SCSI-3 Library Command Set

For Library Models 2/20, 4/40, 6/60, 8/80, 10/100, and the 1/9 Autoloader

Edition 7

Manufacturing Part Number: 5966-9725

November 2002

Notice

Printing History

New editions of this manual incorporate all material updated since the previous edition. The manual printing date and part number indicates the edition. The printing date changes when a new edition is printed.

June 1999	Edition 1: Initial printing.
February 2000	Edition 2: Added information for autoloader model 1/9.
June 2000	Edition 3: Added information for library model 6/140.
September 2000	Edition 4: Revised library commands. Deleted DLT drive information. We are now referencing the drive manufacturer's SCSI specifications instead of recreating our own manual.
March 2001	Edition 5: Added information for library models 4/100, 8/140, 10/140 and 12/140.
June 2002	Edition 6: Updated Read Buffer command set, added commands for Galactica 2 firmware updates. Change bars indicate information that was changed for edition 6.

November 2002 Edition 7: Updated Error Code Qualifiers.

About This Reference Manual

Chapter 1 .	SCSI Command Overview: Explains SCSI commands and their use with tape drives and libraries. This section does not replace the *SCSI-2 Command Specifications*.
Chapter 2 .	Library SCSI-3 Command Set: Provides a list of all the supported SCSI commands, explaining each command's structure.
Chapter 3 .	Library Error Codes: Lists all error codes associated with the library.
Appendix A .	Field Replaceable Units: Lists the field replaceable units by number for the library.
Appendix B .	Programmer's Tips: Provides information on integration, tape drive and library drivers, utilities, and TapeAlert.
Appendix C .	Move Sequence IDs: Lists all micro- and macro-moves for the tape library.
Index.	Assists you in locating information quickly.

Where to Find Information for SCSI Drive Commands

This manual includes the library command set only. This manual does not include the SCSI command set for the drive commands.

To view the SCSI command set for each drive, refer to the following websites where pdfs of the drive SCSI commands are available.

- HP Ultrium LTO: To access HP's SCSI manual for the Ultrium LTO drive, go to: http://brintwww.bri.hp.com/learning_products/ultrium/Ultrium%20Tech%20Manual/document/ultrium/scsi/common/eng/scsihome.htm
- Quantum DLT: You can navigate to the DLT SCSI manuals by going to http://www.quantum.com and clicking on Customer Support.
  1. Select **Download Quantum's Data Protection System (QDPS) and other useful software.**
  2. Select **Agree** for accept the user license and select the **Click Here** link at the bottom of the page.
  3. Scroll down to the **DLTtape Drive Product Manuals** at the bottom of the page and select the SCSI manual that you would like to view.
- Benchmark DLT 1: To access Benchmark's SCSI manual for the DLT 1 drive, go to: http://www.benchmarktape.com/support/doc.cfm.

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1 SCSI Command Overview

SCSI Command Overview

This chapter provides an overview of SCSI commands as they apply to the library controller.

You can obtain additional information about the Small Computer System Interface - (SCSI-2 and SCSI-3) by writing or calling:

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

Library Control Through SCSI

You can control the tape drive and library with the commands described in this document.

This SCSI command set complies with ANSI X3.131-198X standards. The role of the following is defined in the SCSI specifications:

- Initiator
- Target Device
- Addresses

Initiator

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

Target Device

The target, usually the tape drive or library, receives the command and controls the device. The target will not do the following:

- Generate unsolicited interrupts to the host
- Initiate its own SCSI commands
- Assert bus reset

Addresses

All SCSI commands refer to logical addresses, unless otherwise stated.

Library Control Commands

This section describes all specifications, except the target command specifications. The SCSI commands used by the targets are described later in Chapter 2.

SCSI Bus Phases

The target supports all phases specified in the SCSI standard. This section describes the following phases:

- Arbitration
- Selection
- Reselection
- Information Transfer
- Data
- Command
- Message
- Status

Arbitration Phase

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

Selection Phase

The selection phase allows an initiator to select a target to initiate 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.

Reselection Phase

The reselection phase allows the target to reconnect to an initiator. The purpose of this phase is to continue the command operation already 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. The library only supports asynchronous transfers with a maximum size of 32Kbytes. During all transfer phases that the device writes data to the SCSI bus, odd parity is generated. Parity is checked during all transfer phases where data is read from the bus, but can be disabled.

Data Phase

The data phase encompasses both the *Data In* phase and the *Data Out* phase.

- The *Data In* phase allows the target to request that its data be sent to the initiator.
- The *Data Out* phase allows the target to request that data from the initiator be sent to the target.

Command Phase

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

Message Phase

The message phase is a term that 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 the single message phase.

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

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

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

Table 1-1 Target-Supported Messages

Code (Hex)	*Direction*	*Description*
00H	In	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
0CH	Out	Bus Device Reset
80H-FFH	In/Out	Identify

Command Complete 00H, The target sends a message to the initiator to indicate that a command operation is complete (or series of linked commands) 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). If the library receives the Command Complete message, it will do the following:

1. Handle the message as an illegal message.
2. Return MESSAGE REJECT.
3. Enter the status phase by reporting CHECK CONDITION with the sense key set to COMMAND ABORTED.

Extended Message 01H, The initiator or target sends this message as the first byte of a multiple-byte message (> 2 bytes). The extended message has the following format:

Byte 0	Extended Message Identifier - 01H
Byte 1	Extended Message Length
Byte 2	Extended Message Code
Byte 3	Extended Message Additional Parameters

The extended message length specifies this length plus the number of additional parameter bytes that will follow. The length does not include bytes 0 and 1. An extended message length of zero indicates 256 bytes to follow.

Possible extended message codes include the following:

00H	Modify Data Pointer (not supported)
01H	Synchronous Data Transfer Request
02H	Reserved
03H	Wide Data Transfer request
04H-7FH	Reserved
80H-FFH	Vendor unique

If the tape drive receives an extended message that it does not support, it switches to the Message In phase and returns MESSAGE REJECT after all the bytes of the message have been transferred.

Synchronous Data Transfer Request (SDTR) 01H, This extended message allows the target and initiator to agree on the parameter values relevant to synchronous transfers. The tape drive will not initiate the Synchronous Data Transfer Request message, but relies on the Initiator to do so. The SDTR message has the following format:

Byte 0	Extended Message Identifier = 01H
Byte 1	Length = 03H
Byte 2	Message Code = 01H (SDTR msg)
Byte 3	Transfer Period (min=50h max=32h)
Byte 4	Transfer Req/Ack Offset (max=15h)

Wide Data Transfer Request (WDTR) 03H, The message format is as follows:

Byte 0	Extended Message = 01H
Byte 1	Extended Message Length = 02H
Byte 2	WIDE DATA TRANSFER REQUEST = 03H
Byte 3	Transfer Width Exponent = 00H

A SCSI device initiates a Wide Data Transfer Request (WDTR) message exchange whenever a previously arranged transfer width agreement may have become invalid. The agreement becomes invalid after any condition that leaves the data transfer agreement in an indeterminate state including:

- A hard reset condition
- A `BUS DEVICE RESET` message
- A power cycle

The WDTR message exchange establishes an agreement between two SCSI devices on the data path width used for Data phase transfers. Since this agreement only applies to Data In and Data Out phases, all other information transfer phases will use an eight-bit data path.

Save Data Pointer 02H, The target sends this message to the initiator to direct it to save a copy of the present active data pointer for the currently attached logical unit. The target issues this message when it disconnects the SCSI Bus during data transfer, but not if it intends to move directly to the Status phase. When received as a target, it switches to Message In phase and returns MESSAGE REJECT.

Restore Pointers 03H, The target sends this message to the initiator so that it will restore the most recently saved pointers (for the currently attached logical unit) as follows:

1. Command, data, and status pointers for the logical unit once again become active.
2. Command and Status pointers go to the beginning of the present Command and Status areas.
3. The Data pointer is restored to the value at the beginning of the data area in the absence of a SAVE DATA POINTER message or to the value at the last SAVE DATA POINTER message that occurred for that logical unit.

When the RESTORE POINTERS message is received as a target, the target switches to the Message In phase and returns MESSAGE REJECT.

Disconnect 04H, A target sends a DISCONNECT message to tell an initiator that it wants to release control of the SCSI bus (the target intends to disconnect by releasing BSY). To later complete this operation, SCSI bus reselection is required. This message does not cause the initiator to save the data pointer.

When received from an initiator, the tape drive may respond in one of two ways:

- It may take the message as a request by the initiator to disconnect and comply by entering the Message In phase and sending the DISCONNECT message back to the initiator (possibly preceded by the SAVE DATA POINTERS message). In this case, it will delay a minimum of 200 microseconds before arbitrating for the bus again.
- Alternately, it may enter the Message In phase and return MESSAGE REJECT.

Initiator-Detected Error 05H, The initiator sends this message to inform a target that an error (for example, a bus parity error) has occurred, which does not prevent the target from retrying the operation. When received, the tape drive attempts to retransfer the last command, data, or status bytes by using the RESTORE POINTERS message.

Abort 06H, The initiator sends this message to the target to clear, on the selected unit, the current I/O process. The following then occurs:

- Buffered (cache) write operations will be completed if possible.
- The target goes directly to the BUS FREE phase after receiving this message.
- Current settings of Mode Select parameters, reservations, commands, data, and status for other initiators are not affected.

This message can be sent to a logical unit that is not currently performing another operation for the initiator. If it does not select a unit, the target goes to BUS FREE, which does not affect any commands, data or status on the target.

Message Reject 07, The initiator or target sends this message to indicate that one or more bytes in the last message received was inappropriate or has not been implemented.

To indicate that it intends to send this message, the initiator asserts the ATN signal before it releases ACK for the REQ/ACK handshake of the message to be rejected.

MESSAGE REJECT indicates messages that the drive considers illegal or unsupported. The tape device will send this message to the initiator before requesting additional message bytes.

No Operation 08H, If a target requests a message, the initiator sends NO-OP if it does not have another valid message to send. The message is accepted when the drive is acting as a target, and may be sent when it is an initiator. If the target receives this message during a selection, the drive proceeds to the COMMAND phase (provided ATN does not continue being asserted). The NO-OP message is ignored by the tape drive.

Message Parity Error 09H, The initiator sends this message to the target to indicate that one or more bytes in the last message had a parity error.

To indicate that it intends to send the message, the following occurs:

- The initiator sets the ATN signal before it releases ACK for the REQ/ACK handshake of the message with the parity error. This provides an interlock so that the target can determine which message has the parity error. If the target receives this message under other conditions, it proceeds to the BUS FREE state by releasing the BSY signal, signifying a catastrophic error.
- The target will respond by switching to the Message In phase and resending all the message bytes that generated the original MESSAGE PARITY ERROR message.

Bus Device Reset 0CH, This message from the initiator clears all commands, data, and status in the tape controller. When it recognizes this message, the drive aborts the current command and proceeds to the BUS FREE state. The drive then executes a hard reset as if a Bus Reset had occurred. All data in the write buffer is lost.

Identify 80H-FFH, The initiator or target sends this message to establish the physical path connection between them for a logical unit.

When the Identify message is sent from a target to an initiator during reconnection, a RESTORE POINTERS message is implied.

- Bit 7: This bit is always set to 0.
- Bit 6: This bit is set by the initiator if the target can disconnect/reconnect.
- Bit 5: This bit must be set to zero ("Target Routines" not supported).
- Bit 4: Reserved.
- Bit 3-0: These bits specify a logical unit number. (Only one logical unit number is identified for a selection sequence).

Status Phase

The target sends a status byte to the initiator during the Status Phase, which occurs at the end of each command, unless the command is cleared by ABORT, BUS DEVICE RESET, or a HARDWARE RESET signal. The target supports the following status codes.

Table 1-2 *Target-Supported Status Codes*

Code (Hex)	*Status*
00H	Good
02H	Check Condition
08H	Busy
10H	Intermediate Good
18H	Reservation Conflict
22H	Command Terminated

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 results in a Check Condition status. To determine the condition, the Request Sense Command should be issued following a `CHECK CONDITION` status.

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

Intermediate Good 10H, For commands issued with the LINK bit set, you will see this status instead of `GOOD`. Following this status, the drive will proceed to the `COMMAND` phase for the transfer of the next linked command.

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

Command Terminated 22H, This status is returned for a command that was terminated by a `TERMINATE I/O PROCESS` message. This status also indicates a contigent allegiance condition.

Conditions

Attention Condition

The Attention Condition allows an initiator to inform the target that it has a message ready. The target gets this message at its convenience when it performs a Message Out.

The target responds to the ATN signal at every phase transition with `MESSAGE OUT`, provided ATN was set before REQ was dropped. `MESSAGE OUT` is either received immediately or after the transition completes.

Reset Condition

When you see Reset Condition, the following occurred:

- Power was applied
- The RST (Reset) signal is asserted
- The `BUS DEVICE RESET` message is received

If the target will abort any outstanding commands and undo moves aborted.

If the target is not operating in a cohesive manner (hang encountered--an unrecoverable situation), the following occurs:

- A Power-on reset
- A Hard Bus reset
- A message on the front panel that tells you to write it down and power cycle

NOTE

Within five seconds of power on and within 250 milliseconds (typically under four milliseconds) after a Bus Reset, the library responds to SCSI bus selections.

Unit Attention Condition

For each initiator, a unit attention condition for a logical unit begins for the following:

- Power on
- Bus Reset
- Bus Device Reset
- Tape Loaded
- Micro Code Change
- Inquiry Data Change
- Mode Select Data Change
- Mailslot Accessed
- Log Parameters Changed
- Reservations Preempted
- Operating Conditions Changed

The unit attention condition persists for each initiator until it 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; otherwise it 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 does the following:

- Discards any pending sense data
- Reports a Unit Attention sense key
- Clears the unit attention condition for that initiator

Two queued Unit Attentions are not unusual. For example, if a library is powered up and a cartridge is loaded, Power Up and Not-Ready to Ready Transition Unit attentions are created. If an initiator does not clear Unit Attentions queued for it because of limited buffers, the tape device will eventually stop generating new Unit Attentions for the I-L combination (but existing ones will remain in queue).

Not Ready Condition

NOTE

In contrast to the BUSY status condition, the Library Not Ready Sense Key is returned as part of the sense data following a Request Sense Command. This message indicates that a Media Access Command has been issued, and the media is not ready to be accessed.

In the Not Ready state, the initiator cannot perform any operation that would cause library motion (move, exchange, position, etc.) or ask for data that is unknown (Mode Sense, Read Buffer, Write Buffer). These commands would return a CHECK CONDITION status with a Library Not Ready sense key. However, the initiator can execute commands that do not require access to the media, returning a GOOD status. The commands are as follows:

- Inquiry
- Log Sense/Select
- Mode Sense/Select
- Prevent/Allow Medium Removal
- Read Element Status with curdata set
- Receive Diagnostics Results
- Request Sense
- Reserve/Release Unit
- Send Diagnostic (non-media or motion-access diagnostics)
- Write Buffer
- Report LUNS
- Persistent Reserve In
- Persistent Reserve Out

The Test Unit Ready command is used to determine whether the tape drive accepts a Media Access command without returning `CHECK CONDITION`.

Bus Free Condition

There are several situations when the device might or will go to BUS FREE unexpectedly, as defined in the SCSI-3 standard:

- An internal hardware or firmware fault that makes it unsafe for the device to continue operating without a full reset (similar to a power up reset)
- An ATN asserted or bus parity error during non-tape data transfers

Bus Parity Error Condition

The occurrence of bus parity errors (single bit errors) are rare and very serious since they imply the possibility of undetected double-bit errors on the bus, which could result in undetected data corruption. On properly configured SCSI buses, parity errors should be extremely rare. If detected, immediately take steps to improve the SCSI bus configuration.

Bus parity errors cause the library to do the following:

- Retry the operation
- Go to the Status phase
- Go to Bus Free and prepare Sense Data

Other SCSI Functionality

- Linked commands are not supported.
- Untagged queuing is supported.

SCSI Commands Used by Target

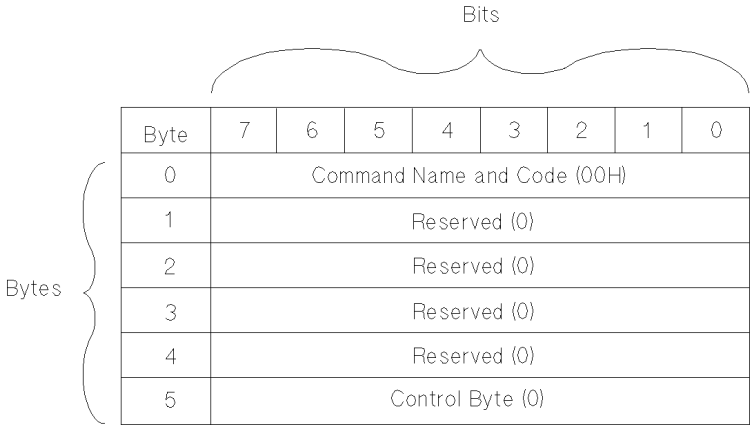
This section describes detailed functions of each supported target program. Entries are arranged in order of operation code.

Each entry includes:

- Command name
- Operation code
- Brief description of the command
- Command descriptor block (CDB)
- Detailed description of the command

Command Descriptor Block (CDB)

This example figure shows a six-byte command, though the format is the same for 10-, 12-, and 16-byte commands.



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 also contains 0.

2 Library SCSI-3 Command Set

Numerical List of Commands

The following tables list the SCSI-3 commands numerically. See Table 2-2 on page 2-4 for an alphabetical list of all commands.

Table 2-1 Tape Library SCSI-3 Commands

Hex Code	Name	Description	Page
00H	Test Unit Ready	Checks to determine if the tape library is ready.	page 2-6
01H	Rezero Unit	Sets the library to a specific predefined state.	page 2-7
03H	Request Sense	Determines a specific error condition when the library fails to successfully complete a command.	page 2-8
07H	Initialize Element Status	Checks all elements for tape cartridges.	page 2-12
12H	Inquiry	Provides vendor, product, and revision information.	page 2-13
15H	Mode Select (6)	Sets the configuration.	page 2-23
16H	Reserve (6)	Reserves the library for use by a single SCSI initiator.	page 2-25
17H	Release (6)	Releases the library for use by multiple SCSI initiators.	page 2-27
1AH	Mode Sense (6)	Reports element parameter and configuration information.	page 2-29
1CH	Receive Diagnostic Results	Retrieves diagnostic test information resulting from the Send Diagnostic Command.	page 2-64
1DH	Send Diagnostic	Causes the library to perform predefined diagnostic test/exerciser routines.	page 2-70

Table 2-1 Tape Library SCSI-3 Commands

Hex Code	*Name*	*Description*	*Page*
1EH	Prevent/Allow Medium Removal	Prevents or allows the manual insertion or removal of a tape cartridge through the mailslot.	page 2-73
2BH	Position To Element	Positions the specified transport element in front of the specified destination element.	page 2-75
3BH	Write Buffer	Writes data to the library controller's data buffers.	page 2-76
3CH	Read Buffer	Reads data from the library controller's data buffers.	page 2-81
4CH	Log Select	Sets and clears logs.	page 2-120
4DH	Log Sense	Retrieves statistical information about the library.	page 2-123
55H	Mode Select (10)	Sets the library configuration mode page.	page 2-156
56H	Reserve (10)	Reserves the library for use by a single SCSI initiator.	page 2-158
57H	Release (10)	Releases the library for use by multiple SCSI initiators.	page 2-160
5AH	Mode Sense (10)	Determines element parameter and configuration information.	page 2-163
A0H	Report LUNS	Retrieves information about Logical Unit Numbers.	page 2-165
A5H	Move Medium	Moves the tape cartridges between library elements.	page 2-167
A6H	Exchange Medium	Exchanges the tape cartridge at the destination element address with the source element address.	page 2-168
B8H	Read Element Status	Determines the status of the storage slots, mailslot, drives, and picker.	page 2-170

Alphabetical List of Commands

The following table lists all the SCSI-3 commands in alphabetical order. A numerical list begins on of this chapter.

Table 2-2 Alphabetical List of Commands

Name	*Hex Code*	*Description*	*Page*
Exchange Medium	A6H	Exchanges the tape cartridge at the destination element address with the source element address.	page 2-168
Initialize Element Status	07H	Checks all elements for tape cartridges.	page 2-12
Inquiry	12H	Provides vendor, product, and revision information.	page 2-13
Log Select	4CH	Sets and clears logs.	page 2-120
Log Sense	4DH	Retrieves statistical information about the library.	page 2-123
Mode Select (6)	15H	Sets the configuration.	page 2-23
Mode Select (10)	55H	Sets the configuration.	page 2-156
Mode Sense (6)	1AH	Reports element parameter and configuration information.	page 2-29
Mode Sense (10)	5AH	Reports element parameter and configuration information.	page 2-162
Move Medium	A5H	Moves the tape cartridges between library elements.	page 2-167
Position To Element	2BH	Positions the specified transport element in front of the specified destination element.	page 2-75
Prevent/Allow Medium Removal	1EH	Prevents or allows the manual insertion or removal of a tape cartridge through the mailslot.	page 2-73

Table 2-2 Alphabetical List of Commands

Name	*Hex Code*	*Description*	*Page*
Read Buffer	3CH	Reads data from the library controller data buffers.	page 2-81
Read Element Status	B8H	Determines the status of the storage slots, mailslot, drives, and picker.	page 2-170
Receive Diagnostic Results	1CH	Retrieves diagnostic test information resulting from the Send Diagnostic Command.	page 2-64
Release (6)	17H	Releases the library for use by multiple SCSI initiators.	page 2-27
Release (10)	57H	Releases the library or element for use by another initiator.	page 2-160
Report LUNS	A0H	Retrieves information about Logical Unit Numbers.	page 2-165
Request Sense	03H	Determines a specific error condition when the library fails to successfully complete a command.	page 2-8
Reserve (6)	16H	Reserves the library for use by a single SCSI initiator.	page 2-25
Reserve (10)	56H	Reserves the library for use by a single SCSI initiator.	page 2-158
Rezero Unit	01H	Sets the library to a specific predefined state.	page 2-7
Send Diagnostic	1DH	Causes the library to perform predefined diagnostic test/exerciser routines.	page 2-70
Test Unit Ready	00H	Checks to determine if the tape library is ready.	page 2-6
Write Buffer	3BH	Writes data to the library controllers data buffers.	page 2-76

Test Unit Ready Command (00H)

Determines the READY state of the library. If the library is in a READY state when it receives this command, it returns a GOOD status. If the library is not ready when it receives the Test Unit Ready Command, it returns a CHECK CONDITION with a sense key of NOT READY.

Table 2-3 Test Unit Ready Command CDB

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

Rezero Unit Command (01H)

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

Table 2-4 Rezero Unit Command CDB

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

Request Sense Command (03H)

Determines the specific error condition when 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. This information can then be used to determine what type of error recovery is appropriate.

Table 2-5 Request Sense Command CDB

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

Allocation Length

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

Table 2-6 Request 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)				Sense Key (Table 3-1 on page 3-3)			
3	Information (MSByte)							
4	Information							
5	Information							
6	Information (LSByte)							
7	Additional Sense Length (Table 2-7 on page 2-10)							
8	Reserved (0)							
9	Reserved (0)							
10	Reserved (0)							
11	Reserved (0)							
12	Additional Sense Code (Table 3-2 on page 3-4)							
13	Additional Sense Code Qualifier (Table 3-2 on page 3-4)							
14	Reserved (0)							
15	SKSV	C/D	Reserved (0)		BPV	Bit Pointer		
16	Field Pointer (MSByte)							
17	Field Pointer (LSByte)							
18-77	Additional Sense Bytes (Table 3-3 on page 3-9)							

Valid

A valid bit of "1" indicates the Information field contains valid information. A bit of "0" indicates the information is not valid.

Error Code

Returns either 70H (current error) or 71H (deferred error).

Sense Key and Additional Sense Length

Table 2-7 *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 Bytes

Contains the Element address in question on an ILLEGAL REQUEST during a 21H or 3BH additional sense code.

Additional Sense Code

The Additional Sense Code specifies detailed information related to the error reported in the Sense Key field. See Table 3-2 on page 3-4.

Additional Sense Code Qualifier

The Additional Sense Code Qualifier specifies detailed information related to the Additional Sense Code. See Table 3-2 on page 3-4.

SKSV

When set to 1, the Sense Key Specific bytes (Bytes 15, 16, and 17) contain valid data. When set to 0, Bytes 15, 16, and 17 are 0.

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.

