
50-55	Drive Identifier “8XMO~~” (ASCII)[b] (“4XMO~~” for 2.6 Gbyte capacity drives)							

a.This field is always 33H.

b.The ~ represents blank spaces.

NOTE If the drive is properly connected and responds to SCSI selection, the Peripheral Qualifier field is set to 000. If Direct Access Inquiry Response (DAIR) has been enabled, the Peripheral Device Type field is set 00H, (Direct Access Device). Otherwise, the Peripheral Device Type field is set to 07H (Optical Memory Device). Because the drive does not support logical unit 1 through 7, an Inquiry command to these logical units always returns 011 for the Peripheral Qualifier and 1FH (Unknown Device Type) for the Peripheral Device Type.

RMB The Removable Media Bit is set to 1 for removable optical disks. The drive only supports removable optical disks, so this bit is always 1.

Device Type Modifier The drive is not using the Device Type Modifier field and will return 0.

ISO, ECMA and ANSI-Approved Versions Approved Version fields indicate compliance of the current firmware to these standards.

Additional Sense Length This field indicates the length in bytes of the additional parameters. This field is always 33H.

RelAdr The Relative Addressing bit is set to 1, which indicates that the drive supports relative addressing mode.

WBus32 The Wide Bus 32 bit of 0 indicates that the drive supports only 8-bit wide data transfers.

WBus16 The Wide Bus 16 bit of 0 indicates that the drive supports only 8-bit wide data transfers.

Sync The Synchronous transfer bit of 1 indicates that the drive supports synchronous data transfer.

Linked The Linked command bit of 1 indicates that the drive supports linked commands.

CmdQue The Command queuing bit of 1 indicates that the drive supports tagged command queuing.

SftRe The Soft Reset bit of 0 indicates that the drive responds to the RESET condition with the hard RESET.

Mode Select Command (15H)

This command sets optical disk and drive parameters for read, write, format, and erase commands.

Table 2-26 Mode Select (Group 0) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (15H)							
1	Logical Unit Number (0)			PF (1)	Reserved (0)			SP
2	Reserved (0)							
3	Reserved (0)							
4	Parameter List Length (Table 2-27 on page 2-32)							
5	Reserved (0)						Flag	Link

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 during the DATA OUT phase, including the header. A length of 0 indicates that no data will be transferred.

Table 2-27 Mode Page Codes

Page Code	Parameter List Length	Description
01H	12	Read-Write Error Recovery Page (See Table 2-30 on page 2-34)
02H	16	Disconnect-Reconnect Page (See Table 2-31 on page 2-36)
08H	12	Caching Page (See Table 2-32 on page 2-37)
0AH	8	Control Mode Page (See Table 2-33 on page 2-39)
0BH	8	Medium Type Supported (See Table 2-35 on page 2-40)
20H	12	Vendor Unique Format Page (See Table 2-37 on page 2-42)
21H	12	Vendor Unique Page (See Table 2-41 on page 2-46)

The Mode Select Parameter List contains a 4-byte header, followed by 0 or 1 block descriptors and 0 or more pages.

A Mode Page of 00H will be rejected and no error will be reported.

Mode Select Header

Table 2-28 Mode Select Header

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Medium Type							
2	Reserved (0)							
3	Block Descriptor Length							

The Medium Type field shall be set to 00H (Default, only one medium type supported), 02H (Write-once medium), or 03H (Optical Reversible or Erasable medium). The Block Descriptor Length specifies the length in bytes of the block descriptor. It shall be equal to 0 or 8. A Block Descriptor Length of zero indicates that the block descriptor is not included in the parameter list. This condition is not considered to be an error.

Table 2-29 Mode Select Block Descriptor

Byte	7	6	5	4	3	2	1	0
0	Density Code							
1	Number of Blocks (MSByte)							
2	Number of Blocks							
3	Number of Blocks (LSByte)							
4	Reserved (0)							
5	Block Length (MSByte)							
6	Block Length							
7	Block Length (LSByte)							

NOTE All fields in the Block Descriptor have no effect on the drive.

Read-Write Error Recovery

Table 2-30 Read-Write Error Recovery Page 01H

Byte	7	6	5	4	3	3	1	0
0	Reserved (0)		Page Code (01H)					
1	Page Length (0AH)							
2	AWRE	Rsvd (0)	TB	RC	Rsvd (0)	PER	DTE	DCR
3	Read Retry Count							
4-7	Reserved (0)							
8	Write Retry Count							
9-11	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), Write and Verify commands (2EH, AEH), and Write Long (3FH, DFH).

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

NOTE 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.

RC A Read Continuous bit of 1 indicates that error correction codes are not used for data error recovery.

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

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.

Disconnect-Reconnect

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

Table 2-31 Disconnect-Reconnect Page 02H

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)		Page Code (02H)					
1	Page Length (0EH)							
2	Buffer Full Ratio							
3	Buffer Empty Ratio							
4-9	Reserved (0)							
10	Maximum Burst Size (MSByte)							
11	Maximum Burst Size (LSByte)							
12-15	Reserved (0)							

Buffer Full Ratio This field has no effect on the drive.

Buffer Empty Ratio This field has no effect on the drive.

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.

Caching Page 08H

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

Table 2-32 Caching Page 08H

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)		Page Code (08H)					
1	Page Length (0AH)							
2	Reserved (0)					WCE	MF	RCD
3	Reserved (0)							
4	Disable Pre-fetch Transfer Length (MSByte)							
5	Disable Pre-fetch Transfer Length (LSByte)							
6	Minimum Pre-fetch (MSByte)							
7	Minimum Pre-fetch (LSByte)							
8	Maximum Pre-fetch (MSByte)							
9	Maximum Pre-fetch (LSByte)							
10	Maximum Pre-fetch Ceiling (MSByte)							
11	Maximum Pre-fetch Ceiling (LSByte)							

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

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.

MF The Multiplication Factor bit is set to 1 and cannot be changed. This bit is used with the Minimum and Maximum Pre-fetch fields during READ operations. If this bit is set to 0 by the MODE SELECT command, a CHECK CONDITION status is returned with the sense key/additional sense code set to ILLEGAL REQUEST/ Invalid Parameter List.

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 The default value is 1 and cannot be changed. If this bit is set to 0 by the MODE SELECT command, a CHECK CONDITION status is returned with the Sense Key/ Additional Sense Code set to Illegal Request/Invalid Parameter List. Since the MF bit is 1 and the Minimum Pre-fetch bit is also 1, the Minimum Pre-fetch size is equal to the READ transfer length. This field does not affect the operation of the drive.

Maximum Pre-fetch The default value is 1 and cannot be changed. If this bit is set to 0 by the MODE SELECT command, a CHECK CONDITION status is returned with the Sense Key/ Additional Sense Code set to Illegal Request/Invalid Parameter List. Since the MF bit is 1 and the Maximum Pre-fetch bit is also 1, the Maximum Pre-fetch size is equal to the READ transfer length. This field does not affect the operation of the drive.

Maximum Pre-fetch Ceiling The Maximum Pre-fetch Ceiling field does not affect the operation of the drive and can be set to 32 or 64. If another value is set, a CHECK CONDITION status is returned with the Sense Key/Additional Sense Code set to Illegal Request/Invalid Parameter List.

Control Mode Page 0AH

Table 2-33 Control Mode Page 0AH

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)		Page Code (0AH)					
1	Page Length (06H)							
2	Reserved (0)							
3	Queue Algorithm Modifier[a]				Reserved			DQue
4-7	Reserved (0)							

a.For 9.1 and 5.2 Gbyte Capacity drives only.

Queue Algorithm Modifier The queue algorithm modifier field specifies restrictions on the algorithm used for reordering commands that are tagged with the Simple Queue Tag message.

DQue A Disabled Queuing bit of 1 indicates that command queuing is disabled.

A Disabled Queuing bit of 0 indicates command queuing is enabled.

Table 2-34 Queue Algorithm Modifier

Value	Definition
0H	Restricted reordering
01H	Unrestricted reordering allowed
2H - 0FH	Reserved

A value of zero (0) in this field specifies that the target will order the actual execution sequence of the commands with a SIMPLE QUEUE TAG such that data integrity is maintained for that initiator.
A value of one (1) in this field specifies that the target may reorder the actual execution of the commands with a SIMPLE QUEUE TAG in any manner.

Medium Types Supported Page 0BH

Table 2-35 Medium Types Supported Page 0BH

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)		Page Code (0BH)					
1	Page Length (06H)							
2	Reserved (0)							
3	Reserved (0)							
4	Medium Type One Supported (02H — Optical Write-once Medium)							
5	Medium Type Two Supported (03H — Optical Erasable Medium)							
6	Medium Type Three Supported (00H)							
7	Medium Type Four Supported (00H)							

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) and 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 2-36 Valid Medium Type Combinations

Byte	Field Name	Setting 1 (default)	Setting 2	Setting 3	Setting 4
4	Medium Type 1 Supported	02H	00H	02H	03H
5	Medium Type 2 Supported	03H	00H	00H	00H
6	Medium Type 3 Supported	00H	00H	00H	00H
7	Medium Type 4 Supported	00H	00H	00H	00H

00H Default Rewritable optical disks only

02H Write-Once medium

03H Rewritable medium

Vendor Unique Format Page 20H

Table 2-37 Vendor Unique Format Page 20H

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)		Page Code (20H)					
1	Page Length (0AH)							
2	Format Mode							
3-11	Format Type Specific Data							

NOTE The drive supports Format Mode 03H and 04H.

Format Mode 03H is for 650-Mbyte optical disks

Format Mode 04H is for 1.3-, 2.6-, 5.2-, and 9.1-Gbyte optical disks.

Format Mode 03H

Format Mode 03H supports two types of format (type 0 and type 1) by setting byte 3.

Table 2-38 Format Mode 03H - Type 0

Byte	7	6	5	4	3	2	1	0
2	Format Mode (03H)							
3	Type 00H							
4	Size of User Band (MSByte)							
5	Size of User Band							
6	Size of User Band							
7	Size of User Band (LSByte)							
8	Size of Spare Band (MSByte)							
9	Size of Spare Band (LSByte)							
10	Number of Bands (MSByte)							
11	Number of Bands (LSByte)							

Size of User Band The Size of User Band field indicates the length of each user band in number of logical blocks.

Size of Spare Band The Size of Spare Band field indicates the length of each spare band in number of logical blocks.

Number of Bands The Number of Bands field indicates the bands on the disk. The drive can read and write multi-band formatted disks, but can create only single-band disks.

Table 2-39 Format Mode 03H - Type 1

Byte	7	6	5	4	3	2	1	0
2	Format Mode (03H)							
3	Type 01H							
4	Reserved (0)							
5	Reserved (0)							
6	Number of Bands (MSByte)							
7	Number of Bands (LSByte)							
8	Size of Spare Bands (MSByte)							
9	Size of Spare Bands (LSByte)							
10	Reserved (0)							
11	Reserved (0)							

Type 1 format exists for compatibility. An initiator cannot change the parameters of this page.

Number of Bands The Number of Bands field indicates the bands on the disk.

Size of Spare Band The Size of User Band field indicates the length of each spare band in number of logical blocks.

Table 2-40 Format Mode 04H

Byte	7	6	5	4	3	2	1	0
2	Format Mode (04H)							
3-9	Reserved (0)							
10	Number of Bands (MSByte)							
11	Number of Bands (LSByte)							

Number of Bands The Number of Bands field indicates the bands on the disk and can be set to 1 (01H), 16 (10H), 30 (1EH), or 34 (22H).

NOTE The Number of Bands for 9.1 and 5.2 Gbyte Capacity drives include 1 (01H), 16 (10H), 24 (18H), 30 (1EH), 34 (22H), 38 (26H), or 45 (2DH).

Vendor Unique Page 21H

Table 2-41 Vendor Unique Page 21H

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)		Page Code (21H)					
1	Page Length (0AH)							
2	Reserved (0)							DAIR
3	DWR	Quick Dis-connect	Rsvd (0)	Force Verify	Reserved (0)			
4	S1-8	S1-7	S1-6	S1-5	S1-4	S1-3	S1-2	S1-1
5	S2-8	S2-7	S2-6	S2-5	S2-4	S2-3	S2-2	S2-1
6	Reserved (0)						DOM	FWC
7-11	Reserved (0)							

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.

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.

Bytes 4 and 5 Bytes 4 and 5 are used to read the setting of the DIP switches on the drive. SX-Y refers to the setting of DIP switch S50X-Y (see Figure 2-1 on page 2-51 and Table 2-44 on page 2-51). If SX-Y=0, the switch is set to the OFF position; if SX-Y=1, the switch is set to the ON position. These fields are not changeable. The switch setting value overrides the saved value.

DOM A drive operating mode of 0 indicates that the drive is installed in a jukebox environment. A DOM bit of 1 indicates that the drive is installed in a stand-alone environment.

NOTE The DOM bit is not selectable using the Mode Select command.

FWC A Force Write Calibration bit of 1 instructs the drive to perform the Write Calibration routine at spin-up. A Force Write Calibration bit of 0 instructs the drive to perform the Write Calibration routine on receipt of the first Write command or 5 minutes after spin-up.

NOTE The bits DAIR and Force Verify on this mode page can also be controlled in HP products by changing external switch settings. In HP's standalone box products, this is accomplished by changing the thumb wheel settings on the rear of the box. In HP's library products, this is accomplished by changing the front panel settings. In all cases, changes to the mode page settings will override the external switch settings.

Mode Page Parameter Default Values

The default values of the Mode Page Parameters are as follows:

Table 2-42 Mode Page Parameter Default Values

Page	Field	Default Value
01H	AWRE	1
01H	TB	0
01H	RC	0
01H	PER	0
01H	DTE	0
01H	DCR	0
01H	Read Retry Count	5
01H	Write Retry Count	5
02H	Buffer Full Ratio	20H
02H	Buffer Empty Ratio	20H
02H	Maximum Burst Size	20H
08H	WCE	1
08H	MF	1
08H	RCD	0
08H	Disable Pre-Fetch Transfer Length	40H
08H	Minimum Pre-Fetch	01H
08H	Maximum Pre-Fetch	01H
08H	Maximum Pre-Fetch Ceiling	40H
0AH	Que Algorithm Modifier[a]	0
0AH	DQUE	0
0BH	Medium Type 1 Supported	02H

Table 2-42 Mode Page Parameter Default Values

Page	Field	Default Value
0BH	Medium Type 2 Supported	03H
0BH	Medium Type 3 Supported	00H
0BH	Medium Type 4 Supported	00H
21H	DAIR	0
21H	DWR	0
21H	Quick Disconnect	0
21H	Force Verify	0

a.This value is for 9.1 and 5.2 Gbyte Capacity drive only.

With power-on or reset and the loaded media holds no format information in itself, the current value of the format page (20H) parameters are set as follows:

Table 2-43 Mode Page 20H Parameter Default Values

Page	Field	Current Value
650 Mbytes/Cartridge		
20H	Format Mode	3
20H	Type	0
20H	Number of Bands	1
20H	Size of Spare Band	2048
1.3/1.2 Gbytes/Cartridge (1024/512 bytes/sector)		
20H	Format Mode	4
20H	Number of Bands	1
2.6 Gbytes/Cartridge (1024 bytes/sector)		
20H	Format Mode	4

Table 2-43 Mode Page 20H Parameter Default Values

Page	Field	Current Value
20H	Number of Bands	34
2.3 Gbytes/Cartridge (512 bytes/sector)		
20H	Format Mode	4
20H	Number of Bands	30
5.2 Gbytes/Cartridge (2048 bytes/sector)[a]		
20H	Format Mode	4
20H	Number of Bands	24
4.8 Gbytes/Cartridge (512 bytes/sector)[a]		
20H	Format Mode	4
20H	Number of Bands	45
4.1 Gbytes/Cartridge (512 bytes/sector)[a]		
20H	Format Mode	4
20H	Number of Bands	38
9.1 Gbytes/Cartridge (4096 bytes/sector)[b]		
20H	Format Mode	4
20H	Number of Bands	16
8.6 Gbytes/Cartridge (2048 bytes/sector)[b]		
20H	Format Mode	4
20H	Number of Bands	30

a.This media is for 9.1 and 5.2 Gbyte capacity drives only.

b.This media is for 9.1 capacity drives only.

DIP Switch Locations

Figure 2-1 **DIP Switch Locations**

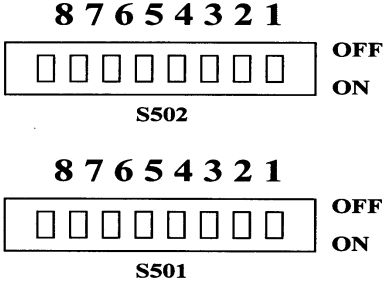


Table 2-44 **DIP Switch Definitions**

	DIP SW S501		DIP SW S502
1	Autochanger Eject Distance Override	1	Reserved for Production
2	DAIR Enable	2	Reserved for Production
3	Reserved for HP	3	Reserved for Production
4	Reserved for HP	4	Reserved for Production
5	Reserved for Debug	5	Enable SCAM
6	Reserved for Debug	6	Force Verify for Write Operation
7	Reserved for Debug	7	SCSI Terminator Enable[a]
8	Reserved for Debug	8	Reserved

a.For 2.6 Gbyte capacity drives, this DIP switch is Fast SCSI Enable.

Reserve Command (16H)

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

Table 2-45 Reserve Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (16H)							
1	Logical Unit Number (0)			3rd Pty	3rd Party Device ID			Rsvd (0)
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Reserved (0)						Flag	Link

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)

This command is sent by the Reserve Command initiator to release the logical unit for use by other initiators.

Table 2-46 Release Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (17H)							
1	Logical Unit Number (0)			3rd Pty	3rd Party Device ID			Rsvd (0)
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Reserved (0)						Flag	Link

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)

This command is used to acquire optical disk, drive, and drive controller parameters.

Table 2-47 Mode Sense (Group 0) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (1AH)							
1	Logical Unit Number (0)			Rsvd (0)	DBD	Rsvd (0)		
2	PC	Page Code (Table 2-50 on page 2-56)						
3	Reserved (0)							
4	Allocation Length							
5	Reserved (0)						Flag	Link

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:
00 - Current Values
01 - Changeable Values
10 - Default Values
11 - Saved Values

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

Allocation Length

This field specifies the number of bytes that the initiator has allocated for returned data. A length of 0 indicates that no data will be returned. The drive will terminate the data-in phase when the allocation length has been transferred or when all available data has been transferred to the initiator.

Table 2-48 Mode Sense Header

Byte	7	6	5	4	3	2	1	0
0	Mode Data Length							
1	Medium Type							
2	WP	Reserved		Cache (1)	Reserved (0)			
3	Block Descriptor Length							

Table 2-49 Mode Sense Descriptor

Byte	7	6	5	4	3	2	1	0
0	Density Codes							
1	Number of Blocks (MSByte)							
2	Number of Blocks							
3	Number of Blocks (LSByte)							
4	Reserved (0)							
5	Block Length (MSByte)							
6	Block Length							
7	Block Length (LSByte)							

Table 2-50 Mode Page Codes

PageCode	Parameter List Length	Description
01H	12	Read-Write Error Recovery Page (See Table 2-51 on page 2-57)
02H	16	Disconnect-Reconnect Page (See Table 2-52 on page 2-59)
08H	12	Caching Page (See Table 2-53 on page 2-60)
0AH	8	Control Mode Page (See Table 2-54 on page 2-63)
0BH	8	Medium Type Supported (Table 2-55 on page 2-64)
20H	12	Vendor Unique Format Page (See Table 2-57 on page 2-66)
21H	12	Vendor Unique Page (See Table 2-61 on page 2-70)
00H,3FH	80	Request for all Pages

Read-Write Error Recover Page

Table 2-51 Read-Write Error Recovery Page 01H

Byte	7	6	5	4	3	2	1	0
0	PS (1)	Rsvd (0)	Page Code (01H)					
1	Page Length (0AH)							
2	AWRE	Rsvd (0)	TB	RC	Rsvd (0)	PER	DTE	DCR
3	Read Retry Count							
4-7	Reserved (0)							
8	Write Retry Count							
9-11	Reserved (0)							

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), Write and Verify commands (2EH, AEH), and WRITE LONG command (3FH).

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.

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.

RC A Read Continuous bit of 1 indicates that error correction codes are not used for data error recovery.

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

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 (DTE) bit of 1 indicates that the target terminates the data phase upon detection of a recovered error.

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.

Disconnect-Reconnect Page 02H

Table 2-52 Disconnect-Reconnect Page 02H

Byte	7	6	5	4	3	2	1	0
0	PS (1)	Rsvd (0)	Page Code (02H)					
1	Page Length (0EH)							
2	Buffer Full Ratio							
3	Buffer Empty Ratio							
4-9	Reserved (0)							
10	Maximum Burst Size (MSByte)							
11	Maximum Burst Size (LSByte)							
12-15	Reserved (0)							

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

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

Buffer Full Ratio This field has no effect on the drive.

Buffer Empty Ratio This field has no effect on the drive.

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.

Caching Page 08H

Table 2-53 Caching Page 08H

Byte	7	6	5	4	3	2	1	0
0	PS (1)	Rsvd (0)	Page Code (08H)					
1	Page Length (0AH)							
2	Reserved (0)					WCE	MF	RCD
3	Reserved (0)							
4	Disable Pre-fetch Transfer Length (MSByte)							
5	Disable Pre-fetch Transfer Length (LSByte)							
6	Minimum Pre-fetch (MSByte)							
7	Minimum Pre-fetch (LSByte)							
8	Maximum Pre-fetch (MSByte)							
9	Maximum Pre-fetch (LSByte)							
10	Maximum Pre-fetch Ceiling Length (MSByte)							
11	Maximum Pre-fetch Ceiling Length (LSByte)							

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.

MF The Multiplication Factor bit is set to 1 and cannot be changed. This bit is set to the Minimum and Maximum Pre-Fetch fields during READ operations. If this bit is set to 0 by the MODE SELECT command, a CHECK CONDITION status is returned with the sense key/ additional sense code set to ILLEGAL REQUEST/ Invalid Parameter List.

RCD A Read Cache Disable bit of 1 indicates read ahead is disabled.

A RCD bit of 0 indicates read ahead is enabled.

NOTE If WCE and RCD are both set to 1, a CHECK CONDITION status is returned with the sense key/additional sense code set to ILLEGAL REQUEST/Invalid Parameter List.

DisablePre-fetchTransfer 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 64.

Minimum Pre-fetch If this bit is set to 0 by the MODE SELECT command, a CHECK CONDITION status is returned with the sense key/additional sense code set to ILLEGAL REQUEST/ Invalid Parameter List. Since the MF bit is 1 and the Minimum Pre-Fetch bit is also 1, the minimum pre-fetch size is equal to the READ Transfer Length. This field does not affect the operation of the drive.

