ATL SuperLoader™ DLT and ATL SuperLoader™ LTO

Software Interface Guide

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Quantum

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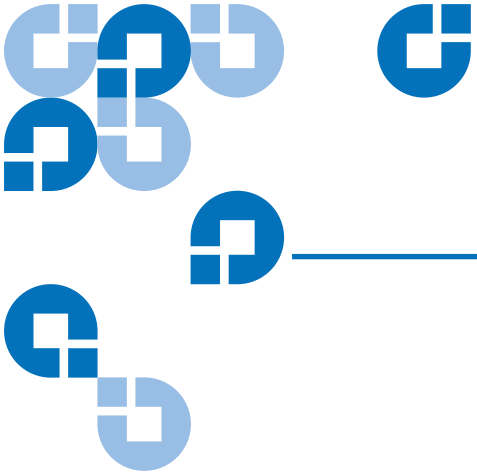

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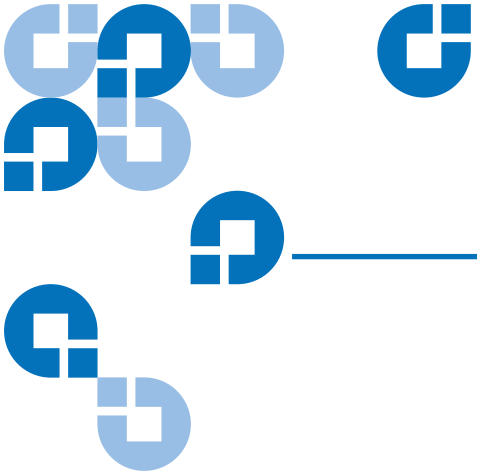


Preface

This section outlines the scope and contents of the Quantum ATL SuperLoader™ Software Interface Guide. It contains information about the intended audience, purpose, organization, and document conventions.

Intended Audience

This interface guide is a written for the following audiences:

- Original Equipment Manufacturers (OEMs) that integrate the Quantum ATL SuperLoader into a system or subsystem
- System integrators that are responsible for the SCSI interface
- End users that operate and troubleshoot the SuperLoader

Purpose

This interface guide describes the procedures and issues involved in the development of software applications and utilities to communicate with the Quantum ATL SuperLoader.

- SCSI interfaces
- SCSI Messages
- Media Changer Commands

Organization

This reference manual is organized as follows:

- Chapter 1, Theory of Operation describes differences between the SuperLoader models, media changer elements, events, and automatic drive cleaning.
- Chapter 2, Messages describes the SCSI messages supported by the SuperLoader.
- Chapter 3, Media Changer Commands describes the SCSI protocol features implemented in the media changer.

Document Conventions

This manual uses the following conventions to designate specific elements:

Element	Convention	Example
Abbreviations	Lowercase, except where standard usage requires uppercase	Mb (megabits) MB (megabytes)
Acronyms	Uppercase	SCSI
Binary Notation	Number followed by lowercase *b*	101b
Commands	Uppercase (unless case-sensitive)	FORMAT UNIT
Decimal Notation	Number followed without suffix	101
Field	Initial Caps (unless case-sensitive)	Application Data
Hexadecimal Notation	Number followed by *h*	101h
Sense Key	Uppercase (unless case-sensitive)	ILLEGAL REQUEST

Chapter 1

Theory of Operation

The SuperLoader products are an integration of two separate devices, a tape drive and a media changer. The media changer consists of all the mechanics and electronics required to store and move tape cartridges while the tape drive provides the read/write functionality.

Each device has a separate interface for communication to the host. The SCSI command set supported by the tape drive is documented separately. The SCSI command set supported by the media changer device is detailed in xxx.

The SuperLoader is fully compliant with the ANSI SCSI-2 standard for tape drive and media changer devices and implements many optional features.

The SuperLoader does not act as an initiator on the SCSI bus. Therefore, it does not generate unsolicited interrupts to the bus, initiate its own SCSI commands, or assert bus reset.

SuperLoader DLT

The SuperLoader DLT family of products utilize a single SCSI ID and two logical units. The tape drive always resides at logical unit 0 and the media changer resides at logical unit 1. The SuperLoader supports narrow and wide, synchronous and asynchronous data transfers. Both LVD and single-ended versions are available.

SuperLoader LTO

The SuperLoader LTO family of products utilize two separate SCSI IDs. The tape drive and media changer each reside on a unique ID. The media changer device supports narrow and wide, asynchronous data transfers only. The tape drive device supports narrow and wide, synchronous and asynchronous data transfers.