Additional Sense Bytes

This field may contain information when the Additional Sense Length field contains a value greater than 10. See Table 3-3 on page 3-9.

Initialize Element Status Command (07H)

Checks all elements for tape cartridges and for relevant status. This information is retained and can be accessed through the Read Element Status Command (B8H). Refer to Table 2-129 on page 2-170.

Table 2-8 Initialize Element Status Command CDB

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

Inquiry Command (12H)

Requests information on the type of SCSI device. This information includes the following:

- Vendor ID
- Product ID
- Product revision

Table 2-9 Inquiry Command CDB

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Operation Code (12H)							
1	Reserved (0)						CmdDt (0)	EVPD
2	Page Code (Table 2-10 on page 2-14)							
3	Reserved (0)							
4	Allocation Length (3CH)							
5	Control Byte (0)							

CmdDt (Command Support Data)

0 = Does not return command supported data.

1 = Returns command supported data. (Not supported.)

EVPD (Enable Vital Product Data)

0 = Requests Standard Inquiry Information.

1 = Specifies that the target returns the optional vital product data specified by the page code field.

Page Code

Specifies which page of vital product data information is returned. If the page code is not in Table 2-10, the target returns CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and additional sense code of INVALID FIELD IN CDB.

Table 2-10 *Inquiry Page Codes*

Page Code	*Description*
00H	Supported Vital Product Data (Table 2-11 on page 2-15)
80H	Unit Serial Number Page (Table 2-12 on page 2-16)
83H	Device identification page
C0H	Returns the firmware revisions and type

Allocation Length

The number of bytes reserved for returned data.

Inquiry Page Code 00H Data

Inquiry Page 00H reports all supported pages. The supported pages are in Table 2-10 on page 2-14.

Table 2-11 Inquiry Page 00H

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Peripheral Qualifier (0)			Peripheral Device Type (08=Medium Changer)				
1	Page Code (00H)							
2	Reserved (0)							
3	Page Length (04H)							
4	First Supported Vital Product Data Page Code (Table 2-10 on page 2-14)							
5	Supported Vital Product Data Page Code (Table 2-10 on page 2-14)							
6	Supported Vital Product Data Page Code (Table 2-10 on page 2-14)							
7	Last Supported Vital Product Data Page Code (Table 2-10 on page 2-14)							

Page Length

The length in bytes of the supported page list.

Inquiry Page Code 80H Data

Inquiry Page 80H - Vital Product Data Unit Serial Number Page (Page Code 80H) reports the units serial numbers.

Table 2-12 Inquiry Page 80H

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Peripheral Qualifier (0)			Peripheral Device Type (08=Medium Changer)				
1	Page Code (80H)							
2	Reserved (0)							
3	Page Length (0CH)							
4-15	Product Serial Number (12 ASCII characters)							

Inquiry Page 83H Data

Inquiry Page 83H returns the device identification information.

Table 2-13 *Inquiry Page 83H*

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Peripheral Qualifier (0)			Peripheral Device Type				
1	Page Code (83H)							
2	Reserved (0)							
3	Page Length (28H)							
4	Reserved (0)				Code Set (2)			
5	Reserved (0)				Identification Type (1)			
6	Reserved (0)							
7	Identifier Length (24H)							
8-15	Vendor Identification (8 ASCII characters) "HP "							
16-31	Product Identification (16 ASCII characters) (Table 2-16 on page 2-22)							
32-43	Product Serial Number (12 ASCII characters)							

Code Set

1= Binary 2= ASCII

Identifier Type

1= Vendor ID, Product ID, Product Serial number

Inquiry Page C0H Data

Inquiry Page C0H returns the revisions and type of firmware.

Table 2-14 *Inquiry Page C0H*

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Peripheral Qualifier (0)			Peripheral Device Type (08=Medium Changer)				
1	Page Code (C0H)							
2	Reserved (0)							
3	Page Length (16H)							
4-7	Controller Firmware Revision (x.xx, ASCII)							
8-11	Transport Firmware Revision (x.xx, ASCII)							
12-15	Controller Boot Revision (x.xx, ASCII)							
16-19	Transport Boot Revision (x.xx, ASCII)							
20-25	Controller Firmware Type Code (xxxxxx, ASCII)							

Inquiry Command Data

Table 2-15 Standard Inquiry Data Format

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Peripheral Qualifier (0)			Peripheral Device Type (08=Medium Changer)				
1	RMB (1)	Reserved (0)						
2	ISO Version (0)		ECMA Version (0)			ANSI-Approved Version (3)		
3	AERC (0)	Trm Tsk (0)	Norm ACA (0)	Rsvd (0)	Response Data Format (2)			
4	Additional Sense Length (27H)							
5	Reserved (0)							
6	Rsvd (0)	Enc Serv (0)	Rsvd (0)	Multip (0)	MChngr (0)	AckReq (0)	Addr 32 (0)	Addr 16 (1)
7	RelAdr (0)	WBus 32 (0)	WBus 16 (0)	Sync (0)	Linked (0)	Tran Dis (0)	Cmd Que (0)	Rsvd (0)
8-15	Vendor Identification ("HP " 8 ASCII bytes)							
16-31	Product Identification (16 ASCII bytes) (Table 2-16 on page 2-22)							
32-35	Product Revision Level							
36-39	Controller Revision Level							
40-43	Transport Revision Level							

RMB

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

ANSI-Approved Version

The returned values of 3 indicate compliance to ISO standard x3131-199x (SCSI-3). A return value of 2 indicates compliance to x3131-1994 (SCSI-2) ISO standard.

AERC, TrmTsk

Asynchronous event reporting capability and the terminate task message are not supported.

NormACA

0: Setting the NACA is not supported.

Response Data Format

2: Data shall be in the format specified in this standard, which is specified in the ANSI-approved version.

EncServ

0: No enclosure service.

MultiP

0: Device is a single port.

MChngr

1: Attached changer.

0: Regular library.

AckReq

0: Doesn't have secondary bus.

Addr32

0: Doesn't support 32-bit addresses.

1: Supports 32-bit addresses.

Addr16

0: Doesn't support 16-bit addresses (16 SCSI IDs).

1: Supports 16-bit addresses (16 SCSI IDs).

RelAdr

0: Doesn't support relative addresses.

WBus32

0: Doesn't support 32-bit wide data transfers.

WBus16

0: Doesn't support 16-bit wide data transfers.

1: Supports 16-bit wide data transfers.

Sync

0: Doesn't support sync transfers.

Linked

0: Doesn't support linked commands.

TranDis

0: Doesn't support continued tasks or target transporters.

CmdQue

0: Doesn't support command queuing.

Product Identification

All library controllers in this family will return the same product identification string, regardless of library model. The inquiry string will depend on the drive type.

See the table below for the product identification string that has been added. All unused trailing bytes are filled with a blank space (ASCII).

Table 2-16 *Product Identification String*[a]

Model	*Library Drive Types*	*Library Product IDs*
HP SureStore DLT Library Models 2/20, 4/40, 6/60	Quantum DLT 7000 only	C7200-7000
HP SureStore DLT Library Models 2/20, 4/40, 6/60, 6/100, 6/120, 6/140	Quantum DLT 8000 only	C7200-8000
HP SureStore DLT Library Models 2/20, 4/40, 4/100, 6/60, 6/100, 6/120, 6/140, 8/140, 10/140, 12/140	For mixed drives: HP Ultrium 1 Quantum DLT 8000	C7200
HP SureStore 9-Slot Autoloader	Quantum DLT 8000	C7145-8000
HP SureStore 9-Slot Autoloader	Quantum DLT 7000	C7145-7000
HP SureStore 9-Slot Autoloader	Benchmark DLT 1 HP Ultrium 1	C7145

a. 16 ASCII bytes.

Mode Select (6) Command (15H)

Please refer to “Mode Sense (6) Command (1AH)” on page 2-29 for more page code information.

The MODE SELECT (6) command (15H) allows the host to specify device parameters to the target. Hosts should issue MODE SENSE (6) (1AH) prior to each MODE SELECT (6) to determine supported pages, page lengths, and other parameters.

NOTE See “Mode Sense (6) Command (1AH)” on page 2-29 for a description of the mode page codes. PS = 0 for Mode Select.

Table 2-17 Mode Select (6) Command CDB

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

If an application sends a MODE SELECT (6) command that changes any parameters applying to other initiators, the device server will generate a unit attention condition for all initiators, except the one that issued the MODE SELECT (6) command. The device server will also set the additional sense condition to MODE PARAMETERS CHANGED.

NOTE Changing fibre channel configurations may result in a different device address after the host computer is rebooted. It is recommended to change fibre configurations through the library front panel or remote management card.

Page Format (PF)

Zero indicates that all parameters after the block descriptors are vendor-specific. One indicates that the MODE SELECT (6) parameters that follow the header and block descriptor(s) are structured as pages of related parameters.

Save Pages (SP)

Zero indicates the device server shall perform the specified MODE SELECT (6) operation and not save any pages. One indicates that the device server shall perform the specified MODE SELECT (6) operation and save as non-volatile.

Parameter List Length

The parameter list length field specifies the length in bytes of the mode parameter list.

The device server will terminate the command with CHECK CONDITION status if the parameter list length truncates the mode parameter header, mode parameter block descriptors, or mode page.

Table 2-18 Mode Select (6) Parameter Header

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

Block Descriptor Length

This byte is not valid for libraries.

Reserve (6) Command (16H)

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

Table 2-19 Reserve (6) Command CDB

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

3rdPty

When set to 1, the library is reserved for the SCSI device specified in the Third Party Device ID field (SCSI-2 compliance, SCSI-3 obsolete).

Third Party Device ID

A third party device ID identifies the SCSI device the library is to be reserved for (SCSI-2 compliance, SCSI-3 obsolete).

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.

NOTE Third Party reservation will not be available through the Fibre Channel Bridge

Reservation Identification

Identifies each element reservation with a code word byte.

Element List Length

Defines the size in bytes 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 2-20 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)							

Element Address

See Table 2-26 on page 2-37 for valid element numbers.

Release (6) Command (17H)

Releases the library or element for use by another initiator.

Table 2-21 Release (6) Command CDB

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

3rdPty

When set to 1, the element or unit is released from a previous reserve that had been made using a third-party reservation (SCSI-2 compliance, SCSI-3 obsolete).

Third Party Device ID

A third party device ID identifies the SCSI device the library is to be reserved for (SCSI-2 compliance, SCSI-3 obsolete).

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 (6) Command (1AH)

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

- Library configuration
- Drive configuration
- Fibre channel configuration
- Remote management card configuration
- Clock setting
- 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 tape drive element address and number of drives
- Characteristics of the various element types

Table 2-22 Mode Sense (6) Command CDB

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

DBD

0: Block Descriptors may be present. (It never returns block descriptors.)

1: Disable Block Descriptors.

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

Specifies a specific page or all pages supported by the library (see Table 2-23).

Identifies the format of the Mode Page format definition by page code and is accessed using Mode Sense Commands 1AH, 5AH and Mode Select Commands 15H and 55H.

Allocation Length

Contains the maximum number of data bytes to return. See Table 2-23 on page 2-31 for the length of each page then add the length of the header.

Table 2-23 Mode Sense Allocation Lengths and Page Codes

# of Return Bytes	*Page Code*	*Description*	*Table*
12	1CH	TapeAlert	Table 2-25 on page 2-33
20	1DH	Element Address Assignment	Table 2-26 on page 2-37
4	1EH	Transport Element Parameters	Table 2-38 on page 2-49
20	1FH	Device Capabilities	Table 2-40 on page 2-51
26	21H	Library Configuration	Table 2-41 on page 2-53
3 * (number of drives) + 2	22H	Drive Configuration	Table 2-42 on page 2-56
6 * (number of fibre cards) + 2	23H	Fibre Channel Configuration	Table 2-43 on page 2-58
8	24H	Real Time Clock	Table 2-44 on page 2-60
32	2EH	Ethernet Configuration	Table 2-45 on page 2-61
87 - 127	3FH, 00H	All Pages[a]	

a. When Page Code 3FH is sent, the Real Time Clock page is not returned.

Table 2-24 Mode Sense (6) Parameter Header

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Mode Data Length							
1	Reserved (0)							
2	Reserved (0)							
3	Block Descriptor Length (0)							

Mode Data Length

Length, in bytes, of the mode page(s) that is specified by the Page Code field in the CDB + 3

Block Descriptor Length

Block descriptors are not valid for libraries.

Page Code 1CH: TapeAlert

The format of the TapeAlert Mode page is as follows:

Table 2-25 TapeAlert Control (1CH)

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	PS	Rsvd (0)	Page Code (0x1C)					
1	Page Length (0x0A)							
2	Perf (0)	Reserved (0)			DExcpt (1)	Test	Rsvd	LogErr (0)
3	Reserved (0)				MRIE (0)			
4-7	Interval Timer (0)							
8-11	Report Count/Test Flag Number							

NOTE See Appendix B for more information about TapeAlert specifications.

PS

On Mode Sense, it is set to 1 and is capable of saving to non-volatile memory. On Mode Select, it is reserved and must be set to 0.

Perf (Always set to 0)

When this bit is set to 0, this indicates informational exception operations that can cause delays are acceptable.

DExcpt (Always set to 1)

When this bit is set to one, the target shall disable all information exception operations, ignoring the MRIE field. (In this mode, the software must poll the TapeAlert Log page.)

Test (Default set to 0)

When this bit is set to 0, this indicates that the target shall not generate any false/test informational exception conditions.

When this bit is set to one and Test Flag Number is set to 0, the target will generate a false informational exception condition based on the MRIE and Interval Timer fields.

When the Test bit is set to one and the Test Flag Number is set to valid non-zero value, the target will generate/clear a test informational exception condition. The value of the Test bit returned by a Mode Sense command will remain at 0. The test action is based on the Test Flag Number value:

1 to 64	This will set in the Log page the TapeAlert flag indicated by the Test Flag Number. Once the TapeAlert flag is set, it is processed normally.
-1 to -64	This will clear the TapeAlert flag indicated by the absolute value of the Test Flag Number. Clearing the flag in this way is equivalent to performing the specified corrective action for that flag.
32767 (0x7FFF)	This will set in the Log page all of the TapeAlert flags that are supported by the target. Once the supported TapeAlert flags are set, they are processed normally.

LogErr (Always set to 0)

When this bit is set to 0, this indicates that the logging of informational exception conditions within a target is vendor specific.

MRIE (Always set to 0x0)

This field indicates the method used by the target to report informational exception conditions.

NOTE This is standard SCSI terminology and is not related in any way to the "Information" severity level for the flags.

The priority of reporting informational exception conditions is vendor specific. If the informational exception condition was generated by an event that caused a real Check Condition to occur, then this real Check Condition will over-ride (i.e. be used instead of) the Check Condition defined in MRIE modes 0x1 to 0x5. The values defined for this field are:

- *0x0: No reporting of informational exception conditions*

  This method instructs the device server to not report information exception condition.

- *0x1: Asynchronous event reporting*

  Not supported.

- *0x3: Conditionally generate recovered error*

  Not supported.

- *0x4: Unconditionally generate recovered error*

  Not supported.

- *0x5: Generate no sense*

  Not supported.

- *0x6: Only report informational exception condition on request*

  Not supported.

With MRIE modes 0x1 to 0x6, the additional sense code of 5D00 indicates that a TapeAlert event has occurred on the device, and detailed information about this event is stored in the TapeAlert Log page.

Interval Timer (Always set to 0)

When this field is set to 0, this indicates that the target shall only report the informational exception condition one time.

Report Count/Test Flag Number (Default set to 0)

This field has a dual purpose. When the Test bit is set to 0, the value of this field in the Mode Select data represents the Report Count. This mode is not supported.

When a Mode Select command is sent with the Test bit is set to one, then the value of this field in the Mode Select data represents the Test Flag Number, which is never returned in response to a Mode Sense command. Valid vales of the Test Flag Number are -64 to 64 and 32677 (0x7FFF). Negative numbers are represented using the 2's complement method.

Page Code 1DH: Element Addressing

This mode page is accessed with page code 1DH. It returns element address assignments.

Table 2-26 Mode Sense Element Address Assignment Page (1DH) Format

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Reserved (0)		Page Code (1DH)					
1	Parameter Length (12H)							
2	First Medium Transport Element Address (MSByte) (0)							
3	First Medium Transport Element Address (LSByte) (0)							
4	Number Of Medium Transport Elements (MSByte) (0)							
5	Number of Medium Transport Elements (LSByte) (1)							
6	First Storage Element Address (MSByte) (0)							
7	First Storage Element Address (LSByte) (31)							
8	Number Of Storage Elements (MSByte (0)							
9	Number Of Storage Elements (LSByte) (See Tables on page 2-38 through page 2-48)							
10	First Import/Export Element Address (MSByte) (0)							
11	First Import/Export Element Address (LSByte) (20)							
12	Number Of Import/Export Elements (MSByte) (0)							
13	Number Of Import/Export Elements (LSByte) (See Tables on page 2-38 through page 2-48)							
14	First Data Transfer Element Address (MSByte) (0)							
15	First Data Transfer Elements Address (LSByte) (1)							

Table 2-26 Mode Sense Element Address Assignment Page (1DH) Format

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
16	Number Of Data Transfer Elements (MSByte) (0)							
17	Number Of Data Transfer Elements (LSByte) (See Tables on page 2-38 through page 2-48)							
18-19	Reserved (0)							

The following tables show the element addressing for the different libraries in this family:

Table 2-27 HP SureStore 9-Slot Autoloader

Description	*No Mailslot*
First transport element address	0
Number of transport elements	1
First storage element address (magazine slots)	31
Number of storage elements	9
First import/export element address (mailslot)	20
Number of import/export elements	0
First data transfer element address	1
Number of data transfer elements	1

Table 2-28 Library Model 2/20

Description	*No Mailslot*	*One-slot Mailslot*	*One Magazine Mailslot*	*Two Magazine Mailslot*
First transport element address	0	0	0	0
Number of transport elements	1	1	1	1
First storage element address (magazine slots)	31	31	31	31
Number of storage elements	20 [a]	19[a]	15[a]	10[a]
First import/export element address (mailslot)	20	20	20	20
Number of import/export elements	0[a]	1[a]	5[a]	10[a]
First data transfer element address	1	1	1	1
Number of data transfer elements	1 to 2	1 to 2	1 to 2	1 to 2

a. Can be configured to 0, 1 slot, 1 magazine, or 2 magazine mailslot, which reduces the number of storage slots. The 2 magazine mailslot is recommended for libraries with mixed drive types.

Table 2-29 Library Model 4/40

Description	*No Mailslot*	*One-slot Mailslot*	*One Magazine Mailslot*	*Two Magazine Mailslot*
First transport element address	0	0	0	0
Number of transport elements	1	1	1	1
First storage element address (magazine slots)	31	31	31	31
Number of storage elements	40[a]	39[a]	35[a]	30[a]
First import/export element address (mailslot)	20	20	20	20
Number of import/export elements	0[a]	1[a]	5[a]	10[a]
First data transfer element address	1	1	1	1
Number of data transfer elements	1 to 4	1 to 4	1 to 4	1 to 4

a. Can be configured to 0, 1 slot, 1 magazine, or 2 magazine mailslot, which reduces the number of storage slots. The 2 magazine mailslot is recommended for libraries with mixed drive types.

Table 2-30 Library Model 4/100

Description	*No Mailslot*	*One-slot Mailslot*	*One Magazine Mailslot*	*Two Magazine Mailslot*
First transport element address	0	0	0	0
Number of transport elements	1	1	1	1
First storage element address (magazine slots)	31	31	31	31
Number of storage elements	100[a]	99[a]	95[a]	90[a]
First import/export element address (mailslot)	20	20	20	20
Number of import/export elements	0[a]	1[a]	5[a]	10[a]
First data transfer element address	1	1	1	1
Number of data transfer elements	1 to 4	1 to 4	1 to 4	1 to 4

a. Can be configured to 0, 1 slot, 1 magazine, or 2 magazine mailslot, which reduces the number of storage slots. The 1 magazine mailslot is recommended for libraries with mixed drive types.

Table 2-31 Library Model 6/60

Description	*No Mailslot*	*One-slot Mailslot*	*One Magazine Mailslot*	*Two Magazine Mailslot*
First transport element address	0	0	0	0
Number of transport elements	1	1	1	1
First storage element address (magazine slots)	31	31	31	31
Number of storage elements	60[a]	59[a]	55[a]	50[a]
First import/export element address (mailslot)	20	20	20	20
Number of import/export elements	0[a]	1[a]	5[a]	10[a]
First data transfer element address	1	1	1	1
Number of data transfer elements	1 to 6	1 to 6	1 to 6	1 to 6

a. Can be configured to 0, 1 slot, 1 magazine, or 2 magazine mailslot, which reduces the number of storage slots. The 2 magazine mailslot is recommended for libraries with mixed drive types.

Table 2-32 Library Model 6/100

Description	*No Mailslot*	*One-slot Mailslot*	*One Magazine Mailslot*	*Two Magazine Mailslot*
First transport element address	0	0	0	0
Number of transport elements	1	1	1	1
First storage element address (magazine slots)	31	31	31	31
Number of storage elements	100[a]	99[a]	95[a]	90[a]
First import/export element address (mailslot)	20	20	20	20
Number of import/export elements	0[a]	1[a]	5[a]	10[a]
First data transfer element address	1	1	1	1
Number of data transfer elements	1 to 6	1 to 6	1 to 6	1 to 6

a. Can be configured to 0, 1 slot, 1 magazine, or 2 magazine mailslot, which reduces the number of storage slots. The 2 magazine mailslot is recommended for libraries with mixed drive types.

Table 2-33 Library Model 6/120

Description	*No Mailslot*	*One-slot Mailslot*	*One Magazine Mailslot*	*Two Magazine Mailslot*
First transport element address	0	0	0	0
Number of transport elements	1	1	1	1
First storage element address (magazine slots)	31	31	31	31
Number of storage elements	120[a]	119[a]	115[a]	110[a]
First import/export element address (mailslot)	20	20	20	20
Number of import/export elements	0[a]	1[a]	5[a]	10[a]
First data transfer element address	1	1	1	1
Number of data transfer elements	1 to 6	1 to 6	1 to 6	1 to 6

a. Can be configured to 0, 1 slot, 1 magazine, or 2 magazine mailslot, which reduces the number of storage slots. The 2 magazine mailslot is recommended for libraries with mixed drive types.

Table 2-34 Library Model 6/140

Description	*No Mailslot*	*One-slot Mailslot*	*One Magazine Mailslot*	*Two Magazine Mailslot*
First transport element address	0	0	0	0
Number of transport elements	1	1	1	1
First storage element address (magazine slots)	31	31	31	31
Number of storage elements	140[a]	139[a]	135[a]	130[a]
First import/export element address (mailslot)	20	20	20	20
Number of import/export elements	0[a]	1[a]	5[a]	10[a]
First data transfer element address	1	1	1	1
Number of data transfer elements	1 to 6	1 to 6	1 to 6	1 to 6

a. Can be configured to 0, 1 slot, 1 magazine, or 2 magazine mailslot, which reduces the number of storage slots. The 2 magazine mailslot is recommended for libraries with mixed drive types.

Table 2-35 Library Model 8/140

Description	*No Mailslot*	*One-slot Mailslot*	*One Magazine Mailslot*	*Two Magazine Mailslot*
First transport element address	0	0	0	0
Number of transport elements	1	1	1	1
First storage element address (magazine slots)	31	31	31	31
Number of storage elements	140[a]	139[a]	135[a]	130[a]
First import/export element address (mailslot)	20	20	20	20
Number of import/export elements	0[a]	1[a]	5[a]	10[a]
First data transfer element address	1	1	1	1
Number of data transfer elements	1 to 8	1 to 8	1 to 8	1 to 8

a. Can be configured to 0, 1 slot, 1 magazine, or 2 magazine mailslot, which reduces the number of storage slots. The 2 magazine mailslot is recommended for libraries with mixed drive types.

Table 2-36 Library Model 10/140

Description	*No Mailslot*	*One-slot Mailslot*	*One Magazine Mailslot*	*Two Magazine Mailslot*
First transport element address	0	0	0	0
Number of transport elements	1	1	1	1
First storage element address (magazine slots)	31	31	31	31
Number of storage elements	140[a]	139[a]	135[a]	130[a]
First import/export element address (mailslot)	20	20	20	20
Number of import/export elements	0[a]	1[a]	5[a]	10[a]
First data transfer element address	1	1	1	1
Number of data transfer elements	1 to 10	1 to 10	1 to 10	1 to 10

a. Can be configured to 0, 1 slot, 1 magazine, or 2 magazine mailslot, which reduces the number of storage slots. The 2 magazine mailslot is recommended for libraries with mixed drive types.