The Minimum Pre-fetch default setting is 1 and cannot be changed.

Maximum Pre-fetch If this bit is set to 0 by the MODE SELECT command, a CHECK CONDITION status is returned with the sense key/additional sense code set tot ILLEGAL REQUEST/ Invalid Parameter List. Since the MF bit is 1 and the Maximum Pre-fetch bit is also 1, the maximum pre-fetch size is equal to the READ Transfer Length. This field does not affect the operation of the drive.

The Maximum Pre-fetch default setting is 1 and cannot be changed.

MaximumPre-fetch Ceiling The Maximum Pre-fetch Ceiling filed does not affect the operation of the drive and can be set to 32 or 64. In another value is set, a CHECK CONDITION status is returned with the sense key/ additional sense code set to ILLEGAL REQUEST/Invalid Parameter List.

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

Control Mode Page (0AH)

Table 2-54 Control Mode Page (0AH)

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)		Page Code (0AH)					
1	Page Length (06H)							
2	Reserved (0)							
3	Que Algorithm Modifier[a]				Reserved (0)			DQue
4 - 7	Reserved (0)							

a.For 9.1 and 5.2 Gbyte capacity drives only.

The parameters of the Control Mode Page are all reserved and cannot be changed by the MODE SELECT command.

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

DQue A Disable Queuing bit of 1 indicates that command queuing is disabled.

A Disable Queuing bit of 0 indicates that command queuing is enabled.

NOTE For more information about the use of Byte 3 (Que Algorithm Modifier), see Table 2-34 on page 2-39.

Medium Types

Table 2-55 Medium Types Supported Page 0BH

Byte	7	6	5	4	3	2	1	0
0	PS (1)	Rsvd (0)	Page Code (0BH)					
1	Page Length (06H)							
2	Reserved (0)							
3	Reserved (0)							
4	Medium Type One Supported (02H — Optical Write-once Medium)							
5	Medium Type Two Supported (03H — Optical Erasable Medium)							
6	Medium Type Three Supported (00H)							
7	Medium Type Four Supported (00H)							

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

This page is used to set the medium type(s) supported by the drive. The drive accepts the following combinations:

Table 2-56 Valid Medium Type Combinations

Byte	Field Name	Setting 1 (default)	Setting 2	Setting 3	Setting 4
4	Medium Type 1 Supported	02H	00H	02H	03H
5	Medium Type 2 Supported	03H	00H	00H	00H
6	Medium Type 3 Supported	00H	00H	00H	00H
7	Medium Type 4 Supported	00H	00H	00H	00H

00H Default (rewritable optical disks only)

02H Write-Once optical disks

03H Rewritable optical disks

Vendor Unique

Table 2-57 Vendor Unique Format Page 20H

Byte	7	6	5	4	3	2	1	0
0	PS (1)	Rsvd (0)	Page Code (20H)					
1	Page Length (0AH)							
2	Format Mode							
3-11	Format Type Specific Data							

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

NOTE The drive supports Format Mode 03H and 04H.

Format Mode 03H is for 650-Mbyte optical disks.

Format Mode 04H is for 1.3-, 2.6-, 5.2-, and 9.1-Gbyte optical disks.

Format Mode

Format Mode 03H supports two types of format (type 0 and type 1) by setting byte 3.

Table 2-58 Format Mode 03H - Type 0

Byte	7	6	5	4	3	2	1	0
2	Format Mode (03H)							
3	Type 00H							
4	Size of User Band (MSByte)							
5	Size of User Band							
6	Size of User Band							
7	Size of User Band (LSByte)							
8	Size of Spare Band (MSByte)							
9	Size of Spare Band (LSByte)							
10	Number of Bands (MSByte)							
11	Number of Bands (LSByte)							

Size of User Band The Size of User Band field indicates the length of each user band in number of logical blocks.

Size of Spare Band The Size of Spare Band field indicates the length of each spare band in number of logical blocks.

Number of Bands The Number of Bands field indicates the bands on the disk. The drive can read and write multi-band formatted disks, but can create only single-band disks.

Table 2-59 Format Mode 03H - Type 1

Byte	7	6	5	4	3	2	1	0
2	Format Mode (03H)							
3	Type 01H							
4	Reserved (0)							
5	Reserved (0)							
6	Number of Bands (MSByte)							
7	Number of Bands (LSByte)							
8	Size of Spare Bands (MSByte)							
9	Size of Spare Bands (LSByte)							
10	Reserved (0)							
11	Reserved (0)							

Type 1 format exists for compatibility. An initiator cannot change these parameters.

Number of Bands The Number of Bands field indicates the bands on the disk.

Size of Spare Band The Size of User Band field indicates the length of each spare band in number of logical blocks.

Table 2-60 Format Mode 04H

Byte	7	6	5	4	3	2	1	0
2	Format Mode (04H)							
3-9	Reserved (0)							
10	Number of Bands (MSByte)							
11	Number of Bands (LSByte)							

Number of Bands The Number of Bands field indicates the bands on the disk and can be set to 1 (01H), 16 (10H), 30 (1EH), or 34 (22H).

NOTE The Number of Bands for 9.1 and 5.2 Gbyte Capacity drives include 1 (01H), 16 (10H), 24 (18H), 30 (1EH), 34 (22H), 38 (26H), or 45 (2DH).

Vendor Unique

Table 2-61 Vendor Unique Page 21H

Byte	7	6	5	4	3	2	1	0
0	PS (1)	Rsvd (0)	Page Code (21H)					
1	Page Length (0AH)							
2	Reserved (0)							DAIR
3	DWR	Quick Dis-connect	Rsvd (0)	Force Verify	Reserved (0)			
4	S1-8	S1-7	S1-6	S1-5	S1-4	S1-3	S1-2	S1-1
5	S2-8	S2-7	S2-6	S2-5	S2-4	S2-3	S2-2	S2-1
6	Reserved (0)						DOM	FWC
7-11								

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

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.

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.

Bytes 4 and 5

Bytes 4 and 5 are used to read the setting of the DIP switches on the drive. SX-Y refers to the setting of DIP switch S50X-Y (see Figure 2-1 on page 2-51 and Table 2-44 on page 2-51). If SX-Y=0, the switch is set to the OFF position; if SX-Y=1, the switch is set to the ON position. These fields are not changeable. The switch setting value overrides the saved value.

DOM

A drive operating mode of 0 indicates that the drive is installed in a jukebox environment. A DOM bit of 1 indicates that the drive is installed in a stand-alone environment.

NOTE The DOM bit is not selectable using the Mode Select command.

FWC A Force Write Calibration bit of 1 instructs the drive to perform the Write Calibration routine at spin-up. A Force Write Calibration bit of 0 instructs the drive to perform the Write Calibration routine on receipt of the first Write command or 5 minutes after spin-up.

NOTE The bits DAIR and Force Verify on this mode page can also be controlled in HP products by changing external switch settings. In HP's standalone box products, this is accomplished by changing the thumb wheel settings on the rear of the box. In HP's library products, this is accomplished by changing the front panel settings. In all cases, changes to the mode page settings will override the external switch settings.

Start/Stop Unit Command (1BH)

This command starts or stops rotation of the optical disk in the drive and/or ejects the optical disk from the drive.

Table 2-62 Start/Stop Unit Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (1BH)							
1	Logical Unit Number (0)			Reserved (0)				Immed
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)						LoEj	Start
5	Reserved (0)						Flag	Link

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 0 requests that no action be taken regarding loading or ejecting the media.

A Load Eject bit of 1 indicates that the media will be unloaded if the Start bit is 0.

A Load Eject bit of 1 indicates that the media will be loaded if the Start bit is 1.

NOTE This command is affected by the Prevent/Allow Medium Removal command. 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)

This command requests diagnostic test data resulting from the Send Diagnostic Command be sent to the initiator.

Table 2-63 Receive Diagnostic Results Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (1CH)							
1	Logical Unit Number (0)			Reserved (0)				
2	Reserved (0)							
3	Allocation Length (MSByte)							
4	Allocation Length (LSByte)							
5	Reserved (0)						Flag	Link

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 (10 bytes), whichever is less.

Table 2-64 Received Diagnostic Results Page Codes

Page Code	Maximum Transfer Length	Description
00H	6	Supported Diagnostics Pages (See Table 2-65 on page 2-75)
81H	10	Controller Test (See Table 2-66 on page 2-75)

Table 2-65 Supported Diagnostic Pages

Byte	7	6	5	4	3	2	1	0
0	Page Code (00H)							
1	Reserved (0)							
2	Page Length (0) (MSByte)							
3	Page Length (2) (LSByte)							
4	Supported Page List (00H)							
5	Supported Page List (81H)							

Table 2-66 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	Internal Error Code (MSByte)							
7	Internal Error Code							
8	Internal Error Code							
9	Internal Error Code (LSByte)							

Send Diagnostic Command (1DH)

This command initiates drive diagnostic tests.

NOTE Disconnect must be allowed to run diagnostic tests.

Table 2-67 Send Diagnostic Command CDB

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

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 2-70 on page 2-78)

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 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 self-test.

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 2-68 Supported Diagnostic Pages

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

Table 2-69 Send Diagnostic Command Page Codes

Page Code	Parameter List Length	Description
00H	4	Supported Diagnostics Pages (See Table 2-68 on page 2-77)
81H	12	Controller Test (See Table 2-70 on page 2-78)

Table 2-70 Controller Test

Byte	7	6	5	4	4	2	1	0
0	Page Code (81H)							
1	Reserved							
2	Page Length (0) (MSByte)							
3	Page Length (8) (LSByte)							
4	No Break	Test Number (See Table 2-71 on page 2-78)						
5	Loop Count							
6-11	Reserved (0)							

No Break The No Break bit directs the target not to terminate looping when an error is detected.

Table 2-71 Interface Manager Diagnostic Tests

Diagnostic Test Name	Test Number (hex.)
Selftest	0x01
ROM Checksum Test	0x02
Microprocessor RAM Test	0x03
Buffer RAM Test	0x04
ODC Chip Test	0x05
DSP Communication Test	0x06

Prevent/Allow Medium Removal Command (1EH)

This command prevents or allows removal of an optical disk from a drive.

Table 2-72 Prevent/Allow Medium Removal Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (1EH)							
1	Logical Unit Number (0)			Reserved (0)				
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							Prevent
5	Control Byte (0)						Flag	Link

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 2-62 on page 2-73.

Read Capacity Command (25H)

This command reads the capacity of the optical disk surface in the drive. The last logical block address and block length of the medium are returned.

Table 2-73 Read Capacity Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (25H)							
1	Logical Unit Number (0)			Reserved (0)				RelAdr
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)							PMI
9	Reserved (0)						Flag	Link

PMI A Partial Medium Indicator bit of 1 indicates that the logical block address field does not need to be set to 0.

A PMI bit of 0 indicates that the logical block address field must be set to 0.

Table 2-74 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)

This command reads data from the specified logical block address.

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

Table 2-75 Read (Group 1) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (28H)							
1	Logical Unit Number (0)			DPO	FUA	Reserved (0)		RelAdr
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)					Flag	Link

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.

NOTE The DPO bit is ignored in 9.1 and 5.2 Gbyte capacity drives.

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.

Rel Adr A relative address bit of one indicates that logical block address specified is a two's complement offset from the last logical block address accessed.

A value of 0 indicates that the logical block address is an absolute address.

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

A value of 0 indicates that no blocks will be transferred and is not considered an error.

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 For write-once media, blank checking is performed following a failed read. If the sector is blank, the sense key/additional sense code will be set to BLANK CHECK/Blank Sector Detected.

NOTE When this command is used with 14X 512 or 1024 byte/sector media, setting the PBA bit will cause the drive to return a CHECK CONDITION status. The sense key/additional sense code will be set to ILLEGAL REQUEST/INVALID FIELD in CDB.

Write (Group 1) Command (2AH)

This command is used to write data starting at the specified logical block address.

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

Table 2-76 Write (Group 1) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (2AH)							
1	Reserved (0)			DPO	FUA	EBP	Rsvd (0)	RelAdr
2	Logical Block Address (MSByte)							
3-4	Logical Block Address							
5	Logical Block Address (LSByte)							
6	Reserved (0)							
7	Transfer Length (MSByte)							
8	Transfer Length (LSByte)							
9	PBA	Ers Cntl	Reserved (0)				Flag	Link

NOTE The 9.1 and 5.2 Gbyte capacity drives cannot Format, Erase, Write, or Write and Verify 650 Mbyte and 1.3-Gbyte optical disks. The 2.6 Gbyte capacity drives cannot Format, Erase, Write, or Write and Verify 650 Mbyte optical disks. If this command is issued with any of these drive/media combinations, a CHECK CONDITION status will result with the Sense Key/Additional Sense Code set to Data Protect/Write Protected.

NOTE For Write-Once media, Byte 9, Bit 7 and Bit 6 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.

Rel Adr A relative address bit of one indicates that logical block address specified is a two's complement offset from the last logical block address accessed.

A value of 0 indicates that the logical block address is an absolute address.

EBP An Erase By-Pass bit of 0 indicates 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 transferred for this command.

A value of 0 indicates that no blocks of data will be transferred and is not considered an error.

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.

ErsCntl The Erase Control bit is identical to the Erase Bypass bit.

NOTE For write-once optical disks, blank checking is performed before writing data. If a written block is detected during blank checking, the drive will return a CHECK CONDITION status. The sense key/additional sense code will be set to BLANK CHECK/Overwrite Attempted.

NOTE When this command is used with 14X 512 OR 1024 byte/sector media, setting the ErsCntl bit or the PBA bit will cause the drive to return a CHECK CONDITION status. The sense key/additional sense code will be set to ILLEGAL REQUEST/INVALID FIELD in CDB.

Seek (Group 1) Command (2BH)

This command seeks the optical head to the physical track where the specified logical block exists.

Table 2-77 Seek (Group 1) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (2BH)							
1	Logical Unit Number (0)			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)					Flag	Link

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 When this command is used with 512 byte/sector 14X media or 1024 byte/sector 14X media, setting the PBA bit will cause the drive to return a CHECK CONDITION status. The sense key/additional sense code will be set to ILLEGAL REQUEST/Invalid Field in CDB.

Erase (Group 1) Command (2CH)

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

Table 2-78 Erase (Group 1) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (2CH)							
1	Logical Unit Number (0)			Reserved (0)		ERA	Rsvd (0)	RelAdr
2	Logical Block Address (MSByte)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSByte)							
6	Reserved (0)							
7	Transfer Length (MSByte)							
8	Transfer Length (LSByte)							
9	PBA	Reserved (0)					Flag	Link

NOTE The 9.1 and 5.2 Gbyte capacity drives cannot Format, Erase, Write, or Write and Verify 650 Mbyte and 1.3-Gbyte optical disks. The 2.6 Gbyte capacity drives cannot Format, Erase, Write, or Write and Verify 650 Mbyte optical disks. If this command is issued with any of these drive/media combinations, a CHECK CONDITION status will result with the Sense Key/Additional Sense Code set to Data Protect/Write Protected.

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.

Rel Adr A relative address bit of one indicates that logical block address specified is a two's complement offset from the last logical block address accessed.

A value of 0 indicates that the logical block address is an absolute address.

Transfer Length The Transfer Length field specifies the number of contiguous logical blocks of data to be erased. A value of 0 indicates that no blocks will be erased and is not considered an error.

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 this command is executed for write-once disks, the drive returns a CHECK CONDITION status with the Sense Key/Additional Sense Code set to Illegal Request/Invalid Command Operation Code.

NOTE When this command is executed with 14X 512 or 1024 byte/sector media, the drive will return a CHECK CONDITION status. The sense key/ additional sense code will be set to ILLEGAL REQUEST/INVALID COMMAND.

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.

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

Table 2-79 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	Rsvd (0)	RelAdr
2	Logical Block Address (MSByte)							
3-4	Logical Block Address							
5	Logical Block Address (LSByte)							
6	Reserved (0)							
7	Transfer Length (MSByte)							
8	Transfer Length (LSByte)							
9	PBA	ErsCntl	Reserved (0)				Flag	Link

NOTE The 9.1 and 5.2 Gbyte capacity drives cannot Format, Erase, Write, or Write and Verify 650 Mbyte and 1.3-Gbyte optical disks. The 2.6 Gbyte capacity drives cannot Format, Erase, Write, or Write and Verify 650 Mbyte optical disks. If this command is issued with any of these drive/media combinations, a CHECK CONDITION status will result with the Sense Key/Additional Sense Code set to Data Protect/Write Protected.

NOTE For Write-Once media, Byte 9, Bit 7 and Bit 6 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 suppresses the erase operation.

Transfer Length The Transfer Length field specifies the number of contiguous logical blocks of data to be transferred for this command. A value of 0 indicates that no blocks will be transferred and is not considered an error.

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.

ErsCntl The Erase Control bit is identical to the Erase Bypass bit.

Rel Adr A relative address bit of one indicates that logical block address specified is a two's complement offset from the last logical block address accessed.

A value of 0 indicates that the logical block address is an absolute address.

NOTE When this command is used with 14X 512 OR 1024 byte/sector media, setting the ErsCntl bit or the PBA bit will cause the drive to return a CHECK CONDITION status. The sense key/additional sense code will be set to ILLEGAL REQUEST/INVALID FIELD in CDB.

Verify (Group 1) Command (2FH)

This command 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 2-80 Verify (Group 1) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (2FH)							
1	Logical Unit Number (0)			DPO	Rsvd (0)	Blk Vfy	Rsvd (0)	RelAdr
2	Logical Block Address (MSByte)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSByte)							
6	Reserved (0)							
7	Verification Length (MSByte)							
8	Verification Length (LSByte)							
9	Reserved (0)						Flag	Link

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 for this command. A value of 0 indicates that no blocks will be verified and is not considered an error.

Rel Adr

A relative address bit of one indicates that logical block address specified is a two's complement offset from the last logical block address accessed.

A value of 0 indicates that the logical block address is an absolute address.

Pre-Fetch (34H)

The Pre-Fetch command is used to transfer the specified number of data blocks starting from the specified logical block address to cache memory.

Table 2-81 Pre-Fetch Command

Byte	7	6	5	4	3	2	1	0
0	Operation Code (34H)							
1	Reserved (0)						Immed	RelAdr
2	Logical Block Address (MSByte)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSByte)							
6	Reserved (0)							
7	Transfer Length (MSByte)							
8	Transfer Length (LSByte)							
9	Reserved (0)						Flag	Link

Immed An Immediate bit of 1 indicates that the drive 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.

Transfer Length This field indicates the number of contiguous logical blocks of data to be transferred.

Rel Adr A relative address bit of one indicates that logical block address specified is a two's complement offset from the last logical block address accessed.

A value of 0 indicates that the logical block address is an absolute address.

Synchronize Cache (35H)

This command 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 2-82 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	Reserved (0)						Flag	Link

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)

This command reads optical disk defect information. The data returned starts with a 4-byte header, followed by one or more defect descriptors.

Table 2-83 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	Reserved (0)						Flag	Link

PList and GList A PList bit of 0 and a GList bit of 1 indicates the drive will return the contents of the defect list (SDL).

A PList bit of 1 and a GList bit of 0 indicates the drive will return the contents of the PDL.

A PList bit of 1 and a GList bit of 1 indicates the drive will return the contents of the PDL and the SDL.

Defect List Format This field specifies the defect list format that is returned. Only the Physical Sector Format (5) is supported. If the Block Format (0) is specified, the defect list will be returned in Physical Sector Format and a CHECK CONDITION status will be returned at the completion of the command with the sense key/ additional sense code set to RECOVERED ERROR/ Defect List Not Available.

Allocation Length This field specifies the number of bytes that the initiator has allocated for the return of this data. A length of 0 indicates that no data will be returned. This condition is not considered an error. The drive will terminate the data — in phase when the allocation length has been transferred or when all available defect data has been transferred to the initiator, whichever is less.

Table 2-84 Read Defect Data Defect List Header

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)							

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

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

Defect List Format This field will be set to the Defect List format that was indicated in byte 2 of the CDB, which specifies the format of the Defect List data returned by the drive.

Defect List Length This field specifies the length in bytes of the defect descriptors (see Table 2-85 on page 2-98).

Table 2-85 Physical Sector Format Defect Descriptor

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

Write Buffer Command (3BH)

This command 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.

Table 2-86 Write Buffer Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (3BH)							
1	Logical Unit Number (0)			Reserved (0)		Mode (Table 2-87 on page 2-100)		
2	Buffer ID (See Table 2-87 on page 2-100)							
3	Buffer Offset (MSByte)							
4	Buffer Offset							
5	Buffer Offset (LSByte)							
6	Parameter List Length (MSByte)							
7	Parameter List Length							
8	Parameter List Length (LSByte)							
9	Reserved (0)						Flag	Link

Mode Indicates which data format is used. Refer to Table 2-87 on page 2-100 for valid values.

Buffer ID Indicates which buffer is used. Refer to Table 2-87 on page 2-100 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.

Parameter List Length Indicates the number of data bytes to be written in the buffer.

Table 2-87 Buffer Access Mode and ID

Buffer Type	Buffer ID	Mode
Buffer RAM	0	0
Download Microcode	1	4
Serial Number and Manufacturing Date	4	1
Customer and Product ID	15	1

Table 2-88 Mode Descriptions (For 2.6 Gbyte Capacity Drives Only)

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

Buffer RAM Indicates the data buffer space used for transfer to and from the optical disk.

Download Microcode Indicates the code the drive uses to operate.

Serial Number and Manufacturing Date Code Indicates the drive's serial number and date code, which indicates the week of manufacturing.

Customer and Product ID Indicates the Vendor Identification and Product Identification fields of the INQUIRY command Response Data.

Table 2-89 Mode Descriptions (For 9.1 and 5.2 Gbyte Capacity Drives Only)

Mode	Description
0	Data Mode (same as Mode 2)
1	Vendor specific
2	Data Mode
4	Download Microcode

Read Buffer Command (3CH)

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

Table 2-90 Read Buffer Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (3CH)							
1	Logical Unit Number (0)			Reserved (0)		Mode		
2	Buffer ID							
3	Buffer Offset (MSByte)							
4	Buffer Offset							
5	Buffer Offset (LSByte)							
6	Parameter List Length (MSByte)							
7	Parameter List Length							
8	Parameter List Length (LSByte)							
9	Reserved (0)						Flag	Link

Mode Indicates which data format is to be used. Refer to Table 2-91 on page 2-103 for valid values.

Buffer ID Indicates which buffer is to be used. Refer to Table 2-91 on page 2-103 for valid values.