Medium Changer Elements

The medium changer command set accesses the address space for the set of physical locations and mechanisms with the SuperLoader. This guide uses the SCSI-2 term element to refer to one member of the SuperLoader address space. Each element is a discrete physical entity that can hold a single tape cartridge. Each element within a SuperLoader is represented by a unique 16-bit element address. The SuperLoader consists of the following medium changer elements.

- Medium transport element
- Storage elements
- Data transfer elements

You can issue the Mode Sense command to determine the SuperLoader configuration. You can also use this command to determine the first address and the number of elements of each type.

Although the SuperLoader does have a mailslot, it is not reported as an Import/Export element for use by the host system. It is strictly to allow users to access tape cartridges using the front panel or On-board Remote Management tool.

Medium Transport Element

This mechanism can hold a single cartridge and is considered a single medium transport element. It is used to move media between elements within the SuperLoader.

Data Transfer Element

The SuperLoader is configured with a single tape drive.

Storage Elements

All of the storage elements within the SuperLoader are contained within removable magazines. There are two magazines which hold eight tape cartridges each, for a total of 16 storage elements. Since the magazines are removable, a user may insert or remove a magazine at any time. Because of this, the SuperLoader always reports 16 storage elements, regardless of how many magazines are currently installed. When a magazine is removed, the corresponding storage elements are reported as inaccessible. This is done via the Read Element Status–Storage Element Descriptor on page 134–byte 2, bit 3.

Events

Events are system conditions created y operator actions or system failures. These events are recorded in sense data for the SCSI host to retrieve via the Request Sense command.

Power Cycle

When the SuperLoader is powered-on, it goes through an initialization sequence, during which it:

- Resets and initializes all hardware
- Responds to SCSI commands which do not require movement
- Responds to Test Unit Read and all movement type comands with a not ready, initialization in progress check condition (SK=02 ASC=29 ASCQ=02).

When the power on initialization is complete, it:

- Generates a Power On/Reset Occurred event (SK=6 ASC=29 ASCQ=02)
- If initialization is sucessful, it generates a note ready to ready transition (SK=6 ASC=28 ASCQ=00), otherwise, failure sense data is set accordingly.

SuperLoader Offline

When a user accesses the SuperLoader via the front panel or On-board Remote Management in such a way that would cause conflict with a SCSI command, the SuperLoader is put into an offline state. If a SCSI command is received while in this offline state, a not ready check condition is reported (SK=01 ASC=04 ASCQ=07).

Magazine Insertion/ Removal

The SuperLoader must be powered-on with at least one magazine, otherwise a check condition is reported (SK=-2 ASC=04 ASCQ=03).

While the system is online, the user may remove a magazine blank and replace it with a magazine. The SuperLoader will calibrate the newly installed magazine and check the presence of tape cartridges in each of the storage elements. While this inventory is in progress, the SuperLoader LTO will report a not ready check condition (SK=02 ASC=04 ASCQ=01). The SuperLoader DLT does not provide any indication that the operation is in progress. Once the inventory is complete, all SuperLoaders report a unit attention (SK=06 ASC=3B ASCQ=13).

Similarly, while a magazine is in the process of being removed, a not ready check condition is reported (SK=02 ASC=04 ASCQ=07). Once the operation is complete, by replacing the magazine with a blank, a unit attention is reported (SK=06 ASC=3B ASCQ=12).

While one or both of the magazine bays are open, a not ready check condition is reported (SK=02 ASC=04 ASCQ=03).

Maximum Temperature Exceeded

The SuperLoader monitors the ambient temperature within the system. If the temperature exceeds the maximum safe temperature for the media, the SuperLoader will disable all movement until the temperature decreases below a safe threshold. While the temperature remains excessive, SCSI commands that require movement will fail (SK=04 ASC=0B ASCQ=01).

Automatic Drive Cleaning

There are two modes of automatic drive cleaning support available:

- Host-initiated cleaning
- SuperLoader managed cleaning

Both modes provide automatic cleaning of the drive, but the first is managed by the host and the second is managed by the SuperLoader. These two modes are configured separately, and only one should be enabled at any given time.

When automatic drive cleaning of the drive is enabled, either the host of the SuperLoader is responsible for all cleaning functions such as:

- Detecting when a drive requires cleaning
- Tracking and selecting cleaning cartridges
- Moving a cleaning cartridge to the drive

- Determining when a cleaning cartridge has used all of its available cleaning cycles

By default, the SuperLoader is configured to allow for host-initiated cleaning. If automatic cleaning is disabled from the host, the SuperLoader can be configured to manage the automatic cleaning of the drive. This is done by enabling the "Auto Clean" function. Please refer to the *Quantum ATL SuperLoader Automated Tape Library User Manual* for information on how this is done.