Table 2-37 Library Model 12/140

Description	*No Mailslot*	*One-slot Mailslot*	*One Magazine Mailslot*	*Two Magazine Mailslot*
First transport element address	0	0	0	0
Number of transport elements	1	1	1	1
First storage element address (magazine slots)	31	31	31	31
Number of storage elements	140[a]	139[a]	135[a]	130[a]
First import/export element address (mailslot)	20	20	20	20
Number of import/export elements	0[a]	1[a]	5[a]	10[a]
First data transfer element address	1	1	1	1
Number of data transfer elements	1 to 12	1 to 12	1 to 12	1to12

a. Can be configured to 0, 1 slot, 1 magazine, or 2 magazine mailslot, which reduces the number of storage slots. The 2 magazine mailslot is recommended for libraries with mixed drive types.

Transport Element (Picker)

Table 2-38 Mode Sense Transport Element Parameter Page (1EH) Format

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

Parameter Length

Number of bytes that describe each transport element (picker).

Rotate

The transport element does not support the rotate function. This bit will always be 0.

Mode Sense Device Capabilities Page for 9-Slot Autoloader (1FH)

Table 2-39 Mode Sense Device Capabilities Page for 9-Slot Autoloader (1FH)

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Reserved (0)		Page Code (1FH)					
1	Parameter Length (12H)							
2	Reserved (0)				StorDT (1)	StorIE (0)	StorST (1)	StorMT (0)
3	Reserved (0)							
4	Reserved (0)				MT->DT (1)	MT->IE (0)	MT->ST (1)	MT->MT (0)
5	Reserved (0)				ST->DT (1)	ST->IE (0)	ST->ST (1)	ST->MT (1)
6	Reserved (0)				IE->DT (0)	IE->IE (0)	IE->ST (0)	IE->MT (0)
7	Reserved (0)				DT->DT (1)	DT->IE (0)	DT->ST (1)	DT->MT (1)
8-11	Reserved (0)							
12	Reserved (0)				MT<> DT (0)	MT<>IE (0)	MT<> ST (0)	MT<> MT (0)
13	Reserved (0)				ST<>DT (1)	ST<>IE (0)	ST<>ST (1)	ST<> MT (0)
14	Reserved (0)				IE<>DT (0)	IE<>IE (0)	IE<>ST (0)	IE<>MT (0)
15	Reserved (0)				DT<>DT (1)	DT<>IE (0)	DT<>ST (1)	DT<> MT (0)
16-19	Reserved (0)							

Mode Sense Device Capabilities Page for Library Models 2/20, 4/40, 4/100, 6/60, 6/100, 6/120, 6/140, 8/140, 10/140, 12/140 (1FH)

Table 2-40 Mode Sense Device Capabilities Page (1FH)

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Reserved (0)		Page Code (1FH)					
1	Parameter Length (12H)							
2	Reserved (0)				StorDT (1)	StorIE (1)	StorST (1)	StorMT (0)
3	Reserved (0)							
4	Reserved (0)				MT->DT (1)	MT->IE (1)	MT->ST (1)	MT->MT (0)
5	Reserved (0)				ST->DT (1)	ST->IE (1)	ST->ST (1)	ST->MT (1)
6	Reserved (0)				IE->DT (1)	IE->IE (1)	IE->ST (1)	IE->MT (1)
7	Reserved (0)				DT->DT (1)	DT->IE (1)	DT->ST (1)	DT->MT (1)
8-11	Reserved (0)							
12	Reserved (0)				MT<> DT (0)	MT<>IE (0)	MT<> ST (0)	MT<> MT (0)
13	Reserved (0)				ST<>DT (1)	ST<>IE (1)	ST<>ST (1)	ST<> MT (0)
14	Reserved (0)				IE<>DT (1)	IE<>IE (1)	IE<>ST (1)	IE<>MT (0)
15	Reserved (0)				DT<>DT (1)	DT<>IE (1)	DT<>ST (1)	DT<> MT (0)
16-19	Reserved (0)							

Table Abbreviations

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

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 2-127 on page 2-167 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 2-128 on page 2-168 for additional information on the Exchange Medium Command.

Page Code 21H: Library Configurations

This mode page is accessed with page code 21H. It records the library configurations.

Table 2-41 Library Configurations Page (21H)

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	PS (1)	RSVD (0)	Page Code (21H)					
1	Number of bytes to follow (18H)							
2	Mailslot size							
3	Error recovery enabled							
4	Barcode reader enabled							
5	I2C & SCSI logging enabled							
6	Reserved (0)							
7	Power secure							
8	Report recoveries							
9	Display HP product ID enabled							
10	Stacker mode enabled							
11	Library SCSI ID							
12	Barcode Report Length							
13	DHCP							
14-17	Remote Management Card (RMC) IP address							
18-21	RMC subnet mask							
22-25	RMC gateway							

PS

On Mode Sense, it is set to 1 and is capable of saving to non-volatile memory. On Mode Select it is reserved and must be set to 0.

Mailslot size

00 = No mailslot; 01 = 1-slot mailslot; 05 = 1 magazine mailslot; 10 = 2 magazine mailslot.

The 9-slot autoloader is set to 0.

Error recovery enabled

0 = disable; 1 = enable.

Barcode reader enabled

0 = disable; 1 = enable.

I2C and SCSI Logging

00 = No logging; 01 = Log SCSI; 02 = Log I2C; 03 = Log Both.

Power secure

0 = disable; 1 = enable.

Report recoveries

0 = disable; 1 = enable.

Display HP product ID enabled

0 = disable; 1 = enable.

Stacker

0 = Stacker, no Autodetect; 01 = Stacker Autodetect; 02, 03 = Random, normal library.

Library models 2/20, 4/40, 4/100, 6/60, 6/100, 6/120, and 6/140, 8/140, 10/140, and 12/140 are set to Random.

Library SCSI ID

Addresses 1-15 are available for use.

Barcode Report Length

Allows you to report 6, 7, or 8 characters of barcode. The default is 8.

DHCP (Dynamic Host Configuration Protocol)

Allows the host to provide the IP, subnet, and gateway addresses. Requires a DHCP server or BootP.

0 = disable; 1 = attempt DHCP.

RMC IP address

Are in format n.n.n.n where n < 256.

RMC subnet

Are in format n.n.n.n where n < 256.

RMC gateway

Are in format n.n.n.n where n < 256.

Page Code 22H: Drive Configurations

This page is accessed with page code 22H. It records the drive configurations. (n = the number of drives in the library)

Table 2-42 Drive Configuration Page (22H)

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	PS (1)	Rsvd (0)	Page Code (22H)					
1	Number of bytes to follow (n * 3)							
2-4	Drive 1 Configuration entry							
. . .	. . .							
n+2	Drive n Configuration entry (3 bytes)							
Drive Configuration Entry Format								
0	SCSI ID							
1	Compression Enabled							
2	Speed Setting (0)							

PS

On Mode Sense, it is set to 1 and is capable of saving to non-volatile memory. On Mode Select it is reserved and must be set to 0.

SCSI ID

Addresses 1-15 are available for use.

Compression

0 = No compression; 1 = Compression

Speed

0 = Automatic; 1 = High; 2 = Medium; 3 = Low

Page Code 23H: Fibre Channel Configurations

This mode page is accessed with page code (23H). This mode page will return a 6-byte entry for every fibre channel card in the library. It records the fibre channel configuration. The first entry is for the controller (on the lowest level).

Table 2-43 Fibre Channel Configuration

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	PS (1)	Rsvd (0)	Page Code (23H)					
1	Number of bytes to follow (n*6)							
2-7	Fibre Channel 1 Configuration entry							
. . .	. . .							
*(6 * n) + 1*	Fibre Channel (n[a]) Configuration entry (6 bytes)							
Fibre Channel Configuration Entry Format:								
0	Fibre Channel Addressing Mode							
1	Reserved (0)							Restart Now
2	Fibre Channel Link Address (MSByte)							
3	Fibre Channel Link Address							
4	Fibre Channel Link Address (LSByte)							
5	Reserved (0)							

a. n = number of Fibre Channel bridge cards in library

PS

On Mode Sense, it is set to 1 and is capable of saving to non-volatile memory. On Mode Select it is reserved and must be set to 0.

Fibre Channel Addressing mode

0 = hard; 1 = soft; 2 = hard: auto-select.

Restart Now

1 = Restart the fibre channel cards now.[1]
0 = Wait until the next power cycle.

Fibre Channel Link Address

The Link address of the fibre channel card. (AL_PA). If on an Arbitrated Loop, the least significant byte is configurable. If on Fabric, the 3 bytes will not be configurable.

1. Rev 0 Fibre Channel bridge cards always will require a restart.

Page Code 24H: Real Time Clock

This page is accessed with page code (24H). It records the clock information. This page is not returned as part of the data for a MODE SENSE with the page set to 3FH (all pages).

Table 2-44 Real Time Clock Configuration

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	PS (1)	Rsvd (0)	Page Code (24H)					
1	Parameter Length (06H)							
2	Time Stamp valid							
3	Sign	Time Zone						
4-7	Time Stamp							

PS

On Mode Sense, it is set to 1 and is capable of saving to non-volatile memory. On Mode Select, it is reserved and must be set to 0.

Time stamp valid

0 = invalid
1 = valid

Sign

0 = +
1 = -

Time zone

Every 1/2 hour is 1 count from UTC (universal time coordinated).

Time stamp

4-byte hex number of seconds since midnight January 1, 1970 in UTC Zone 0.

Page Code 2EH: Ethernet Configuration

This page is accessed with page code (24H). It records the Ethernet Configuration information.

Table 2-45 Ethernet Configuration

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	PS (1)	Rsvd (0)	Page Code (2EH)					
1	Page Length (1EH)							
2	Rsvd	SNMP	HTTP	IP info valid	DHCP info valid	Connect info valid	Mode info valid	MAC info valid
3-8	MAC Address							
9	Connection info				Ethernet Mode			
10	Reserved (0)				DHCP info			
11	Reserved (0)							
12-15	IP Address							
16-19	IP Net Mask							
20-23	IP Gateway							
24-31	Rsvd							

SNMP (Simple Network Management Protocol)

1 = SNMP supported
0 = SNMP not supported

HTTP (Hyper Text Transfer Protocol)

1 = HTTP supported
0 = HTTP not supported

IP info valid

1 = IP information is valid
0 = IP information is not valid

DHCP info valid

1 = DHCP information is valid
0 = DHCP information is not valid

Connect info valid

1 = Connect information is valid
0 = Connect information is not valid

Mode info valid

1 = Mode information is valid
0 = Mode information is not valid

MAC info valid

1 = MAC information is valid
0 = MAC information is not valid

Connection Info

0 = not connected
1 = connected at unknown speed
2 = connected to 10Base-T network
3 = connected to 100Base-T network

Ethernet Mode

0 = auto sensing (or not yet connected to network)
1 = half duplex
2 = full duplex
3 = x-10

DHCP Info

0 = not DHCP capable
1 = DHCP capable, but not attempted
2 = DHCP capable, attempted but failed (so far)
3 = DHCP capable, attempted and successful

IP address

Are in format n.n.n.n where n < 256.

IP Net Mask

Are in format n.n.n.n where n < 256.

IP gateway

Are in format n.n.n.n where n < 256.

Receive Diagnostic Results Command (1CH)

Retrieves the results of a library diagnostic test performed using the Send Diagnostic Command (Table 2-49 on page 2-70). The diagnostic test number and additional sense 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 2-46 Receive Diagnostic Results Command CDB

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

PCV (Page Code Valid)

0 - Shall return Table 2-47 on page 2-65.

1 - Shall return data defined on Table 2-48 on page 2-69.

Page Code

00h - Supported diagnostic page list.

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 2-47 Receive Diagnostic Results Parameter List

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Reserved (0)							
1	Test Number							
2	FRU Locator							
3	Error Code							
4	FRU 1							
5	FRU 2							
6	FRU 3							
7	Move Command Attempted							
8-9	Source Element Number							
10-11	Destination Element Number							
12-13	Second Destination Element Number							
14-19	Move Sequence IDs							
20	Error Code Qualifier							
21	Reserved (0)							
22-23	Vertical Motor Commanded Position							
24-25	Vertical Motor Actual Position							
26-27	Plunge Motor Commanded Position							

Table 2-47 Receive Diagnostic Results Parameter List

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
28-29	Plunge Motor Actual Position							
30-31	Translate Motor Commanded Position							
32-33	Translate Motor Actual Position							
34-37	Time Stamp							

Test Number

The diagnostic test number. This will not be a sequence number, but the specific test that failed. Refer to Table 3-6 on page 3-27 for a list of the library diagnostic tests.

FRU Locator

Returns either the drive number or level number, then slot number (4 bits each). This helps isolate the error.

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 3-4 on page 3-16.

FRU 1

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

NOTE The FRUs 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 listed FRU may or may not fix the associated problem.

FRU 2

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

FRU 3

The third most likely FRU to be at fault. (See Table A-1 on page A-2.)

Move Command Attempted

0 - Exchange

1 - Move

2 - Seek

3 - Initialize Element

4 - Rezero

5 - Diag

6 - Restore

7 - Emulate stacker

8 - 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 Element Number

The Element Number to which the Second Destination refers.

Move Sequence ID

The last six library move sequences for the original movement command prior to the failure. Byte 12 is the least recent move, and Byte 16 is the most recent move. (See Table C-1 on page C-2.)

Error Code Qualifier

The qualifier associated with the failed error code. (See Table 3-5 on page 3-22.)

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.

Time Stamp

4-byte hex number of seconds since January 1, 1970.

Supported Diagnostic Pages List

Table 2-48 Supported Diagnostic Pages List

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

Send Diagnostic Command (1DH)

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

The Request Sense (Table 2-5 on page 2-8) and the Receive Diagnostic Results (Table 2-46 on page 2-64) commands can be used to get the results of a test.

Table 2-49 Send Diagnostic Command CDB

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

PF

When set to 0, the Send Diagnostic Parameters are vendor specific.

SelfTst (Self Test)

When set to 1, the Power-on Selftest runs. This selftest is equivalent to running Test Sequence 1, the Power-on Sequence. The parameter list length must be 0.

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

DevOfL (Device Offline)

Must be set to 1 for any test, other than the Selftest.

UnitOfl (Unit Offline)

Must be set to 1 for any test, other than the 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 2-50 on page 2-71.

Send Diagnostic Command Data

Table 2-50 Send Diagnostic Command Parameter List

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

Test Number

Diagnostic test number. See Table 3-6 on page 3-27 for a list of the library 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

NOTE Be aware of disconnect time out when running multiple test loops (see Table B-4 on page B-15).

Parameters

Parameters associated with the specified tests. Currently, all parameter bytes are reserved.

Prevent/Allow Medium Removal Command (1EH)

Either prevents or allows users to insert or remove tape cartridges using either the mailslot or removable magazines.

Table 2-51 Prevent/Allow Medium Removal Command CDB

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

The table below defines the Prevent values and their meanings. Prevent values 10B and 11B are valid only when the RMB bit and the Mchngr bit are equal to one in the standard INQUIRY data (Table 2-15 on page 2-19).

Table 2-52 Prevent Field

Prevent	*Description*
00B	Medium removal shall be allowed from both the data transport element and the attached medium changer (if any).
01B	Medium removal shall be prohibited from the data transport element but allowed from the attached medium changer (if any).
10B	Medium removal shall be allowed for the data transport element but prohibited for the attached medium changer.
11B	Medium removal shall be prohibited for both the data transport element and the attached medium changer.

Position To Element Command (2BH)

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

Table 2-53 Position to Element Command CDB

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

Transport Element Address

The default transport element address should always be 0.

Destination Element Address

See Table 2-26 on page 2-37 in the description of the Mode Sense (6) Command for more information about addressing.

Write Buffer Command (3BH)

Writes data to the library.

CAUTION

Incorrect use of this command may cause an overwrite of critical information needed for the library to operate. If this occurs, a service call will be necessary.

Only Buffer IDs listed in Table 2-56 on page 2-77 are intended for use outside of the factory.

Table 2-54 Write Buffer Command CDB

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Operation Code (3BH)							
1	Reserved (0)					Mode (See Table 2-55 on page 2-77)		
2	Buffer ID (See Table 2-56 on page 2-77)							
3	Buffer Offset (MSByte)							
4	Buffer Offset							
5	Buffer Offset (LSByte)							
6	Byte Transfer Length (MSByte)							
7	Byte Transfer Length							
8	Byte Transfer Length (LSByte)							
9	Control Byte (0)							

Mode

Indicates which data format is used. Refer to Table 2-55 on page 2-77 for valid values.

Buffer ID

Indicates which buffer is used. Refer to Table 2-56 on page 2-77 for valid values.

Buffer Offset

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

Byte Transfer Length

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

Table 2-55 Write Buffer Mode Descriptions

Mode	*Description*
1	Vendor specific
4	Download microcode
5	Download and save microcode

Table 2-56 User Accessible Buffers and Allowed Write Modes

User-Accessible Buffers	*Buffer ID*	*Allowed Write Modes*
Download Microcode (FLASH EPROM)	1	4, 5
Prepare a single FC board for download[a]	3	4
Units Serial Number (NVRAM)	4	1
Customer and Product ID (NVRAM)	15	1
Online Fibre Repair	125	1
Online Drive Repair	128	1

a. Offset-fibre controller number to download (zero counted Fibre slot number 0 -10). Then send the download data for the whole library same as always. Other images will be skipped until the correct fibre image is seen, then it will be downloaded.

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

Table 2-57 *Write Buffered Data Format When Buffer ID Set to Serial Number*

Byte	*Description*
0	MSByte Serial Number in ASCII
1-10	Serial Number in ASCII
11	LSByte Serial Number in ASCII

Table 2-58 *Write Buffer Data Format When Buffer ID Set to Customer Product ID*

Byte	*Description*
0	MSByte Vendor Identification (ASCII)
1-6	Vendor Identification (ASCII)
7	LSByte Vendor Identification (ASCII)
8	MSByte Product Identification (ASCII)
9-22	Product Identification (ASCII)
23	LSByte Product Identification (ASCII)

Table 2-59 Write Buffer Data Formware When Buffer ID Set to Online Slot Replacement

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Buffer ID = 125							
1	Reserved (0)							
2-3	Length							
4	Interface slot online status level 1							
5	Interface slot online status level 2							
6	Interface slot online status level 3							
7	Interface slot online status level 4							
8	Interface slot online status level 5							
9	Interface slot online status level 6							
10-15	Reserved (0)							

OLR Status

0 = Invalid Fibre, no change or missing

1 = Online

2 = Online Pending

3 = Offline

Table 2-60 *Write Buffer Data Format When Buffer ID Set to Online Drive Repair*

Byte	*Description*
0	Drive 1 Control
1	Drive 2 Control (model dependent)
2	Drive 3 Control (model dependent)
3	Drive 4 Control (model dependent)
4	Drive 5 Control (model dependent)
5	Drive 6 Control (model dependent)
6	Drive 7 Control (model dependent)
7	Drive 8 Control (model dependent)
8	Drive 9 Control (model dependent)
9	Drive 10 Control (model dependent)
10	Drive 11 Control (model dependent)
11	Drive 12 Control (model dependent)
12-15	Reserved (0)

Table 2-61 *Drive Control Definition for Online Repair*

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)

Reads data from the library.

NOTE Only Buffer IDs listed in Table 2-64 on page 2-83 are intended for use outside the factory.

Table 2-62 Read Buffer Command CDB

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Operation Code (3CH)							
1	Reserved (0)					Mode (Table 2-63 on page 2-82)		
2	Buffer ID (Table 2-64 on page 2-83)							
3	Buffer Offset (MSByte)							
4	Buffer Offset							
5	Buffer Offset (LSByte)							
6	Allocation Length (MSByte)							
7	Allocation Length							
8	Allocation Length (LSByte)							
9	Control Byte (0)							

Mode

Indicates which data format is to be used. Refer to Table 2-63 on page 2-82 for valid values.

Buffer ID

Indicates which buffer is to be used. Refer to Table 2-64 on page 2-83 for valid values.

Buffer Offset

Indicates at what address the data should be read, offset from the beginning of the buffer.

Allocation Length

Indicates the maximum number of data bytes to be read from the buffer (maximum of 65535).

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

Table 2-63 *Read Buffer Mode Descriptions*

Mode	*Description*
1	Vendor Specific

Read Buffer ID Descriptions

Table 2-64 Read Buffer ID Descriptions

Buffer ID	*User-Accessible Buffers*	*Description*
125	Online Fibre Replacement	Online Fibre repair status
128	Online Drive Repair	Online drive repair status
129	Board Status for Drives	Drive module card I2C status (format defined as "Drive General Status" in DLT Interactive Library Interface Specification)
130	Board Status for Slave Reporters	Library slave card I2C status
131	Board Status for Front Panel Status	Front panel card I2C status
132	Board Status for Remote Management Card Status	Remote Management card I2C status
133	Board Status for Fibre Channel Status	Fibre Channel card I2C status
134	Card Cage Slot Status	All library card's status returns a status packet for all cards in the library card cage and firmware revisions
135	Drive Data Packet 1 Status	Returns an eight-byte packet for every DLT drive in the library (format defined as "Tape Data Pack 1" in DLT Interactive Library Interface Specification)
136	Drive Data Packet 2 Status	Returns an 18-byte packet for every DLT drive in the library (format defined as "Tape Data Packet 2" in DLT Interactive Library Interface Specification)
137	Drive Data Packet 3 Status	Returns an eight-byte packet for every DLT drive in the library (format defined as "Tape Data Packet 3" in DLT Interactive Library Interface Specification)

Table 2-64 Read Buffer ID Descriptions

Buffer ID	*User-Accessible Buffers*	*Description*
138	Library Status	Returns general status about the library
140	Library Bus Status	Returns the library SCSI bus status
141	Percent Humidity	Returns the humidity percentage in the library
142	Drive Revisions	Returns the firmware revision for the drive
143	Whole product revs	Returns the whole product revisions.
144	Fibre mapping logs	Returns all the fibre drives mapping logs
145	LTO get drive info	Returns all the HP Ultrium 1 get drive information

NOTE For more information on the drive's Read Buffer status logs, see the DLT Interactive Library Specification from Quantum or from Benchmark.

Status Logs

Table 2-65 Status Logs Header

Byte	*Descriptions*
0	Buffer ID
1	Number of status reporting
2-3	Number of bytes to follow

Buffer ID

Defined in Table 2-64 on page 2-83.

Number of Status Reporting

Indicates the number of cards or drives reporting.

Number of Bytes to Follow

Reports the number of bytes in the data.

Online Fibre Replacement

Table 2-66 Online Fibre Replacement Status (ID 125)

Byte	*Descriptions*
0	Buffer ID = 125
1	Reserved (0)
2-3	Length
4	Interface OLR status Level 1
5	Interface OLR status Level 2
6	Interface OLR status Level 3
7	Interface OLR status Level 4
8	Interface OLR status Level 5
9	Interface OLR status Level 6
10-15	Reserved (0)

Online Drive Repair

Table 2-67 Online Drive Repair Status (ID 128)[a]

Byte	*Descriptions*
0	Drive 1 OLR status
1	Drive 2 OLR status (model dependent)
2	Drive 3 OLR status (model dependent)
3	Drive 4 OLR status (model dependent)
4	Drive 5 OLR status (model dependent)
5	Drive 6 OLR status (model dependent)
6	Drive 7 OLR status (model dependent)
7	Drive 8 OLR status (model dependent)
8	Drive 9 OLR status (model dependent)
9	Drive 10 OLR status (model dependent)
10	Drive 11 OLR status (model dependent)
11	Drive 12 OLR status (model dependent)
12-15	Reserved (0)

a. There is no header for this ID.