Buffer Offset Indicates at what address the data should be written, offset from the beginning of the buffer.

Parameter List Length Indicates the number of data bytes to be read from the buffer.

Table 2-91 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 2-92 Buffer Access Mode and ID

Buffer Type	Buffer ID	Mode
Buffer RAM	0	0

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

Table 2-93 Mode Descriptions (For 2.6 Gbyte Capacity Drives Only)

Mode	Description
0	Data retained for subsequent read buffer command

Table 2-94 Mode Descriptions (For 9.1 and 5.2 Gbyte Capacity Drives Only)

Mode	Description
0	Data Mode (same as Mode 2)
2	Data Mode
3	Descriptor Mode

Read Long Command (3EH)

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

Table 2-95 Read Long Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (3EH)							
1	Logical Unit Number (0)			Reserved (0)				RelAdr
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)				Flag	Link

Transfer Length

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

- 4096 media = 4760 bytes (4096 data + 664 pointer, CRC, pad, & ECC) **For 9.1 Gbyte Capacity drives only**.
- 2048 media = 2380 bytes (2048 data + 332 pointer, CRC, pad, & ECC) **For 5.2 Gbyte Capacity drives only.**
- 1K media = 1200 bytes (1024 data + 176 pointer, CRC, pad, &ECC)
- 512 media = 610 bytes (512 data + 98 pointer, CRC, pad, &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 2380 bytes for 2K media, 1200 bytes for 1K media, or 610 bytes for 512 media.

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

Rel Adr

A relative address bit of one indicates that logical block address specified is a two's complement offset from the last logical block address accessed.

A value of 0 indicates that the logical block address is an absolute address.

NOTE

When this command is executed with 14X 512 or 1024 byte/sector media, the drive will return a CHECK CONDITION status. The sense key/ additional sense code will be set to ILLEGAL REQUEST/INVALID COMMAND.

Write Long Command (3FH)

This command 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 2-96 Write Long Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (3FH)							
1	Logical Unit Number (0)			Reserved (0)				RelAdr
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)				Flag	Link

NOTE The 9.1 and 5.2 Gbyte capacity drives cannot Format, Erase, Write, or Write and Verify 650 Mbyte and 1.3-Gbyte optical disks. The 2.6 Gbyte capacity drives cannot Format, Erase, Write, or Write and Verify 650 Mbyte optical disks. If this command is issued with any of these drive/media combinations, a CHECK CONDITION status will result with the Sense Key/Additional Sense Code set to Data Protect/Write Protected.

Transfer Length

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

- 4096 media = 4760 bytes (4096 data + 664 pointer, CRC, pad, & ECC) **For 9.1 Gbyte Capacity drives only**.
- 2048 media = 2380 bytes (2048 data + 332 pointer, CRC, pad, & ECC) **For 5.2 Gbyte Capacity drives only**.
- 1K media = 1200 bytes (1024 data + 176 pointer, CRC, pad, &ECC)
- 512 media = 610 bytes (512 data + 98 pointer, CRC, pad, &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 2380 bytes for 2K media, 1200 bytes for 1K media or 610 bytes 512 media.

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

Rel Adr

A relative address bit of one indicates that logical block address specified is a two's complement offset from the last logical block address accessed.

A value of 0 indicates that the logical block address is an absolute address.

NOTE

If this command is executed for write-once disks, the drive returns a CHECK CONDITION status with the Sense Key/Additional Sense Code set to Illegal Request/Invalid Command Operation Code.

NOTE When this command is executed with 14X 512 or 1024 byte/sector media, the drive will return a CHECK CONDITION status. The sense key/ additional sense code will be set to ILLEGAL REQUEST/INVALID COMMAND.

Log Select Command (4CH)

This command clears drive resident logs.

Table 2-97 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 2-98 on page 2-110)							
9	Reserved (0)						Flag	Link

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 2-99 on page 2-110.

Parameter List Data

Table 2-98 Parameter List Data for Byte 8 of the Log Select Command

Byte	7	6	5	4	3	2	1	0
0	Page Code (Table 2-99 on page 2-110)							
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) (Table 2-99 on page 2-110)							
9	Password Parameter Information							
10	Password Parameter Information							
11	Password Parameter Information (LSByte)							

Table 2-99 Log Select Command

Page Code	Description	Parameter 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

Log Sense Command (4DH)

This command provides a means for the initiator to manage statistical information maintained by the drive.

Table 2-100 Log Sense Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (4DH)							
1	Reserved (0)							
2	PC (01H)		Page Code (See Table 2-101 on page 2-112)					
3	Reserved (0)							
4	Reserved (0)							
5	Parameter Pointer (MSByte) (See Table 2-101 on page 2-112)							
6	Parameter Pointer (LSByte)							
7	Allocation Length (MSByte)							
8	Allocation Length (LSByte)							
9	Reserved (0)						Flag	Link

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 2-101 Log Sense Page Codes

Page Code	Description
00H	Supported Log Pages
02H	Error Counter Page for Write Errors (See Table 2-103 on page 2-113)
03H	Error Counter Page for Read Errors (See Table 2-105 on page 2-114)
05H	Error Counter Page for Verify Errors (See Table 2-107 on page 2-115)
07H	Last n Error Events Page (See Table 2-109 on page 2-116)
33H	Error Counter Page for Erase Errors (See Table 2-112 on page 2-119)
34H	Error Counter Page for Blank Check Errors (See Table 2-114 on page 2-120)

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 use this log page.

Table 2-102 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) (LSByte)							
4	Supported Page List							
n	Supported Page List							

Table 2-103 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) (LSByte)							
4	Parameter Code (MSByte) (See Table 2-104 on page 2-113 or Table 2-106 on page 2-114)							
5	Parameter Code (LSByte)							
6	Reserved (0)							
7	Parameter Length (n-7)							
8	Parameter Value							
n	Parameter Value							

Table 2-104 Parameter Codes/Structure for Write Errors

Param. Code	Length Bytes	Description
1	12	Sectors Corrected with Retries
2	12	Total Number of Retry Attempts
3	12	Total Sectors Corrected
5	14	Total Bytes Processed
6	12	Total Number of Uncorrectable Sectors
0	46	Request for all pages

Table 2-105 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) (LSByte)							
4	Parameter Code (MSByte) (See Table 2-104 on page 2-113 or Table 2-106 on page 2-114)							
5	Parameter Code (LSByte)							
6	Reserved (0)							
7	Parameter Length (n-7)							
8	Parameter Value							
n	Parameter Value							

Table 2-106 Parameter Codes/Structure for Read Errors

Param. Code	Length Bytes	Description
1	12	Sectors Corrected with Retries
2	12	Total Number of Retry Attempts
3	12	Total Sectors Corrected
5	14	Total Bytes Processed
6	12	Total Number of Uncorrectable Sectors
0	46	Request for all pages

Table 2-107 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) (LSByte)							
4	Parameter Code (MSByte) (See Table 2-106 on page 2-114 or Table 2-108 on page 2-115)							
5	Parameter Code (LSByte)							
6	Reserved (0)							
7	Parameter Length (n-7)							
8	Parameter Value							
n	Parameter Value							

Table 2-108 Parameter Codes/Structure for Verify Errors

Param. Code	Length Bytes	Description
1	12	Sectors Corrected with Retries
2	12	Total Number of Retry Attempts
3	12	Total Sectors Corrected
5	14	Total Bytes Processed
6	12	Total Number of Uncorrectable Sectors
0	46	Request for all pages

Table 2-109 Last N Error Events Page 07H

Byte	7	6	5	4	3	2	1	0
0	Rsvd (0)		Page Code (07H)					
1	Reserved (0)							
2	Page Length (n-3) (MSByte)							
3	Page Length (n-3) (LSByte)							
4	Parameter Pointer (MSByte) (See Table 2-110 on page 2-117)							
5	Parameter Pointer (LSByte)							
6	Reserved (0)							
7	Parameter Length (n-7)							
8	Parameter Value							
n	Parameter Value							

Table 2-110 Parameter Pointers/Structure for Last N Error Events Page

Parameter Pointer	Length Bytes	Description
0	10	Number of Events in the Log (Maximum Events = 50 or 250 for 9.1 Gbyte Drives)
1	34	Most Recent Error Event Log (See Table 2-109 on page 2-116 or Table 2-111 on page 2-118)
2	34	Next Most Recent Event (See Table 2-109 on page 2-116 or Table Table 2-111 on page 2-118)
50	34	Least recent Error Event (See Table 2-109 on page 2-116 or Table 2-111 on page 2-118)
. . .	. . .	. . .
0	Up to 1510 for 50 events; up to 7510 for 250 events	Request for all pages

Table 2-111 Error Event Log

Byte	7	6	5	4	3	2	1	0
0	Log Type (1-read, 2-write, 3-erase, 4-verify, 5-blank check, 6-spin-up error, 7-loading error, 8-check condition)							
1	Occurrence 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	UMID Byte 5							
11	UMID Byte 6							
12	UMID Byte 7							
13	UMID Byte 8							
14	Internal Error Code (MSByte)							
15	Internal Error Code							
16	Internal Error Code							
17	Internal Error Code (LSByte)							
18	Logical Block Address (MSByte)							
19	Logical Block Address							
20	Logical Block Address							

Table 2-111 Error Event Log

Byte	7	6	5	4	3	2	1	0
21	Logical Block Address (LSByte)							
22	Physical Block Address (MSByte)							
23	Physical Block Address							
24	Physical Block Address							
25	Physical Block Address (LSByte)							

Table 2-112 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) (LSByte)							
4	Parameter Code (MSByte) (See Table 2-113 on page 2-120 or Table 2-115 on page 2-121)							
5	Parameter Code (LSByte)							
6	Reserved (0)							
7	Parameter Length (n-7)							
8	Parameter Value							
n	Parameter Value							

Table 2-113 Parameter Codes/Structure for Erase Errors

Param. Code	Length Bytes	Description
1	12	Sectors Corrected with Retries
2	12	Total Number of Retry Attempts
3	12	Total Sectors Corrected
5	14	Total Bytes Processed
6	12	Total Number of Uncorrectable Sectors
0	46	Request for all pages

Table 2-114 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 2-115 on page 2-121)							
5	Parameter Code (LSByte)							
6	Reserved (0)							
7	Parameter Length (n-7)							
8	Parameter Value							
n	Parameter Value							

Table 2-115 Parameter Codes/Structure for Blank Check Errors

Param. Code	Length Bytes	Description
1	12	Sectors Corrected with Retries
2	12	Total Number of Retry Attempts
3	12	Total Sectors Corrected
5	14	Total Bytes Processed
6	12	Total Number of Uncorrectable Sectors
0	46	Request for all pages

Mode Select (Group 2) Command (55H)

This command sets optical disk, drive unit, or controller unit parameters.

Table 2-116 Mode Select (Group 2) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (55H)							
1	Logical Unit Number (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)							
8	Parameter List Length (LSByte)							
9	Reserved (0)						Flag	Link

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. The pages are only saved if different from those currently saved.

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

Parameter List Length This field specifies the length in bytes of the MODE SELECT parameter list that the initiator will transfer to the drive during the DATA OUT phase. A length of 0 indicates that no data will be transferred. This condition is not considered an error.

The Mode Select Parameter List contains an 8-byte header followed by 0 or 1 block descriptors, and followed by 0 or more pages (see Table 2-117 on page 2-123).

Table 2-117 Mode Select Header

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Reserved (0)							
2	Medium Type							
3	Reserved (0)							
4	Reserved (0)							
5	Reserved (0)							
6	Block Descriptor Length (MSByte)							
7	Block Descriptor Length (LSByte)							

Medium Type The Medium Type field will be set to 00H (default, only one medium type supported), 02H (write-once optical disks) or 03H (optical reversible or erasable medium).

Block Descriptor Length The Block Descriptor Length specifies the length in bytes of the block descriptor, equal to 0 or 8. A Block Descriptor Length of 0 indicates that no block descriptors are included in the parameter list. This condition is not considered an error.

Table 2-118 Mode Select Block Descriptor

Byte	7	6	5	4	3	2	1	0
0	Density Code							
1	Number of Blocks (MSByte)							
2	Number of Blocks							
3	Number of Blocks (LSByte)							
4	Reserved (0)							
5	Block Length (MSByte)							
6	Block Length							
7	Block Length (LSByte)							

NOTE All fields in the Block Descriptor have no effect on the drive.

Refer to "Mode Sense (Group 0) Command (1AH)" on page 2-54 for detailed information on each page.

Mode Sense (Group 2) Command (5AH)

Table 2-119 Mode Select (Group 2) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (5AH)							
1	Logical Unit Number (0)			Rsvd (0)	DBD	Reserved (0)		
2	PC		Page Code					
3-6	Reserved (0)							
7	Allocation Length (MSByte)							
8	Allocation Length (LSByte)							
9	Reserved (0)						Flag	Link

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

PC Page control defines the type of parameter values to be returned as follows:
00 - Current Values
01 - Changeable Values
10 - Default Values
11 - Saved Values

Page Code Page code values are the same as for the Mode Select (Group 0) command. If the page code is specified as 00H or 3FH, all the pages are returned.

Allocation Length Indicates the number of bytes that the indicator has allocated for return of this data. A length of 0 indicates that no data will be returned. This condition is not considered an error. The drive will terminate the data - in phase when the allocation length has been transferred or when all available data has been transferred to the initiator, whichever is less.

Table 2-120 Mode Sense Header

Byte	7	6	5	4	3	2	1	0
0	Mode Data Length (MSByte)							
1	Mode Data Length (LSByte)							
2	Medium Type							
3	WP	Reserved (0)		Cache (1)	Reserved (0)			
4	Reserved (0)							
5	Reserved (0)							
6	Block Descriptor Length (MSByte)							
7	Block Descriptor Length (LSByte)							

Mode Data Length This field specifies the length in bytes of the MODE SENSE data to follow.

Medium Type The Medium Type field is set to 00H (default, only one medium type is supported), 02H (write-once optical disks), or 03H (rewritable optical disks), depending on the drive condition (00H if no disk or not ready, and 02H or 03H if it is ready to access the disk).

WP A write protect bit of 1 indicates that the optical disk in the drive is 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 storage.

Block Descriptor Length The Block Descriptor Length field specifies the length in bytes of the block descriptor.

Table 2-121 Mode Sense Block Descriptor

Byte	7	6	5	4	3	2	1	0
0	Density Codes							
1	Number of Blocks (MSByte)							
2	Number of Blocks							
3	Number of Blocks (LSByte)							
4	Reserved (0)							
5	Block Length (MSByte)							
6	Block Length							
7	Block Length (LSByte)							

NOTE Descriptions of each page can be found in “Mode Sense (Group 0) Command (1AH)” on page 2-54.

Read (Group 5) Command (A8H)

This command reads data from the specified logical block address.

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

Table 2-122 Read (Group 5) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (A8H)							
1	Logical Unit Number (0)			DPO	FUA	Reserved (0)		RelAdr
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)					Flag	Link

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.

NOTE The DPO bit is ignored in 9.1 and 5.2 Gbyte capacity drives.

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.

Rel Adr A relative address bit of one indicates that logical block address specified is a two's complement offset from the last logical block address accessed.

A value of 0 indicates that the logical block address is an absolute address.

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

A value of 0 indicates that no blocks will be transferred and is not considered an error.

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 For Write-Once optical disks, blank checking is performed following a failed read. If the sector is blank, the sense key/additional sense code will be set to BLANK CHECK/Blank Sector Detected.

NOTE When this command is used with 14X 512 or 1024 byte/sector media, setting the PBA bit will cause the drive to return a CHECK CONDITION status. The sense key/additional sense code will be set to ILLEGAL REQUEST/INVALID FIELD in CDB.

Write (Group 5) Command (AAH)

This command writes data starting at the specified logical block address.

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

Table 2-123 Write (Group 5) Command CDB

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

NOTE For Write-Once media, Byte 11, Bit 7 and Bit 6 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.
Rel Adr	A relative address bit of one indicates that logical block address specified is a two's complement offset from the last logical block address accessed. A value of 0 indicates that the logical block address is an absolute address.
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 indicates the number of contiguous logical blocks to be transferred for this command. A value of 0 indicates that no blocks will be transferred and is not considered an error.
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.
ErsCntl	The Erase Control bit is identical to the Erase Bypass bit.

NOTE The 9.1 and 5.2 Gbyte capacity drives cannot Format, Erase, Write, or Write and Verify 650 Mbyte and 1.3-Gbyte optical disks. The 2.6 Gbyte capacity drives cannot Format, Erase, Write, or Write and Verify 650 Mbyte optical disks. If this command is issued with any of these drive/media combinations, a CHECK CONDITION status will result with the Sense Key/Additional Sense Code set to Data Protect/Write Protected.

NOTE When this command is used with 14X 512 OR 1024 byte/sector media, setting the ErsCntl bit or the PBA bit will cause the drive to return a CHECK CONDITION status. The sense key/additional sense code will be set to ILLEGAL REQUEST/INVALID FIELD in CDB.

NOTE For write-once optical disks, blank checking is performed before writing data. If a written block is detected during blank checking, the drive will return a CHECK CONDITION status. The sense key/additional sense code will be set to BLANK CHECK/Overwrite Attempted.

Erase (Group 5) Command (ACH)

This command 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 2-124 Erase (Group 5) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (ACH)							
1	Logical Unit Number (0)			Reserved (0)		ERA	Rsvd (0)	RelAdr
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)					Flag	Link

NOTE The 9.1 and 5.2 Gbyte capacity drives cannot Format, Erase, Write, or Write and Verify 650 Mbyte and 1.3-Gbyte optical disks. The 2.6 Gbyte capacity drives cannot Format, Erase, Write, or Write and Verify 650 Mbyte optical disks. If this command is issued with any of these drive/media combinations, a CHECK CONDITION status will result with the Sense Key/Additional Sense Code set to Data Protect/Write Protected.

NOTE If this command is executed for write-once disks, the drive returns a CHECK CONDITION status with the Sense Key/Additional Sense Code set to Illegal Request/Invalid Command Operation Code.

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.

Rel Adr A relative address bit of one indicates that logical block address specified is a two's complement offset from the last logical block address accessed.

A value of 0 indicates that the logical block address is an absolute address.

Transfer Length The Transfer Length field specifies the number of contiguous logical blocks of data to be erased for this command. A value of 0 indicates that no blocks will be erased and is not considered an error.

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 When this command is executed with 14X 512 or 1024 byte/sector media, the drive will return a CHECK CONDITION status. The sense key/ additional sense code will be set to ILLEGAL REQUEST/INVALID COMMAND.

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 2-125 Write and Verify (Group 5) CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (AEH)							
1	Logical Unit Number (0)			DPO	Rsvd (0)	EBP	Rsvd (0)	RelAdr
2	Logical Block Address (MSByte)							
3-4	Logical Block Address							
5	Logical Block Address (LSByte)							
6	Transfer Length (MSByte)							
7-8	Transfer Length							
9	Transfer Length (LSByte)							
10	Reserved (0)							
11	PBA	ErsCntl	Reserved (0)				Flag	Link

NOTE For Write-Once media, Byte 11, Bit 7 and Bit 6 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.

EBP	An Erase By-Pass bit of 0 indicates an erase automatically performs before writing the data. An EBP bit of 1 suppresses the erase operation.
Rel Adr	A relative address bit of one indicates that logical block address specified is a two's complement offset from the last logical block address accessed. A value of 0 indicates that the logical block address is an absolute address.
Transfer Length	The Transfer Length field indicates the number of contiguous logical blocks to be transferred for this command. A value of 0 indicates that no blocks will be transferred and is not considered an error.
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.
ErsCntl	The Erase Control bit is identical to the Erase Bypass bit.

NOTE The 9.1 and 5.2 Gbyte capacity drives cannot Format, Erase, Write, or Write and Verify 650 Mbyte and 1.3-Gbyte optical disks. The 2.6 Gbyte capacity drives cannot Format, Erase, Write, or Write and Verify 650 Mbyte optical disks. If this command is issued with any of these drive/media combinations, a CHECK CONDITION status will result with the Sense Key/Additional Sense Code set to Data Protect/Write Protected.

NOTE For write-once optical disks, blank checking is performed before writing data. If a written block is detected during blank checking, the drive will return a CHECK CONDITION status. The sense key/additional sense code will be set to BLANK CHECK/Overwrite Attempted.

NOTE When this command is used with 512 byte/sector 14X media or 1025 byte/sector 14X media, setting the PBA bit or the ErsCntl bit will cause the drive to return a CHECK CONDITION status. The sense key/additional sense code will be set to ILLEGAL REQUEST/Invalid Field in CDB.

Verify (Group 5) Command (AFH)

This command 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 Blk Vfy 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 2-126 Verify (Group 5) CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (AFH)							
1	Logical Unit Number (0)			DPO	Rsvd (0)	Blk Vfy	Rsvd (0)	RelAdr
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)						Flag	Link

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 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.

Rel Adr

A relative address bit of one indicates that logical block address specified is a two's complement offset from the last logical block address accessed.

A value of 0 indicates that the logical block address is an absolute address.

Verification Length

Specifies the number of contiguous logical blocks of data to be verified. A value of 0 indicates that no blocks will be verified and is not considered an error.

Read Defect Data (Group 5) Command (B7H)

This command reads optical disk defect information. The data returned starts with an 8-byte header, followed by one or more defect descriptors.

Table 2-127 Read Defect Data (Group 5) Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (B7H)							
1	Logical Unit Number (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	Reserved (0)						Link	Flag

PList &GList A Primary List bit of 0 and a Grown List bit of 1 indicates the drive will return the contents of the Primary Defect List (PDL) and the Secondary Defect List (SDL).

A PList bit of 1 and a GList bit of 0 indicates the drive will return the contents of PDL.

A PList bit of 1 and a GList bit of 1 indicates the drive will return the contents of the PDL and the SDL.

Defect List Format This field specifies the Defect List Format that is returned. Only the Physical Sector Format (5) is supported. If the Block Format (0) is specified, the defect list will be returned in Physical Sector Format and a CHECK CONDITION status will be returned at the completion of the command with the sense key/ additional sense code set to RECOVERED ERROR/ Defect List Not Available.

Allocation Length Specifies the number of bytes that the initiator has allocated for return of this data. A length of 0 indicates that no data will be returned. This condition is not considered an error. The drive will terminate the data — in phase when the allocation length has been transferred or when all defect data has been transferred to the initiator, whichever is less.

Table 2-128 Read Defect Data Defect List Header

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)							

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 This field will be set to the Defect List Format that was indicated in byte 1 of the CDB, which specifies the format of the Defect List data returned by the drive.

Defect List Length This field specifies the total length in bytes of the defect descriptors (see Table 2-129 on page 2-144).

Table 2-129 Physical Sector Format Defect Descriptor

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

Read Long Command (DEH)

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

Table 2-130 Read Long Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (DEH)							
1	Reserved (0)							RelAdr
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)				Flag	Link

Transfer Length

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

4096 media = 4760 bytes (4096 data + 664 pointer, CRC, pad and ECC). *For 9.1 Gbyte Capacity drives only*.

2048 media = 2380 bytes (2048 data + 332 pointer, CRC, pad, and ECC). *For 5.2 Gbyte capacity drives only*.

1K media = 1200 bytes (1024 data + 176 pointer, CRC, pad, and ECC).

512 media = 610 bytes (512 data + 98 pointer, CRC, pad, and ECC).

All other numbers are rejected unless SC = 1.

Rel Adr

A relative address bit of one indicates that logical block address specified is a two's complement offset from the last logical block address accessed.

A value of 0 indicates that the logical block address is an absolute address.

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 2380 bytes for 2K media, 1200 bytes for 1K media or 610 bytes for 512 media.

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

NOTE When this command is executed with 14X 512 or 1024 byte/sector media, the drive will return a CHECK CONDITION status. The sense key/ additional sense code will be set to ILLEGAL REQUEST/INVALID COMMAND.

Write Long Command (DFH)

This command 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 2-131 Write Long Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (DFH)							
1	Logical Unit Number (0)			Reserved (0)				RelAdr
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)				Flag	Link

NOTE The 9.1 and 5.2 Gbyte capacity drives cannot Format, Erase, Write, or Write and Verify 650 Mbyte and 1.3-Gbyte optical disks. The 2.6 Gbyte capacity drives cannot Format, Erase, Write, or Write and Verify 650 Mbyte optical disks. If this command is issued with any of these drive/media combinations, a CHECK CONDITION status will result with the Sense Key/Additional Sense Code set to Data Protect/Write Protected.

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

4096 media = 4760 bytes (4096 data + 664 pointer, CRC, pad, & ECC). *For 9.1 Gbyte Capacity drives only.*

2048 media = 2380 bytes (2048 data + 332 pointer, CRC, pad, and ECC). *For 5.2 Gbyte capacity drives only.*

1K media = 1200 bytes (1024 data + 176 pointer, CRC, pad, &ECC).

512 media = 610 bytes (512 data + 98 pointer, CRC, pad, &ECC).

All other numbers are rejected unless SC = 1.

Rel Adr A relative address bit of one indicates that logical block address specified is a two's complement offset from the last logical block address accessed.

A value of 0 indicates that the logical block address is an absolute address.

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 2380 bytes for 2048 media, 1200 bytes for 1024 media or 610 bytes for 512 media.

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

NOTE If this command is executed for write-once disks, the drive returns a CHECK CONDITION status with the Sense Key/Additional Sense Code set to Illegal Request/Invalid Command Operation Code.

NOTE When this command is executed with 14X 512 or 1024 byte/sector media, the drive will return a CHECK CONDITION status. The sense key/ additional sense code will be set to ILLEGAL REQUEST/INVALID COMMAND.

3 Jukebox SCSI-2 Command Set

Numerical List of Commands

Table 3-1 Numerical List of Commands

Code (hex.)	Name	Description	Page Number
00H	Test Unit Ready	Checks to determine if the optical library is ready.	3-6
01H	Rezero Unit	Sets the library to a specific predefined state.	3-7
03H	Request Sense	Determines a specific error condition when the library fails to successfully complete a command.	3-8
07H	Initialize Element Status	Checks all elements for media.	3-12
0CH	Rotate Mailslot Command Controls	Controls mailslot rotation.	3-13
12H	Inquiry	Provides vendor, product, and revision information	3-14
16H	Reserve	Reserves the library for use by a single SCSI initiator.	3-18
17H	Release	Releases the library for use by multiple SCSI initiators.	3-20
1AH	Mode Sense	Determines element parameter information	3-21
1CH	Receive Diagnostic Results	Retrieves diagnostic test information resulting from the Send Diagnostic Command	3-33

Table 3-1 Numerical List of Commands

Code (hex.)	Name	Description	Page Number
1DH	Send Diagnostic	Causes the library to perform predefined diagnostic test/exerciser routines.	3-35
1EH	Prevent/Allow Medium Removal	Prevents or allows the manual insertion or removal of media through the mailslot.	3-37
2BH	Position To Element	Positions the specified transport element in front of the specified destination element.	3-38
3BH	Write Buffer Command	Writes data to the jukebox	3-39
3CH	Read Buffer Command	Reads data from the jukebox	3-43
4DH	Log Sense	Retrieves statistical information about the library.	3-47
A5H	Move Medium	Moves media between library elements.	3-64
A6H	Exchange Medium	Exchanges media at the source element address with the destination element address.	3-66
B8H	Read Element Status	Retrieves the status of the storage slots, mailslot, drives, and picker.	3-68

Alphabetical List of Commands

Table 3-2 Alphabetical List of Commands

Code (hex.)	Name	Description	Page Number
A6H	Exchange Medium	Exchanges media at the source element address with the destination element address.	3-66
07H	Initialize Element Status	Checks all elements for media.	3-12
12H	Inquiry	Provides vendor, product, and revision information	3-14
4DH	Log Sense	Retrieves statistical information about the library.	3-47
1AH	Mode Sense	Determines element parameter information	3-21
A5H	Move Medium	Moves media between library elements.	3-64
2BH	Position To Element	Positions the specified transport element in front of the specified destination element.	3-38
1EH	Prevent/Allow Medium Removal	Prevents or allows the manual insertion or removal of media through the mailslot.	3-37
3CH	Read Buffer Command	Reads data from the jukebox.	3-43
B8H	Read Element Status	Retrieves the status of the storage slots, mailslot, drives, and picker.	3-68

Table 3-2 Alphabetical List of Commands

Code (hex.)	Name	Description	Page Number
1CH	Receive Diagnostic Results	Retrieves diagnostic test information resulting from the Send Diagnostic Command	3-33
17H	Release	Releases the library for use by multiple SCSI initiators.	3-20
03H	Request Sense	Determines a specific error condition when the library fails to successfully complete a command.	3-8
16H	Reserve	Reserves the library for use by a single SCSI initiator.	3-18
01H	Rezero Unit	Sets the library to a specific predefined state.	3-7
0CH	Rotate Mailslot Command Controls	Controls mailslot rotation.	3-13
1DH	Send Diagnostic	Causes the library to perform predefined diagnostic test/ exerciser routines.	3-35
00H	Test Unit Ready	Checks to determine if the optical library is ready.	3-6
3BH	Write Buffer Command	Writes data to the jukebox	3-39

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

Test Unit Ready Command (00H)

This command 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 3-3 Test Unit Ready Command CDB

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

Rezero Unit Command (01H)

This command recalibrates the mechanical system and sets the library to a specific predefined state.

Table 3-4 Rezero Unit Command CDB

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

Request Sense Command (03H)

This command determines the specific error condition when the library fails to successfully 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 initiator sends another 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 3-5 Request Sense Command CDB

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

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

Table 3-6 Request Sense Data Parameter Block Format

Byte	7	6	5	4	3	2	1	0
0	Valid	Error Code (70H or 71H)						
1	Reserved (0)							
2	Reserved (0)				Sense Key (Table 3-7 on page 3-10)			
3-6	Information							
7	Additional Sense Length (Table 3-7 on page 3-10)							
8-11	Reserved (0)							
12	Additional Sense Code (Table B-2 on page B-4)							
13	Additional Sense Code Qualifier (Table B-2 on page B-4)							
14	Reserved (0)							
15	SKSV	Sense Key Specific (Table 3-8 on page 3-11)						
16-17	Sense Key Specific							
18-77	Additional Sense Bytes							

Valid A valid bit of "1" indicates the information field contains valid information.

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

Sense Key and Additional Sense Length See Table 3-7 on page 3-10.

Table 3-7 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

Information Contains the Element address in question on an Illegal Request during a 21H or 3BH sense code.

Additional Sense Code The Additional Sense Code specifies detailed information related to the error reported in the Sense Key field. See Table B-2 on page B-4.

Additional Sense Code Qualifier The Additional Sense Code Qualifier specifies detailed information related to the Additional Sense Code. See Table B-2 on page B-4.

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

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 3-8 on page 3-11.

Additional Sense Bytes This field may contain information when the Additional Sense Length field contains a value greater than 10. See Table B-5 on page B-8 and Table B-6 on page B-14.

Table 3-8 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. When a multiple bit field is in error, the pointer points to the most significant bit in the field.

Field Pointer Specifies which byte is 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.

Initialize Element Status Command (07H)

This command 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 3-70 on page 3-68.

Table 3-9 Initialize Element Status Command CDB

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

NOTE This command takes a few minutes to complete

Rotate Mailslot Command (0CH)

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

Table 3-10 Rotate Mailslot Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (0CH)							
1	Logical Unit Number (0)			Reserved (0)				
2	Reserved (0)							
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.

Inquiry Command (12H)

This command requests information describing the type of SCSI device. This information includes the following:

- Vendor ID
- Product ID
- Product revision

Table 3-11 Inquiry Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (12H)							
1	Logical Unit Number (0)			Reserved (0)				EVPD
2	VPD Identifier							
3	Reserved (0)							
4	Allocation Length							
5	Control Byte (0)							

EVPD A 0 in this bit requests Standard Inquiry Information. A 1 in this bit requests the vital product data specified by the VPD identifier field.

VPD Identifier If EVPD is 0, this field should be 0. If EVPD is 1, this field will contain the code for the requested vital product data page (Table 3-12 on page 3-15).

Allocation Length The number of bytes reserved for returned data.

NOTE Vital Product data pages are not supported in “fx” model jukeboxes.

Table 3-12 Vital Product Data Page Codes

Page Code	Description
0	Supported vital product data pages
80H	Unit serial number
C0H	Firmware information page

Inquiry Command Data

Table 3-13 Standard Inquiry Data Format

Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type (08H=Medium Changer).				
1	RMB (1)	Device-Type Qualifier (0)						
2	ISO Version (0)		ECMA Version (0)			ANSI-Approved Version (2)		
3	AENC (0)	TrmIOP (0)	Reserved (0)		Response Data Format (2)			
4	Additional Length (1FH)							
5-7	Reserved (0)							
8-15	Vendor Identification (HP)							
16-31	Product Identification							
32-35	Product Revision Level							

RMB Removable medium bit. When this bit is set to 1, medium is removable.

ANSI and Response Data Format The returned value 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 All unused bytes are filled with a blank space. (ASCII)

Product Identification String All unused bytes are filled with a blank space. (ASCII)

Vital Product Data Pages

Table 3-14 Supported Vital Product Data Pages

Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type (08H)				
1	Page Code (0)							
2	Reserved (0)							
3	Page Length (03H)							
4	0 (this page)							
5	80H (Unit Serial Number Page)							
6	C0H (Firmware Information Page - Vendor Unique)							

Table 3-15 Unit Serial Number Page

Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type (08H)				
1	Page Code (80H)							
2	Reserved (0)							
3	Page Length (0CH)							
4-15	Serial Number (ASCII)							

Table 3-16 Firmware Information Page

Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type (08H)				
1	Page Code (C0H)							
2	Reserved (0)							
3	Page Length (0AH)							
4-7	Controller Firmware Revision (x.xx, ASCII)							
8-13	Controller Firmware Type Code (xxxxxx, ASCII)							

Reserve Command (16H)

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

Table 3-17 Reserve Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (16H)							
1	Logical Unit Number (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.

Third Party Device ID A third party device ID indicates identification of the SCSI device the library is to be reserved for.

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 with a code word byte.

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 a transport device (a picker) or an unused Element Address, a status of CHECK CONDITION, Sense Key = ILLEGAL REQUEST is returned.

Table 3-18 Reserve Command Element List Descriptors

Byte	7	6	5	4	3	2	1	0
0	Reserved (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)

This command releases the library or element for use by another initiator.

Table 3-19 Reserve Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (17H)							
1	Logical Unit Number (0)			3rdPty	Third Party Device ID			Element
2	Reservation Identification							
3	Reserved (0)							
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 code word byte.

Mode Sense Command (1AH)

This command 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 3-20 Mode Sense Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (1AH)							
1	Reserved (0)							
2	PC		Page Code					
3	Reserved (0)							
4	Allocation Length (Table 3-21 on page 3-22)							
5	Control Byte (0)							

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 Valid Page Code values are:

1DH - Element Address Assignment Page (Table 3-22 on page 3-23)

1EH - Transport Element Parameters (Table 3-25 on page 3-25)

1FH - Device Capabilities Page (Table 3-26 on page 3-27 or Table 3-27 on page 3-28)

3FH - All Pages

Allocation Length The number of bytes returned for each page code are shown in the following two tables:

Table 3-21 Mode Sense Allocation Lengths

# of Return Bytes	Page Code	Description	Table
24	1DH	Element Address Assignment	Table 3-22 on page 3-23
8 or 10	1EH	Transport Element Parameters	Table 3-25 on page 3-25
24	1FH	Device Capabilities	Table 3-26 on page 3-27
12	20H	Configuration Parameters	Table 3-28 on page 3-30
62 or 64[a]	3FH	All Pages	

a. All models except the 40fx, 80ex, 125ex and 220mx will run in either single- or double- picker mode. The higher number represents double-picker mode. (Double picker mode is the default mode).

Table 3-22 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) (Table 3-23 on page 3-24)							
8	Number Of Medium Transport Elements (MSByte) (0)							
9	Number Of Medium Transport Elements (LSByte) (Table 3-23 on page 3-24)							
10	First Storage Element Address (MSByte) (0)							
11	First Storage Element Address (LSByte) (Table 3-24 on page 3-24)							
12	Number Of Storage Elements (MSByte) (0)							
13	Number Of Storage Elements (LSByte) (Table 3-24 on page 3-24)							
14	First Import/Export Element Address (MSByte) (0)							
15	First Import/Export Element Address (LSByte) (Table 3-24 on page 3-24)							
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 3-24 on page 3-24)							
22-23	Reserved (0)							

Table 3-23 Number of Transport Elements

Transport Mode[a]	First Transport Address	# of Transport Elements
Dual Picker Mode	16	2
Single Picker Mode	0	1

a.All models except the 40fx, 80ex, 125ex and 220mx will run in either single-or double-picker mode. All other jukebox models run in single-picker mode only.

Table 3-24 Number of Data Transfer Elements

Model	First Storage Address	Storage Elements	First Import Address	Data Transfer Elements
40fx	11	16	10	1 or 2
80fx	31	32	20	2
160fx	31	64	20	4
200fx	31	76	20	2
330fx	31	128	20	4 or 6
600fx	31	238	20	6,8,10,12
80ex	11	16	10	1 or 2
160ex	31	32	20	2
320ex	31	64	20	4
400ex	31	76	20	2
660ex	31	128	20	4 or 6
1200ex	31	238	20	4, 6, or 10

Transport Element (Picker)

Table 3-25 Mode Sense Transport Element Parameter Page (1EH) Format

Byte	7	6	5	4	3	2	1	0
0	Sense Data Length (7) or (9)[a]							
1	Reserved (0)							
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)		Page Code (1EH)					
5	Parameter Length (02H) or (04H)							
6	Reserved (0)							Rotate (1)
7	Member Number In Transport Element Set (0)							
8	Reserved (0)							Rotate (1)
9	Member Number In Transport Element Set (1)							

a. All models except the 40fx, 80ex, 125ex and 220mx will run in either single- or double-picker mode. All other jukebox models run in single-picker mode only. In single picker mode 7 bytes will be returned; in dual-picker mode 9 bytes will be returned.

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.

The following abbreviations are used in the field names of the following two tables:

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

Table 3-26 Mode Sense Device Capabilities Page (1FH)[a]

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 (0)
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 (1)	MT<>IE (0)	MT<>ST (1)	MT<>MT (0)
17	Reserved (0)				ST<>DT (1)	ST<>IE (1)	ST<>ST (1)	ST<>MT (0)
18	Reserved (0)				IE<>DT (1)	IE<>IE (0)	IE<>ST (1)	IE<>MT (0)
19	Reserved (0)				DT<>DT (1)	DT<>IE (1)	DT<>ST (1)	DT<>MT (0)
20-23	Reserved (0)							

a. This table applies to all jukeboxes, EXCEPT the 40fx, 80ex, 125ex and 220mx models.

Table 3-27 Mode Sense Device Capabilities Page (1FH)[a]

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 (0)
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 (1)	MT<>IE (0)	MT<>ST (1)	MT<>MT (0)
17	Reserved (0)				ST<>DT (1)	ST<>IE (1)	ST<>ST (1)	ST<>MT (0)
18	Reserved (0)				IE<>DT (1)	IE<>IE (0)	IE<>ST (1)	IE<>MT (0)
19	Reserved (0)				DT<>DT (1)	DT<>IE (1)	DT<>ST (1)	DT<>MT (0)
20-23	Reserved (0)							

a. This table applies ONLY to the 40fx, 80ex, 125ex and 220mx models.

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 3-68 on page 3-64 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 3-69 on page 3-66 for additional information on the Exchange Medium Command.

Table 3-28 Autochanger Configuration Mode Page (20H)

Byte	7	6	5	4	3	2	1	0
0	Sense Data Length (11)							
1-3	Reserved (0)							
4	Reserved (0)		Page Code (20H)					
5	Page Length (06H)							
6	Recovery	Dual Picker	Starwars / Bump Check	Secure	Secure Mail In/Out	Power Secure	Report Recovered	Write Verify
7	Slots 230-238	Mail In/Out	Mail Rotation	Reserved (0)				
8	Reserved (0)							
9	SCSI Log	Conf 40	No Break on Fail	Reserved (0)				
10	Reserved (0)							
11	Reserved (0)							

This Mode Page provides information on the state of the autochanger's configuration options. Page control requests for Current and Saved values return the same values. Requests for changeable values return all zeros because none of these values are changeable through a Mode Select. Requests for Default values return the Default values.

The following lists the correspondences between fields of this Page and the control panel options on the jukeboxes.

NOTE

"Large Jukebox" in the following list means Models 330fx, 600fx, 660fx, 1200ex, 1200mx, and 2200mx.

"Medium Jukebox" in the following list means Models 80fx, 160fx, 200fx, 160ex, 320ex, 400ex, 300mx, 600mx, and 700mx.

"Small Jukebox" in the following list means Models 40fx and 80ex, 125ex, and 220mx.

Recovery
Large Jukebox: RECOVERY ON/OFF (1 = ON)
Medium Jukebox: RECOVERY ON/OFF (1 = ON)
Small Jukebox: CONFIG 21 ON/OFF (1 = ON)

Dual Picker
Large Jukebox: DUAL PICKER ON/OFF (1 = ON)
Medium Jukebox: DUAL PICKER ON/OFF (1 = ON)
Small Jukebox: Reserved (0)

Starwars
Large Jukebox: STARWARS ON/OFF (1 = ON)
Medium Jukebox: STARWARS ON/OFF (1 = ON)
Small Jukebox: CONFIG 42 ON/OFF (1 = ON)

Secure
Large Jukebox: SECURE ON/OFF (1 = ON)
Medium Jukebox: SECURE ON/OFF (1 = ON)
Small Jukebox: CONFIG 15 ON/OFF (1 = ON)

Secure Mail In/Out
Large Jukebox: Reserved (0)
Medium Jukebox: SECURE MAIL IN/OUT (1 = IN)
Small Jukebox: CONFIG 31 ON/OFF (1 = ON)

Power Secure
Large Jukebox: POWER SECURE ON/OFF (1 = ON)
Medium Jukebox: POWER SECURE ON/OFF (1 = ON)
Small Jukebox: CONFIG 20 ON/OFF (1 = ON)

Report Recovered
Large Jukebox: REP RECOVERED ON/OFF (1 = ON)
Medium Jukebox: REP RECOVERED ON/OFF (1=ON)
Small Jukebox: CONFIG 27 ON/OFF (1 = ON)

Write Verify
Large Jukebox: WRITE VERIFY ON/OFF (1 = ON)
Medium Jukebox: WRITE VERIFY ON/OFF (1 = ON)
Small Jukebox: CONFIG 41 ON/OFF (1 = ON)

Slots 230-238	Large Jukebox: SLOTS 230-238 ON/OFF (1 = ON) Medium Jukebox: Reserved (0) Small Jukebox: Reserved (0)
Mail In/Out	Large Jukeboxes DOOR OPEN/CLOSED 1=CLOSED Medium Jukebox: Reserved (0) Small Jukebox: Reserved (0)
Mail Rotation	Large Jukebox: Reserved (0) Medium Jukebox: Reserved (0) Small Jukebox: CONFIG 32 ON/OFF (1 = ON)
SCSI Log	Large Jukebox: SCSI LOG ON/OFF (1 = ON) Medium Jukebox: SCSI LOG ON/OFF (1 = ON) Small Jukebox: Reserved (0)
Conf 40	Large Jukebox: CONF40 ON/OFF (1 = ON) Medium Jukebox: CONF40 ON/OFF (1 = ON) Small Jukebox: CONF40 ON/OFF (1 = ON)
No Break on Fail	Large Jukebox: Reserved (0) Medium Jukebox: Reserved (0) Small Jukebox: CONFIG 8 ON/OFF (1 = ON)

Receive Diagnostic Results Command (1CH)

This command retrieves the results of a library diagnostic test performed using the Send Diagnostic Command (Table 3-31 on page 3-35). The diagnostic test number and parameters, error codes, and FRU information are provided.

NOTE The following tables provide information that 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 3-29 Receive Diagnostic Results Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (1CH)							
1	Logical Unit Number (0)				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 3-30 Receive Diagnostic Results Command CDB

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

Hardware Error Code Code is generated only if an unrecoverable error occurs (See Table B-7 on page B-19).

FRU 1 The FRU most likely to be at fault (See Table C-1 on page C-2 or Table C-2 on page C-4).

FRU 2 The second most likely FRU to be at fault. (See Table C-1 on page C-2 or Table C-2 on page C-4).

FRU 3 The third most likely FRU to be at fault (See Table C-1 on page C-2 or Table C-2 on page C-4).

Test Number The diagnostic test number. This will not be a sequence number, but the specific test that failed. Refer to Table B-12 on page B-40 for a list of the jukebox diagnostic tests.

Parameters Additional parameters as defined for individual tests.

There may be several like components in a unit. 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)

This command causes the library to perform certain predefined diagnostic test/exercise routines.

The Request Sense (Table 3-5 on page 3-8) and the Receive Diagnostic Results (Table 3-29 on page 3-33) commands can be used to get the results of a test.