Drive OLR status:

0 = Invalid Drive

1 = Online

2 = Online Pending

4 = Offline

5 = Offling Pending

IPMB Message, Board Status, and Board Type

Table 2-68 IPMB Message Status

Byte	*Descriptions*
00H	Good, command completed normally
C0H	Busy, node busy
C1H	Invalid command
C3H	Time out while processing command
C4H	Out of space
C5H	Reservation cancelled
C6H	Request data truncated
C7H	Request data length invalid
C8H	Request data field length limit exceeded
C9H	Parameter out of range
CAH	Returned data truncated
CBH	Requested sensor, data, or record not present
CCH	Invalid data field in request
CDH	Command illegal for specified sensor or record type
CEH	Command response could not be provided
CFH	Cannot execute duplicated request
FFH	Unspecified error
10H	Checksum A error
11H	Checksum B error
12H	VSCSI phase error

Table 2-69 *Board Status*

Byte	*Descriptions*
00H	Good, command completed normally
01H	Timeout, internal board time out
02H	Single sourced
03H	Failed
04H	Queue full
05H	Busy
06H	Drive controller to drive timeout
0AH	Pending response
0BH	Command level timeout, no response
0CH	Missing off I2C
0DH	Bad IPMB status
FFH	Unknown status

Table 2-70 *Board Type*

Byte	*Descriptions*
00H	AC controller
01H	Picker board controller
02H	Slave repeater controller
03H	Drive module controller DLT 7000 & 8000 drives
04H	Front panel controller
06H	Drive module controller Ultrium LTO1 drives
07H	Drive module controller Benchmark DLT1 drive
10H	Remote management controller

Table 2-70 Board Type

Byte	*Descriptions*
11H	Fibre channel controller, 509 rev 0, 519 rev 3, 529 rev 4 (standard)
12H	Fibre channel controller, 539 rev 5, 549 rev 6 (high performance)
FFH	Unknown

Drive Module Status

Table 2-71 Drive Module Card I2C Status (ID = 129)

Byte	*Descriptions*
0	Buffer ID = 129
1	Number of drives reported (N[a])
2-3	Number of bytes to follow
4 thru (n+3)	Drive 1 status (length = n[b])
. . .	
(N * n) + 3	Drive (N) status

a. N = # of drives <=12
b. n = 16 for DLT drive

Table 2-72 Drive Status for DLT

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	IPMB Message status							
1	Board status							
2	Board type							
3	Been setup	Boot code	Reserved		Controller number			
4	Reserved							
5	Fan detect	Drive power	Handle open	Handle closed	Rsvd	Drive connected	Reserved	
6	For factory use							
7	Reserved							
8-15	Drive general status from ATN[a]							

a. For more information on Drive General Status, see the DLT Interactive Library Specification from Quantum or Benchmark.

IPMB Message status: See Table 2-68 on page 2-87.

Board status: Current status of the controller board. See Table 2-69 on page 2-88.

Board type: The type of controller (DLT = 3, 7). See Table 2-70 on page 2-88.

Been setup: Set if the controller has been given its setup variables.

Boot code: Is the controller current running boot code? 1 = Yes; 2 = No.

Controller number: Controller number of the above type (i.e., controller 1 of type drive).

Fan detect: 1 = Fan is spinning; 0 = Fan is not spinning.

Drive power: 1 = Power on to drives; 0 = Power off to drives.

Handle open: 1 = Drive handle is open; 0 = Drive handle is not open.

This bit is only applicable for the DLT 7000 and DLT 8000 drives.

Handle closed: 1 = Drive handle is closed; 0 = Drive handle is not closed.

This bit is only applicable for the DLT 7000 and DLT 8000 drives.

Drive connected: 1 = Drive is connected on RS422; 0 = Drive is not connected on RS422 or drive power is off.

Table 2-73 Drive Status for Ultrium LTO

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	IPMB Message status							
1	Board status							
2	Board type							
3	Been setup	Boot code	Reserved		Controller number			
4	Reserved							
5	Fan detect	Drive power	Reserved			Drive connected	Reserved	
6	For factory use							
7	Reserved							
8-15	Drive status[a]							

a. For more information on Drive General Status, see the LTO Specification for a Tape Drive Automation Controller Interface.

IPMB Message status: See Table 2-68 on page 2-87.

Board status: Current status of the controller board. See Table 2-69 on page 2-88.

Board type: The type of controller. See Table 2-70 on page 2-88.

Been setup: Set if the controller has been given its setup variables.

Boot code: Is the controller current running boot code? 1 = Yes; 2 = No.

Controller number: Controller number of the above type (i.e., controller 1 of type drive).

Fan detect: 1 = Fan is spinning; 0 = Fan is not spinning.

Drive power: 1 = Power on to drives; 0 = Power off to drives.

Drive connected: 1 = Drive is connected on RS422; 0 = Drive is not connected on RS422 or drive power is off.

Drive status: HP LTO: Drive status Rdata 3 bytes + Get error Rdata information 5 bytes.

Library Slave Status

Table 2-74 Library Slave Card I2C Status (ID = 130)

Byte	*Descriptions*
0	Buffer ID = 130
1	Number of cards reported (N[a])
2-3	Number of bytes to follow
4 thru (n+3)	Slave 1 status (length = n[b])
. . .	
(N * n) + 3	Slave (N) status

a. N = (# of levels) - 1
b. n = 8

Table 2-75 Slave Status

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	IPMB Message status							
1	Board status							
2	Board type							
3	Been setup	Boot code	Reserved		Controller number			
4	Rsvd		Drive 2	Drive 1	Rsvd	Fibre	RMC	Rsvd
5	Lift	IR	Fan stop	Front panel	Lower I2C	Upper I2C	Reserved	

Table 2-75 Slave Status

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
6	Left side mag	Right side mag	Mail-slot sensor	Mail-slot open	Left back sensor	Right back sensor	Reserved	
7	Reserved				Redundant power supply status			

IPMB Message status: See Table 2-68 on page 2-87.

Board status: Current status of the controller board. See Table 2-69 on page 2-88.

Board type: The type of controller (2 = slave controller). See Table 2-70 on page 2-88.

Been setup: Set if the controller has been given its setup variables.

Controller number: Controller number of the above type (i.e., controller 2 of type repeater).

Byte 4, Board detect: This byte shows which PC assemblies are plugged in on this level. 0 = Not present, 1 = Present.

Byte 5, Cable detect: This byte shows which cable assemblies within the level are plugged in. 1 = Not present; 0 = Present; Fan stop 1 = good, 0 = stopped .

Byte 6, Sensor detect: This byte contains the state of the sensors that are plugged into this level. 0 = Sensor broken; 1 = Sensor not broken. On mailslot open, 1 = Open; 0 = Closed.

Redundant power supply status:
0 = Power supply no redundancy
1 = Power supply low unknown
2 = Power supply 1 missing
3 = Power supply 2 missing
4 = Power supply all okay
5 = Power supply 1 has fault
6 = Power supply 2 has fault
7 = Power supply high unknown
8 = Power supply not determined

Front Panel Status

Table 2-76 Front Panel Card I2C Status (ID = 131)

Byte	*Descriptions*
0	Buffer ID = 131
1	Number of cards reported (1)
2-3	Number of bytes to follow
4 thru (n+3)	Front panel status (length = n[a])

a. n = 6

Table 2-77 Front Panel Status

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	IPMB Message status							
1	Board status							
2	Board type							
3	Been setup	Reserved			Controller number			
4	Reserved			Key 5	Key 4	Key 3	Key 2	Key 1
5	Reserved							Screen connect

IPMB Message status: See Table 2-68 on page 2-87.

Board status: Current status of the controller board. See Table 2-69 on page 2-88.

Board type: The type of controller (4 = front panel). See Table 2-70 on page 2-88.

Been setup: Set if the controller has been given its setup variables.

Controller number: Controller number of the above type (i.e., controller 1 of front panel).

Key #: 0 = Not pressed; 1 = Pressed.

Screen connect: 1 = Front panel screen is connected; 0 = Not connected.

Remote Management Card Status

Table 2-78 *Remote Management Card I2C Status (ID = 132)*

Byte	*Descriptions*
0	Buffer ID = 132
1	Number of cards reported (1)
2-3	Number of bytes to follow
4 thru (n+3)	Remote management card status (length = n[a])

a. n = 26

Table 2-79 *Remote Management Card Status*

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	IPMB Message status							
1	Board status							
2	Board type							
3	Been setup	Factory use			Controller number			
4	IP addr valid	Sub-net valid	Gate-way valid	Factory use	MAC addr valid	Net connect valid	Reserved	
5-8	IP address							
9-12	Subnet address mask							
13-16	Gateway address							
17	Factory use							
18-23	MAC address							
24	Reserved			100bT capable	DHCP information		Net connect information	
25	Reserved		Board revision					

IPMB Message status: See Table 2-68 on page 2-87.

Board status: Current status of the controller board. See Table 2-69 on page 2-88.

Board type: The type of controller (10H = remote management). See Table 2-70 on page 2-88.

Been setup: Set if the controller has been given its setup variables.

Controller number: Controller number of the above type (i.e., controller 0 of type remote management).

IP addr valid: 1 = information in IP Address is valid; 0 = not valid.

Subnet valid: 1 = information in subnet address mask is valid; 0 = not valid.

Gateway valid: 1 = information in gateway address is valid; 0 = not valid.

MAC addr valid: 1 = information in the MAC address is valid; 0 = not valid.

Net connect valid: 1 = Net connect information is valid; 0 = not valid.

IP address: The IP address of the remote management card.

Subnet address mask: The subnet address mask for the remote management card.

Gateway address: The gateway address for the remote management card.

MAC address: The MAC address for the remote management card.

100bT Capable: Set to 1 if the remote management card is 10/100 capable.

DHCP information: 0 = Not DHCP capable; 1 = DHCP capable, DHCP connection not attempted; 2 = DHCP capable, DHCP connection attempted but failed; 3 = DHCP capable, DHCP connection attempted and successful.

Net connect information: 0 = Not connected to a network; 1 = Connected to a network at unknown speed; 2 = Connected to a network at 10bT speed; 3 = Connected to a network at 100bT speed.

Board revision: 0 = 10bT board with 850 processor; 1 = 10bT/100bT

board with 860 processor.

Fibre Channel Status

Table 2-80 Fibre Channel Card I2C Status (ID = 133)

Byte	*Descriptions*
0	Buffer ID = 133
1	Number of cards reported (N[a])
2-3	Number of bytes to follow
4 thru (n_1+3)	Fibre channel card 1 status (length = n_1)
. . .	
n_1 + ... n_N + 3	Fibre channel card (N) status (length = n_N[b])

a. N = # of fibre controllers
b. n_n = depends on drive and library connections to a specific fibre board.

Table 2-81 Fibre Channel Status (Rev 0 Format)

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	IPMB Message status							
1	Board status							
2	Board type							
3	Been setup	Format Rev (0)	Reserved		Controller number			
4	Rsvd	Device valid	Rsvd	Addr valid	WWN valid	LVD/ HVD	Bus 2 fault	Bus 1 fault
5	Factory use							
6	Factory use							
7	Factory use							

Table 2-81 Fibre Channel Status (Rev 0 Format)

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
8	# of SCSI device entries to follow (N)							
9	Bus #		Device 1 SCSI ID					
10	Device 1 type				Device 1 OLR status			
11-22	Device 1 serial number (12 bytes)							
...	...							
n-14	Bus #		Device N SCSI ID					
n-13	Device N type				Device N OLR status			
n-12... n-1	Device N serial number (12 bytes)							
n...n+2	Link address (3 bytes)							
n+3	Rsvd	Link up	Link init status		Addr mode		Reserved	
n+4 ...n+11	Worldwide name (Port) (8 bytes)							
n+12... n+19	Worldwide name (Node) (8 bytes)							
n+20	SE/ Diff 2	SE/ Diff 1	Board revision					

n = (N * 14) + 9

IPMB Message status: See Table 2-68 on page 2-87.

Board status: Current status of the controller board. See Table 2-69 on page 2-88.

Board type: The type of controller (11 = fibre, 2 = channel). See Table 2-70 on page 2-88.

Been Setup: Set to 1 if the controller has been given its setup variables.

Format rev: 0 = The report format with 14 bytes per target device. Used on code revisions below 1.20x; 1 = The report format with 24 bytes per target device.

Controller number: Controller number of the above type (i.e., controller 1 of type fibre).

Device valid: 1 = information in Device fields are valid; 0 = not valid.

Addr valid: 1 = information in link address is valid; 0 = not valid.

WWN valid: 1 = information in Worldwide Names is valid; 0 = not valid.

LVD/HVD: 1 = Low voltage differential board; 0 = High voltage differential board.

Bus 1 fault: 1 = SCSI bus 1 has a fault; 0 = no fault.

Bus 2 fault: 1 = SCSI bus 2 has a fault; 0 = no fault.

 # SCSI Device entries: Is equal to the number of device entries following (14 bytes each).

Bus #: 1 = SCSI bus 1; 2 = SCSI bus 2.

Device # SCSI ID: Device # SCSI ID, one entry per SCSI device in the library.

Device # OLR Status:

0 = Drive invalid
1 = Online good
2 = Online pending
3 = Offline failed pending
4 = Offline failed
5 = Offline good pending
6 = Offline good
7 = Offline missing
8 = Offline library
9 = Offline missing library

Device # type: 0 = library; 1 = DLT7000; 2 = DLT8000; F = Unknown.

Device # serial number: Serial number of device, ASCII string padded at end with zeros (currently returns all 0xff).

Link address: The link address of the fibre channel board (AL_PA or FLA).

Link up: 0 = link not detected; 1 = link detected.

Link init status: 0 = Initialization pending; 1 = Initialization failed; 2 = Initialization successful.

Addr mode: Address mode: 0 = hard; 1 = soft; 2 = firm

Worldwide name (WWN): A unique registered name that is given to each fibre channel board.

SE/DIFF #: 0 = This bus is a differential bus; 1 = This bus is a single-ended bus.

Board Revisions: 0 = The HVD 509 board; 4 = The HVD 529 board.

Table 2-82 Fibre Channel Status (Rev 1 Format)

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	IPMB Message status							
1	Board status							
2	Board type							
3	Been setup	Format Rev (1)	Rsvd		Controller number			
4	Rsvd	Device valid	FC status valid	Addr valid	WWN valid	LVD/ HVD	Reserved	
5	Factory use							
6	Factory use							
7	Factory use							
8	# of SCSI device entries to follow (N)							
9	Device entry length							
10	Data format revision							
11	Bus #				Device 1 SCSI ID			
12	Reserved			Device 1 SCSI width	Device 1 SCSI speed			
13	Device 1 type							
14	Device 1 OLR status							
15-26	Device 1 serial number (12 bytes)							
27-34	Device 1 vendor ID (8 bytes)							
...	...							
n-24	Bus #		Device N SCSI ID					

Table 2-82 Fibre Channel Status (Rev 1 Format)

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
n-23	Reserved			Device N SCSI width		Device N SCSI speed		
n-22	Device N type							
n-21	Device N OLR status							
n-20... n-9	Device N serial number (12 bytes)							
n-8... n-1	Device N vendor ID (8 bytes)							
n...n+2	Link address (3 bytes)							
n+3	Bypass /active	Link up	Link init status		Addr mode		Connection	
n+4 ...n+11	Worldwide name (Port) (8 bytes)							
n+12... n+19	Wordwide name (Node) (8 bytes)							
n+20	PAL revision				Board Revision			
n+21	Bus 4 failed	Bus 3 failed	Bus 2 failed	Bus 1 failed	SE/Diff 4	SE/Diff 3	SE/Diff 2	SE/Diff 1
n+22	Current mode		Future mode		# of SCSI ports			
n+23	Current ALPA requested							
n+24	Future ALPA							
n+25	Lock map-ping	Port type	Rsvd (0)	Rsvd (0)	Trace Level			
n + 26	IBTW4	IBTW3	IBTW2	IBTW1	Rsvd (0)	Number FC LUNs		
n + 27	Reserved (0)							xcopy
n + 28	Reserved (0)							

Table 2-82 Fibre Channel Status (Rev 1 Format)

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
n+29	Additional length							

n = (N * 24) + 11

IPMB Message status: See Table 2-68 on page 2-87.

Board status: Current status of the controller board. See Table 2-69 on page 2-88.

Board type: The type of controller (11, 12 = fibre). See Table 2-70 on page 2-88.

Been Setup: Set if the controller has been given its setup variables.

Format rev: 0 = The report format with 14 bytes per target device. Used on code revisions below 1.20x
1 = The report format with 24 bytes per target device.

Single sourced: Set if the controller is single sourced.

Controller number: Controller number of the above type (i.e., controller 1 of type fibre).

Device valid: 1 = information in Device fields are valid; 0 = not valid.

Addr valid: 1 = information in link address is valid; 0 = not valid.

WWN valid: 1 = information in Worldwide Names is valid; 0 = not valid.

LVD/HVD: 1 = Low voltage differential board; 0 = High voltage differential board.

 # SCSI device entries to follow: Specifies the number of device entries following.

Device entry length: Format revision 1 has a device length of 24 bytes per target device.

Data format revision: 0 = initial revision of format rev 1.

Bus #: 1 = SCSI bus 1; 2 = SCSI bus 2.

Device # SCSI width: The device's negotiated SCSI width. 0 = unknown; 1 = 8 bits; 2 = 16 bits.

Device # SCSI speed: The device's negotiated SCSI speed. 0 = async; 1

= synch 5 Mbytes; 2 Fast 10 Mbytes; 3 = Ultra 20 Mbytes; 7 = Unknown.

Device # SCSI ID: Device # SCSI target ID.

Device type: 0 = library; 1 = DLT7000; 2 = DLT8000; 3 = Ultrium LTO; 4 = DLT1 (Benchmark).

Device # OLR Status:

0 = Drive invalid
1 = Online good
2 = Online pending
3 = Offline failed pending
4 = Offline failed
5 = Offline good pending
6 = Offline good
7 = Offline missing
8 = Offline library
9 = Offline missing library

Device # serial number: Serial number of device, ASCII string padded at end with zeros.

Device # vendor ID: The vendor ID of the drive. 8-byte ASCII string padded a the end with zeros.

Link address: The link address of the fibre channel board (AL_PA or FLA).

Bypass/active: 1 = Fibre transceiver is in loopback; 0 = Fibre transceiver is able to connect to an outside link.

Link up: 0 = link not detected; 1 = link detected.

Link init status: 0 = Initialization pending; 1 = Initialization failed; 2 = Initialization successful.

Addr mode: Address mode: 0 = hard; 1 = soft; 2 = firm.

Connection: Connection type. 0 = none; 1 = loop; 2 = fabric.

Worldwide name (WWN): A unique registered name that is given to each fibre channel board.

PAL revision: PAL's revision.

Board Revision: 0 = The HVD 509 board; 3 = The LVD 519 board; 4 = The HVD 529 board; 5 = The LVD high-performance 539 board; 6 = The HVD high-performance 549 board.

Bus # fault: 1 = SCSI bus # has a fault; 0 = no fault.

SE/Diff #: 0 = This SCSI bus is a differential bus; 1 = This SCSI bus is a single-ended bus.

Current mode: The Addressing Mode last requested. ***Note***: This may not be the addressing mode in use.

Future mode: The future Addressing Mode to be attempted on reboot.

 # SCSI ports: 2 = 2 SCSI ports; 4 = 4 SCSI ports.

Current ALPA requested: The ALPA last requested. ***Note***: This may not be the ALPA currently in use.

Future ALPA: The future ALPA to be used on reboot.

Lock Mapping: 0 = Do not save over reboot the map log; 1 = Lock the mapping log over reboot.

Port Type: 0 = Auto Sense port; 1 = N_Port.

Trace Level: The trace level setting of the FC bridge.

IMBTW: 0 = No Initiator mode Buffered Tape Writes; 1 = Initiator made Buffered Tape Write Enabled.

FC LUNs: The number of FC LUNS to be used in 3rd party copy.

Xcopy: 0 = The serverless backup licensing is disabled; 1 = The serverless backup licensing is enabled.

Additional length: The additional length supported currently is set to 0.

Card Cage Status

Table 2-83 Card Cage Slot I2C Status (ID = 134)

Byte	*Descriptions*
0	Buffer ID = 134
1	Number of slots reported (N)
2-3	Number of bytes to follow
4-15	Card 1 status (12 bytes) (see Table 2-84 on page 2-108)
. . .	
(12 * N) + 3	Card (N) status

Table 2-84 Card Status Format

Byte	*Descriptions*
0	IPMB address
1	Board type (see Table 2-70 on page 2-88)
2	Controller number
3	Board status (see Table 2-69 on page 2-88)
4-7	Board revision (ASCII)
8-11	Reserved

Drive Data Packets

Table 2-85 DLT Specific Drive Data Packet 1 (ID = 135)

Byte	*Descriptions*
0	Buffer ID = 135
1	Number of drives reported (N)
2-3	Number of bytes to follow
4-11	Drive 1 Tape Data Packet 1 (8 bytes)[a]
. . .	
(N * 8) + 3	Drive (N) Tape Data Packet 1 (8 bytes)

a. For more information on all these Read Buffer status logs, see the DLT Interactive Library Specification from Quantum.

Table 2-86 DLT Specific Drive Data Packet 2 (ID = 136)

Byte	*Descriptions*
0	Buffer ID = 136
1	Number of drives reported (N)
2-3	Number of bytes to follow
4-21	Drive 1 Tape Data Packet 2 (18 bytes)[a]
. . .	
(N * 18) + 3	Drive (N) Tape Data Packet 2 (18 bytes)

a. For more information on all these Read Buffer status logs, see the DLT Interactive Library Specification from Quantum.

Table 2-87 DLT Specific Drive Data Packet 3 (ID = 137)

Byte	*Descriptions*
0	Buffer ID = 137
1	Number of drives reported (N)
2-3	Number of bytes to follow
4-11	Drive 1 Tape Data Packet 3 (8 bytes)[a]
. . .	
(N * 8) + 3	Drive (N) Tape Data Packet 3 (8 bytes)

a. For more information on all these Read Buffer status logs, see the DLT Interactive Library Specification from Quantum.

Library General Status

Table 2-88 Library General Status (ID = 138)

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Buffer ID = 138							
1	Reserved (0)							
2-3	Number of bytes to follow (6)							
4	Library Status							
5	Rsvd (0)	Drive needs to be clean	Drive critical error	Drive (s) Fw error	Drive (s) not on FC	Drive(s) Online Pending	Drive(s) Offline	Drive(s) not present
6	FRU Fw error	Reserved (0)		Incom-patible maga-zines	SE on LVDS	Mailslot open	Door(s) open	Mag(s) missing
7	FC card(s) failed	Slave card(s) failed	Front Panel failed	RMC failed	Power supply failed	Slave card(s) not present	Front Panel not present	RMC not present
8	Clock not set	Reserved (0)						Library fan failure
9	Reserved (0)							

Library Status

0 = Good (Green)
1 = Partial Availability (Yellow)
2 = Failed (Red); see latest entry in Hard Error Log
3 = Powering up

Table 2-89 Partial Availability Conditions

Error Status	*Causes*
Drive(s) not present	Library could not detect the drive modules.
Drive(s) offline	Drive(s) taken offline by library controller. • Drive(s) failed power-on test. • Drive module board failed power-on test. • Failed serial communication to drive. • Failed load/unload. Drive(s) taken offline by front panel operator. Drive(s) taken offline by host computer.
Drive(s) online pending	Drive(s) are present and powered up, but have incompatible firmware.
Drive(s) not available on fibre channel	Drive(s) are detected by library controller but are not detected by any of the fibre channel cards.
Drive(s) Fw error	Drive(s) are present and powered up but have incompatible firmware.
Drive critical	A critical error has occurred on a drive.
Drive needs cleaning	A drive needs cleaning.
Mag(s) missing	Library could not detect all the magazines.
Door(s) open	One or more tape doors are open.
Mailslot open	Mailslot door is open.
SE connect to LVDS	The low voltage differential SCSI bus has a single-ended connection.

Table 2-89 Partial Availability Conditions

Error Status	*Causes*
Incompatible magazines	The magazine is incompatible with the drive type.
FRU Fw error	A FRU's firmware is inconsistent with the released download code.
RMC not present	Library could not detect the remote management card.
Front panel not present	Library could not detect the front panel display.
Slave card(s) not present	Library could not detect the library slave controller cards.
Power supply failed	Library detected one or more redundant power supplies in a failed condition.
RMC failed	Remote management card failed power-up test.
Front panel failed	Front panel display failed power-up test.
Slave card(s) failed	Library slave controller card failed power-up test. *NOTE*: The slave controller cards are present in all but the lowest level of the library.
FC card(s) failed	Fibre channel card failed power-up test.
Clock not set	The clock needs to be set.
Library fan fail	One of the library card cage's fans have failed.

Table 2-90 Library Bus Status (ID = 140)

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Buffer ID = 140							
1	Number of library status reporting (1)							
2-3	Number of bytes to follow							
4-18	Reserved (factory use)							
19	Rsvd (0)	LVD/ HVD	SE/ DIFF	Bus Fault	Board Revision			

LVD/HVD

0 = HVD (High Voltage Differential SCSI)

1 = LVD (Low Voltage Differential SCSI)

SE/DIFF

0 = Connected to differential SCSI

1 = Connected to single ended

Bus Fault

0 = No fault condition

1 = Not connected or bus fault

Board Revision

0 = Initial release of board

Table 2-91 Percent Humidity (ID = 141)

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Buffer ID = 141							
1	Number of humidity reporting							
2-3	Number of bytes to follow							
4	Percent humidity							

Percent Humidity

0 - 100% humidity of the library controller.