Table 3-31 Send Diagnostic Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (1DH)							
1	Logical Unit Number (0)			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 3-32 on page 3-36.

Send Diagnostic Command Data

Table 3-32 Send Diagnostic Command Parameter List

Byte	7	6	5	4	3	2	1	0
0	Test Number							
1	Break	Loop Count Identifier						
2	Parameters							
3	Parameters							
4	Parameters							
5	Parameters							
6	Parameters							
7	Parameters							
8	Parameters							
9	Parameters							

Test Number Diagnostic test number. See Table B-12 on page B-40 or Table B-13 on page B-44 for a list of the jukebox 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.

Prevent/Allow Medium Removal Command (1EH)

This command either prevents or allows users to insert or remove optical disks using the mailslot.

Table 3-33 Prevent/Allow Medium Removal Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (1EH)							
1	Logical Unit Number (0)			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 an optical disk. A prevent bit of 0 allows removal of an optical disk. Default is 0.

Position To Element Command (2BH)

This command positions the specified transport element in front of the specified destination element.

Table 3-34 Position To Element Command CDB

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

Transport Element Address The default address of zero is the best address for use. (Changing from the default could result in a decrease in jukebox performance.) However, this field can also be set to a specific transport element address (see Table 3-22 on page 3-23).

Destination Element Address See Table 3-22 on page 3-23 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)

This command writes data to the jukebox.

CAUTION

Incorrect use of this command may cause an overwrite of critical information needed for the jukebox to operate. If this occurs, call service.

Only Buffer IDs listed in Table 3-37 on page 3-40 are intended for use outside of the factory.

Table 3-35 Write Buffer Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (3BH)							
1	Logical Unit Number (0)			Reserved (0)		Mode (See Table 3-37 on page 3-40)		
2	Buffer ID (Table 3-37 on page 3-40)							
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 3-37 on page 3-40 for valid values.

Buffer ID Indicates which buffer is used. Refer to Table 3-37 on page 3-40 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 3-36 Write Buffer Mode Descriptions

Mode	Description
1	Vendor specific
4	Download microcode
5	Download microcode

Table 3-37 User Accessible Buffers and Allowed Write Modes

User-Accessible Buffers	Buffer ID	Allowed Write Modes
Download Microcode (FLASH EPROM)	1	4,5
Customer and Product ID (NVRAM)	15	1
Online Drive Repair ID	128	1

NOTE Additional buffer IDs are for factory use only and are subject to change without notice.

Table 3-38 Write Buffer Data Format When Buffer ID Set to Online Drive Repair

Byte	Description
0	Drive 1 Control
1	Drive 2 Control
2	Drive 3[a] Control
3	Drive 4[a] Control
4	Drive 5[a] Control
5	Drive 6[a] Control
6	Drive 7[a] Control
7	Drive 8[a] Control
8	Drive 9[a] Control
9	Drive 10[a] Control
10	Drive 11[a] Control
11	Drive 12[a] Control
12	Reserved
13	Reserved
14	Reserved
15	Reserved

a.Model dependent

Table 3-39 Drive Control Definition

Byte	Description
00	No change to the drive state.
01	Set drive to "Online_good" state.
04	Set drive to "Offline_failed" state.
06	Set drive to "Offline_good" state.

Read Buffer Command (3CH)

This command reads data from the jukebox.

NOTE Only the Buffer IDs listed in Table 3-42 on page 3-44 are intended for use outside of the factory.

Table 3-40 Read Buffer Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (3CH)							
1	Logical Unit Number (0)			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 Table 3-41 on page 3-44 for valid values.

Buffer ID Indicates which buffer is to be used. Refer to Table 3-41 on page 3-44 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).

NOTE Additional Buffer IDs are for factory use only and are subject to change without notice.

Table 3-41 Read Buffer Mode Descriptions

Mode	Description
1	Vendor specific

Table 3-42 User Accessible Buffers and Allowed Read Modes

User-Accessible Buffers	Buffer ID	Allowed Read Modes
Online Drive Repair ID	128	1

Table 3-43 Read Buffer Data Format When Buffer ID Set to Online Drive Repair

Byte	Description
0	Drive 1 Status
1	Drive 2 Status
2	Drive 3[a] Status
3	Drive 4[a] Status
4	Drive 5[a] Status
5	Drive 6[a] Status
6	Drive 7[a] Status
7	Drive 8[a] Status
8	Drive 9[a] Status
9	Drive 10[a] Status
10	Drive 11[a] Status
11	Drive 12[a] Status
12	Reserved
13	Reserved
14	Reserved
15	Reserved

a.Model dependent

Table 3-44 Drive Status Definition

Byte	Status	Description
00	Drive is not valid	
01	Online_good	The drive is online and in a good state. This is the normal state. All accesses allowed.
02	Online_pending	The drive is offline and ready to go to the "Online_good" state. No accesses allowed.
04	Offline_failed	The drive is offline and in a failed state. No accesses allowed. No power is applied to the drive.
05	Offline_good_pending	The drive is online but requesting to go the "Offline_good" state. All accesses allowed.
06	Offline_good	The drive is offline but is not in a failed state. No accesses allowed. No power is applied to the drive.

Log Sense Command (4DH)

This command retrieves statistical library information maintained by the jukebox.

Table 3-45 Log Sense Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (4DH)							
1	Logical Unit Number (0)			Reserved (0)				
2	Reserved (0)		Page Code (Table 3-46 on page 3-48)					
3	Reserved (0)							
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 3-46 on page 3-48.

Log Sense Parameter Data

Parameter data returned by the Log Sense Command is organized into pages. The parameter data available in each page is described in Table 3-46 on page 3-48.

Table 3-46 Log Sense Parameter Data Available in Each Page

Page Code	Length Bytes[a]	Length Bytes[b]	Description
0	16	16	List of supported pages
30H	510	366	Error log (Table 3-47 on page 3-49)
31H	72	NS[c]	Move Success log (Table 3-51 on page 3-53)
32H	varied	NS	Force log (Table 3-53 on page 3-54)
33H	406	366	Recovery log (Table 3-54 on page 3-55)
34H	204	204	Regression (vendor unique)
35H	14-44	24-44	Drive log [d] (Table 3-58 on page 3-57)
36H	6	NS	Byte 0 = Version #; Byte 1 = Revision #
37H	24	24	The Odometer log (Table 3-60 on page 3-58)
38H	116	366	Run-Time log (Table 3-61 on page 3-59)
39H	108	NS	Retry log (Table 3-64 on page 3-61)
3AH	52	NS	Move History log (Table 3-66 on page 3-63)
3BH	72	164-340	Mechanism Parameters (factory use only)
3CH	8	8	PROM Information (factory use only)
3DH	204	NS	Alternate Regression (factory use only)

a. This column ONLY applies to the 40fx, 80ex, 125ex and 220mx.
b. This column applies to all models, EXCEPT 40fx, 80ex, 125ex and 220mx.
c. If "NS" appears in this field, the log is not supported for all models, EXCEPT 40fx, 80ex, 125ex and 220mx.
d. 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 that contains the page number, a reserved byte, and the length of the data to follow the header. (Refer to the following example.)

Error Logs Table Format

This table is accessed using the Log Sense Command (4DH), Table 3-45 on page 3-47 with page code 30H. It records hard errors that occur during normal operation of the jukebox.

This log may be initialized before exerciser 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.

Table 3-47 Error Logs Table Format [a]

Byte #	Description
0	Page Code 30H
1	Reserved = 0
2	Number of bytes to follow (MSByte)
3	Number of bytes to follow (LSByte)
4	Current Entry
5	Number of Entries
6-366	Array of 10 log entries (36 Bytes each)

a. This table applies to all models, EXCEPT 40fx, 80ex, 125ex and 220mx.

Table 3-48 Error/ Recovery/Runtime Log Data Entry Format

Byte	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Hardware Error Code (Table B-7 on page B-19)							
2	FRU 1 (Table C-1 on page C-2)							
3	FRU 2 (Table C-1 on page C-2)							
4	FRU 3 (Table C-1 on page C-2)							
5	Command Attempted							
6-7	Source Element Number							
8-9	Destination Element Number							
10-11	Second Destination Element Number							
12-16	Micro-Move ID History (Table Table D-1 on page D-2)							
17	Failed Micro-Move ID (Table D-1 on page D-2)							
18	Failed Micro-Move Error Code (Table B-10 on page B-32)							
19	Active Picker	Active Thumb	Reserved (0)					
20-21	Vertical Motor Commanded Position							
22-23	Vertical Motor Actual Position							
24-25	Plunge Motor Commanded Position							
26-27	Plunge Motor Actual Position							
28-29	Translate Motor Commanded Position							
30-31	Translate Motor Actual Position							
32-35	Odometer							

Table 3-49 Error Logs Table Format (For 40fx, 80ex, 125ex and 220mx models ONLY)

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 the log
8-9	Log entry currently being displayed
10-509	Array of 50 log entries (10 bytes each) See Table 3-50 below.

Table 3-50 Error Log Entry Format (For 40fx, 80ex, 125ex and 220mx models only)

Byte	7	6	5	4	3	2	1	0
0	Diagnostic User Number							
1	Hardware Error Code (Table B-7 on page B-19)							
2	FRU 1 (Table C-1 on page C-2)							
3	FRU 2 (Table C-1 on page C-2)							
4	FRU 3 (Table C-1 on page C-2)							
5	Test Number							
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 C).
FRU 2	The second most likely FRU to be at fault. (See Appendix C).
FRU 3	The third mostly likely FRU to be at fault. (See Appendix C).
Test Number	The diagnostic test number. See Table B-12 on page B-40 for a list of diagnostic tests.
Time Stamp	Indicates when the error occurred (measured in hours since the odometer was initialized).

NOTE The FRU numbers returned indicate the most likely cause of the error, but these FRUs might not be the actual cause of the problem.

Move Success Log Table Format

NOTE This log is ONLY supported on the 40fx and 80ex models.

This table can be accessed via the Log Sense Command (4DH), Table 3-45 on page 3-47 with page code 31H. The Move Success Log is intended for use during normal jukebox operation, not diagnostic operation.

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

Table 3-51 Move Success Log Table Format (For 40fx, 80ex, 125ex and 220mx models ONLY)

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 the 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 (Table 3-52 on page 3-53

NOTE Hard errors are unrecoverable and generate a hardware error code. Soft errors are recoverable with normal operation continuing after recovery.

Table 3-52 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

NOTE This log is ONLY supported on 40fx and 80ex models.

This table can be accessed via the Log Sense Command (4DH), Table 3-45 on page 3-47) 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 3-53 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 D-1 on page D-2 or Table D-2 on page D-17)
6-7	Z-axis maximum force for the Micro-Move ID (Table D-1 on page D-2 or Table D-2 on page D-17)

Recovery Log Data Format

This table can be accessed via the Log Sense Command (4DH), Table 3-45 on page 3-47, with page code 33H. It records soft errors and related information on error recovery method and success.

It is reset to 0 before any jukebox 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 3-54 Recovery Log Data Format (For all models EXCEPT 40fx, 80ex, 125ex and 220mx)

Byte	Description
0	Page Code 33H
1	Reserved = 0
2	Number of bytes to follow (MSByte)
3	Number of bytes to follow (LSByte)
4	Current Entry
5	Number of Entries
6-366	Array of 10 log entries (36 Bytes each) (See Table 3-48 on page 3-50)

Table 3-55 Recovery Log Data Format (For the 40fx, 80ex, 125ex and 220mx models ONLY)

Byte	Description
0	Page Code 33H
1	Reserved = 0
2-3	Number of bytes to follow
4-5	Current entry number (range 1 - 20)
5	Number of Entries
6-405	20 recovery log entries, 20 bytes each (See Table 3-56 on page 3-56)

Table 3-56 Recovery Log Entry Format (For the 40fx, 80ex, 125ex and 220mx models ONLY)

Byte	Description
0	Macro-Move ID (Table D-1 on page D-2)
1	Error Recovery State (Table 3-57 on page 3-56)
2	Micro-Move ID (Table D-2 on page D-17)
3	Micro-Move Error Code (Table B-10 on page B-32)
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 from the encoder

Table 3-57 Error Recovery State (For the 40fx, 80ex, 125ex and 220mx models ONLY)

Byte	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 3-45 on page 3-47 with page code 35H. It records the number of times a drive is used by the jukebox.

Table 3-58 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, seeTable 3-24 on page 3-24)
24-33	Log entry for Drive # (Model dependent, see Table 3-24 on page 3-24)
34-43	Log entry for Drive #4 (Model dependent, see Table 3-24 on page 3-24)

Table 3-59 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

Odometer Log Data Format

This table can be accessed via the Log Sense Command (4DH), Table 3-45 on page 3-47 with page code 37H. It counts the number of times various types of moves are completed. An exchange is counted as two moves.

Table 3-60 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
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 3-45 on page 3-47 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.

Table 3-61 Run-Time Logs Data Format (For all models, EXCEPT 40fx, 80ex, 125ex and 220mx)

Byte	Description
0	Page Code 38H
1	Reserved = 0
2	Number of bytes to follow (MSByte)
3	Number of bytes to follow (LSByte)
4	Current Entry
5	Number of Entries
6-366	Array of 10 log entries (36 Bytes each)

Table 3-62 Run-Time Logs Data Format (For the 40fx, 80ex, 125ex and 220mx models ONLY)

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

Table 3-62 Run-Time Logs Data Format (For the 40fx, 80ex, 125ex and 220mx models ONLY)

Byte	Description
15	Number of the most current entry
16-115	10 Run-time log entries, 10 bytes each (See Table 3-63)

Table 3-63 Run-Time Log Entry Format

Byte	Description
0-3	Number of Macro-Move IDs since this log was reset
4	Macro-Move ID
5	Number of entries in Recovery Log when the entry was made
6	First Micro-Move ID in the Recovery Log (Table D-1 on page D-2 or Table D-2 on page D-17)
7	First Micro-Move Error Code in the Recovery Log (Table B-10 on page B-32)
8	Second Micro-Move ID in Recovery Log (Table D-1 on page D-2 or Table D-2 on page D-17)
9	Second Micro-Move Error Code in Recovery Log (Table B-10 on page B-32)

Retry Log Data Format

NOTE This log is ONLY supported on the 40fx, 80ex, 125ex and 220mx models.

This table can be accessed via the Log Sense Command (4DH), Table 3-45 on page 3-47, 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 3-64 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 3-65 on page 3-62)
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 jukebox was built), and the second word is the cumulative number of Major Retries (since the jukebox 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 3-65 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 3-24 on page 3-24 for the actual number of drives within a specific jukebox.

Move History Log Data Format

NOTE This log is ONLY supported on the 40fx, 80ex, 125ex and 220mx models.

This table can bee accessed via the Log Sense Command (4DH), Table 3-45 on page 3-47 with page code 3AH.

Table 3-66 Move History Log Data Format

Byte	Description
0	Page Code 3AH
1	Reserved = 0
2-3	Number of bytes to follow
4-83	6 History Log entries, 8 bytes each (see

Table 3-67 Move History Log Entry Format

Byte	Description
0	Least recent Micro-Move ID (Table D-2 on page D-17)
1	Next recent Micro-Move ID (Table D-2 on page D-17)
2	Next recent Micro-Move ID (Table D-2 on page D-17)
3	Next recent Micro-Move ID (Table D-2 on page D-17)
4	Next recent Micro-Move ID (Table D-2 on page D-17)
5	Failed Micro-Move ID (Table D-2 on page D-17)
16	Micro-Move Error Code (Table B-10 on page B-32)
7	Reserved (0)

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

Move Medium Command (A5H)

NOTE This command moves optical disks between library elements.

Table 3-68 Move Medium Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (A5H)							
1	Logical Unit Number (0)			Reserved (0)				
2	Transport Element Address (MSByte)							
3	Transport Element Address (LSByte)							
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)							

Transport Element Address The default address of zero is the best address for use. (Changing from the default could result in a decrease in jukebox performance.) However, this field can also be set to a specific transport element address (see Table 3-22 on page 3-23).

Source/Destination Element Address See Table 3-22 on page 3-23 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.

Exchange Medium Command (A6H)

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.

Table 3-69 Exchange Medium Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (A6H)							
1	Logical Unit Number (0)			Reserved (0)				
2	Transport Element Address (MSByte)							
3	Transport Element Address (LSByte)							
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)							

Transport Element Address The default address of zero is the best address for use. (Changing from the default could result in a decrease in jukebox performance.) However, this field can also be set to a specific transport element address (see Table 3-22 on page 3-23).

Source/Destination Element Address — See Table 3-22 on page 3-23 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.

Read Element Status Command (B8H)

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

Table 3-70 Read Element Status Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (B8H)							
1	Logical Unit Number (0)			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 type(s) to report.

0H - All element types reported

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 3-71 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 Report Available The number of bytes of element status page data available.

Element Type Code 1H - Picker

Table 3-72 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.

Full When set to 1, the element contains a cartridge.

Element Type Code 2H - Storage Slot

Table 3-73 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 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.

Full When set to 1, the element contains a cartridge.

Element Type Code 3H - Mailslot

Table 3-74 Read Element Status Import/Export 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)		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 jukebox is enabled.

ExEnab When set to 1, Export from the jukebox 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.
Imp/Exp	When set to 1, the operator inserted the cartridge into the mailslot. When set to 0, the jukebox mechanism puts the cartridge in the mailslot.
Full	When set to 1, the element contains a cartridge.

Element Type Code 4H - Drive

Table 3-75 Read Element Status Data Transfer Element Descriptor Block

Byte	7	6	5	4	3	2	1	0
0	Element Type Code (4H)							
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)							
12	Additional Sense Code (See Table B-2 on page B-4)							
13	Additional Sense Code Qualifier (See Table B-2 on page B-4.)							
14	Not Bus	Reserved (0)	ID Valid	LU Valid	Reserved (0)	Logical Unit Number		
15	SCSI Bus Address							
16	Reserved (0)							
17	SValid	Invert	Reserved (0)					
18	Source Storage Element Address (MSByte)							
19	Source Storage Element Address (LSByte)							

Table 3-75 Read Element Status Data Transfer Element Descriptor Block

Byte	7	6	5	4	3	2	1	0
20-23[a]	Reserved (0)							
24-33[a]	Drive Serial Number (ASCII)							

a. These fields are applicable for the 300mx, 600mx, 700mx, 1200mx and 2200mx models only.

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 B-2 on page B-4)

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 on the SCSI Bus used to select the library.

IDValid	When set to 1, the SCSI Bus Address field contains valid information.
LUValid	When set to 1, the logical unit number field contains valid information.
Logical Unit Number	If valid, provides the logical unit number within the SCSI bus address of the device served by the jukebox at this element.
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.

A Drive Error Codes

Chapter Overview

This chapter contains the following information:

- Request Sense Command sense key values
- Request Sense Command additional sense code values
- Internal Error Codes
- DSP Error Codes

Drive Request Sense Command Values

The Request Sense Command (see Table 2-6 on page 2-10) returns values for the Sense Key and Additional Sense Code.

Drive Request Sense - Sense Key Values

Table A-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 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.

Table A-1 Request Sense - Sense Key Values Byte 2, Bits 3 through 0

Sense Key	Name	Abbrev.	Description
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.
8H	Blank Check	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	Indicates that the drive aborted the last command. The initiator may be able to recover by attempting the command again.

Request Sense - Additional Sense Code Values

Bytes 12 and 13

Table A-2 Request Sense - Additional Sense Code Values

Sense Code and Qualifier	Sense Key	Description
00 00	0H - NS	No Additional Sense Information
03 00	4H - HE	Write Fault, Write Command Failed
04 00	2H - NR	Drive Not Ready
04 01	2H - NR	LUN in Process of Becoming Ready
04 02	2H - NR	LUN Not Ready, Initializing Command Required
04 04	2H - NR	LUN Not Ready, Format in Progress
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	3H - ME	ID CRC or ECC Error
11 00	3H - ME	Unrecovered Read Error
15 00	4H - HE	Random Positioning Error
16 00	3H - ME	Data Synchronization Mark Error
18 00	1H - RE	Recovered Read Data With ECC Procedure
18 01	1H - RE	Recovered Data with Error Correction and Retries
19 01	1H - RE	Defect List Not Available

Table A-2 Request Sense - Additional Sense Code Values

Sense Code and Qualifier	Sense Key	Description
1A 00	5H - IR	Parameter List Length Error
1B 00	4H - HE	Synchronous Data Transfer Error
1C 00	3H - ME	Defect List Not Found
1C 01	3H - ME	Primary Defect List Not Found
1C 02	3H - ME	Grown Defect List Not Found
20 00	5H - IR	Invalid Command Operation Code
21 00	5H - IR	Logical Block Address out of Range
24 00	5H - IR	Invalid Field In CDB
25 00	5H - IR	LUN Not Supported
26 00	5H - IR	Invalid Parameter List
26 01	5H - IR	Parameter Not Supported
26 02	5H - IR	Parameter Value Invalid
27 00	7H - DP	Write Protected
28 00	6H - UA	Medium Changed
29 00	6H - UA	Power-On, Reset or Bus Device Reset Occurred
2A 00	6H - UA	Mode Select Parameters Changed
2F 00	6H - UA	Command Cleared by Another Initiator
30 00	3H - ME	Incompatible Cartridge
31 00	3H - ME	Medium Format Corrupted
32 00	3H - ME	No Defect Spare Location Available
32 01	3H - ME	Defect List Update Error

Table A-2 Request Sense - Additional Sense Code Values

Sense Code and Qualifier	Sense Key	Description
39 00	5H - IR	Saving Parameters Not Supported
3A 00	2H - NR	Medium Not Present
3D 00	5H - IR	Invalid Bits in Identify Message
3F 01	6H - UA	Microcode Has Been Changed
40 80	4H - HE	Bias Magnet Failure
40 81	4H - HE	Limited Laser Life
40 84	4H - HE	Temperature Alarm
40 85	4H - HE	Laser Failure, No LD Power
40 86	4H - HE	Read Channel Calibration Error
40 87	4H - HE	Illegal Servo Signal
40 88	4H - HE	Sensor Failure
40 90	4H - HE	DSP Diag Error
40 91	4H - HE	12V Line Failure
40 92	4H - HE	Medium Recognition Error
40 95	4H - HE	Buffer Memory Test Error
40 97	4H - HE	DSP Communication Diag Error
40 98	4H - HE	DSP Download Error
40 99	4H - HE	RAM Diag Error
40 9A	4H - HE	ODC Diag Error
40 9B	4H - HE	Buffer Memory Diag Error
40 9D	4H - HE	Write CAL Error
43 00	BH - AC	Message Error

Table A-2 Request Sense - Additional Sense Code Values

Sense Code and Qualifier	Sense Key	Description
44 00	4H - HE	Internal Target Failure
45 00	BH - AC	Select or Reselect Failure
47 00	BH - AC	SCSI Parity Error
48 00	BH - AC	Initiator Detected Error Message Received
49 00	BH - AC	Invalid Message Error
4E 00	BH - AC	Overlapped Commands Attempted
53 00	4H - HE	Media Load/Eject Failure
53 02	5H - IR	Medium Removal Prevented
92 00	8H - BC	Overwrite Attempted
93 00	8H - BC	Blank Sector Detected
94 00	8H - BC	Written Sector Detected

Internal Error Codes

NOTE The XXXX that follows the internal error code refers to the 1 byte dsp/odc error code where available.

Table A-3 Internal Error Codes

Error Code (hex.)	Message
00070000	Medium was changed
00080000	Power on, reset, or bus device reset occurred (5.2 Gb drives)
00080001	Unit Attention: power on reset (9.1 Gb drives)
00080002	SCSI bus reset (9.1 Gb drives)
00080003	SCSI bus device reset message (9.1 Gb drives)
00080004	Autochanger reset (9.1 Gb drives)
00090000	Mode parameter changed
006B0000	Microcode changed
02540000	Queued command cleared by another initiator
012BXXXX	An invalid SCSI message was received
012CXXXX	An invalid bit of Identify message is set to 1
012DXXXX	Parity error was detected while receiving a SCSI message
012EXXXX	A SCSI message was rejected
012FXXXX	The Attention signal was asserted after the Message Out Phase
0130XXXX	A SCSI interface parity error was detected
0131XXXX	The Initiator Detected Error Message was received
0133XXXX	The offset of the synchronous data transfer is too large

Table A-3 Internal Error Codes

Error Code (hex.)	Message
0134XXXX	The period of the synchronous data transfer is too short
0139XXXX	The Clear Queue message was received
013AXXXX	Initiator does not respond to reselection
013BXXXX	Unusual SCSI controller condition
013CXXXX	Unusual SCSI controller condition
0204XXXX	An invalid microcode data was received
020AXXXX	An invalid operation code was specified
020BXXXX	An invalid LBA range was specified
020CXXXX	An invalid field in CDB was specified
020DXXXX	An invalid parameter list was specified
0210XXXX	Parameter list length is wrong
0211XXXX	The parameter saving function is not supported
0212XXXX	The parameter is not currently saved
0213XXXX	Cartridge eject was prevented
0250XXXX	Attempt to write data to a written sector of a write-once disk
0254XXXX	A queued command is cleared by another initiator
0255XXXX	A command was received for the same ITL (or ITLQ) nexus
026CXXXX	An invalid command for the write-once disk was specified
02B3XXXX	Invalid command when using 14x 512 b/s or 1024 b/s disk
0321XXXX	Loader task ended with an unusual condition
0322XXXX	Sensor failure during loader initialization
0323XXXX	Failed recovery procedure during loader initialization

Table A-3 Internal Error Codes

Error Code (hex.)	Message
0324XXXX	Cartridge loading failed
0327XXXX	Cartridge unloading failed
0417XXXX	The loader is being initialized
0418XXXX	No cartridge is in the drive
041AXXXX	The disk is being spun-up
041BXXXX	The disk is being loaded
041CXXXX	The disk load is complete (not an error)
041DXXXX	The drive is not ready
041EXXXX	A disk is being spun-down
041FXXXX	A disk is being unloaded
0420XXXX	Drive unable to go Ready because of an unknown reason
0425XXXX	The drive is in process of becoming ready
046FXXXX	The drive is in process of formatting a disk
0514XXXX	The Defect List Format is not supported
0515XXXX	The cartridge is write-protected
0528XXXX	Invalid cartridge ID hole
0529XXXX	The medium is not supported
053EXXXX	PDL data is invalid
053FXXXX	SDL data is invalid
0540XXXX	DDS sectors were not found
0541XXXX	PDL sector was not found
0542XXXX	SDL sector was not found

Table A-3 Internal Error Codes

Error Code (hex.)	Message
0543XXXX	DMA sector cannot be read
0544XXXX	DDS data are invalid
0545XXXX	SFP sector cannot be read
0546XXXX	SFP data is invalid
0547XXXX	Failed in Erase/Blank Check/Write/Read/Compare test after disk load and spin-up
0548XXXX	Spare area for defective sector is full
0549XXXX	Failed updating DMA sectors
054AXXXX	PEP data is invalid
054BXXXX	Defective sector was recovered with automatic write reallocation procedure
054CXXXX	Failed in automatic write reallocation procedure
0551XXXX	A blank sector was detected
0577XXXX	Automatic Write Reallocation performed due to ID Error
0578XXXX	Automatic Write Reallocation performed due to uncorrectable ECC Error
0579XXXX	Automatic Write Reallocation performed due to SYNCH Error
057AXXXX	Automatic Write Reallocation performed due to Servo Fault Error
057EXXXX	ID Error recovered by retry
057FXXXX	Uncorrectable ECC Error recovered by retry
0580XXXX	SYNCH Error recovered by retry
0581XXXX	Servo Fault Error recovered by retry

Table A-3 Internal Error Codes

Error Code (hex.)	Message
0582XXXX	ID Error reoccurs after retry even after changing ID Error criteria
0583XXXX	DMA Update failed after Automatic Reallocation
058AXXXX	DMA Update Error condition
0601XXXX	Received error code NN (see Table A-5 on page A-17) from ODC chip
0664XXXX	An ODC interrupt time out
0669XXXX	A disk type cannot be distinguished (ID Status is CRC=NG)
066AXXXX	A disk type cannot be distinguished (no ODC interrupt)
066DXXXX	SFP sector cannot be read (ID Status is CRC=NG)
0670XXXX	Cannot abort ODC command
0692XXXX	Error Code NN received from the ODC chip
0702XXXX	Received error code NN (see Table A-6 on page A-19) from the DSP
075CXXXX	Failed downloading DSP code
075EXXXX	DSP request command communication error occurred
0760XXXX	DSP command communication error occurred
0762XXXX	Failed in the ECHO command of DSP
0767XXXX	Target sector cannot be found (time out after SEEK complete)
0774XXXX	Servo failure during write operation
0789XXXX	LPC calibration failed
078BXXXX	ID Offset Calibration failed
078CXXXX	MO Offset Calibration failed

Table A-3 Internal Error Codes

Error Code (hex.)	Message
078DXXXX	VFO Offset Calibration failed
078EXXXX	ID VGA Calibration failed
078FXXXX	MO VGA Calibration failed
0791XXXX	Focus bias calibration failed
07B4XXXX	Read power calibration failed
0957XXXX	Power-on diagnostic time out
0959XXXX	ROM Checksum Error
095AXXXX	Illegal request for DSP Interface task
095FXXXX	Command Parameter Length contradiction to DSP
0961XXXX	Release wait of DSP I/F task
0965XXXX	ODC command was aborted
0968XXXX	Illegal request to Read/Write task
096EXXXX	Parameter Block data is invalid
0A4FXXXX	12V line is not supplied
0A71XXXX	RAM Test Error
0A72XXXX	ODC Test Error
0E03XXXX	Failed updating the flash ROM
0E05XXXX	Failure when updating the Parameter Block
0E56XXXX	Parameter Block Error

Table A-4 ODC Error Codes

Code (hex.)	Description
01	ODC command was aborted
08	Search condition does not occur
11	A number of error bytes exceeds the setting value
12	Cannot detect the SYNC
13	Both 11 and 12 error occur
14	A number of the RESYNC mis-detecting exceeds the setting value
15	Both 11 and 14 occur
16	Both 12 and 14 occur
17	Both 13 and 14 occur
20	Sector Mark (SM) error
21	ID CRC error
22	Cannot detect the SYNC and the first RESYNC
23	DTRG (Data Transfer Read Gate) becomes non-active before all data of a sector was transferred
24	Uncorrectable error
25	CRC error (uncorrectable)
29	Cannot follow the read data transfer from the drive
31	Cannot follow the write data transfer from the drive
32	Digital Sum Value (DSV) error
34	Written sector is detected
42	Buffer Memory Write/Read/Compare error

Table A-4 ODC Error Codes

Code (hex.)	Description
44	Cannot proceed with error correction because the syndrome buffer was filled
45	Cannot correct the error bytes within the time of one sector
46	A write data transfer to the encoder was too short
47	A write data transfer to the encoder was too long
48	Unexpected sequence of the error correction occurred
4E	Unexpected interrupt was detected in the ODC chip
4F	Unexpected firmware sequence occurred in the ODC chip
50	Asynchronous interrupt of the DSP was detected
51	Unexpected ID value was detected
52	Both unexpected and expected ID value detected on one track
54	Target sector was passed before the current position was detected
57	A detected ID sector number was greater than the maximum sector number
70	A Parameter List was not prepared
71	A sector number of the Parameter List was greater than the maximum sector number
72	A sector count of the Parameter List is set to 0 in the W/R/S
73	Undefined condition is set in the DTS, DLS command
7D	Setup command was issued while executing the Identify operation
7E	A command was issued while executing another command
7F	Undefined command was issued

Table A-5 ODC Error Codes

Code (hex.)	Description
01	ODC command was aborted
08	Search condition does not occur
11	A number of error bytes exceeds the setting value
12	Cannot detect the SYNC
13	Both 11 and 12 error occur
14	A number of the RESYNC mis-detecting exceeds the setting value
15	Both 11 and 14 occur
16	Both 12 and 14 occur
17	Both 13 and 14 occur
20	Sector Mark (SM) error
21	ID CRC error
22	Cannot detect the SYNC and the first RESYNC
23	DTRG becomes non-active before all data of a sector was transferred
24	Uncorrectable error
25	CRC error (uncorrectable)
29	Cannot follow the read data transfer from the drive
31	Cannot follow the write data transfer from the drive
32	Digital Sum Value (DSV) error
34	Written sector is detected
42	Written sector is detected

Table A-5 ODC Error Codes

Code (hex.)	Description
44	Cannot proceed with error correction because the syndrome buffer was filled
45	Cannot correct the error bytes within the time of one sector
46	A write data transfer to the encoder was too short
47	A write data transfer to the encoder was too long
48	Unexpected sequence of the error correction occurred
4E	Unexpected interrupt was detected in the ODC chip
4F	Unexpected firmware sequence occurred in the ODC chip
50	Asynchronous interrupt of the DSP was detected
51	Unexpected ID value was detected
52	Both unexpected and expected ID value detected on one track
54	Target sector was passed before the current position was detected
57	A detected ID sector number was greater than the maximum sector number
70	A Parameter List was not prepared
71	A sector number of the Parameter List was greater than the maximum sector number
72	A sector count of the Parameter List is set to 0 in the W/R/S
73	Undefined condition is set in the DTS, DLS command
7D	Setup command was issued while executing the Identify operation
7E	A command was issued while executing another command
7F	Undefined command was issued

DSP Error Codes

Table A-6 DSP Error Codes

Code (hex.)	Description
01	Offset measurement failed
09	AC portion of ID signal calibration failure
0B	Read channel vga calibration failure (1X/2X/4X/8X)
0C	Read channel vga calibration failure (1X/2X/4X/8X)
0D	Read channel OST calibration failure (4X/8X)
0E	Read channel MOVGAcalibration failure (1X/2X)
0F	Focus failure (read channel VGA calibration) (1X/2X/4X/8X)
10	Cannot be arranged (Read channel IDVGA calibration) (4X/8X)
11	Medium mischuking (FCSFLR)
21	Spindle off aborted
34	Calibration request
41	Drive is not ready
43	Imitation ATT signal caused by ESD
44	Focus failed (ID search)
45	LPC Attention occurred
52	Illegal zone selected (ALTERNATE ZONE)
53	Illegal zone selected (LD READ/PEP)
54	Illegal target zone (SEEK start)
55	Illegal target zone (SEEK One-Track Jump loop)

Table A-6 DSP Error Codes

Code (hex.)	Description
56	Illegal target zone (SEEK landing)
57	Illegal next zone (SEEK landing)
58	Illegal zone (ID search)
59	Illegal zone (ID search)
5A	Illegal zone (focus search)
5B	Kick inner area failed
5C	Servo agc time out
61	Focus on failed
62	Focus on aborted
63	Tracking on failed
64	Tracking drive saturation
65	No ID (No SM or CRC=NG) (DON start)
66	No ID (No SM or CRC=NG) (SEEK start)
67	No ID (No SM or CRC=NG) (SEEK landing)
68	Seek slip too much
69	Voice Coil Motor and Multi-Track Jump Seek time out
6A	Seek target is too far for a One Track Jump
6B	Multi-Track Jump is too long
6C	Focus failure
6D	Tracking failure
6E	Low Pull-in
6F	Focus drive saturation
71	Cannot detect PEP signal

Table A-6 DSP Error Codes

Code (hex.)	Description
72	Focus failed (PEP positioning)
74	Focus failed (searching PEP GAP)
75	Focus failed (searching PEP PA)
76	Focus failed (searching PEP data)
77	Focus on failed (before searching PEP data)
78	No PEP gap found
79	Illegal PEP format found (PEP Postamble)
7A	Illegal PEP format found (PEP data)
7B	PEP decoding byte count error
7C	Invalid PEP SYNC found
7D	No PEP SYNC found
7E	PEP CRC=NG
7F	First and second PEP data compare error
C1	An error occurred in the position sensor
C2	Catastrophic error in the bias magnet
C4	R/C revision error
C9	No laser diode power
CA	Assert write fault for controller debug
CF	Temperature alarm
D1	Illegal address selected
D3	Invalid command
D4	Communication failure
E1	Spindle Lock time out (drive on)

Table A-6 DSP Error Codes

Code (hex.)	Description
E2	Spindle off failed
E3	Medium mischuking (Spindle On Failure)
E4	Tracking failure for certifier
E5	Spindle lock time out
E6	Focus failure for certifier
F3	E/AR/C Serial Write Block = NG
F4	E/A LPC Serial Write Block = NG
F5	E/A R/C Serial Read Block = NG

Table A-7 Terms Used In the Tables

Acronym or Term Used	Meaning
ATT	Attention Signal
CDB	Command Descriptor Block
CRC	Cyclic Redundancy Check
DDS	Disk Definition Standard
DMA	Defect Management Area
DON	Drive On
DSP	Digital Signal Processor
DSV	Digital Sum Value
DTRG	“D” Trigger Signal
ITL	Initiator Target and Logical Unit

Table A-7 Terms Used In the Tables

Acronym or Term Used	Meaning
ITLAQ	Initiator Target and Logical Unit and Queue Tag
LBA	Logical Block Address
NG	No Good
ODC	Optical Drive Controller
PA	Postamble
PEP	Phase-Encoded Part
PDL	Primary Defect List
RESYNC	Resynchronization pattern
SDL	Secondary Defect List
SM	Sector Mark
SFP	Standard Format Part
SYNC	Synchronization pattern
VCM	Voice Coil Motor
VGA	Variable Gain Adjust
VFO	Variable Frequency Oscillator

B Autochanger Error Codes

Chapter Overview

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 C for a list of field replaceable units for the each of the jukebox models.

Request Sense Error Codes

This section identifies each of the error responses for the autochanger "Request Sense Command (03H)", Table 3-5 on page 3-8.

Table B-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.

Table B-1 Request Sense - Sense Key Values — Byte 2, Bits 3 through 0

Sense Key	Name	Abbrev.	Description
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 B-2 Request Sense Data (bytes 12 and 13)

Sense Code and Qualifier	Sense Key	Description
00 00H	0H-NS	No additional sense information
00 00H	1H-RE	Error recovered invoked and completed (Table B-6 on page B-14)
04 00H	0B-AC	Aborted command (boot code)
04 01H	2H-NR	Autochanger becoming ready
04 02H	2H-NR	Unit must first initiate element status
04 03H	2H-NR	Fatal error - unit must be corrected manually
04 88H	02-NR	Firmware download needed (boot code)
04 89H	4H-HE	Download checksum error
15 01H	4H-HE	Move error (Check additional sense bytes) (Table B-6 on page B-14)
1A 00H	5H-IR	Invalid parameter list length
20 00H	5H-IR	Unsupported command
21 01H	5H-IR	Invalid address - (Table B-3 on page B-7)

Table B-2 Request Sense Data (bytes 12 and 13)

Sense Code and Qualifier	Sense Key	Description
22 00H	5H-IR	Unsupported command
22 80H	5H-IR	Drive is not online
24 00H	5H-IR	Illegal field in CDB
25 00H	5H-IR	Invalid LUN
26 00H	5H-IR	Invalid parameter list
29 00H	6H-UA	Power on sense or bus reset
2A 80H	6H-UA	Online repair parameters
2F 00H	0BH-AC	Command cleared by initiator
3F 01H	06H-UA	Microcode has been changed
3B 0DH	5H-IR	Element full - (Table B-4 on page B-7)
3B 0EH	5H-IR	Source empty - (Table B-4 on page B-7)
3D 00H	5H-IR	Invalid identify message in
3F 03	06-UA	Inquiry data has changed
40 80H	4H-HE	Diagnostic failure (Table B-6 on page B-14)
42 00H	4H-HE	Poweron selftest failure
43 00H	OB-AC	Message parity error
44 00H	4H-HE	Internal target error
45 00H	0B-AC	Reselection timeout error
47 00H	0B-AC	Parity error
48 00H	0B-AC	Initiator detected error
4B 00H	0B-AC	Bus protocol error - data phase error

Table B-2 Request Sense Data (bytes 12 and 13)

Sense Code and Qualifier	Sense Key	Description
4E 00H	0B-AC	Bus protocol error (second command sent early)
53 00H	5H-IR	Media load or eject failed
53 02H	5H-IR	Medium removal prevented
53 82H	5H-IR	Medium removal prevented on drive
55 00H	2H-NR	Transaction queue is full

Table B-3 Invalid Address: Sense Code 2IH

Field Pointer	Description
00	Invalid element address
02	Invalid transport element
04	Invalid source element
06	Invalid destination element
08	Invalid second destination element

Table B-4 Element Full/Empty: Sense Code 3BH

Field Pointer	Description
02	Transport full
04	Source empty
06	Destination full/empty
08	Second destination full

Additional Sense Data Format for Error Recovery

For all models, EXCEPT 40fx and 80ex.

Below is a description of the 60 Additional Sense Bytes returned during the Data In Phase of the Request Sense Command (03H), (Table 3-6 on page 3-9) from the autochanger. The overall layout of the data is presented first, followed by a description of each byte.

Table B-5 Request Sense - Additional Sense Data (For all models, EXCEPT 40fx, 80ex, 125ex and 220mx)

Byte	7	6	5	4	3	2	1	0
18	Reserved (0)							
19	Hardware Error Code (Table B-7 on page B-19)							
20	First FRU (Table A-1 on page A-2)							
21	Second FRU (Table A-1 on page A-2)							
22	Third FRU (Table A-1 on page A-2)							
23	Move Command Attempted							
24-25	Source Element Number							
26-27	Destination Element Number							
28-29	Second Destination Element Number							
30-34	Micro-Move ID History (Table C-1 on page C-2)							
35	Failed Micro-Move ID (Table C-1 on page C-2)							
36	Micro-Move Error Code							
37	Active Picker	Active Thumb	Reserved (0)					
38-39	Vertical Motor Commanded Position							

Table B-5 Request Sense - Additional Sense Data (For all models, EXCEPT 40fx, 80ex, 125ex and 220mx)

Byte	7	6	5	4	3	2	1	0
40-41	Vertical Motor Actual Position							
42-43	Plunge Motor Commanded Position							
44-45	Plunge Motor Actual Position							
46-47	Translate Motor Commanded Position							
48-49	Translate Motor Actual Position							
50-53	Odometer							
54	Move Cap	Last SCSI	Reserved (0)		Cart 16	Cart 17	Reserved (0)	
55	Valid	Reservd (0)	Cart Tran	Cart Elem	Reserved (0)			
56	Valid	Reservd (0)	Cart Tran	Cart Elem	Reserved (0)			
57	Valid	Reservd (0)	Cart Tran	Cart Elem	Reserved (0)			
58-77	Reserved (0)							

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 B-7 on page B-19.

First FRU The most likely Field Replacable Unit to be the cause of the failure. (See Table A-1 on page A-2)

Second FRU The second most likely Field Replacable Unit to be the cause of the failure. (See Table A-1 on page A-2.)

Third FRU The third most likely Field Replacable Unit to be the cause of the failure. (Table A-1 on page A-2.)

NOTE The FRU numbers returned are indicators for the most likely cause of an error, but may not be the actual cause of a problem. Simply changing the FRU listed may or may not fix the associated problem.

Move Command Attempted
0 - Exchange
1 - Move
2 - Seek
3 - Initialize Element
4 - Rezero
5 - Rotate Mailslot
6 - Restore
7 - Passthru

Source Element Number The Element Number to which the source refers.

Destination Element Number The Element Number to which the destination refers.

Second Destination Number The Element Number to which the second destination refers.

Micro-Move ID History The last five autochanger Micro-Move IDs for the original movement command prior to the failure. (See Table C-1 on page C-2.)

Failed Micro-Move ID Actual micro-move that failed. (See Table C-1 on page C-2)

Micro-Move Error Code The error code associated with the failed Micro-Move ID. (See Table B-10 on page B-321.)

Active Picker This bit signifies which side of the disk transport mechanism is active: 1= top, 0= bottom.

Active Thumb This bit signifies which thumb is active: 0 = north, 1 = south.

Vertical Motor Commanded Position The position to which the vertical motor was commanded.

Vertical Motor Actual Position The actual position of the vertical motor.

Plunge Motor Commanded Position The position to which the plunge motor was commanded.

Plunge Motor Actual Position The actual position of the plunge motor.

Translate Motor Commanded Position The position to which the translate motor was commanded.

Translate Motor Actual Position The actual position of the translate motor.

Odometer The move odometer.

Mechanism State Bit Map (Byte 54) The state of the jukebox after the termination of the retry or recovery algorithms. This byte is bit mapped from least significant bit to most significant bit as follows:

7 - Move Capability 1=The jukebox is capable of performing movement commands.

6 - Last SCSI State 1=The jukebox returned cartridges to the state they were in prior to the failed command.

5-4 Reserved

3 - Cartridge in Transport 16 1=a cartridge is in the transport 16 mechanism. If the cartridge wasn't replaced after a failure, the appropriate Element Bit Map will indicate which cartridge is in the transport.

2 - Cartridge in Transport 17 1=a cartridge is in the transport 17 mechanism. If the cartridge wasn't replaced after a failure, the appropriate Element Bit Map will indicate which cartridge is in the transport.