Table 2-92 Drive Revisions (ID = 142)

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Buffer ID = 142							
1	Number of drives reported							
2-3	Number of bytes to follow							
*4 thru (n * N) + 3*	Drive revision entry (length = n)							

n = 12
N = # of drives

Table 2-93 Drive Revision Entry

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0-4	Drive revision (ASCII)							
5-8	Manufacturing date code							
9-11	Reserved (0)							

Drive Revision
The drive firmware revision (4-byte ASCII).

Manufacturing date code
FFFF = unknown.

Whole Product Revision

Table 2-94 Whole Product Revisions (ID = 143)

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Buffer ID = 143							
1-3	Length of data returned							
4-7	Whole product revision							
8-11	Library revision							
12-15	Picker revision							
16-19	RMC revision							
20-23	Fibre type = 11 revision							
24-31	Fibre type = 12 revision							
32-35	Reserved (ffh)							

The revision can be in the following formats that are 4 bytes long (ASCII)

0x00 0x00 0x00 0x00 = card will fail if included

0xFF 0xFF 0xFF 0xFF = card revision is not included download image or will not be checked if present.

0xnn 0xnn 0xnn 0xnn = card will be checked and has to match or it will generate firmware update neede

All Fibre Map Log

Table 2-95 All Fibre Map Log (ID = 144)

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Buffer ID = 144							
1	Number of FC report = N							
2-3	Length of data returned							
4 thru (n+4)	Fibre map log entry							

Table 2-96 Fibre Map Log Entry

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Fibre controller number (zero counted Fibre level number 0-5)							
1	Number of devices report = n							
2-3	Reserved (0)							
4	Device 0 Fibre LUN							
5	Device 0 SCSI Bus number							
6	Device 0 SCSI Target ID							
7	Device 0 SCSI Target LUN							
...	...							
n-3	Device n Fibre LUN							
n-2	Device n SCSI Bus Number							
n-1	Device n SCSI Target ID							
n	Device n SCSI Target LUN							

n = 15 + 15 +1 = 31 (Max Device Bus 0, Max Devices Bus 1, VSCSI device)

HP LTO Get Drive Information

Table 2-97 HP LTO Get Drive Information (ID = 145)

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Read Buffer ID = 145							
1	Number of devices report = N							
2-3	Length of data returned = 4+(54*N)							
4 thru (n+4)	Get Drive Info entry							

Table 2-98 Get Drive Info Entry

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0-7	Vendor ID							
8-23	Product ID							
24-27	Product Revision Level (ASCII)							
28-31	Manufacturing Date Code (ASCII)							
32-41	Serial Number (ASCII)							
42-45	ACI version (ASCII)							
46-52	Firmware version (ASCII)							
53	Reserved (0)							

Data is only valid for LTO drives. All other drives return zero.

Log Select Command (4CH)

The LOG SELECT command (Table 2-99) allows an application client to manage statistical information maintained by the device about the device or its logical units. Device servers that implement the LOG SELECT command shall also implement the LOG SENSE command.

Table 2-99 Log Select Command CDB

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Operation Code (4CH)							
1	Reserved (0)						PCR (0)	SP (1)
2	PC (01)		Reserved (0)					
3-6	Reserved (0)							
7	Parameter List Length (MSByte)							
8	Parameter List Length (LSByte)							
9	Control Byte (0)							

PCR = 0

A Parameter Code Reset (PCR) bit of one and a parameter list length of 0 shall cause all implemented parameters to be set to the target-defined default values (e.g., 0). If the PCR bit is one and the parameter list length is greater than 0, the command shall be terminated with CHECK CONDITION status. A PCR bit of 0 specifies that the log parameters shall not be reset.

SP = 1

A Save Parameters (SP) bit of one indicates that after performing the specified LOG SELECT operation, the target shall save to non-volatile memory. A SP bit of 0 specifies that parameters shall not be saved.

PC

The Page Control (PC) field defines the type of parameter values to be selected. The Page Control field is defined in the table below.

Table 2-100 Page Control Field

Type	*Log Select Parameter Values*	*Log Sense Parameter Values*
00B	Current threshold values	Threshold values
01B	Current cumulative values	Cumulative values
10B	Default threshold values	Default threshold values
11B	Default cumulative values	Default cumulative values

The current cumulative values may be updated by the target or by the application client using the LOG SELECT command to reflect the cumulative number of events experienced by the target.

Parameter List Length

The parameter list length field specifies the length in bytes of the parameter list that shall be located in the Data-Out Buffer. A parameter list length of 0 indicates that no pages shall be transferred.

The parameter list length shall not result in the truncation of any log parameter. The application client should send pages one page code at a time.

NOTE Initiators should issue LOG SENSE commands prior to issuing LOG SELECT commands to determine supported pages.

The target does not support independent sets of log parameters and if any log parameters are changed that affect other initiators, then a unit attention condition for all initiators will be generated. This unit attention condition shall be returned with an additional sense code of LOG PARAMETERS CHANGED.

Log Select Data Format

The Log Select shall have the following format or the format of the Log Sense in Table 2-102 on page 2-123.

Table 2-101 *Log Select Page Data Format*

Byte	*Description*
0	Page Code
1	Reserved
2	Number of bytes to follow (MSByte) (0)
3	Number of bytes to follow (LSByte) (0)

Log Sense Command (4DH)

Retrieves statistical information maintained by the library.

Table 2-102 Log Sense Command CDB

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Operation Code (4DH)							
1	Reserved (0)						PPC (0)	SP (0)
2	PC (01)		Page Code (See Table 2-103 on page 2-124)					
3-4	Reserved (0)							
5	Parameter Pointer (MSByte) (0)							
6	Parameter Pointer (LSByte) (0)							
7	Allocation Length (MSByte)							
8	Allocation Length (LSByte)							
9	Control Byte (0)							

PPC

0 - All logs returned, and even those not changed.

SP

0 - Do not save; logs are already in NVRAM.

PC

01 - Current Cumulative values.

Page Codes

See Table 2-103.

Allocation Length

The number of parameter bytes, including the Log Page Descriptor Block and the parameter structures. See Table 2-103.

Log Sense Parameter Data

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

Table 2-103 *Log Sense Parameter Data Available in Each Page Code*

Page Code	*Length (Bytes)*	*Description*
00H	17	List of supported pages
2EH	320	TapeAlert log (Table 2-104 on page 2-126)
30H	366	Hard error log (Table 2-106 on page 2-134)
31H	(40 * entries) + 6	Library event log (Table 2-108 on page 2-139)
32H	(8 * number of drives) + 4	Drive Status Log
33H	366	Recovery log (Table 2-111 on page 2-146)
37H	23	Odometer (Table 2-112 on page 2-147)
38H	366	Soft error log (Table 2-113 on page 2-148)
3BH	703	Mech parameter log (factory use only)
3CH	8	Prom information (factory use only)
3DH	(44 * entries) + 6	I2C log (factory use only)

Table 2-103 Log Sense Parameter Data Available in Each Page Code

Page Code	*Length (Bytes)*	*Description*
3EH	(40 * entries) + 6	Drive media log (Table 2-114 on page 2-149)
3FH	(32 * entries) + 6	Drive media log (Table 2-116 on page 2-153)

TapeAlert SCSI Log Sense Format

This table can be accessed via the Log Sense Command (4DH) Table 2-102 on page 2-123 with page code 2EH. The TapeAlert interface to the library is via the SCSI bus, based on a new LOG SENSE page code 2EH that contains 64 one-byte alert flags. The specific conditions for any one flag to be set and cleared are device-specific. The format of the LOG SENSE page is as follows:

Table 2-104 Log Sense Format

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Page Code (2EH)							
1	Reserved (0)							
2	Page Length (01H) MSByte							
3	Page Length (40H) LSByte							
TapeAlert Flags:								
5n-1	Parameter Code (n) MSByte							
5n	Parameter Code (n) LSByte							
5n+1	DU(0)	DS(1)	TSD(0)	ETC(0)	TMC(0)	Rsvd(0)	Res(0)	LP(0)
5n+2	Parameter Length (1)							
5n+3	Value of Flag (set when bit = 1)							

Each flag will be cleared to 0 in the following circumstances:

- At drive power on
- When the TapeAlert Log page is read
- When specified corrective action has been taken (such as using a cleaning cartridge)
- On SCSI bus reset or bus device reset message
- On Log Select reset

There are three types of flags, listed below in order of increasing severity:

Severity	*Urgent User Intervention*	*Risk of Data Loss*	*Explanations*
Critical	X	X	
Warning		X	X
Information			X

The definitions of the 64 alert flags in the Log page vary, depending on the device type.

The following table details the currently defined error flags in the TapeAlert specification for libraries.

Table 2-105 Tape Drive/ Library Flag Definitions

No	*Flag*	*Type*	*Displayed Message*	*Probable Cause*
1	Library Hardware A	C	The library mechanism is having difficulty communicating with the drive. 1. Turn the library off then on. 2. Wait for the library to finish POST. 3. If necessary, put the drive back online. 4. Restart the operation. 5. If problem persists, contact library support.	Changer mechanism is having trouble communicating with the internal drive.
2	Library Hardware B	W	There is a problem with the library mechanism. If problem persists, contact library support.	Changer mechanism had a mechanical fault that was recovered.

Table 2-105 Tape Drive/ Library Flag Definitions

No	*Flag*	*Type*	*Displayed Message*	*Probable Cause*
3	Library Hardware C	C	The library has a hardware fault: 1. Close library door. -or- 2. Clear any tapes that may be blocking the picker path. 3. Reset the library by running "Recalibrate" from the front panel or by issuing a re-zero and initalize elements command over SCSI. 4. Restart the operation. Check the library user manual for device-specific instructions on resetting the device.	The changer mechanism has a hardware fault that requires reset to recover. This flag is set anytime the changer needs to be recalibrated, when there is a mechanical fault, or when the door is open during operation.
4	Library Hardware D	C	The library has a hardware fault: 1. Turn the library off and then on again. 2. Restart the operation. 3. If the problem persists, call library support. Check the library user manual for device-specific instructions on turning the device power on and off.	The changer mechanism has a hardware fault that is not mechanically related or requires a power cycle to recover. This flag is set when an RTL error exit occurs; therefore, the TapeAlert log will not be available over the SCSI interface. The flag will be recorded in the event log when possible.

Table 2-105 Tape Drive/ Library Flag Definitions

No	*Flag*	*Type*	*Displayed Message*	*Probable Cause*
6	Library Interface	C	The library has a problem with the host interface: 1. Check the cables, cable connections, and terminators. 2. Restart the operation.	The library has identified an interfacing fault. This flag is set when the changer has detected a problem with the SCSI interface, but has continued to function. RTL error exit will continue.
9	Library Humidity Limits	C	General environmental conditions inside the library are outside the specified humidty range. 1. Stop changer operation. 2. Correct the environment by raising or lowering humidity levels as needed. 3. Restart the operation.	Library humidity limits exceeded. The humidity is either too low or too high for proper changer operations.
13	Library Pick Retry	W	There is a potential problem with a drive ejecting cartridges short or with the library mechanism picking a cartridge from a slot. 1. No action needs to be taken at this time. 2. If the problem persists, call tape drive support.	Operation to pick a cartridge from a slot had to perform an excessive number of retries before succeeding. This flag is set anytime the changer had to retry a picker operation from a drive or slot.

Table 2-105 Tape Drive/ Library Flag Definitions

No	*Flag*	*Type*	*Displayed Message*	*Probable Cause*
14	Library Place Retry	W	There is a potential problem with the library mechanism placing a cartridge into a slot. 1. No action needs to be taken at this time. 2. If the problem persists, call library support.	Operation to place a cartridge into a slot had to perform an excessive number of retries before succeeding. This flag is set anytime the changer had to retry a place operation to a slot.
15	Library Load Retry	W	There is a potential problem with a drive or the library mechanism loading cartridges or an incompatible cartridge. 1. Remove any incompatible media.	Operation to load a cartridge into a drive had to perform an excessive number of retries before succeeding. This flag is set anytime the changer had to retry a place operation to the drive or if incompatible media was detected.
16	Library Door	C	The operation has failed because the library door is open: 1. Clear any obstructions from the library door. 2. Close the library door. 3. If the problem persists, call library support.	Changer door open prevents library from functioning. This flag is set only when an open door prevented a library operation over the SCSI interface.
18	Library Magazine	C	The library cannot operate without a magazine. 1. Insert a magazine into the library. 2. Restart the operation.	Library magazine(s) not present. This flag is only set when there are no magazines detected by the library.

Table 2-105 Tape Drive/ Library Flag Definitions

No	*Flag*	*Type*	*Displayed Message*	*Probable Cause*
19	Library Security	W	Library security has been compromised.	Library door was opened while reserved by a host over the SCSI interface. The library doors can only be opened by an override in the service menu when the library is reserved.
22	Library Drive Offline	I	A drive inside the library has been taken offline. This is for information purposes only. No action is required.	Library turned internal drive offline. This flag is set anytime a drive is put off-line or if drive is off-line at power up. The drive can be put off-line by the user, via the front panel or SCSI interface and by the library, when a drive error occurs during POST or if the drive module fan fails.

Table 2-105 Tape Drive/ Library Flag Definitions

No	*Flag*	*Type*	*Displayed Message*	*Probable Cause*
23	Library Scan Retry	W	There is a potential problem with the barcode label in the library mechanism. 1. No action needs to be taken at this time. 2. If the problem persists, call library support.	Operation to scan the barcode on a cartridge had to perform an excessive number of retries before succeeding. This flag is set when there is a problem with the barcode scanner. It is not set when a barcode label is unreadable.
24	Library Inventory	C	The library has detected an inconsistency in its inventory. 1. Redo the library inventory to correct inconsistency. 2. Restart the operation. Check the applications user manual or the hardware user manual for specific instructions on redoing the library inventory.	Inconsistent media inventory. This flag is set only when an inventory operation is required before a SCSI operation can be completed.
25	Library Illegal Operation	W	A library operation has been attempted that is invalid at this time.	Illegal operation detected. This flag is set anytime an illegal operation is reported over the SCSI interface.
27	Cooling Fan Failure	W	A library cooling fan has failed.	One or more fans inside the library have failed. This flag is set when one of the library fans has failed. It is not set if a drive module fan has failed.

Table 2-105 Tape Drive/ Library Flag Definitions

No	*Flag*	*Type*	*Displayed Message*	*Probable Cause*
28	Power Supply	W	A reundant power supply has failed inside the library. Check the library user manual for instructions on replacing the failed power supply.	Redundant power supply failure inside the library subsystem.
32	Unreadable barcode labels	I	The library was unable to read the barcode on a cartridge. 1. Replace the barcode label with an approved label.	Unable to read a barcode label on a cartridge during library inventory/scan. This flag is set only if the barcode is unreabable. It is not set if there is no barcode label.

Hard Error Logs Format

This table is accessed using the Log Sense Command (4DH), Table 2-102 on page 2-123 with page code 30H. It records hard errors that occur during normal operation of the library.

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 2-106 *Hard Error Logs Format*

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 hard error log entries (36 Bytes each, see Table 2-107 on page 2-135)

Table 2-107 Hard Error/Recovery/Soft Error Log Entry Format

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	FRU Locator							
1	Error Code							
2	FRU 1							
3	FRU 2							
4	FRU 3							
5	Command Attempted							
6-7	Source Element Number							
8-9	Destination Element Number							
10-11	Second Destination Element Number							
12-17	Move Sequence IDs							
18	Error Code Qualifier							
19	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	Time Stamp							

FRU Locator

Returns either the drive number or level number, then slot number (4 bits each). This helps isolate the error.

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 3-4 on page 3-16.

FRU 1

The FRU most likely to be at fault. Refer to the FRU list in this manual (“Field Replaceable Units (FRUs)” on page A-2).

NOTE

The FRUs numbers returned indicate the most likely cause of an error, but may not be the actual cause of the problem. Simply changing the FRU might fix the problem.

FRU 2

The second most likely FRU to be at fault. Refer to the FRU list in this manual (“Field Replaceable Units (FRUs)” on page A-2).

FRU 3

The third most likely FRU to be at fault. Refer to the FRU list in this manual (“Field Replaceable Units (FRUs)” on page A-2).

Move Command Attempted

0 - Exchange

1 - Move

2 - Seek

3 - Initialize Element

4 - Rezero

5 - Diag

6 - Restore

7 - Emulate Stacker

8 - 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 Element Number

The Element Number to which the Second Destination refers.

Move Sequence IDs

The last six library Move Sequence IDs for the original movement command prior to the failure. Byte 12 is the least recent move, and Byte 16 is the most recent move. See Table C-1 on page C-2.

Error Code Qualifier

The qualifier associated with the failed error code. See Table 3-5 on page 3-22.

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.

Time Stamp

The number of seconds from 00:00:00 January 1, 1970 that the unit has been powered on.

Library Event Log

This table can be accessed via the Log Sense Command (4DH) Table 2-101 on page 2-122 with page code 31H.

Table 2-108 Library Log Entry Format

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Page Code (31H)							
1	Reserved (0)							
2-3	Number of Bytes to Follow							
4	Current Entry							
5	Number of Entries							
6-505	Array of 30 library log entries (See Table 2-109 on page 2-139)							

Table 2-109 Library Log Data Entry Format

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0-3	Time Stamp							
4	Board Type							
5	Error Flag	Event ID						
6	Additional Length (21H)							
Event Unique: TapeAlert message, Bus reset, Motion aborted, Powerup								
7	CDB valid	Sense valid	Error valid	Status valid	TA valid	Reserved (0)		
8	Host ID							
9	CDB Byte 0							

Table 2-109 Library Log Data Entry Format

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
10-19	. . .							
20	CDB Byte 11							
21	Reserved				Sense Key			
22	Additional Sense Code (ASC)							
23	ASC Qualifier (ASCQ)							
24	SKSV	C/D	Reserved (0)		BPV	Bit Pointer		
25	Field Pointer (MSByte)							
26	Field Pointer (LSByte)							
27	Error Code							
28	Error Code Qualifier							
29	SCSI Command Status							
30	TapeAlert Major Revision				TapeAlert Minor Revision			
31	Flag 8	Flag 7	Flag 6	Flag 5	Flag 4	Flag 3	Flag 2	Flag 1
32	Flag 16	Flag 15	Flag 14	Flag 13	Flag12	Flag 11	Flag 10	Flag 9
33	Flag 24	Flag 23	Flag 22	Flag 21	Flag 20	Flag 19	Flag 18	Flag 17
34	Flag 32	Flag 31	Flag 30	Flag 29	Flag 28	Flag 27	Flag 26	Flag 25
35	Flag 40	Flag 39	Flag 38	Flag 37	Flag 36	Flag 35	Flag 34	Flag 33
36	Flag 48	Flag 47	Flag 46	Flag 45	Flag 44	Flag 43	Flag 42	Flag 41
37	Flag 56	Flag 55	Flag 54	Flag 53	Flag 52	Flag 51	Flag 50	Flag 49
38	Flag 64	Flag 63	Flag 62	Flag 61	Flag 60	Flag 59	Flag 58	Flag 57

Table 2-109 Library Log Data Entry Format

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
39	Reserved (0)							
Event Unique: Library error exits state								
7	Reserved (0)				Continued	Infinite Loop	Busfree	Reboot
8-37	Error exit string (ASCII)							
38-39	Reserved (0)							
Event Unique: SCSI ID								
7	Old SCSI ID							
8	New SCSI ID							
9-39	Reserved (0)							
Event Unique: Library firmware update needed, error information available								
7-10	Whole product revision (ASCII)							
11-14	Mismatched revision (ASCII)							
15-18	Good revision (ASCII)							
19	Slot				Level			
20-39	Reserved (0)							

Time Stamp

4-byte hex number of seconds since January 1, 1970.

Board Type

The type of controller. (See Table 2-69 on page 2-88).

Error Flag

Indicates that the event is an error condition.

Event ID

The event number that triggered the log entry. See Table 3-7 on page 3-30.

Additional Length of Each Entry

The number of bytes after this byte that is left in this entry.

CDB Valid

1 = The SCSI CDB field and host ID that follows is valid.
0 = The SCSI CDB field and host ID that follows is not valid.

Sense Valid

1 = The SCSI Sense Key ASC, ASCQ, and SKS are valid.
0 = The SCSI Sense Key ASC, ASCQ, and SKS are not valid.

Error Valid

1 = The error code and error code qualifier are valid.
0 = The error code and error code qualifier are not valid.

Status Valid

1 = The SCSI command status is valid.
0 = The SCSI command status is not valid.

TA Valid

1 = The TapeAlert information is valid.
0 = The TapeAlert information is not valid.

Host ID

0-15 = SCSI IDs on SCSI bus
16 = Front panel logged
18 = RMC logged
FF = unknown logged

CDB

For a description of one, see “Command Descriptor Block (CDB)” on page 1-20.

Sense Key

See Table 3-1 on page 3-3.

Additional Sense Code (ASC)

The Additional Sense Code specifies detailed information related to the error reported in the Sense Key field. See Table 3-2 on page 3-4.

Additional Sense Code Qualifier (ASCQ)

The Additional Sense Code specifies detailed information related to the error reported in the Sense Key field. See Table 3-2 on page 3-4.

SKSV

When set to 1, the Sense Key Specific bytes contains valid data. When set to 0:

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.

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 3-4 on page 3-16.

Error Code Qualifier

The qualifier associated with the failed error code. (See Table 3-5 on page 3-22.)

SCSI Command Status

The target sends a status byte to the initiator during the Status Phase, which occurs at the end of each command, unless the command is cleared by ABORT, BUS DEVICE RESET, or a RESET. See Table 1-1 on page 1-6.

TapeAlert Revision

The TapeAlert revision level of the associated drive.

Flag Number

TapeAlert flags ordered as numbered.

Drive Status Log

This table can be accessed via the Log Sense Command (4DH) Table 2-102 on page 2-123 with page code 32H. This log will return a 8-byte packet for every DLT drive in the library. The format of the packet as the General Status Packet in the DLT Interactive Library Specification from Quantum, Benchmark, or the Autochanger Interface Specification for Ultrium LTO.

Table 2-110 Drive Status Log

Byte	*Descriptions*
0	Page Code (32H)
1	Reserved (0)
2	Number of bytes to follow (MSByte)
3	Number of bytes to follow (LSByte)
4-11	Drive 1 General Status Packet (8 bytes)
. . .	
(n * 8) + 4	Drive (n) General Status Packet

Recovery Log Format

This table can be accessed via the Log Sense Command (4DH), Table 2-102 on page 2-123 with page code 33H. It records soft errors and related information on error recovery methods.

It is reset to 0 before any library 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 2-111 Recovery Log Format

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 recovery log entries (36 Bytes each, see Table 2-107 on page 2-135)

Odometer Log Format

This table can be accessed via the Log Sense Command (4DH), Table 2-102 on page 2-123 with page code 37H. It counts the number of times various moves are completed. An exchange is counted as two moves.

Table 2-112 Odometer Log Format

Byte	*Description*
0	Page Code (37H)
1	Reserved = 0
2-3	Number of bytes to follow
4-7	Move Odometer
8-11	Reserved (0)
12-15	Translate Odometer
16-19	Reserved (0)
20-23	Power-Up Time Stamp

Power-Up Time Stamp:

The number of seconds (00:00:00) since January 1, 1970 that the unit was powered on.

Soft Error Log Format

This table can be accessed via the Log Sense Command (4DH), Table 2-102 on page 2-123 with page code 38H. It keeps a record or error recovery activity. An entry is added to the Soft Error Log when a move fails or when any error recovery is required. Only the last 100 entries are saved.

Table 2-113 Soft Error Logs Format

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 soft error log entries (36 Bytes each, see Table 2-107 on page 2-135)

Drive Media Event Log Data Format
(for library code version >=1.20 or autoloader code >=2.10)

This table is accessed using the Log sense Command (4DH), Table 2-102 on page 2-123 with page code 3FH. It returns drive media information.

Table 2-114 Drive Media Log Entry Format

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Page Code (3EH)							
1	Reserved (0)							
2-3	Number of Bytes to Follow							
4	Current Entry							
5	Number of Entries							
6-405	Array of 100 drive media log entries (See Table 2-115 on page 2-149)							

Table 2-115 Drive Media Log Data Entry Format

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0-3	Time Stamp							
4	Board Type (Drives)							
5	Error Flag	Event ID						
6	Additional Length (21H)							
7-8	Drive number							
9-20	Drive serial number							
Event Unique: TapeAlert								
21-22	Slot number							
23-30	Media ID							

Table 2-115 Drive Media Log Data Entry Format

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
31	TapeAlert Major Revision				TapeAlert Minor Revision			
32	Flag 8	Flag 7	Flag 6	Flag 5	Flag 4	Flag 3	Flag 2	Flag 1
33	Flag 16	Flag 15	Flag 14	Flag 13	Flag12	Flag 11	Flag 10	Flag 9
34	Flag 24	Flag 23	Flag 22	Flag 21	Flag 20	Flag 19	Flag 18	Flag 17
35	Flag 32	Flag 31	Flag 30	Flag 29	Flag 28	Flag 27	Flag 26	Flag 25
36	Flag 40	Flag 39	Flag 38	Flag 37	Flag 36	Flag 35	Flag 34	Flag 33
37	Flag 48	Flag 47	Flag 46	Flag 45	Flag 44	Flag 43	Flag 42	Flag 41
38	Flag 56	Flag 55	Flag 54	Flag 53	Flag 52	Flag 51	Flag 50	Flag 49
39	Flag 64	Flag 63	Flag 62	Flag 61	Flag 60	Flag 59	Flag 58	Flag 57
Event Unique: SCSI ID								
21	Old SCSI ID							
22	New SCSI ID							
23-39	Reserved (0)							
Event Unique: Serial number, drive fan failed, drive cleaned, drive not on fibre, incorrected drive revision								
21-39	Reserved (0)							
Event Unique: Drive firmware update								
21-24	Old revision (ASCII)							
25-28	New revision (ASCII)							
29-39	Reserved (0)							

Table 2-115 Drive Media Log Data Entry Format

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
Event Unique: Online and offline, drive rejected tape load, not present, not on fibre, firmware error, critical error, needs cleaning								
21-22	Slot number							
23-32	Barcode label							
33-39	Reserved (0)							
Event Unique: Error information								
21-22	Slot number							
23-30	Barcode label							
31-38	Drive status							
39	Reserved							

Time Stamp

4-byte hex number of seconds since January 1, 1970.

Board Type

The type of controller. See Table 2-69 on page 2-88.

Error Flag

Indicates that the event is an error condition.

Event ID

The event number that triggered the log entry. See Table 3-7 on page 3-30.

Additional Length of Each Entry

The number of bytes after this byte that is left in this entry.

Drive Number

The number of the drive associated with the event entry.

Slot Number

The source slot of the current tape.

Media ID

This field contains a barcode label.

TapeAlert Revision

The TapeAlert revision level of the associated drive.

Flag Number

TapeAlert flags ordered as numbered.

Drive Status

For HP LTO: See ***The Specification for a Tape Drive Automation Controller Interface*** drive status Rdata (3 bytes) then get error information Rdata (5 bytes).

For DLT: See ***The DLT Interactive Library Specification*** from Quantum or Benchmark for drive general status for ATN.

Drive Media Log Data Format
(for library code version <1.20 or autoloader code <2.10)

This table is accessed using the Log sense Command (4DH), Table 2-102 on page 2-123 with page code 3FH. It returns drive media information.

Table 2-116 Drive Media Log Entry Format

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Page Code (3FH)							
1	Reserved (0)							
2-3	Number of Bytes to Follow							
4	Current Entry							
5	Number of Entries							
6-325	Array of 100 drive media log entries (See Table 2-117 on page 2-154)							

Table 2-117 Drive Media Log Data Entry Format

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0-1	Drive Number							
2-7	Media ID/Slot Number							
8	Error Flag	Event ID						
9	TapeAlert Major Revision				TapeAlert Minor Revision			
10	Flag 8	Flag 7	Flag 6	Flag 5	Flag 4	Flag 3	Flag 2	Flag 1
11	Flag 16	Flag 15	Flag 14	Flag 13	Flag12	Flag 11	Flag 10	Flag 9
12	Flag 24	Flag 23	Flag 22	Flag 21	Flag 20	Flag 19	Flag 18	Flag 17
13	Flag 32	Flag 31	Flag 30	Flag 29	Flag 28	Flag 27	Flag 26	Flag 25
14	Flag 40	Flag 39	Flag 38	Flag 37	Flag 36	Flag 35	Flag 34	Flag 33
15	Flag 48	Flag 47	Flag 46	Flag 45	Flag 44	Flag 43	Flag 42	Flag 41
16	Flag 56	Flag 55	Flag 54	Flag 53	Flag 52	Flag 51	Flag 50	Flag 49
17	Flag 64	Flag 63	Flag 62	Flag 61	Flag 60	Flag 59	Flag 58	Flag 57
18-27	Serial Number							
28-31	Time Stamp							

Drive Number

The number of the drive associated with the event entry.

Media ID/Slot Number

If first byte is not 0, then this field contains a barcode. Otherwise, this field contains the slot number.

Slot Number

The Element number of the source slot of the current tape.

Error Flag

Indicates that the event is an error condition.

Event ID

See Table 3-7 on page 3-30.

TapeAlert Revision

The TapeAlert revision level of the associated drive.

Flag Number

TapeAlert flags ordered as numbered.

Serial Number

The serial number of the associated drive.

Time Stamp

4-byte hex number of seconds since January 1, 1970.

Mode Select (10) Command (55H)

The MODE SELECT (10) 55H command allows the host to specify device parameters to the target.

Host should issues MODE SENSE (10) Command (5AH) prior to each MODE SELECT (55H) to determine supported pages, page lengths, and other parameters. Device servers that implement the MODE SELECT (10) Command (55H) will also implement the MODE SENSE (5AH) command.

NOTE See "Mode Sense (6) Command (1AH)" on page 2-29 for a description of the Mode Sense page codes. PS = 0 for Mode Select.

Table 2-118 Mode Select (10) Command (55H)

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Operation Code (55H)							
1	Reserved (0)			PF (0)	Reserved (0)			SP (1)
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	Control Byte (0)							

If a host sends a MODE SELECT (10) command that changes any parameters applying to other initiators, the device server will generate a unit attention condition for all initiators, except the one that issued the MODE SELECT (10) command. The host server will also set the additional sense condition to MODE PARAMETERS CHANGED.

Page Format (PF)

Zero indicates that all parameters after the block descriptors are vendor-specific. One indicates that the MODE SELECT (10) parameters that follow the header and block descriptor(s) are structured as pages of related parameters.

Save Pages (SP)

Zero indicates the device server shall perform the specified MODE SELECT (10) operation and not save any pages. One indicates that the device server shall perform the specified MODE SELECT (10) operation and save as non-volatile.

Parameter List Length

The parameter list length field specifies the length in bytes of the mode parameter list.

The device server will terminate the command with CHECK CONDITION status if the parameter list length truncates the mode parameter header, mode parameter block descriptors, or mode page.

Table 2-119 Mode Sense (10) Parameter Header

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

Block Descriptor Length

This byte is not valid for libraries.

Reserve(10) Command (56H)

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

Table 2-120 Reserve Command CDB

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Operation Code (56H)							
1	Reserved (0)			3rdPty	Reserved (0)		LongID (0)	Element
2	Reservation Identification							
3	Third Party Device ID							
4-6	Reserved (0)							
7	Element List Length (MSByte)							
8	Element List Length (LSByte)							
9	Control Byte (0)							

3rdPty

When set to 1, the library is reserved for the SCSI device specified in the Third Party Device ID field.

Long ID

When set to 0, the library does not support the Long ID extension.

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.

Third Party Device ID

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

Element List Length

Defines the size in bytes 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 2-121 Reserve Command Element List Descriptors

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

Element Address

Refer to Table 2-26 on page 2-37 for valid element numbers.

Release (10) Command (57H)

Releases the library or element for use by another initiator.

Table 2-122 Release Command CDB

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Operation Code (57H)							
1	Reserved (0)			3rdPty	Reserved (0)		Long ID (0)	Element
2	Reservation Identification							
3	Third Party Device ID							
4-6	Reserved (0)							
7	Element List Length (MSByte)							
8	Element List Length (LSByte)							
9	Control Byte (0)							

3rdPty

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

Long ID

When set to 0, the Long ID extension is not supported.

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.

Third Party Device ID

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

Element List Length

Defines the size in bytes of the element list. Set this to 0 since Long ID is not used.

Mode Sense (10) Command (5AH)

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

- Library configuration
- Drive configuration
- Fibre channel configuration
- Remote management card configuration
- Clock settings
- 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 tape drive element address and number of drives
- Characteristics of the various element types

NOTE

See “Mode Sense (6) Command (1AH)” on page 2-29 for a description of the mode sense and mode select page codes. PS = 0 Mode Select.

Table 2-123 Mode Sense (10) Command (5AH)

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

Table 2-124 Mode Sense (10) Parameter Header

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Mode Data Length (MSByte)							
1	Mode Data Length (LSByte)							
2-5	Reserved (0)							
6	Block Descriptor Length (MSByte) (0)							
7	Block Descriptor Length (LSByte) (0)							

Mode Data Length

The length in bytes of the Mode Page(s) specified in the Page Code field in CDB + 6.

Block Descriptor Length

Not supported for libraries.

Report LUNS Command (A0H)

The REPORT LUNS command requests that the peripheral device logical unit numbers of known logical units in the target be sent to the application client. The REPORT LUNS command shall return information about only those logical units to which commands may be sent.

Table 2-125 Report LUNS Command

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Operation Code (A0H)							
1-4	Reserved (0)							
5	Reserved (0)							
6	Allocation Length (MSByte)							
7-8	Allocation Length							
9	Allocation Length (LSByte)							
10	Reserved (0)							
11	Control Byte (0)							

The REPORT LUNS command shall not be affected by reservations or persistent reservations.

Allocation Length

The Allocation length shall be at least 16 bytes.

The device server shall report the logical unit number of configured logical units using the format below.

Table 2-126 LUN Reporting Parameter List Format

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	LUN List Length (MSByte)							
1-2	LUN List Length							
3	LUN List Length (8) (LSByte)							
4-7	Reserved (0)							
LUN List:								
8	LUN (MSByte) (0)							
9-14	LUN (0)							
15	LUN (LSByte) (0)							

The LUN List Length shall contain the length in bytes of the LUN list that is available to be transferred. The LUN list length is the number of logical unit numbers reported multiplied by eight. If the allocation length in the command descriptor block is too small to transfer information about all configured logical units, the LUN list length value shall not be adjusted to reflect the truncation.

Move Medium Command (A5H)

Moves tape cartridges between library elements.

Table 2-127 Move Medium Command CDB

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Operation Code (A5H)							
1	Reserved (0)							
2	Transport Element Address (MSByte)							
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)							
11	Control Byte (0)							

Transport Element Address

The default address is 0.

Source/Destination Element Address

See Table 2-26 on page 2-37 for more information about addressing.

Exchange Medium Command (A6H)

Exchanges the tape cartridge at the destination element address with the tape cartridge at the source element address.

Table 2-128 Exchange Medium Command CDB

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Operation Code (A6H)							
1	Reserved (0)							
2	Transport Element Address (MSByte)							
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 (MSByte)							
10	Reserved (0)							
11	Control Byte (0)							

NOTE The tape cartridge in the first destination element is moved to the second destination element and the tape cartridge in the source element is moved to the first destination element. The first destination element cannot be the same as the source element.

Transport Element Address

The default address is 0.

Source/Destination Element Address

See Table 2-26 on page 2-37 for more information about addressing.

Read Element Status Command (B8H)

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

Table 2-129 Read Element Status Command CDB

Byte	7	6	5	4	3	2	1	0
0	Operation Code (B8H)							
1	Reserved (0)			Voltag	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)						Cur Data	Dvc ID
7	Allocation Length (MSByte)							
8	Allocation Length							
9	Allocation Length (LSByte)							
10	Reserved (0)							
11	Control Byte (0)							

Voltag

A Volume Tag bit of 1 indicates the target will report volume tag information. A Volume Tag bit of 0 indicates no volume tag information will be reported.

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)

NOTE Some library models do not support mailslots.

Starting Element Address

Specifies the minimum element address to report.

Number of Elements

Maximum number of elements to report.

CurData (Current Data)

0: May cause motion to confirm element status data.

1: Returns element status without causing motion.

Dvc ID (Device Identification Descriptors)

0: No device identification descriptors.

1: Target shall return device identification descriptors.

Allocation Length

The number of bytes of element status to return. Consists of an 8-byte Element Status Page Header, followed by one or more Element Status pages (contains 8-byte header and n-8 bytes of descriptor block).

Read Element Status Data

Read Element Status Data consists of a data header, followed by one or more Element Status pages.

Table 2-130 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							
7	Byte Count of Report Available (LSByte)							

First Element Address Reported

See Table 2-26 on page 2-37 for more information about addressing.

Number of Elements Reported

Indicates the total number of elements reported, which can be different element types.

Byte Count of Report Available

The number of bytes of elements status page data available for all elements meeting the request in the CDB.

Element Type Code 1H: Picker

Table 2-131 Medium Transport Element Status Page

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							
7	Byte Count of Descriptor Data Available (LSByte)							
Descriptors:								
8	Element Address (MSByte)							
9	Element Address (LSByte)							
10	Reserved (0)					Except	Rsvd (0)	Full
11	Reserved (0)							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							

Element Descriptor Length

The number of bytes in each Element Descriptor Block.

Byte Count of Descriptor Data Available

Element Descriptor Length for X Number of Elements of the type shown in byte 0.

Element Address

The address of the element being reported by this descriptor block.

Except

When set to 1, the element is in an abnormal state. Information about the abnormal state is available in the Additional Sense code and Additional Sense Code Qualifier bytes.

Full

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

Additional Sense Code and Additional Sense Code Qualifier

See Table 3-2 on page 3-4.

Element Type Code 2H: Storage Slot

Table 2-132 Storage Element Status Page

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Element Type Code (2H)							
1	P Voltag	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							
7	Byte Count Of Descriptor Data Available (LSByte)							
Descriptors:								
8	Element Address (MSByte)							
9	Element Address (LSByte)							
10	Reserved (0)				Access	Except	Rsvd (0)	Full
11	Reserved (0)							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14-16	Reserved (0)							
17	SValid	Invrt (0)	Reserved (0)					
18	Source Element Address (MSByte)							
19	Source Element Address (LSByte)							

Table 2-132 Storage Element Status Page

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
Primary Volume Tag Information:								
20-51	Primary Volume Identification							
52-53	Reserved (0)							
54-55	Volume Sequence Number (0)							
Descriptors Continued (fields move up if Primary Voltag = 0):								
56	Reserved (0)				Code Set (0)			
57	Reserved (0)				Identifier Type (0)			
58	Reserved (0)							
59	Identifier Length (0)							
Descriptors Continued (fields move up if DVD ID) = 0):								
60	Media Domain							
61	Media Type							
62-63	Reserved (0)							

PVoltag

A Primary Volume Tag bit of 0 indicates the Primary Volume Tag information field is omitted, only bytes 0 through 19 and 56 through the end are present.

A Primary Volume Tag bit of 1 indicates the Primary Volume Tag information field is present, bytes 0 through 19 are present in addition to bytes 20 through the end.

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 (Table 3-2 on page 3-4)

Full

When set to 1, the element contains a cartridge.

Additional Sense Code and Additional Sense Code Qualifier

See Table 3-2 on page 3-4.

SValid

When set to 1, the source storage element address field and the invert bit information are valid.

Source Element Address

Always equals the current Element Address.

Primary Volume Identification

Returns a 6-byte or 8-byte ASCII barcode. (The rest of the bytes are blank.)

Media Domain

The Media Domain field indicates the type of media in the element.

01h = Contains a DLT form factor cartridge
4Ch = Contains a LTO form factor cartridge
FFh = The media domain cannot be determined

Media Type

The Media Type field indicates the type of media in the element and is filled in with the 7th character from 7 barcode labels for DLT and 8 characters for LTO.

If Domain = 01h
42h, "B" = Benchmark Type IV cartridge
43h, "C" = Cleaning
44h, "D" = Type IV cartridge
45h, "E" = Type III cartridge
FFh = The media type cannot be determined

If Domain = 4Ch
43h, "C" = Cleaning
31h, "1" = LTO Tape Density 1
FFh = The media type cannot be determined

Element Type Code 3H: Import/Export (Mailslot)

Table 2-133 Import/Export Element Status Page

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Element Type Code (3H)							
1	P Voltag	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							
7	Byte Count of Descriptor Data Available (LSByte)							
Descriptors:								
8	Element Address (MSByte)							
9	Element Address (LSByte)							
10	Reserved (0)		In Enab	Ex Enab	Access	Except	Imp/ Exp	Full
11	Reserved (0)							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14-16	Reserved (0)							
17	SValid	Invrt (0)	Reserved (0)					
18	Source Element Address (MSByte)							
19	Source Element Address (LSByte)							

Table 2-133 Import/Export Element Status Page

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
Primary Volume Tag Information:								
20-51	Primary Volume Identification							
52-53	Reserved (0)							
54-55	Volume Sequence Number (0)							
Descriptors Continued (fields move up if Primary Voltag = 0):								
56	Reserved (0)				Code Set (0)			
57	Reserved (0)				Identifier Type (0)			
58	Reserved (0)							
59	Identifier Length (0)							
Descriptors Continued (fields move up if DVD ID = 0):								
60	Media Domain							
61	Media Type							
62-63	Reserved (0)							

PVoltag

A Primary Volume Tag bit of 0 indicates the Primary Volume Tag information field is omitted, only bytes 0 through 19 are present.

A Primary Volume Tag bit of 1 indicates the Primary Volume Tag information field is present, bytes 0 through 19 are present in addition to bytes 20 through 55.

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 element 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 library is enabled.

ExEnab

When set to 1, export from the library is enabled.

Access

When set to 1, access to the element by the Medium Transport Element is allowed.

Except

When set to 1, the element is in an abnormal state. Information about the abnormal state is available in the Additional Sense Code and Additional Sense Code Qualifier.

Imp/Exp

When set to 1, the operator inserts the tape cartridge into the mailslot.

When set to 0, the library mechanism places the tape cartridge in the mailslot.

Full

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

Additional Sense Code and Additional Sense Code Qualifier

See Table 3-2 on page 3-4.

SValid

When set to 1, the source storage element address field and the invert bit information are valid.

Source Storage Element Address

Indicates what storage slot the media in the drive came from.

Primary Volume Identification

Returns a 6-byte or 8-byte ASCII barcode. (The rest of the bytes are blank.)

Media Domain

The Media Domain field indicates the type of media in the element.

01h = Contains a DLT form factor cartridge
4Ch = Contains a LTO form factor cartridge
FFh = The media domain cannot be determined

Media Type

The Media Type field indicates the type of media in the element and is filled in with the 7th character from 7 barcode labels for DLT and 8 characters for LTO.

If Domain = 01h
42h, "B" = Benchmark Type IV cartridge
43h, "C" = Cleaning
44h, "D" = Type IV cartridge
45h, "E" = Type III cartridge
FFh = The media type cannot be determined

If Domain = 4Ch
43h, "C" = Cleaning
31h, "1" = LTO Tape Density 1
FFh = The media type cannot be determined

Element Type Code 4H: Drive

Table 2-134 Read Element Status Data Transfer Element Status Page

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Element Type Code (4H)							
1	P Voltag	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							
7	Byte Count of Descriptor Data Available (LSByte)							
Descriptors:								
8	Element Address (MSByte)							
9	Element Address (LSByte)							
10	Reserved (0)				Access	Except	Rsvd (0)	Full
11	Reserved (0)							
12	Additional Sense Code (See Table 3-2 on page 3-4)							
13	Additional Sense Code Qualifier (See Table 3-2 on page 3-4)							
14	Not Bus	Rsvd (0)	IDValid	LU Valid	RSVD (0)	Logical Unit Number		
15	SCSI Bus Address							
16	Reserved (0)							

Table 2-134 Read Element Status Data Transfer Element Status Page

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
17	SValid	Invrt (0)	Reserved (0)					
18	Source Storage Element Address (MSByte)							
19	Source Storage Element Address (LSByte)							
Primary Volume Tag Information:								
20-51	Primary Volume Identification							
52-53	Reserved (0)							
54-55	Volume Sequence Number (0)							
Descriptors Continued (fields move up if Primary Voltag = 0):								
56	Reserved (0)				Code Set (2)			
57	Reserved (0)				Identifier Type (1)			
58	Reserved (0)							
59	Identifier Length							
Device Identification Descriptors:								
60-67	Vendor Identification (Table 2-135 on page 2-187)							
68-83	Product Identification (Table 2-136 on page 2-188)							
84-95	Product Serial Number (ASCII)							
Descriptors Continued (fields move up if DVD ID = 0):								
96	Media Domain							
97	Media Type							
98-99	Reserved (0)							

PVoltag

A primary Volume Tag bit of 0 indicates the Primary Volume Tag information field is omitted. Bytes 0 - 19 and 56 - end are present.

A Primary Volume Tag bit of 1 indicates the Primary Volume Tag information field is present. Bytes 0 - end are present.

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 (Table 3-2 on page 3-4)

Full

When set to 1, the element contains a cartridge.

Additional Sense Code and Additional Sense Code Qualifier

See Table 3-2 on page 3-4.

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 library at this element.

SCSI Bus Address

SCSI Bus Address of the drive.

SValid

When set to 1, the source storage element address field and the invert bit information are valid.

Source Storage Element Address

Indicates what storage slot the media in the drive came from.

Primary Volume Identification

Returns a 6-byte or 8-byte ASCII barcode. (The rest of the bytes are blank.)

Vendor Identification Bytes

Table 2-135 Vendor Identification Bytes[a]

Vendor	*Description of Bytes*
HP	All unused bytes are filled with blank spaces (ASCII)
Quantum	All unused bytes are filled with blank spaces (ASCII)
QUANTUM	All unused bytes are filled with blank spaces (ASCII)
BNCHMARK	All unused bytes are filled with blank spaces (ASCII)

a. 8 ASCII characters

Product Identification Bytes

Table 2-136 *Product Identification Bytes*[a]

Drive Type	*Description of Bytes*
DLT 7000	All unused bytes are filled with blank spaces (ASCII)
DLT 8000	All unused bytes are filled with blank spaces (ASCII)
DLT1	All unused bytes are filled with blank spaces (ASCII)
Ultrium - SCSI Ultrium - Fibre	All unused bytes are filled with blank spaces (ASCII)

a. 16 ASCII characters

Product Serial Number

This field is used for reporting the unique serial number of the drive. The field is 12 bytes long and each byte is an ASCII character. This number is the same unique number that is returned from the drive over SCSI when an Inquiry Command (Page 80H) is issued. The number is retrieved directly from the drive so the number that the drive reports matches the number that the library reports. If the drive serial number is less than 12 bytes, the rest of the bytes will be zero filled.

Media Domain

The Media Domain field indicates the type of media in the element.

01h = Contains a DLT form factor cartridge
4Ch = Contains a LTO form factor cartridge
FFh = The media domain cannot be determined

Media Type

The Media Type field indicates the type of media in the element and is filled in with the 7th character from 7 barcode labels for DLT and 8 characters for LTO.

If Domain = 01h
42h, "B" = Benchmark Type IV cartridge
43h, "C" = Cleaning
44h, "D" = Type IV cartridge
45h, "E" = Type III cartridge
FFh = The media type cannot be determined

If Domain = 4Ch
43h, "C" = Cleaning
31h, "1" = LTO Tape Density 1, 100GB
FFh = The media type cannot be determined

3 Library Error Codes

Library Error Codes

This chapter contains the following library error code tables:

- Request Sense Keys
- Request Sense Additional Sense Codes and Qualifiers
- Additional Sense Data Format
- 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), Receive Diagnostic Results Command (1CH), or through the control panel.

See Table A-1 on page A-2 for a list of field replaceable units for each of the library models.

Request Sense Keys

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

Sense Key	*Name*	*Abrev.*	*Description*
00H	No Sense	NS	The command completed successfully.
01H	Recovered Error	RE	The last command was completed successfully with some recovery action performed by the library/controller.
02H	Not Ready	NR	The library cannot be accessed.
03H	Medium Error	ME	The command terminated with an unrecovered error condition that was caused by a tape defect.
04H	Hardware Error	HE	The library/controller detected a hardware error.
05H	Illegal Request	IR	There was an illegal parameter in the command descriptor block or in the additional parameters supplied for some commands.
06H	Unit Attention	UA	The tape has been loaded, the unit has been reset, or the Mode Select parameters have been changed.
0BH	Aborted Command	AC	This sense key shall be reported if a target or LUN receives a second command from the same initiator before the previous command from that initiator has completed.