1-0 Reserved

Source Element Bit Map (Byte 55)

Status of the cartridge in the specified Source Element of the Move or Exchange command after the failure or retry, as well as the status of the element itself, as shown below:

7 - Valid 1 = the values in this byte and the Element Number byte are valid.

6 - Reserved

5 - Cartridge in Transport 1 = the cartridge originally in this element is still in the transport.

4 - Cartridge in Element 1 = after all recovery algorithms have been exhausted, the cartridge being moved from this element remained in this element.

3-0 Reserved

Destination 1 Element Bit Map (Byte 56)

Indicates the status of the element that was the First Destination of the Exchange command after the failure or retry of the command.

7 - Valid 1= the values in this byte and the Element Number are valid.

6 - Reserved

5 - Cartridge in Transport 1 = the cartridge originally in this element is still in the transport.

4 - Cartridge in Element 1 = after all recovery algorithms have been exhausted, the cartridge being moved from this element remained in this element.

3-0 Reserved

Destination 2 Element Bit Map (Byte 57)

Indicates the status of the element that was the Destination Element of a move or Second Destination of the Exchange command after the failure or retry of the command.

7 - Valid 1 = the values in this byte and the Element Number are valid.

6 - Reserved

5 - Cartridge in Transport 1 = the cartridge being moved to this element is still in the transport.

4 - Cartridge in Element 1 = the cartridge being moved to this element is in this element after all recovery algorithms have been exhausted.

3-0 Reserved

Table B-6 Request Sense - Additional Sense Data (For models 40fx, 80ex, 125ex and 220mx ONLY)

Byte	7	6	5	4	3	2	1	0
18	Move Error (Table B-9 on page B-29)							
19	Hardware Error Code (Table B-8 on page B-22)							
20	First FRU (Table A-2 on page A-4)							
21	Second FRU (Table A-2 on page A-4)							
22	Third FRU (Table A-2 on page A-4)							
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
45-46	Second Destination Element Number							

Table B-6 Request Sense - Additional Sense Data (For models 40fx, 80ex, 125ex and 220mx ONLY)

Byte	7	6	5	4	3	2	1	0
47-49	Reserved (0)							
50-54	Micro-Move ID History (Table C-2 on page C-17)							
55	Failed Micro-Move ID (Table C-2 on page C-17)							
56	Micro-Move Error Code (Table B-11 on page B-36)							
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 B-9 on page B-29.

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 B-8 on page B-22.

First FRU The most likely Field Replacable Unit to be the cause of the failure. (See Table A-2 on page A-4)

Second FRU The second most likely Field Replacable Unit to be the cause of the failure. (See Table A-2 on page A-4.)

Third FRU The third most likely Field Replacable Unit to be the cause of the failure. (See Table A-2 on page A-4.)

NOTE The FRU numbers returned are indicators for the most likely cause of an error, but may not be the actual cause of a problem. 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 cartridges 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.)

FHR A Find Home Recalibration bit of 1 Find Home algorithm was invoked to recalibrate the mechanism (For Byte 26, this attempt refers to Retry algorithm and for Byte 30 it refers to Recovery algorithm).

Retry Count The total number of retry attempts that were performed.

Recovery Count The total number of recovery attempts that were performed.

Valid A "0" indicates that this and the next two bytes contain invalid data. Valid in bytes 41 and 44 are only set during the Exchange Medium Command.

ErrEn An Error Encountered bit of 1 indicates an error occurred while the picker was enroute to this element.

CartEl A Cartridge in Element bit of 1 indicates the cartridge associated with this move is in this element.

UnexpMt An Element Unexpected Empty bit of 1 indicates this element was unexpectedly empty.

UnexpFl An Element Unexpected Full bit of 1 indicates this element was unexpectedly full.

CartInv A Cartridge Inverted bit of 1 indicates the cartridge is inverted from its state before the operation began.

ElRty An Element Required Retry bit of 1 indicates an operation in or out of this element required one or more retries.

Source Element Number The Element Number to which the Source Element Bit Map (Byte 35) refers.

Destination Element Number The Element Number to which the Destination Element Bit Map (Byte 38) refers.

Secondary Source Element Number The Element Number to which the Secondary Source Element Bit Map (Byte 41) refers.

Second Destination Element Number The Element Number to which the Second Destination Element Bit Map (Byte 44) refers.

Micro-Move ID History The last five autochanger Micro-Move IDs for the original movement command prior to the failure. (See Table C-2 on page C-17.)

Failed Micro-Move ID Actual micro-move that failed. (See Table C-2 on page C-17)

Micro-Move Error Code The error code associated with the failed Micro-Move ID. (See Table 5-11 on page 5-35.)

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 5-6 on page 5-14), the Log Sense Command (4DH), and the Receive Diagnostic Results Command (1CH), (Byte 1, Table 3-30 on page 3-34).

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 FRU numbers returned are indicators for the most likely cause of an error, but may not be the actual cause of a problem. Simply changing the FRU listed may or may not fix the associated problem.

Table B-7 Hardware Error Codes (medium and large models only)

Error Code (hex.)	Failure Description
01	ROM checksum error
02	Register error
03	Microprocessor error
04	Controlled area of RAM checksum error
05	RAM test error
06	SCSI chip error
07	Jukebox controller chip error
0F	Configuration module failure

Table B-7 Hardware Error Codes (medium and large models only)

Error Code (hex.)	Failure Description
11	Drive serial communications failure
1E	Translate motor error
1F	Vertical motor error
10	Drive configuration error
20	Plunge motor error
28	Mailslot sensor error
2B	Top thumb sensor error
2C	Bottom thumb sensor error
32	Invalid test number
33	Invalid configuration
34	Need to initialize element status
35	Exercise test failed
36	Elements reserved
38	Test can only be run from SCSI
39	Unable to run test
3C	Move to
3D	Flip
3E	Translate
3F	Put magazine in
40	Get magazine out
41	Test magazine
42	Put drive in
43	Get drive out

Table B-7 Hardware Error Codes (medium and large models only)

Error Code (hex.)	Failure Description
44	Test drive
45	Put mailslot in
46	Get mailslot out
47	Test mailslot
48	Rotate mailslot in
49	Rotate mailslot out
4A	Test picker
4B	Switch active picker
4C	Restore picker
4D	Find translate home
4E	Find vertical home
4F	Find plunge home
50	Clear flip area
51	Clear magazine path
52	Clear drive path
53	Clear mailslot path
5B	Finish switch picker
5C	Wait plunge
5D	Wait vertical
5E	Powerfail clear path
5F	Powerfail restore cartridges
60	Repeater controller
61	External SCSI cables

Table B-8 Hardware Error Codes (For the 40fx, 80ex, 125ex, and 220mx models ONLY)

Error Code (hex.)	Failure Description
JUKEBOX 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 [a]
06	Illegal interrupt encountered by microprocessor
07	Illegal CPU exception encountered by microprocessor
09	Firmware error
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

Table B-8 Hardware Error Codes (For the 40fx, 80ex, 125ex, and 220mx models ONLY)

Error Code (hex.)	Failure Description
19	SCSI connector loopback error in DB1 or C/D
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

Table B-8 Hardware Error Codes (For the 40fx, 80ex, 125ex, and 220mx models ONLY)

Error Code (hex.)	Failure Description
39	Drive 2 not connected
3A	Drive 3 not connected
3B	Drive 4 not connected
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
45H	Unable to free the Picker fingers in preparation for translate motion
46H	Carriage motion failed while initializing Home position during Find Home sequence
47H	Translate failed while moving towards non-leadscrew side during Find Home sequence
48H	Carriage motion failed during Carriage/Picker assembly calibration (leadscrew side)
49H	Carriage motion failed during Carriage/Picker assembly calibration (non-leadscrew side)
4AH	Motion error while determining orientation of the Picker

Table B-8 Hardware Error Codes (For the 40fx, 80ex, 125ex, and 220mx models ONLY)

Error Code (hex.)	Failure Description
4BH	No sensor found (V4.2 code only)
4CH	Failed flip motion during the Find Home sequence (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
50H	Excessive tilt of the Carriage/Picker assembly (away from the drives)
51H	Excessive tilt of the Carriage/Picker assembly (toward the drives)
52H	Excessive cone angle on Picker
53H	Excessive stack tilt
54H	Unable to complete an interrupted move at power up
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	

Table B-8 Hardware Error Codes (For the 40fx, 80ex, 125ex, and 220mx models ONLY)

Error Code (hex.)	Failure Description
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)
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
DRIVE ERROR CODES	
B8H	Drive #1 access error

Table B-8 Hardware Error Codes (For the 40fx, 80ex, 125ex, and 220mx models ONLY)

Error Code (hex.)	Failure Description
B9H	Drive #2 access error
BAH	Drive #3 access error
BBH	Drive #4 access error
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
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
CDH	Unable to find a hard stop while turning the Carriage motor
CEH	Excessive force required to move the Carriage leadscrew
MISCELLANEOUS ERROR CODES	
D0H	Find magazine edge failed
D1H	Unexpected mailslot empty
FCH	The test can only be run from the Front Panel
FDH	The test can only be run from the SCSI interface

Table B-8 Hardware Error Codes (For the 40fx, 80ex, 125ex, and 220mx models ONLY)

Error Code (hex.)	Failure Description
FEH	The test did not run, probably a configuration error
FFH	Invalid test number

a. For further explanation, refer to the next section "Additional Descriptions of Hardware Error Codes."

Autochanger Move Error Codes

NOTE These error codes ONLY apply to the model 40fx, 80ex, 125ex, and 220mx jukeboxes.

Move Errors are reported through byte 18 of the Additional Sense Bytes Request Sense Command (03H) in Table 5-6 on page 5-14.

Table B-9 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.
1A	Failure while moving the Picker fingers back after inserting a cartridge in the destination storage slot.

Table B-9 Autochanger Move Error Codes

Error Code (hex.)	Failure Description
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).
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.

Table B-9 Autochanger Move Error Codes

Error Code (hex.)	Failure Description
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.

Jukebox Micro-Move Error Codes

Micro-Move Errors are reported through bytes 50-55 in the additional sense bytes (Table 5-6 on page 5-14) of the Request Sense Command (03H) and the "Log Sense Command (4DH)" with page code 33H. (See Table 3-45 on page 3-47.)

NOTE For all models EXCEPT 40fx, 80ex, 125ex, and 220mx.

Table B-10 Micro-Move Error Codes

Error Code (hex.)	Failure Description
00	No error
01	Vertical over voltage exceeded limit set by firmware
02	Vertical over force exceeded limit set by firmware
03	Vertical servo error
04	Vertical timeout
05	Vertical open path
06	Vertical closed path
0A	Plunge over voltage exceeded limit set by firmware
0B	Plunge over force exceeded limit set by firmware
0C	Plunge servo error
0D	Plunge timeout
0E	Plunge open path
0F	Plunge closed path
10	Top picker expected to be active picker in plunge. Runtime.

Table B-10 Micro-Move Error Codes

Error Code (hex.)	Failure Description
11	Bottom picker expected to be active picker in plunge. Runtime.
12	Bottom thumb expected to be active in plunge home. Powerup.
13	Top thumb expected to be active in plunge home. Powerup.
14	Translate over voltage error.
15	Translate over force error.
16	Translate servo error.
1A	Vertical open loop
1B	No load complete
1C	Translate open loop
1E	No load complete
1F	Unexpected load complete
20	Unexpected cartridge in drive
21	No cartridge in drive
22	Drive put in accept failed
23	Drive get out accept failed
24	Drive eject failed
25	Drive insert failed
26	Drive eject retry
27	Drive insert retry
28	Clear drive path
29	Drive signal (not used)

Table B-10 Micro-Move Error Codes

Error Code (hex.)	Failure Description
2A	Drive not connected
32	Magazine put in saturate failed
33	Magazine get out saturate failed
34	Magazine put in accept failed
35	Magazine get out accept failed
36	Magazine measure failed
37	Test magazine failed
38	Return magazine failed
39	Clear magazine path
3C	Mailslot put in saturate failed
3D	Mailslot get out saturate failed
3E	Mailslot put in accept failed
3F	Mailslot get out accept failed
40	Measurement of mailslot depth failed
41	Recovery did not clear vertical path.
42	Rotate mailslot in failed
43	Rotate mailslot out failed
46	Flipped too far
47	Did not flip far enough
48	Flip side incorrect
50	Failed to finish a translate
51	Extra force needed to translate

Table B-10 Micro-Move Error Codes

Error Code (hex.)	Failure Description
5A	Command received to rotate mailslot but both pickers are full
5B	Back sensor in mailslot is bad
5C	Front sensor in mailslot is bad
5D	Command received to eject from the mailslot, but both pickers are full
5E	Attempt to load from an empty mailslot
5F	Engaging the mailslot failed on a rotate in
60	Disengaging the mailslot failed on a rotate in
61	Rotate in catch error (not used)
62	Rotate in push out error (not used)
63	Rotate in armed failed (not used)
64	Did not detect hard stop on a rotate in
65	Rotate in was too much distance
66	Engaging the mailslot failed on a rotate out
67	Disengaging the mailslot failed on a rotate out
68	Did not detect hard stop on a rotate out
69	Rotate out distance was too short
6A	Could not move thumbs out of the vertical path after a rotate out
6B	Vertical distance difference detected after error recovery
6C	Cartridge in mailslot incorrectly at rotate in
6D	Mailslot rotate in accept fail

Table B-10 Micro-Move Error Codes

Error Code (hex.)	Failure Description
6E	Test failed

Table B-11 Micro-Move Error Codes (For the 40fx, 80ex, 125ex, and 220mx models ONLY)

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.

Table B-11 Micro-Move Error Codes (For the 40fx, 80ex, 125ex, and 220mx models ONLY)

Error Code (hex.)	Description
12	Diagnose FRU failed.
13	Initial recovery failed.
14	Find home failed.
15	Picker initialization failed.
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.

Table B-11 Micro-Move Error Codes (For the 40fx, 80ex, 125ex, and 220mx models ONLY)

Error Code (hex.)	Description
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.
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.

Table B-11 Micro-Move Error Codes (For the 40fx, 80ex, 125ex, and 220mx models ONLY)

Error Code (hex.)	Description
74	No load complete.
75	Drive error signal.
76	Unexpected cartridge in the drive.
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 above here are counted in the runtime log as in-line.	
Errors below here are counted in the runtime log as retries.	
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.

Diagnostic Tests

The following tables describe the optical disk library diagnostic tests for all models, EXCEPT for 40fx, 80ex, 125ex, and 220mx jukeboxes. See Table B-13 on page B-44 for diagnostic tests for the 40fx, 80ex, 125ex, and 220mx models.

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 listed in Table 5-12 on page 5-39 are supported on all HP jukebox models.

Table B-12 Diagnostic Tests (EXCEPT for models 40fx, 80ex, 125ex, and 220mx)

No.	Front Panel Test Name	Description
1	**POWER UP TEST**	Checks out the general capability of jukebox by running **INIT MECHANICS** test.
2	**WELLNESS TEST**	Checks out the general capability of the jukebox by running the **INIT MECHANICS** and **EXERCISE MECH** tests. Requires one loaded cartridge; drive and mailslot must be empty.
5	**INIT MECHANICS**	Runs the **FIND PLUNGE HOME**, **FIND VERTICAL HOME**, **FIND XLATE HOME**, and the **INIT ELEM STATUS** tests, and rotates the mailslot out.
10	**INIT ELEM STATUS**	Functions the same as the SCSI Initialize Element Status command. This test physically scans the entire unit to determine which storage slots contain disks and if the drives contain disks.
11	**EXERCISE MECH**	Runs **VERTICAL TEST**, **TRANSLATE TEST**, **FLIP TEST**, **MAGAZINE IO**, **DRIVE IO**, and **MAILSLOT IO** tests.

Table B-12 Diagnostic Tests (EXCEPT for models 40fx, 80ex, 125ex, and 220mx)

No.	Front Panel Test Name	Description
12	**VERTICAL TEST**	Moves the disk transport mechanism up and down the full length of the rail. Returns PASS/FAIL. No cartridges required.
13	**TRANSLATE SENSOR**	Reports ON or OFF. Looks at translate sensor.
14	**FLIP TEST**	Makes a combination of moves with a PASS/FAIL result. It does several flips at various locations. No optical disks are required.
15	**MAGAZINE IO**	Makes a combination of moves with a PASS/FAIL result. It moves an optical disk from a randomly-chosen full to a randomly-chosen empty slot, with a random flip. It then moves the disk back to its original storage slot with its original orientation. This test displays "FAIL" if there are no disks in the jukebox or if all storage slots are full. The drives and mailslot must be empty.
16	**DRIVE IO**	Makes a combination of moves with a PASS/FAIL result. It moves an optical disk from a randomly-chosen full slot to a randomly-chosen drive, with a random flip. It then moves the cartridge back to its original slot with its original orientation. This test displays if there are no disks in the jukebox or if all storage slots are full. The drives and mailslot must be empty.

Table B-12 Diagnostic Tests (EXCEPT for models 40fx, 80ex, 125ex, and 220mx)

No.	Front Panel Test Name	Description
17	**MAILSLOT IO**	Makes a combination of moves with a PASS/FAIL result. It moves an optical disk 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. This test displays if there are no disks in the jukebox or if all storage slots are full. The drives and mailslot must be empty.
18	**EMPTY DRIVES**	Moves cartridges out of the drive mechanism(s) and returns them to their storage slots.
20	**PLUNGE FULL SPD**	Allows the disk transport mechanics to be run at full speed. This configuration should always be used when the jukebox is being used.
21	**PLUNGE 1/2 SPD**	Allows the disk transport mechanics to be run at half speed. Use this configuration for diagnostic purposes only.
22	**PLUNGE 1/4 SPD**	Allows the mechanics to be run at quarter speed. Use this configuration for diagnostic purposes only.
24	**FILL PICKER**	Moves an optical disk into the disk transport mechanism from the first storage slot containing a disk.
25	**EMPTY PICKER**	Moves an optical disk from the disk transport mechanism to its home storage slot location if that location is known, otherwise the disk is placed into the first available empty storage slot.
26	**CLEAR SOFT LOG**	The runtime log (soft error log) is initialized to all zeros.

Table B-12 Diagnostic Tests (EXCEPT for models 40fx, 80ex, 125ex, and 220mx)

No.	Front Panel Test Name	Description
29	**CLEAR HARD LOG**	Sets Information log 0, Autochanger Error Log, back to zero.
30	**VERTICAL ENCODER**	Moves the disk transport mechanism up and down the full length of the rail. Returns PASS/FAIL. No cartridges are required.
101	**FIND PLUNGE HOME**	Runs mechanism recalibration, establishes which picker side is up, and determines the reference points in the picker travel path. This test assumes that the mechanics and servo system are functional.
102	**FIND VERTICAL HOME**	Recalibrates the vertical position and verifies that the vertical path is clear.
103	**FIND XLATE HOME**	Calibrates the translate position.
104	**PICKER TEST**	Flips the disk transport mechanism and switches active thumbs.

Table B-13 Sequence Tests (For models 40fx, 80ex, 125ex, and 220mx ONLY)

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

Table B-13 Sequence Tests (For models 40fx, 80ex, 125ex, and 220mx ONLY)

No.	Test Name	Description
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
5	**Initialize Mechanism**	Prepares the unit for movement. Sequence Order: • Initialize RAM variables to defaults • 50: Find Home
Exerciser Tests		
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.

Table B-13 Sequence Tests (For models 40fx, 80ex, 125ex, and 220mx ONLY)

No.	Test Name	Description
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 valid for the Model 10LC)	Performs a combination of moves with a pass/fail result. It performs several translations 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.
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.

Table B-13 Sequence Tests (For models 40fx, 80ex, 125ex, and 220mx ONLY)

No.	Test Name	Description
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.
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.

Table B-13 Sequence Tests (For models 40fx, 80ex, 125ex, and 220mx ONLY)

No.	Test Name	Description
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.
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		
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.

Table B-13 Sequence Tests (For models 40fx, 80ex, 125ex, and 220mx ONLY)

No.	Test Name	Description
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.
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.

Table B-13 Sequence Tests (For models 40fx, 80ex, 125ex, and 220mx ONLY)

No.	Test Name	Description
43	**Mailslot Sensor Test** (Interactive if done through the control panel)	See the description for Test 42.

44	**Cartridge-in-path** (Interactive if done through the control panel)	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). 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.

50	**Find Home Sequence**	50Find Home SequenceMoves 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.

Table B-13 Sequence Tests (For models 40fx, 80ex, 125ex, and 220mx ONLY)

No.	Test Name	Description
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.
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. The test returns: PASS or FAIL.
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.

C Field Replaceable Units (FRUs)

HP Field Replaceable Units (FRUs)

Table C-1 Jukebox FRUs (For all models, EXCEPT 40fx, 80ex, 125ex, and 220mx)

FRU #	Description
1	Controller PCA
2	MO Drive
4	Interconnect PCA
5	Lower Interconnect Board
6	Stars Wars Board
8	SCSI LUN/Repeater PCA (Bus 1)
18	SCSI LUN/Repeater PCA (Bus 2)
19	Configuration Module
22	Display Panel
23	Vertical Motor Gearbox Assembly
24	Vertical Motion Motor
26	Magazine (8 slots)
27	Picker Assembly
29	Mailslot Assembly
30	Vertical Encoder Strip & Sensor
31	Magazines (6 slots)
32	AC/12V Power
33	AC/24V Power
34	Vertical Rope/Pulley System
40	Translate Frame

Table C-1 **Jukebox FRUs (For all models, EXCEPT 40fx, 80ex, 125ex, and 220mx)**

FRU #	Description
41	Vertical Umbilical Cable
43	Translate Umbilical Cable
51	5/12 Power Cable
54	Drive Power Cable
57	Vertical Path-Clear Sensor Cable
59	Internal SCSI Cable
62	MO Drive Power Cable
65	Control Panel Cable
66	Interposer Cable
86	AC Power PCA
220	Media
200	Clear path blockage (no FRU)
201	Cartridge moved

Table C-2 Jukebox FRUs (For the 40fx, 80ex, 125ex and 220mx models ONLY)

FRU #	Description
1	Autochanger Controller PCA
4	Interconnect PCA
20	MO/MF Drive (single-ended)
21	Left Way
22	Display/Front Panel PCA
23	Carriage Motor
24	Front Panel
25	Picker Motor
26	Magazine
27	Picker
28	Power Supply Module
29	Mailslot Assembly
31	Optical Sensor Assembly
32	Carriage Lead Screw
34	Picker Motor Belt(s)
35	Carriage Motor Belt
36	MO/MF Drive Control ROM[a]
37	Autochanger Controller ROMS[a]
38	Fan Assembly
39	Spring Bearing Block Assembly
40	Carriage Assembly

Table C-2 **Jukebox FRUs (For the 40fx, 80ex, 125ex and 220mx models ONLY)**

FRU #	Description
51	MO Drive/Controller Power Cable
52	5/12V Module Power Cable
55	SCSI Cable (internal)
56	Front Panel Address Cable
57	Motor Power/Encoder Cable
58	Motor Cable
59	Interconnect Cable
65	AC/24V Power Cable
66	Line Switch Cable
67	24V Power Cable
71	Mailslot Connector Cable
75	Interface Cable

a. Code is downloadable into flash ROMs

D Micro/Macro-Moves

HP Surestore Optical Micro-Move IDs

Table D-1 **HP Surestore Optical Micro-Move ID Table (For all models, EXCEPT 40fx, 80ex, 125ex and 220mx)**

Move ID (hex.)	Description
0	Vertical idle.
1	Move picker transport up. Fast.
2	Move picker transport down. Fast.
3	Move picker transport up slowly, looking for resistance. Used in vertical find home sequence.
4	Move picker transport down slowly, looking for resistance. Used in vertical find home sequence.
5	Move a small amount upward, to relieve tension in the servos. Used after finding "home" in the vertical find home sequence.
6	Make a small vertical movement as a plunge is made into a drive. Used to "wiggle" the picker during error recovery.
7	Vertical coarse measure (not used).
8	Move picker transport up to the top of the jukebox, checking for a clear path. Used in the vertical find home sequence.
9	Move picker transport to the bottom of the jukebox, checking for a clear path. Used in the vertical find home sequence.
A	Vertical fine measure (not used).
B	Vertical engage mailslot 1 (not used).
C	Vertical engage mailslot 2 (not used).
D	Vertical get mail duck (not used).