Request Sense Additional Sense Code and Qualifier

Table 3-2 Request Sense Additional Sense Code and Qualifier

Sense Code and Qualifier	*Sense Keys*	*Description*
00 00H	00H-NS	No additional sense information
00 00H	01H-RE	Error recovered invoked and completed
00 06H	0BH-AC	I/O process terminated
00 16H	05H-IR	Operation in progress
00 17H	05H-IR	Cleaning requested
02 00H	04H-HE	No seek complete
04 00H	02H-NR	Not ready cause not reportable
04 01H	02H-NR	Library becoming ready
04 02H	02H-NR	Unit must first initiate element status
04 03H	02H-NR	Fatal error - unit must be corrected manually
04 07H	05H-IR	Operation in progress
04 88H	02H-NR	Download needed
04 89H	04H-HE	Download checksum error
05 00H	02H-NR	LUN did not respond to selection
06 00H	04H-HE	No reference position found
0A 00H	06H-UA	Log overflow
0B 00H[a]	06H-UA	Warning
0B 01H[a]	06H-UA	Warning temperature exceeded
15 00H	04H-HE	Restored move error

Table 3-2 Request Sense Additional Sense Code and Qualifier

Sense Code and Qualifier	*Sense Keys*	*Description*
15 01H	04H-HE	Hard move error
1A 00H	05H-IR	Invalid parameter list length
20 00H	05H-IR	Invalid CDB
21 01H	05H-IR	Invalid element address
22 00H	05H-IR	Illegal function
22 80H[a]	05H-IR	Drive is not online
22 81H[a]	01H-RE	DRV to LIB interface communication error
22 82H[a]	02H-NR	Drive is not present
24 00H	05H-IR	Illegal field in CDB
25 00H	05H-IR	Invalid LUN
26 00H	05H-IR	Invalid parameter list
26 01H	05H-IR	Parameter not supported
26 02H	05H-IR	Parameter value invalid
26 04H	05H-IR	Invalid release of active persistent reservation
28 00H	06H-UA	Changed from not ready to ready, medium may have changed; door has just closed
28 01H	06H-UA	Import or export element accessed; mailslot closed
29 00H	06H-UA	Power on or bus reset occurred
29 01H	06H-UA	Power on occurred
29 02H	06H-UA	SCSI bus reset occurred
29 04H	06H-UA	Device internal reset
2A 01H	06H-UA	Mode parameters have changed

Table 3-2 Request Sense Additional Sense Code and Qualifier

Sense Code and Qualifier	*Sense Keys*	*Description*
2A 02H	06H-UA	Log parameters changed
2A 03H	06H-UA	Reservations preempted
2A 80H	06H-UA	Online repair parameters changed
2F 00H	0BH-AC	Command cleared by initiator
30 00H	05H-IR	Incompatible medium
30 07H[a]	06H-HE	Cleaning failures
3A 00H[a]	02H-NR	Medium not present
3A 01H[a]	02H-NR	Medium not present, door closed
3A 02H[a]	02H-NR	Access door is open, medium not present
3A 80H[a]	02H-NR	I/O door is open, medium not present
3B 0DH	05H-IR	Element full
3B 0EH	05H-IR	Source empty
3B 11H[a]	05H-IR	Medium magazine not accessible
3B 12H[a]	05H-IR	Medium magazine removed
3B 13H[a]	05H-IR	Medium magazine inserted
3B 14H[a]	05H-IR	Medium magazine locked
3B 15H[a]	05H-IR	Medium magazine unlocked
3D 00H	05H-IR	Invalid bit in identify message
3E 00H	02H-NR	Logical unit has not self-configured yet
3F 00H[a]	06H-UA	Operating conditions have changed
3F 01H	06H-UA	Microcode has been changed

Table 3-2 Request Sense Additional Sense Code and Qualifier

Sense Code and Qualifier	*Sense Keys*	*Description*
3F 02H	06H-UA	Changed operating definition
3F 03H	06H-UA	Inquiry data has changed
40 80H	04H-HE	Diagnostic failure
42 00H	04H-HE	Power-on selftest failure
43 00H	0BH-AC	Message error
44 00H	04H-HE	Internal target error
45 00H	0BH-AC	Reselection timeout error
46 00H	0BH-AC	Unsuccessful soft reset
47 00H	0BH-AC	SCSI Parity error
48 00H	0BH-AC	Initiator detected error
49 00H	0BH-AC	Invalid message error
4A 00H	0BH-AC	Command phase error
4B 00H	0BH-AC	Bus protocol error, data phase error
4C 00H	04H-HE	Logical unit failed self-configuration
4E 00H	0BH-AC	Bus protocol error (second command sent early) overlapped commands attempted
53 00H	05H-IR	Media load or eject failed
53 02H[a]	05H-IR	Medium removal prevented
55 00H	02H-NR	System Resources Full
5A 00H	06H-UA	Operator request or state change input
5A 01H	06H-UA	Operator medium removal request
5B 00H	06H-UA	Log exception
5B 01H	06H-UA	Threshold conditions met

Table 3-2 Request Sense Additional Sense Code and Qualifier

Sense Code and Qualifier	*Sense Keys*	*Description*
5B 02H	06H-UA	Log counter at maximum
5B 03H	06H-UA	Log list codes exhausted
5D 00H	06H-UA	Failure prediction threshold exceeded
5D FFH	06H-UA	Failure prediction threshold exceeded (false)
65 00H	04H-HE	Voltage fault
80 07H	04H-HE	Download to the transport failed
80 08H	04H-HE	Download to the fibre card failed
80 09H	04H-HE	Download to Remote Management card failed
80 0AH	04H-HE	Need new library controller boot
80 0BH	04H-HE	Need new transport boot
80 0CH	04H-HE	Trying to put in wrong transport code
80 0DH	05H-IR	Download error, no drives found
89 OEH	04H-HE	Download to drives failed

a. These can be returned in Read Element Additional Sense Code and Read Element Additional Sense Code Qualifier.

Additional Sense Data Format for Error Recovery

Below is a description of the 60 Additional Sense Bytes returned during the Data In Phase of the Request Sense Command (03H), (Table 2-5 on page 2-8) from the library. The byte description follows the overall layout of the data.

Table 3-3 Request Sense - Additional Sense Data

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
18	FRU Locator							
19	Error Code							
20	First FRU							
21	Second FRU							
22	Third FRU							
23	Move Command Attempted							
24-25	Source Element Number							
26-27	Destination Element Number							
28-29	Second Destination Element Number							
30-35	Move Sequence IDs							
36	Error Code Qualifier							
37	Reserved (0)							
38-39	Vertical Motor Commanded Position							
40-41	Vertical Motor Actual Position							
42-43	Plunge Motor Commanded Position							
44-45	Plunge Motor Actual Position							
46-47	Translate Motor Commanded Position							

Table 3-3 Request Sense - Additional Sense Data

Byte	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
48-49	Translate Motor Actual Position							
50-53	Time Stamp							
54	Move Cap	Last SCSI	Reserved (0)		Cart in Tran	Reserved (0)		
55	Valid	Rsvd (0)	Cart Tran	Cart Elem	Reserved (0)			
56	Valid	Rsvd (0)	Cart Tran	Cart Elem	Reserved (0)			
57	Valid	Rsvd (0)	Cart Tran	Cart Elem	Reserved (0)			
58-77	Reserved (0)							

FRU Locator

Returns either the drive number or level number, then the slot number (4 bits each). This helps isolate the error.

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 3-4 on page 3-16.

FRU 1

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

NOTE The FRUs 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 listed FRU may or may not fix the associated problem.

FRU 2

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

FRU 3

The third most likely FRU to be at fault. (See Table A-1 on page A-2.)

Move Command Attempted

0 - Exchange

1 - Move

2 - Seek

3 - Initialize Element

4 - Rezero

5 - Diag

6 - Restore

7 - Emulate stacker

8 - 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 Element Number

The Element Number to which the Second Destination refers.

Move Sequence ID

The last six library move sequences for the original movement command prior to the failure. Byte 12 is the least recent move, and Byte 16 is the most recent move (See Table C-1 on page C-2).

Error Code Qualifier

The qualifier associated with the failed error code. (See Table 3-5 on page 3-22.)

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.

Time Stamp

4-byte hex number of seconds since January 1, 1970.

Mechanism State Bit Map (Byte 54)

The state of the library 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 library is capable of performing movement commands.

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

5-4 Reserved

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

2-0 Reserved

Source Element Bit Map (Byte 55)

The 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

Destination1 Element Bit Map (Byte 56)

Indicates the status of the element that was the Destination Element of a move or 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

Destination2 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

Error Codes

Errors are reported through the Request Sense Command (03H), (Byte 19, Table 3-3 on page 3-9) the Log Sense Command (4DH), (Byte 1, Table 2-107 on page 2-133), and the Receive Diagnostic Results Command (1CH), (Byte 3, Table 2-47 on page 2-65).

If an error is unrecoverable (i.e., something is broken or jammed beyond recovery without manual intervention), the library will take an additional step of attempting to identify the FRU that is causing the failure.

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 3-4 *Error Codes*

Decimal Error	*Hex Error*	*Description*
0	00H	Error code not set.
1-8	01H - 08H	Failed library controller self test.
9	09H	Failed translate motor test.
10	0AH	Failed vertical motor test.
11	0BH	Failed plunge motor test.
12	0CH	Transport failed to find the translate home position.
13	0DH	Transport failed to find the vertical home position.
14	0EH	Transport failed to find the plunge home position.
15	0FH	Has wrong library family firmware or the controller is on the wrong level.

Table 3-4 *Error Codes*

Decimal Error	*Hex Error*	*Description*
18	12H	Failed because magazine door(s) were open.
19	13H	Vertical motor cable is missing or faulty.
20	14H	Transport umbilical cable is missing or faulty.
21	15H	A chassis fan is disconnected of faulty.
22	16H	Chassis interconnect cables are disconnected or faulty.
23	17H	Front panel cable is disconnected or faulty.
24	18H	Transport barcode reader failed self test.
25	19H	Library levels measured does not match the number of levels detected.
26	1AH	Failed upper level fan cable.
27	1BH	Transport controller unable to communicate with transport.
28	1CH	Transport controller needs new firmware.
29	1DH	Failed transport firmware download.
50	32H	Test not run, an invalid test number was specified.
51	33H	Tapes not run, tapes not in required locations.
52	34H	Test not run, an inventory check is needed.
53	35H	Failed test, refer to previous error.
54	36H	Test not run, some elements are reserved.
56	38H	Cannot run test with tapes in current locations.

Table 3-4 *Error Codes*

Decimal Error	*Hex Error*	*Description*
57	39H	Test not run, not enough tapes in the library.
58	3AH	Test not started, transport contains a tape.
59	3BH	Failed to put tape into magazine slot.
60	3CH	Failed to get tape from magazine slot.
61	3DH	Failed inventory check on a magazine slot.
62	3EH	Failed to load a tape into a drive.
63	3FH	Failed to unload a tape from a drive.
64	40H	Transport unable to inventory drive.
65	41H	Failed while checking for a cartridge in the transport.
66	42H	Transport stuck at home position.
67	43H	Transport stuck at vertical home position.
68	44H	Failed to move after finding the plunge home position.
69	45H	Transport unable to move to the end of the track.
70	46H	Failed inventory check, transport contains a tape.
71	47H	Timeout moving transport to the top of the library.
72	48H	Unable to put tape back into slot after power cycle.
74	4AH	Drive module disconnected or has failed.
75	4BH	Drive(s) fan disconnected or faulty.
76	4CH	Failed to perform an inventory check.

Table 3-4 *Error Codes*

Decimal Error	*Hex Error*	*Description*
77	4DH	Transport moved above highest detected level.
78	4EH	Not all drives in the library are the same type.
80	50H	Drive reports hardware error.
81	51H	Library failed during initialization.
82	52H	Library connected to wrong type of SCSI bus.
89	59H	Cleaning cartridge has expired.
90	5AH	Not a cleaning cartridge.
100	64H	Library controller unable to communicate with drive module.
101	65H	Drive module unable to communicate with drive.
102	66H	Drive command timeout on drive module controller.
103	67H	A drive module controller has failed.
104	68H	Failed drive module initialization.
105	69H	Drive module serial timeout to drive.
110	6EH	Library controller unable to communicate with slave card.
111	6FH	Slave controller card missing or faulty.
112	70H	Slave board command timeout.
113	71H	Slave controller card failed self test.
114	72H	Slave controller card failed initialization.
118	76H	Slave controller is on level 1.

Table 3-4 *Error Codes*

Decimal Error	*Hex Error*	*Description*
120	78H	Library controller unable to communicate with fibre channel card.
121	79H	Fibre channel card missing or faulty.
122	7AH	Fibre channel board command timeout.
123	7BH	A fibre channel card has failed.
126	7EH	More than one fibre channel card on a library level.
130	82H	Library controller unable to communicate with remote management card.
131	83H	Remote management card is missing or faulty.
132	84H	Remote management card timeout.
133	85H	A remote management card has failed.
134	86H	Remote management card is not on library level 1.
135	87H	More than one remote management card has been detected.
136	88H	Library expander card is missing or faulty.
137	89H	Failed because the library expansion card is present, but on the wrong library level.
138	8AH	More than one library expansion card has been detected.
140	8CH	Front panel Send command did not complete.
141	8DH	Front panel board missing.
142	8EH	Front panel board timeout.
143	8FH	Front panel board failed.

Table 3-4 *Error Codes*

Decimal Error	*Hex Error*	*Description*
150-155	96H - 9BH	Failed transport controller self test.
157	9DH	Transport plunge motor cable is missing or faulty.
158	9EH	Transport translate motor cable is missing or faulty.
159	9FH	Transport barcode reader cable is missing or faulty.
160	A0H	Transport illuminator cable is missing or faulty.
161	A1H	Two transport cables are missing or faulty.
162	A2H	Three transport cables are missing or faulty.
163	A3H	Four transport cables are missing or faulty.

Error Code Qualifier

Error Code Qualifier are reported through bytes 36 or 18 in the additional sense bytes (Table 3-3 on page 3-9) of the Request Sense Command (03H) and the "Log Sense Command (4DH)" with page code 30H, 33H, or 38H. (See “Log Sense Command (4DH)” on page 2-123.)

Table 3-5 *Error Code Qualifiers*

Decimal Error	*Hex Error*	*Description*
0	00H	Qualifier code not set.
1	01H	Vertical control system detected an over voltage.
2	02H	Vertical control system detected an over force.
3	03H	Vertical control system detected an error.
4	04H	Vertical control system timed out.
7	07H	Vertical control system detected an unknown error.
10	0AH	Plunge control system detected an over voltage.
11	0BH	Plunge control system detected an over force.
12	0CH	Plunge control system detected an error.
13	0DH	Plunge control system timed out.
16	10H	Plunge control system detected an unknown error.
19	13H	Translate control system detected an unknown error.
20	14H	Translate control system detected an over voltage.

Table 3-5 *Error Code Qualifiers*

Decimal Error	*Hex Error*	*Description*
21	15H	Translate control system detected an over force.
22	16H	Translate control system detected an error.
24	18H	Vertical control system failed to detect a hardstop.
25	19H	Plunge control system failed to detect a hardstop.
26	1AH	Translate control system failed to detect a hardstop.
27	1BH	Vertical control system not initialized.
28	1CH	Plunge control system not initialized.
29	1DH	Translate control system not initialized.
33	21H	Failed to detect a cartridge in the drive.
36	24H	Drive module failed to eject a tape.
37	25H	Plunge system went too far while inserting a tape.
38	26H	Plunge system went too far while unloading a tape.
42	2AH	Drive module is missing or not communicating.
43	2BH	The drive combination in the library is unsupported.
44	2CH	Failed to detect a magazine calibration target.
46	2EH	Barcode reader is not working.
47	2FH	Drive module fan is not working properly.

Table 3-5 *Error Code Qualifiers*

Decimal Error	*Hex Error*	*Description*
48	30H	Failed to detect that the transport has gotten a tape.
50	32H	Did not stop where expected when storing a tape.
54	36H	Did not stop where expected while getting a tape.
56	38H	Failed to empty the transport during an inventory check.
57	39H	Requested a move above the maximum vertical height.
58	3AH	Detected that the transport translate frame is crooked.
60	3CH	Internal bus command did not complete successfully.
83	53H	A diagnostic test failed to complete.
86	56H	A command sent to the transport timed out.
87	57H	A command to the transport was corrupted.
88	58H	Attempted to overlap commands to the transport controller.
89	59H	The transport lost power.
90	5AH	Vertical system failed wakeup from powersave mode.
91	5BH	Status report from transport was corrupted.
92	5CH	Transport timed out while executing a command.
93	5DH	General transport communication error.

Table 3-5 *Error Code Qualifiers*

Decimal Error	*Hex Error*	*Description*
94	5EH	Failed to establish communication with transport.
95	5FH	Transport needs firmware downloaded.
96	60H	Information received from transport was corrupted.
97	61H	A drive reported a hardware error during powerup.
98	62H	Drives did not recover during power-fail recovery.
99	63H	Transport is in an unknown state.
100	64H	Unable to move expected translate distance.
101	65H	Drive rejected the load of a tape.
102	66H	Command sent to drive timed out.
103	67H	Drive controller module hardware failed.
104	68H	Drive controller module is busy.
105	69H	Drive communications error.
106	6AH	Command sent to drive failed.
107	6BH	Drive command is in progress.
108	6CH	Command sent to drive controller module timed out.
109	6DH	Drive controller module is single sourced.
110	6EH	Status of the drive controller module is unknown.
111	6FH	Drive controller module is missing from I2C bus.

Table 3-5 Error Code Qualifiers

Decimal Error	Hex Error	Description
112	70H	Drive controller module reported bad status.
113	71H	Drive sensor does not report handle open.
114	72H	Drive handle open sensor set when handle closed.
115	73H	Drive sensor does not report handle closed.
116	74H	Drive handle close sensor set when handle closed.
117	75H	Drive not ready for command.
118	76H	Drive detected faulty media.
119	77H	Multiple IR checksum errors in transport communication.
120	78H	*DLT only*. Drive may have broken tape or dropped leader.
121	79H	*DLT only*. Drive failed to respond to unload request.
123	7BH	Drive module status good. No error.
124	7CH	Failed to open or close drive handle.

Diagnostic Tests

The following tables describe the tape library diagnostic tests.

CAUTION Some diagnostic tests can result in a tape cartridge being placed into an improper storage slot. If this happens, the tape library file system is no longer accurate.

Table 3-6 Diagnostic Tests

Test	*Test Number*	*Description*
Check Inventory	10	Physically scans the entire library to determine which slots contain tapes and if the drives contain tapes.
Recalibrate Library	5	Performs the power-up self-tests. Each test runs one time per test loop. This test recalibrates the mechanics and clears any hard error.
Test Vertical Motion	12	Moves the vertical assembly to the bottom of the library, then to the top, while the transport moves around its lateral range. Upon completion of these moves, the transport assembly then stops. *NOTE:* This test is functional in all library models, but only moves upward in multi-level libraries.
Test Lateral Motion	13	Moves the transport assembly to a random slot. No tape is required.
Test Magazine Swaps	15	Moves a tape from a random slot to an empty, random slot, and then returns it to the original location.
Wellness Test	16	Moves a tape from a random slot to an empty drive, repeats the process until all drives are full, and then returns all tapes to their original slots.

Table 3-6 Diagnostic Tests

Test	*Test Number*	*Description*
Rewind Media	60	***CAUTION: Do not run this test if the drive contains a tape that is receiving data from the host.*** Rewinds the tape in the drive.
Lock Transport	194	Locks transport assembly in place to allow for moving the library. *NOTE:* Transport assembly automatically unlocks when library is powered on.
Unlock Transport	195	Unlocks transport assembly in place to allow for moving the library. *NOTE:* Transport assembly automatically unlocks when library is powered on.
Empty Drives	18	***CAUTION: Do not run this test if the drive contains a tape that is receiving data from the host.*** ***CAUTION: Run an inventory check from the backup software after performing this test.*** Moves a tape out of the drive module and returns it to its original storage slot if the locations are known; otherwise, a tape is placed into the first available storage slot.
Fill Transport	24	***CAUTION: Run an inventory check from the backup software after performing this test.*** Moves a tape from a random storage slot into the transport.
Empty Transport	25	***CAUTION: Run an inventory check from the backup software after performing this test.*** Moves the tape in the transport back to the original slot, or a different slot if the original position is full. The test passes if the transport is successfully emptied.

Table 3-6 Diagnostic Tests

Test	*Test Number*	*Description*
Clear Soft Logs	26	Clears all historical data from the Soft Error (recoverable error) Log.
Clear Hard Logs	29	Clears all historical data from the Hard Error (unrecoverable error) Log. This test clears any "Hard Error" indicator on the front panel display status bar.
Find Plunge Home	101	Moves the transport to the back of the transport assembly.
Find Vertical Home	102	Moves the transport to the bottom of the transport assembly.
Find Lateral Home	103	Moves the transport to the extreme left side of the library and then locates slot 2.
Test Transport Comm	196	Exercises the infra-red communications path between the library controller and the transport micro-controllers. Reports the health of this link. If the test passes, the Test IR Communication link is good.
Show All Sensors	197	Dynamically displays the state of sensors. Toggle door sensors opens and closes the doors. Toggle mailslot sensor opens the mailslot to allow access to the first two tapes. *NOTE*: Available through the front panel only.
Demonstration	100	***CAUTION: Run an inventory check from the host backup application after performing this test.*** Selects a random full storage slot, moves the tape to the drive, and repeats the process until all drives are full. The program locates a full slot, a full drive, an empty slot, and then performs an exchange.

Library and Drive Media Event ID Table

Table 3-7 *Common Event IDs*

Hex ID Number	Decimal ID Number	Description
01H	1	A new TapeAlert flag has been posted
02H	2	SCSI ID has changed
03H	3	Serial number has changed
04H	4	Firmware revision has changed
05H	5	Firmware update is needed
06H	6	Drive has been taken off-line by the library
07H	7	Drive put off-line
08H	8	Drive is being taken off-line
09H	9	Drive not present
0AH	10	Drive put on-line
0BH	11	Fan has failed
0CH	12	Failed taking drive off-line
0DH	13	Failed putting drive on-line
0EH	14	Drive has been cleaned
0FH	15	Failed because the drive rejected load
10H	16	Media format invalid for drive type
11H	17	Drive was not found on Fibre SCSI bus
12H	18	Library saw error exit state
13H	19	Error information available
14H	20	Library saw power up sequence

Table 3-7 Common Event IDs

Hex ID Number	Decimal ID Number	Description
15H	21	Library saw SCSI bus reset event
16H	22	Library saw this motion aborted
17H	23	Redundant power fault
1EH	30	Drive dropped leader or snapped tape
1FH	31	Drive failed to unload

A Field Replaceable Units

Field Replaceable Units (FRUs)

This section contained the FRU numbers that display on the front panel. These numbers indicates parts of the library that might contain an error.

Table A-1 *FRUs*

FRU Number	*Description*
PC Boards	
1	Library contoller
3	Mother board
6	Slave controller
7	Remote management card assembly
9	Fibre channel assembly
10	Library expansion card
Assemblies	
22	Display panel
24	Vertical motor assembly
26	Magazine
27	Picker assembly
32	Power supply
48	Chassis fan
Cables	
41	Main harness cable
59	External SCSI daisy-chain cable
62	Drive interface cable
65	Front panel cable

Table A-1 *FRUs*

FRU Number	*Description*
66	I2C cable (Interconnect cable)
Miscellaneous	
2	Drive Assembly
70	Media

NOTE When ordering replacement cables FRUs, these are packaged together as a kit.

Field Replaceable Units (FRUs)

B Programmer's Tips

Initial Integration

Sense Key Specific Information During Initial Integration

During initial integration, there may be SCSI commands that respond with the following:

- A Sense Key of ILLEGAL REQUEST
- Additional Sense Codes of INVALID FIELD IN CDB (24 00) or INVALID FIELD IN PARAMETER LIST (26 00).

The tape drive supports the Sense Key Specific field in the Request Sense data to make it easier to determine the cause of the error.

The C/D bit, byte 15 bit 6 of the Request Sense data, indicates whether the invalid field was in the command descriptor bytes or in the transferred data.

- If this bit is set to 1, the Invalid Field is in the command descriptor block.
- If this bit is set to 0, the Invalid Field resides in the data bytes.

The Field Pointer, bytes 16 and 17 of the Request Sense data, indicates which byte in the command descriptor bytes or data contains the invalid field.

If the BPV bit (byte 16 bit 3 of the Request Sense data) is set to 1, the Bit Pointer field (byte 16 bits 2 through 0 of the Request Sense data) will be valid.

The Bit Pointer indicates which bit within the byte (indicated by the Field Pointer) contains the Invalid Field.

Using this information, the integrator can quickly determine what portion of the command or data sent to the target is causing the problem. For example, if the command descriptor bytes sent from the Initiator were 00 00 00 00 04 00, the drive recognizes this as a Test Unit Ready command with bit 2 of byte 4 set to 1. This bit is reserved and must be set to 0. The drive would then return a CHECK CONDITION status. The following Request Sense Command would contain a Sense Key of ILLEGAL REQUEST with Additional Sense Codes of INVALID FIELD IN CDB (24 00).

- The SKSV (Sense Key Specific Valid) bit would be set to 1, indicating that Sense Key Specific data is available.
- The C/D bit would be set to 1, indicating that the error is in the command descriptor block.
- The BPV bit would be set to 1, indicating the Bit Pointer field is valid.
- The Bit Pointer field would be set to 2, indicating the error is in bit 2.
- The Field pointer would be 4, indicating the error is in bit 2 of byte 4.

Performance Tuning

To enhance the overall tape drive performance, use the drive's buffer memory to optimize read and write operations.

The buffer memory is for both the write and read-ahead cache. If one is enabled, the entire buffer memory is available for the enabled operation. If both are enabled, they share the buffer memory without any distinct allocation. Allocate the memory as needed.

For example, if the customer use pattern includes many or large writes followed by reads, the writes may utilize all the available buffer space. When the reads start, the tuning parameters force the write cached data to write to tape so that buffer memory is available for read-aheads. After the read operations complete and the write operations restart, the operation system frees the read-ahead cache for needed buffer space.

Write Performance

Two parameters determine the tape drive's performance during write operations:

- The write delay time
- The Maximum Burst Size

Data stored in the write cache transfers to tape when conditions associated with these two parameters occur. This performance increase is only available when the Immediate Response functionality is enabled.

Immediate Response with Buffer Mode

Immediate Response means the return of a GOOD status on write operations after all the write data has been transferred from the initiator into the target's data buffer and before the data is transferred to tape.

Immediate Response greatly improves write performance by allowing the tape drive to simultaneously perform multiple operations. The drive can transfer write data from one command to the tape while it is evaluating/validating another write request and transferring data for the second write request into the write cache.

The drive flushes the write buffer to tape under the following conditions:

- The write hold-off time limit is exceeded (see MODE SELECT command)
- Receipt of the following non-write commands:

  LOAD-UNLOAD

  REWIND

  ERASE

  LOCATE

  MOVE MEDIUM

  PREVENT/ALLOW MEDIUM REMOVAL that clears a prevent state
- A Write Filemarks command with the immediate bit cleared

If Buffered Mode is not selected, the buffer will flush after every write-type command, and the tape drive's transfer rate degrades. Therefore, use MODE SELECT to configure the Buffered Mode.

Write operations are written in the order received. The write cache will not reorder writes.

Read Performance (Read-ahead)

After each read request from the initiator, the tape drive reads additional blocks into the read-ahead cache. When the initiator receives the next read request, the following occurs:

1. Read-ahead cache is checked to see if any blocks are included in the buffer.
2. If all of the blocks are found in the buffer, the data is immediately transferred to the initiator.
3. If there is only a partial hit, only the blocks not in the buffer are read.
4. All blocks transfer to the initiator.

Use the Mode Select command to disable read-ahead.

Data Transfer Size

The tape drive transfers read and write data to and from the initiator in bursts based on the Maximum Burst Size in the Disconnect-Reconnect Mode Page 02H. This parameter controls how often the drive disconnects, reselecting the initiator during large data transfers. The default value for the Maximum Burst Size is 64 Kbytes. If the Maximum Burst Size is smaller, the target transfers data to and from the initiator while reading or writing data to the media.

Each time the tape drive disconnects, the overhead for disconnect and reselect operations consumes additional SCSI bus time. To maximize performance, weigh these two factors:

- The simultaneous data transfer with media operations
- The overhead of the disconnect and reselect process

Non-Volatile Configuration Values

Configuration information is retained in the tape drive's EEPROM storage. Configure the values that maximize performance after a cache reset condition by using the Mode Select command.

In many cases, the performance tuning parameters that yield the best performance varies between applications. To update the current operating parameters, the user may also include the Mode Select operation when invoking the application.

Error Analysis

The data returned in response to the Request Sense command has ten bytes of vendor information appended to the ANSI standard data. This information is helpful in analyzing the drive usage. Set the Allocation Length field in the Command Descriptor Block to a value greater than or equal to 28 for the tape drive and 78 for the autochanger to ensure that additional error information is available for analysis by the integrator and/or the tape drive development team.

Autochanger Load Performance

Since many tape libraries return SCSI status for a move operation as soon as the tape is in the drive, the initiator must then determine when the tape is ready. To determine tape readiness, the following occurs:

1. Polling the drive with Test Unit Ready commands until a GOOD status is received. Polling consumes both SCSI bus bandwidth and initiator processor bandwidth and therefore is not an optimal solution. As the initiator's time between polls increases, the bandwidth consumed decreases, yet the average response time increases. The tape drive solves this problem by providing a load completion functionality.
2. Once the tape library returns a GOOD status for the move operation, the initiator should wait for 15 seconds and then issue a SCSI Load/Unload Command with the Load Bit (byte 4, bit 0) set to 1 and the Immediate Response Bit (byte 1, bit 0) set to 1. If you do not wait the 15 seconds, NOT READY returns on the load command and the load command may have to be re-issued.
3. The tape drive disconnects from the initiator, then reselects the initiator after loading the tape. The SCSI status returned is GOOD. By taking advantage of this capability, the initiator will not consume bandwidth polling and will receive immediate notification when the tape drive is ready to accept tape access requests.

Error Recovery

If the host receives an error (such as a read or write error) from the tape drive, the host should issue a Move Medium Command to the tape library to reload the tape into the drive.

For example, if Drive 2 fails with a "Medium Error" while doing a read, the host should send the Move Medium Command with "Source=2" and "Destination=2." The host should then re-issue the Read Command to Drive 2.

Determining Media Type Loaded

The HP digital linear tape drives support the following ISO standard media types.

- HP DLTtape IV Data Cartridges
- HP DLTtape III XT Data Cartridges

The Media Type field in the Mode Select Data Header reports what media type is in the tape drive.

Cleaning Errors

Use the control panel options or the Send Diagnostic commands 80, 81, 82, 83, 84 to clean drives (with HP 4228, 4248, and 4448 tape libraries, a cleaning cartridge must be in the reserved cleaning slot; with HP 4115 and 4215 tape libraries, the cleaning cartridge storage location must be specified). The Send Diagnostic command will return a Source Empty message if the cleaning tape is not in the storage slot and a Destination Full message if the drive to be cleaned contains a tape.

If the host software will control tape cartridge moves and exchanges, the tape library modules can use a standard data cartridge storage slot. This process allows the host software to send a move command to move the cleaning cartridge to the drive and then to unload the cleaning cartridge from the drive. Since the second move command cannot be issued until the drive cleaning process completes, include a delay of three to five minutes in the routine.

Drive Cleaning Errors

NOTE If the drive cleaning problems persist, call an authorized service provider.

Table B-1 Drive Cleaning Troubleshooting

Problem	*Reason*	*Solution*
A brand new tape is used and a drive cleaning icon is displayed.	Debris from the tape manufacturing process was deposited on the drive head.	• Clean the drive. • If the clean drive icon is displayed again within a short amount of time, replace the tape.
An older, frequently used tape is loaded and a drive cleaning icon is displayed.	Dust from frequent tape loads and unloads has probably built up on the tape and deposited on the drive head.	• Clean the outside of the tape cartridge using a damp cloth. • Clean the drive.
An older, frequently used tape causes the cleaning icon to be displayed for the second time during a short period of time.	The cleaning cartridge needs to be replaced or the tape may be damaged. (Damaged tapes can result in unnecessary use of the cleaning cartridge.)	• Verify the tape is readable by: — Clearing the error message. — Reading the tape again. • If the data tape can be read, back up data from the damaged tape to another tape, and discard the damaged one. • Replace the cleaning tape.

Host System Integration

The integration effort required to utilize these tape drive products varies by software and desired feature support.

This section provides hints for the following:

- Creating a driver from a SCSI tape driver
- Modifying the driver to work with an autochanger
- Developing a tape library application

Prerequisites

Before reading the remaining sections, you should be very familiar with the following:

- SCSI terminology
- SCSI operations
- Tape drivers
- Programming concepts

Modifying the SCSI Driver

When developing an autochanger application for a non-HP system, you must provide a host system driver. A typical approach to this consists of the following:

1. Modifying an existing tape SCSI driver for the tape drive
2. Modifying the tape driver for the mechanical picker
3. Using a pass-thru driver

Refer to these materials for supplemental information:

- Tape Drive SCSI-2 Command Set, See page iv for information on getting manuals.
- Library SCSI Command Set, Chapter 2 of this manual.
- HPUX Driver Development Reference; HP Part No 98577-90602
- HPUX Driver Development Guide; HP Part No 98577-90001
- The American National Standard for Information Systems (ANSI) SCSI-2 documentation is available from:

  Global Engineering Documents

  2805 McGaw

  Irvine, CA 92714

  (800) 854-7179 or (714) 261-1455

Modifying a SCSI Disk Driver for the Tape Drive

Though a SCSI disk driver can be modified for the tape drive, this is an involved process since they are very different drivers. To modify a SCSI disk driver, refer to the Appendix A in the HP-UX Driver Development Guide for the Hewlett-Packard version (HP Part No. 98577-90001).

Change Considerations

Consider this list of possible changes/issues when modifying a disk driver for the tape drive.

Abort Behavior: When a command is aborted while the tape drive is logically disconnected from the bus, it will not immediately respond. The abort will be ignored until the tape drive reconnects. At this point, the abort is recognized and the appropriate check condition status returned.

Removable Media: Because the tape cartridge is removable, several unit attention conditions unique to digital linear tape drives can be generated:

Table B-2 *Unit Attention Conditions*

Sense Key	*Sense Code*	*Occurs*
Not Ready	No Disk	Media is not loaded
Unit Attention	Medium Changed	Each time the autochanger swaps a tape cartridge
Unit Attention	Poweron or Reset	After poweron or reset for all SCSI devices. Medium Format Corrupted
Medium Error	Cannot Read Media Unknown Format	When tape is an unknown type and not compatible
Data Protect	Write Protected	When tape is write protected
Hardware Error	Load/Unload Failure	Something mechanically impedes the load/unload process

Additional Considerations

The following commands may be needed depending on the intended application.

Load/Unload: Used in conjunction with moving tapes in and out of the drives for loading and unloading the tape

Erase: Use for applications to pre-erase an entire tape

Verify: Used for applications that require an extra level of data verification. A second pass is done to reread the tape that is causing performance degradation

Modifying the Tape Driver for the Library

The driver that interacts with the library can be an extension to the tape driver or a separate driver, depending on the architecture of the I/O subsystem. For library functionality, the following SCSI commands need to be supported by the driver:

Table B-3 Necessary Autochanger SCSI Commands

	Command	*OP Code*
Must Support	Initialize Element Status	07H
	Inquiry	12H
	Move Medium	A5H
	Read Element Status	B8H
	Request Sense	03H
	Test Unit Ready	00H

Table B-3 *Necessary Autochanger SCSI Commands*

	Command	*OP Code*
Optional	Exchange Medium	A6H
	Mode Sense / Select	1AH
	Position To Element	2BH
	Prevent/Allow Medium Removal	1EH
	Receive Diagnostic Result	1CH
	Log Sense / Select	4CH, 4DH
	Report Luns	A0H
	Release	17H
	Reserve	16H
	Rezero Unit	01H
	Rotate Mailslot	0CH
	Persistent Reserve	5EH, 5FH

For more information on the I/O subsystem, refer to Chapters 2 and 3 in the HP-UX Driver Development Guide for the Hewlett-Packard version (HP Part No. 98577-90001).

Disconnect Timeouts

The following commands will cause a SCSI disconnect. It is useful to know what the maximum times for disconnect are so driver timeouts can be set appropriately:

CAUTION

In Table B-4, the maximum disconnect time is represented by the nominal number of seconds plus the number of levels of error recovery times 60. Though the maximum disconnect time can be rather long, we strongly recommend using this time over the nominal timeout. If the timeout is too short, the command will be aborted and a I/O request

timeout will be logged against the system.

Table B-4 Timeout Settings

Command	*Nominal Disconnect Time (seconds)*	*Maximum Disconnect Time (seconds)*	*Levels of Error Recovery*
Exchange Medium (Data Cartridge)	130	1800	6
Exchange Medium (Cleaning Cartridge)	300	1800	6
Initialize Element Status	720	1800	6
Log Sense/Select	10	720	
Mode Sense/Select	500	1800	
Move Medium (Data Cartridge)	120	1800	6
Move Medium (Cleaning Cartridge)	300	1800	6
Position To Element	10	720	6
Prevent/Allow Medium Removal	10	720	6
Read Buffer	500	1800	
Read Element Status	720[a]	1800	6
Release	10	720	6
Reserve	10	720	6
Rezero Unit	60	720	6
Send Diagnostic	600[b]	720	
Write Buffer	500	1800	

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 run in a loop. The host should never run a diagnostic test in a loop. Therefore, set the loop count to one, and set the timeout to 10 minutes.

Overview of the Online Drive Repair

On-line drive repair (ODR) allows the replacement and/or addition of tape drives within the library with minimal affect on the host system. ODR reduces host system down time due to drive failures. Since the library has multiple drives, the host system can continue operating while one or more drives are taken offline for replacement.

The Online Drive Repair Process

Before beginning the online drive repair process, drive failures must be detected in one of the following ways:

- The host issues a command to eject or load a cartridge and receives status that the operation was unsuccessful
- The host detects failure status from the drive
- The host receives system-level indications that the drive is not operating correctly

After becoming aware of drive failure, the host or user via the front panel informs the library to set the drive(s) to the "Offline_failed" state. The library then allows no further access to the drive(s) until the state is changed to "Online_good." Qualified persons may service the library drive(s) while the library is operating. When the drive(s) are replaced and the drive state is "Online_good," the host system can again access the drive(s).

Communication Methods

Host to Library Communication

The host will communicate to the library via the SCSI "Write Buffer" command. Whenever the host wants to change the state of the drive(s), it will simply issue the appropriate "Write Buffer" command (see Chapter 3 for the information about the "Write Buffer" command).

Library to Host Communication

The library will communicate to the host via the SCSI "Read Buffer" command and the SCSI "Unit Attention" condition. When the library wants to inform the host of a change in the state of the drive(s), it will issue a "Unit Attention" condition (ASC=0x2A, ASCQ=0x80). This condition informs the host that it must send a "Read Buffer" command to determine the state change of the drives (see Chapter 2 for information about the "Read Buffer" command).

Developing Library Manager Software

Development Considerations

Address these issues for the autochanger manager software:

- Tape moves:
  - — into a drive
  - — from a drive
  - — to and from other elements
- Tape cartridge security
- Volume management
- Swap scheduling
- Error recovery
- Error detection

Moving a Tape Cartridge into a Drive

To access data on a given tape cartridge, the following occurs:

1. The cartridge must be moved into a drive.
2. When a move command is issued to the autochanger where the destination is a drive, it will move the specified tape cartridge into the drive.
3. Once the tape is loaded, the autochanger will return the status for the move.

Moving a Tape Cartridge from a Drive

To remove tape cartridges from a drive, the following occurs:

1. Unload the drive and remove the cartridge.
2. When the autochanger is issued a move command where the source is a drive, it automatically unloads the cartridge and then moves the cartridge to the specified destination element.

Other Moves

For moves that do not involve drives, issue a move command with the appropriate parameters.

Move Summary

To move a tape cartridge from one element to another, issue the appropriate move command. If the destination is a drive, poll the device with load commands to verify that it has loaded.

Physical Security of Tape Cartridges

With an autochanger, consider unauthorized physical access of tape cartridges. If a cartridge is "active" in an autochanger, it should not be allowed to be removed via the mailslot. The definition of active varies with the application. For instance, it may mean that a file on that cartridge is "open" or that the cartridge is available for use.

The autochanger provides the following two levels of physical security that can be controlled by the autochanger manager software:

1. The most stringent security is provided if the autochanger prevent/allow media removal is set to prevent. When enabled, no tape cartridge may be inserted or removed through the mailslot. Prevent/Allow media removal can be changed in two ways:

   Set via the front panel configuration

   Send the prevent/allow media removal command via the SCSI interface

2. A less stringent level of physical security allows individual cartridges to be controlled. When a storage element is reserved by the host (by using the Reserve SCSI command), tape cartridges cannot be inserted into or removed from this element via the mailslot. This level of physical security allows some cartridges to be removed from the autochanger while others are being used.

Volume Management

Some applications may require that tape cartridges be cataloged to organize information. The HP digital linear tape libraries have a bar-code reader, which allows the Read Element Status command to return volume tag information.

Swap Scheduling

One of the main jobs of the autochanger manager software is to control the movement of tape cartridges from slot to drive and vice versa. The autochanger manager software must have a policy for swapping cartridges, which the user can control and adapt.

Error Recovery

The tape library is an extremely reliable unit, but the possibility of failure must be handled by the autochanger manager software. Depending on the application and user needs, this error recovery can be simple or very complex.

A system with simple error recovery may shut down the tape library so that all requests return errors until the system is repaired.

A system with complex error recovery would be able to detect that an element is defective and work around the problem. For instance, if one tape drive was not functioning, the swapping algorithm would only use the remaining drive and implement the online drive repair algorithm (see "The Online Drive Repair Process" in this Appendix).

Error Detection

The first step in any error recovery is detection. The error codes returned from the SCSI commands allow the autochanger manager software to know if there is a hardware error, restored error, or recovered error.

- Hardware errors ASC = 15 ASCQ = 01 Key = 04: Are not recoverable, all moves will be blocked.
- Restored errors ASC = 15 ASCQ = 00 Key = 04: Got the media back in the state before move, but something is wrong with one of the elements. Other moves might be able to complete successfully.
- Recovered errors ASC = 0 ASCQ = 00 Key = 01: The unit should be able to continue successfully.

TapeAlert Specifications

Overview

TapeAlert is based on the tape drive/library performing constant self-diagnostics, and then returning high-level error flags. TapeAlert allows any storage software application using TapeAlert capable tape drives/libraries to access standard diagnostic information. Given this additional diagnostic information, the storage software can communicate clearly the tape drive or library's behavior, improving the overall reliability and usability of the storage solution.

The TapeAlert specification is designed for easy addition of other device types in the future, by adding new device specific definitions for the 64 alert flags in the TapeAlert Log page.

Host Software Interface

The TapeAlert information is accessed via a Log Sense page, and configuration is via a Mode Select page. The Mode Sense/Select configuration of the TapeAlert interface is compatible with the SMART diagnostic standard for disc drives. The host software should first check the tape drive/library to determine whether it supports the TapeAlert Log Sense page 0x2e. By default the host software access to the TapeAlert Log Sense page is via polling.

The TapeAlert Log Sense page should be read from a tape drive/autoloader device at the following times:

- At the beginning of a write/read job, even if media is not loaded
- Immediately after a fatal error during the write/read job
- At the end of each tape when the write/read job spans multiple tapes. If the tape is to be ejected then the Log Sense page must be read BEFORE this.
- At the end of a write/read job

The TapeAlert Log Sense page should be read from a library device at the following times:

- At the beginning of a write/read job occurring on a device inside the library, even if a tape is not loaded in that device
- Immediately after a fatal error during a write/read job for a device inside the library
- At the end of a write/read job on a device inside the library

Though not mandatory, the host software may also poll the Log Sense page every 60 seconds while the tape drive/library is idle. However, the host software may use the TapeAlert Mode page to configure other access methods, depending on what options are supported by the tape drive/library.

Each time the host software reads the TapeAlert Log page, it should check all 64 flags to discover which are set (there may be more than one). The definitions of the 64 flags are device specific, so one definition is for tape drive/autoloader devices, and one is for stand-alone changer devices (in libraries). For each set flag, the host software should communicate and log the defined error message and severity for that flag to the user. If multiple flags are set simultaneously, they will be displayed together in ascending order of severity.

At the beginning of each set of TapeAlert error messages, the tape device/library that initiated them must be identified. For the tape drive media-related flags (flags 4, 7 and 14), the software label of the tape should be included in the TapeAlert error messages so that the user knows which tape has the error. Such information could also be displayed with the messages for other flags if required.

NOTE The information read in the TapeAlert flags should not in itself cause the software to stop a current backup/restore job.

C Move Sequence IDs

Move Sequence IDs

Move Sequence IDs

This section describes the Move Sequence IDs for the HP DLT Libraries.

Table C-1 *Sequence Numbers*

Sequence (Decimal)	Sequence (Hex)	Description
Vertical Sequence Numbers		
0	00H	Vertical assembly idle
1	01H	Move vertical assembly up (quickly)
2	02H	Move vertical assembly down (quickly)
3	03H	Vertical saturate up
4	04H	Vertical saturate down
5	05H	Vertical relax
6	06H	Measure vertical 1
7	07H	Measure vertical 2
8	08H	Vertical fast saturate
9	09H	Vertical relax home
10	0AH	Move vertical assembly up slowly, looking for resistance
11	0BH	Move vertical assembly down slowly, looking for resistance.
12	0CH	Vertical slow
13	0DH	Move up. Used in the motor test during powerup
14	0EH	Move down. Used in the motor test during power-up.

Move Sequence IDs

Table C-1 *Sequence Numbers*

Sequence (Decimal)	Sequence (Hex)	Description
Translate Sequence Numbers		
50	32H	Translate idle
51	33H	Translate saturate right
52	34H	Translate saturate left
53	35H	Translate right
54	36H	Translate left
55	37H	Translate corner right
56	38H	Translate corner left
57	39H	Translate test right
58	3AH	Translate test left
59	3BH	Translate relax
60	3CH	Translate calibrate
61	3DH	Translate barcode
62	3EH	Translate integral right
63	3FH	Translate integral left
64	40H	Translate power fail right
65	41H	Translate power fail left
Plunge Sequence Numbers		
100	64H	Plunge idle
101	65H	Plunge move
102	66H	Plunge relax
103	67H	Plunge gets splayed

Move Sequence IDs

Table C-1 *Sequence Numbers*

Sequence (Decimal)	Sequence (Hex)	Description
104	68H	Plunge rearm
105	69H	Plunge enable rearm
106	6AH	Plunge saturate home
107	6BH	Plunge wait drive eject
108	6CH	Plunge test magazine pre-plunge
109	6DH	Plunge test magazine saturate
110	6EH	Plunge test magazine out
111	6FH	Get magazine pre-plunge
112	70H	Get magazine saturate
113	71H	Get magazine in
114	72H	Get magazine out 1
115	73H	Get magazine out 2
116	74H	Put magazine pre-plunge
117	75H	Put magazine saturate
118	76H	Put magazine in
119	77H	Put magazine out
120	78H	Clear magazine saturate
121	79H	Clear magazine out
122	7AH	Clear magazine out 1
123	7BH	Clear magazine out 2
124	7CH	Get drive pre-plunge
125	7DH	Get drive saturate

Table C-1 *Sequence Numbers*

Sequence (Decimal)	Sequence (Hex)	Description
126	7EH	Get drive in
127	7FH	Get drive in 2
128	80H	Get drive out 1
129	81H	Get drive out 2
130	82H	Get drive out 3
131	83H	Put drive pre-plunge
132	84H	Put drive saturate
133	85H	Put drive in
134	86H	Put drive out 1
135	87H	Clear drive in
136	88H	Clear drive saturate
137	89H	Clear drive out
138	8AH	Clear saturate
139	8BH	Clear finish
140	8CH	Find transport length
141	8DH	Finish transport length
142	8EH	Test transport saturate
143	8FH	Active transport test
144	90H	Plunge motor test out
145	91H	Plunge motor test in
146	92H	Plunge power fail saturate
147	93H	Plunge power fail drive saturate

Move Sequence IDs

Table C-1 *Sequence Numbers*

Sequence (Decimal)	Sequence (Hex)	Description
148	94H	Plunge power fail out
149	95H	Plunge power fail in
150	96H	Plunge test get saturation
151	97H	Plunge put soft load
152	98H	Plunge put soft saturation

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