Table D-1 HP Surestore Optical Micro-Move ID Table (For all models, EXCEPT 40fx, 80ex, 125ex and 220mx)

Move ID (hex.)	Description
E	Vertical put mail duck (not used).
F	Vertical saturate home (not used).
10	Vertical relax home (not used).
11	Move slowly up far enough to establish that there is enough room to flip the picker. Used in the plunge find home sequence.
12	Move slowly down far enough to establish that there is enough room to flip the picker. Used in the plunge find home sequence.
13	Move slowly to the flip clear area (determined in micro-moves 11 and 12). Used in the plunge find home sequence. Also used in power fail recovery to move the picker off of a cartridge that may have been between the picker and the magazines when the power failed and the picker settled.
14	Move slowly downward to the flip clear area (determined in micro-moves 11 and 12). Used in the plunge find home sequence.
15	Move vertically to restore the picker to the position it had before an error (and error recovery) occurred. Only called in error recovery.
16	Move up. Used in the motor test during powerup.
17	Move down. Used in the motor test during powerup.
18	Move fast vertically to initial element 1.
19	Move fast vertically to initial element 2.
1A	Move fast vertically to initial element 3.
1B	Move fast vertically to initial element 4.

Table D-1 HP Surestore Optical Micro-Move ID Table (For all models, EXCEPT 40fx, 80ex, 125ex and 220mx)

Move ID (hex.)	Description
32	Translate idle.
33	Translate and saturate right.
34	Translate and saturate left.
35	Translate right.
36	Translate left.
37	Translate relax.
38	Translate calibrate.
62	Move slowly to one side of the translate frame. Used to find translate home during powerup. Movements after powerup use the translate home ID, 63.
63	Move to one side of the translate frame. Used to find translate home.
64	Plunge idle (not used).
65	Plunge move (not used).
66	Plunge saturate (not used).
67	Move a short distance back from the plunge position where an overforce shutdown error occurred. Relaxes the tension.
68	Retract the plunge assembly on the picker all the way back to find "home" in the plunge axis. May start a flip, depending on starting position. (One of three plunge find homes in the sequence; 68, 69, 6A.)
69	Retract the plunge assembly on the picker all the way back and flip the picker at the same time. Used to find "home" in the plunge axis. (One of three plunge find homes in the sequence; 68, 69, 6A.)

Table D-1 HP Surestore Optical Micro-Move ID Table (For all models, EXCEPT 40fx, 80ex, 125ex and 220mx)

Move ID (hex.)	Description
6A	Retract the plunge assembly on the picker all the way back and then flip the picker. Used to find "home" in the plunge axis. Second flip of the sequence. (One of three plunge find homes in the sequence; 68, 69, 6A.)
6B	Plunge toward magazine to get cartridge.
6C	First time plunge into magazine (first "get"). Feels for resistance to learn the distance to the cartridge when it is seated.
6D	Retraction to pull the cartridge out of the magazine.
6E	Plunge get magazine out 2 (not used).
6F	First part of a two-step move to put a cartridge into a magazine. Puts the cartridge nearly all the way in. Next part of move is micro-move 70.
70	Second part of a two-step move to put a cartridge into a magazine. Continues movement of micro-move 6F and puts the cartridge in the rest of the way (the distance learned in micro-move 6C).
71	First time plunge into a magazine (first "put"). Feels for resistance to learn the distance to the cartridge when it is seated.
72	Retract picker plunge assembly after putting cartridge into a magazine. Assembly is retracted just far enough that the thumbs are clear of the picker vertical path.
73	Plunge put magazine out 2 (not used).
74	Plunge put magazine out 3 (not used).
75	First part of a two-step plunge move to put a cartridge into a drive. Cartridge is inserted to a point where the drive shutter arms start to engage.

Table D-1 HP Surestore Optical Micro-Move ID Table (For all models, EXCEPT 40fx, 80ex, 125ex and 220mx)

Move ID (hex.)	Description
76	First time "put" plunge into a drive. Slow. Feels for resistance to learn the distance to the cartridge when it is seated.
77	First time "get" plunge into a drive. Slow. Feels for resistance to learn the distance to the cartridge when it is seated.
78	Fast "put" plunge into a drive (distance has been previously learned).
79	Retract picker plunge assembly after putting cartridge into drive. Assembly is retracted just far enough to that the thumbs are clear of the picker vertical path.
7A	Plunge put drive out 2 (not used).
7B	Plunge put drive out 3 (not used).
7C	(Used in an emergency cartridge eject). Plunge toward a drive, stopping at a position close to the drive. This the wait position until the drive ejects the cartridge.
7D	(Used in an emergency cartridge eject). Plunge to contact and get the cartridge from the drive. Follows micro-move 7C.
7E	Log ID (no motion). Logs that picker is in position in front of drive, waiting for the drive to eject the cartridge.
7F	Plunge forward to get cartridge from the drive. Thumbs wrap over the ears on the cartridge.
80	Retract a small amount o take up the slack between the picker thumbs and the cartridge ears.
81	Retract plunge assembly fully back into the picker.
82	Plunge get drive out 3 (not used).

Table D-1 HP Surestore Optical Micro-Move ID Table (For all models, EXCEPT 40fx, 80ex, 125ex and 220mx)

Move ID (hex.)	Description
83	Flip during plunge when cartridge is in the top picker.
84	Flip during plunge when cartridge is in the bottom picker.
85	Plunge finish flip (not used).
86	Plunge test picker saturate with media (not used).
87	Short plunge out to test for a cartridge in the picker. If a cartridge is in the picker, the path clear beam will be interrupted. Used in an ISTAT.
88	Short plunge out to test for a cartridge in a magazine when the picker contains a cartridge. If resistance is felt, this is interpreted as a cartridge in the magazine. Used in an ISTAT.
89	Retract picker plunge assembly into the picker after executing micro-move 88. Used in an ISTAT.
8A	Short plunge to test for a cartridge in a drive when the picker contains a cartridge. If resistance is felt, this is interpreted as a cartridge in the drive. Used in an ISTAT.
8B	Plunge out. Used in error recovery. Is an attempt to push a cartridge out of the vertical picker path and into a magazine.
8C	Retract thumbs back into the picker. Used in error recovery. Is an attempt to pull a cartridge out of the vertical picker path and into the picker. Either this micro-move or micro-move 8D is used, depending on position of the picker at the start of recovery.
8D	Retract thumbs back into the picker. Used in error recovery. Is an attempt to pull a cartridge out of the vertical picker path and into the picker. Either this micro-move or micro-move 8C is used, depending the on the position of the picker at the start of recovery.

Table D-1 HP Surestore Optical Micro-Move ID Table (For all models, EXCEPT 40fx, 80ex, 125ex and 220mx)

Move ID (hex.)	Description
8E	Move picker plunge assembly out to rearm the picker mechanism before switching active picker.
8F	Retract picker plunge assembly to a point just short of tripping the thumb selection mechanism. First of two steps (second step is micro-move 90).
90	Retract picker fingers all the way back. Trips the mechanism that makes the opposite thumb "active."
91	Move picker plunge assembly forward, away from the full retracted position. Clears the tripping mechanism and makes the new thumb "active."
92	Plunge picker diagnostic 1 (factory use only).
93	Plunge picker diagnostic 2 (factory use only).
94	Plunge picker diagnostic 3 (factory use only).
95	Plunge picker diagnostic 4 (factory use only).
96	Plunge picker back 1 (not used).
97	Plunge picker back 2 (not used).
98	Plunge find handoff distance 1 (factory use only).
99	Plunge find handoff distance 2 (factory use only).
9A	Plunge find handoff distance 3 (factory use only).
9B	Plunge find flip distance 1 (factory use only).
9C	Plunge find flip distance 2 (factory use only).
9D	Plunge find picker length (factory use only).
9E	Plunge picker state 1 (factory use only).
9F	Plunge picker state 2 (factory use only).

Table D-1 HP Surestore Optical Micro-Move ID Table (For all models, EXCEPT 40fx, 80ex, 125ex and 220mx)

Move ID (hex.)	Description
A0	Plunge finish home (not used).
A1	Plunge finish saturate home (not used).
A2	First of two plunge movements toward the drive during error recovery. Vertical movement is done before the second part of this movement (micro-move A3) is done.
A3	Second of two plunge movements toward the drive during error recovery. Done after a small vertical movement is done to "wiggle" the picker.
A4	Plunge out. Is an attempt to clear the vertical picker path during drive error recovery.
A5	First part of a two-step move to fully retract the picker plunge assembly. Retract assembly almost all the way back. Next part of move is micro-move A6.
A6	Second part of a two-step move to fully retract the picker plunge assembly. Continues movement of micro-move A5 and brings picker plunge assembly all the way back.
A7	Move picker plunge assembly forward a small amount from full retracted position. Completes rearm of the picker mechanism.
A8	Move to a position where the picker thumb sensor can be read. Used in the find plunge home recalibration.
A9	Move to a position where the current active picker can be read. Used in the plunge home recalibration.
AA	Fully retract picker plunge assembly to switch the active picker. One of three moves used to make the top picker the active picker during a picker recalibration.

Table D-1 HP Surestore Optical Micro-Move ID Table (For all models, EXCEPT 40fx, 80ex, 125ex and 220mx)

Move ID (hex.)	Description
AB	Move picker plunge assembly forward a small amount to complete the rearm of the picker mechanism. One of three moves used to make the top picker the active picker during a picker recalibration.
AC	Move picker plunge assembly forward to normal position after a active picker has been change by micro-moves AA and AB. One of three moves used to make the top picker the active picker during a picker recalibration.
AD	Move the picker plunge assembly a small amount away from the flip mechanism so that the mechanism is rearmed for a flip. Used in a flip sequence.
AE	Move the picker plunge assembly out a small amount from the full retracted position to relieve the pressure on the mechanism after a flip.
AF	First of two moves to move the thumb to the magazine during an ISTAT when no cartridge is in the picker. Next move is micro-move B0.
B0	Second of two moves to move the thumb to the magazine during an ISTAT when no cartridge is in the picker. Slow move to check for an overforce (cartridge in the magazine slot).
B1	Retract picker plunge assembly back into the picker to a point where the thumbs can unsplay. Used during an ISTAT, with no cartridge in the picker, when the thumbs are splayed and are they must be unsplayed.
B2	Retract picker plunge assembly into the picker to a point just short of where the thumbs would be released and unsplay. Used during an ISTAT, with no cartridge in the picker, when the thumbs are splayed and must be kept splayed.

Table D-1 HP Surestore Optical Micro-Move ID Table (For all models, EXCEPT 40fx, 80ex, 125ex and 220mx)

Move ID (hex.)	Description
B3	Retract picker plunge assembly back far enough to release the thumbs and let them go to an unsplayed position. Used during an ISTAT, and the thumbs are being returned to an unsplayed position after contacting, grabbing, and replacing the first cartridge.
B4	Retract picker plunge assembly into the picker to a point just short of where the thumbs would be released and unsplay. Used during an ISTAT, and the thumbs are being retained in the splayed position after contacting, grabbing, and replacing the first cartridge.
B5	Retract picker plunge assembly far enough to get the thumbs out of the vertical picker path. Used during an ISTAT, no cartridge in the picker, and no cartridge was contacted in the first magazine.
B6	Pull picker plunge assembly fully back to rearm a "put." Enable the picker to replace the cartridge it picked up during an ISTAT.
B7	First of two moves that put a cartridge back into the magazine after the cartridge is detected during an ISTAT. Moves the cartridge almost fully into the magazine. Followed by micro-move B8.
B8	Second of two moves that put a cartridge back into the magazine after the cartridge is detected during an ISTAT. Moves the cartridge fully into the magazine.
B9	Second of two moves to test for the presence of a cartridge in a magazine during an ISTAT when there is a cartridge in the picker. Slow move to check for an overforce (cartridge in the magazine slot). Follows micro-move BA.

Table D-1 HP Surestore Optical Micro-Move ID Table (For all models, EXCEPT 40fx, 80ex, 125ex and 220mx)

Move ID (hex.)	Description
BA	First of two moves to test for the presence of a cartridge in a magazine during an ISTAT when there is a cartridge in the picker. Fast plunge that places the en of the cartridge in the picker close to the magazine. Followed by micro-move B9.
BB	Testing for media in picker. After the physical force check.
BC	Retract picker plunge assembly after detecting a cartridge in the drive. Used in an ISTAT when there is a cartridge in the picker.
BD	Retract picker plunge assembly to a point just short of where the thumbs would be released from their splayed position. Used if thumbs are splayed after checking magazines in an ISTAT.
BE	Retract picker plunge assembly after inserting a cartridge into a drive.
BF	Quickly retract the picker plunge assembly if an error occurred while inserting a cartridge into a drive.
C0	Retract picker plunge assembly to a point where the thumbs are released and go to an unsplayed position. Used in an ISTAT.
C1	Insert cartridge into a drive, just past the shutters. Distance has not been learned.
C2	Insert cartridge into a drive, just past the shutters. Distance has NOT been learned. Part one of a two-stage move. Used in the sequence to return a cartridge into a drive after an emergency eject during an ISTAT.
C3	Insert cartridge into a drive, just past the shutters. Distance has been learned. Part one of a two-stage move. Used in the sequence to return a cartridge into a drive after an emergency eject during an ISTAT.

Table D-1 **HP Surestore Optical Micro-Move ID Table (For all models, EXCEPT 40fx, 80ex, 125ex and 220mx)**

Move ID (hex.)	Description
C4	Insert cartridge fully into a drive. Distance has been learned. Part two of a two-stage move. Used in the sequence to return a cartridge into a drive after an emergency eject during an ISTAT.
C5	Insert cartridge fully into a drive. Distance has been learned. Additional push in case the drive acknowledge signal was not seen. Used in the sequence to return a cartridge into a drive after an emergency eject during an ISTAT.
C6	Insert cartridge fully into a drive. Distance has been learned. Part two of a two-stage move. Used in the sequence to return a cartridge into a drive after an emergency eject during an ISTAT.
C7	Retract picker to rearm position to splay the fingers. Used when an error in the drive acknowledge signal is seen and a drive eject will be done and the thumbs must be in the splayed position.
C8	Plunge thumbs out close to the end of the picker to get ready to "get" a cartridge. Done at the same time as vertical moves and in-transit translates and flips.
C9	Same as micro-move C8 but is a retry (if needed).
CA	Plunge rotate mailslot 1 saturate (not used).
CB	Retract picker plunge assembly back far enough to clear the thumbs from the vertical picker path. Used after a cartridge is put in the mailslot.
CC	Plunge out to clear the mailslot path. Distance has not been learned. Used in error recovery.
CD	Short plunge out to fully seat a cartridge in the mailslot and to measure the distance of a fully-inserted cartridge.

Table D-1 HP Surestore Optical Micro-Move ID Table (For all models, EXCEPT 40fx, 80ex, 125ex and 220mx)

Move ID (hex.)	Description
CE	Plunge out to clear the mailslot path. Used in error recovery.
CF	Retract picker plunge assembly in an attempt to clear the mailslot path. Used in error recovery.
D0	Short plunge to push the cartridge to a fully seated position during a "get" to the mailslot. Distance is learned.
D1	Short plunge during a mailslot "put." Ducks under the mailslot rotation mechanism and positions the picker so it can move up all the way to mailslot insertion position.
D2	Short plunge to put the cartridge all the way into the mailslot.
D3	Short plunge during a mailslot "get". Ducks under the mailslot rotation mechanism and positions the picker so it can move up all the way to the mailslot "get" position.
D4	Plunge to get the cartridge from the mailslot.
D5	Retract cartridge most of the way into the picker. Positions the picker so that it can duck under the mailslot rotation mechanism during a "get."
D6	Continue retraction in micro-move D5. Pull cartridge all the way back into the picker.
D7	Retract thumbs to a point just inside the picker. Used to clear the vertical picker path during error recovery.
D8	Plunge to a position where the mailslot rotation actuator can by pulled in.
D9	Plunge to a position where the mailslot rotation actuator can by pushed out.

Table D-1 **HP Surestore Optical Micro-Move ID Table (For all models, EXCEPT 40fx, 80ex, 125ex and 220mx)**

Move ID (hex.)	Description
DA	Move picker plunge assembly to a position where the mailslot rotation actuator can be engaged to rotate the mailslot out. Used when the state of the mailslot is unknown and must be placed in a known state.
DB	Retract the picker plunge assembly a short distance to clear the thumbs away from the mailslot after rotating the mailslot out.
The following move IDs are only for 80fx, 160fx, 200fx, 160ex, 320ex, 400ex, 300mx, 600mx, and 700mx model jukeboxes.	
DC	Slow retract of the picker plunge assembly, pulling the mailslot in. Checks that the cartridge is in properly. First move of a rotate in.
DD	Retract thumbs back into the picker after rotating the mailslot out.
DE	Plunge rotate mailslot 3 (not used).
DF	Plunge rotate mailslot 4 (not used).
E0	Plunge rotate mailslot 5 (not used).
E1	First of two moves rotating the mailslot in. Quickly retract the picker plunge assembly, pulling the mailslot most of the way in. Followed by micro-move E3.
E2	Plunge out to rotate the mailslot almost all the way out.
E3	Short retraction of the picker plunge assembly until pressure is felt. Used at end of rotating the mailslot in and ensures that the mailslot has been rotated fully in.
E4	Short plunge out to relieve the pressure after rotating the mailslot in.
E5	Short plunge out, feeling for pressure, to ensure that the mailslot is rotated all the way out.

Table D-1 HP Surestore Optical Micro-Move ID Table (For all models, EXCEPT 40fx, 80ex, 125ex and 220mx)

Move ID (hex.)	Description
E6	Retract picker plunge assembly a short distance to relieve the pressure after micro-move E5.
The following move IDs are only for 330fx, 600fx, 660ex, 1200ex, 1200mx and 2200mx model jukeboxes.	
DC	Mailslot finished move in.
DD	Mailslot finished move out.
DE	Mailslot pulled cartridge flush with front panel to check media present/media inserted correctly.
DF	Mailslot starting a move in.
E0	Mailslot starting a move out.
E1	Mailslot in the middle of a move in or move out.
E2	Mailslot approaching the end of a move in or move out.
E3	Mailslot unexpected stop.
E4	Mailslot start initialization after an error or at startup.
E5	Mailslot initialization successful.
E6	Mailslot end move with error; move not complete.
The following move IDs are for all model jukeboxes.	
E7	On powerup, testing for motion in one direction on the plunge motor.
E8	On powerup, testing for motion in the plunge motor. Opposite direction than in micro-move E7.
E9	Plunge out to clear the picker vertical path. Used when path is blocked during powerup.
EA	Picker plunge assembly retraction to clear the picker vertical path. Used when path is blocked during powerup.

Table D-2 HP Surestore Optical Micro-Move ID Table (For models 40fx, 80ex, 125ex and 220mx ONLY)

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

Table D-2 HP Surestore Optical Micro-Move ID Table (For models 40fx, 80ex, 125ex and 220mx ONLY)

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 grabbing the cartridge
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

Table D-2 HP Surestore Optical Micro-Move ID Table (For models 40fx, 80ex, 125ex and 220mx ONLY)

Move ID (hex.)	Description
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
27	Carriage motion during mailslot insert
28	Push cartridge forward into the mailslot
29	Detect the 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 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 mailslot rotate arm
31	Release tension on the mailslot 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 D-2 HP Surestore Optical Micro-Move ID Table (For models 40fx, 80ex, 125ex and 220mx ONLY)

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	Move cartridge in or out of picker during test for a cartridge in a storage slot
38	Move fingers in or out of picker during test for a cartridge in a storage slot
39	Move cartridge in and out of picker during test for cartridge in the drive
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

Table D-2 HP Surestore Optical Micro-Move ID Table (For models 40fx, 80ex, 125ex and 220mx ONLY)

Move ID (hex.)	Description
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
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)

Table D-2 HP Surestore Optical Micro-Move ID Table (For models 40fx, 80ex, 125ex and 220mx ONLY)

Move ID (hex.)	Description
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
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

Table D-2 HP Surestore Optical Micro-Move ID Table (For models 40fx, 80ex, 125ex and 220mx ONLY)

Move ID (hex.)	Description
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

E Disconnect Timeout Settings

Disconnect Timeout Settings

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 E-1 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 E-1 Timeout Settings

Command	Nominal Disconnect Time (seconds)	Maximum Disconnect Time	Levels of Error Recovery
Exchange Medium	14	600 sec	6
Initialize Element Status	120	600 sec	6
Move Medium	5	600 sec	6
Position To Element	5	600 sec	6
Prevent/Allow Media Removal	10	600 sec	6
Read Element Status	120[a]	600 sec	6
Release	10	600 sec	6
Reserve	10	600 sec	6
Rezero Unit	120	600 sec	6
Send Diagnostic	600[b]	600 sec	6
Rotate	5	600 sec	6

a. 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.
b. 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 so set the loop count to one and set the timeout to 10 minutes.

Disconnect Timeout Settings

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