> **Note:** There is no way for the host and SuperLoader to know how the other is configured with respect to automatic drive cleaning. It is up to the user to make sure only one is enabled.

In host-initiated cleaning mode, the host tracks all cleaning cartridges and their use. When the SuperLoader Auto Clean feature is enabled, a "cleaning slot" is allocated and the cleaning cartridge is stored in this storage element. The SuperLoader assumes that any cartridge stored in this location is a cleaning cartridge and will attempt to use it as such.

The SuperLoader does not keep track of the number of times a cleaning tape is used. Instead, it relies on the tape drive to report when the tape has expired. When this happens, the superLoader will notify the user via the front panel. The Auto Clean function is automatically disabled until the user inserts a new cleaning tape and re-enables the feature.

Element Status Information

When the SuperLoader Auto Clean feature is enabled, the allocated storage element is reported as inaccessible to the host. This is done by setting the access bit to 0 in the Read Element Status Storage Element Descriptor page.

Automatic Cleaning Operation

when the SuperLoader Auto Clean feature is enabled, the SuperLoader checks if the drive needs cleaning after each successful move from the drive. Therefore, each time the drive is unloaded, it is checked.

The movement of the cleaning tape is handled differently depending on the SuperLoader model.

SuperLoader DLT

If the move command, that unloaded the drive, was initiated from SCSI, the cleaning tape is moved from its storage slot, to the drive, the cleaning is performed and the cleaning tpae is returned to its storage slot, before command complete status is returned to the SCSI host. If an unrecoverable error occrus when moving a cleaning cartridge that prevents a subsequent host initiated command from completing, a check condition will be set in the returned status byte and sense data is set appropriately.

SuperLoader LTO

If the move command that unloaded the drive was initiated from SCSI, command complete is returned to the host when the move completes. The cleaning tape is then moved from its storage slot to the drive. The cleaning is performed and once complete, the cleaning tape is returned to its stoage location. If a SCSI command is received during this cleaning process, a not ready check condition is reported (SK=-2 ASC=30 ASCQ=03).

Chapter 2

Messages

The SCSI message system allows communication between an initiator and the SuperLoader for interface management and command qualification. Messages can be originated by either the initiator or the SuperLoader. This section contains a detailed description of the messages supported by the SuperLoader.

Message Format

A message can be one or more bytes in length. One or more messages can be sent during a single MESSAGE phase, but a message cannot be split over MESSAGE phases. The initiator is required to end the MESSAGE OUT phase (by negating ATN) when it sends certain messages that are identified in table 1.

When a connection to the SuperLoader is established, for example the SuperLoader is selected with ATN asserted, the first message byte passed by the initiator must be either an IDENTIFY, ABORT, or BUS DEVICE RESET message. If not, the SuperLoader discards the message, saves no status information, and goes to the BUS FREE phase.

If an initiator supplies an unsupported message, for example, COMMAND COMPLETE or a reserved or undefined message code, the SuperLoader returns a MESSAGE REJECT message and continues where it left off, possibly returning to MESSAGE OUT if ATN is raised.

The first byte of the message, as defined in table 1, determines the format of the message.

Table 1 Message Format

Message Code	Message
00h	One-byte message (COMMAND COMPLETE)
01h	Extended message
02h – 1Fh	One-byte message
20h – 2Fh	Two-byte message
40h – 7Fh	Reserved
80h – FFh	One-byte message (IDENTIFY)

The SuperLoader supports the messages listed in table 2. The message code and the direction of the message flow is also included in the table (In = target to initiator, Out = initiator to target).

Table 2 Supported Messages

Message	Message Code	Direction	
ABORT	06h		Out
BUS DEVICE RESET	0Ch		Out
COMMAND COMPLETE	00h	In	
DISCONNECT	04h	In	Out

Message	Message Code	Direction	
EXTENDED MESSAGE (Synchronous Data and Wide Data Transfer Requests) *	01h	In	Out
IDENTIFY	80h – FFh	In	Out
IGNORE WIDE RESIDUE	23h	In	
INITIATOR DETECTED ERROR	05h		Out
LINKED COMMAND COMPLETE	0Ah	In	
LINKED COMMAND COMPLETE (with flag)	0Bh	In	
MESSAGE PARITY ERROR	09h		Out
MESSAGE REJECT	07h	In	Out
NO OPERATION	08h		Out
RESTORE POINTERS	03h	In	
SAVE DATA POINTER	02h	In	

* Extended message (figure 1).

Two-byte messages consist of two consecutive bytes. The value of the first byte, as defined in table 1, determines which message is to be transmitted. The second byte is a parameter byte that is used as defined in the message description.

A value of 1 in the first byte indicates the beginning of a multiple-byte extended message. The minimum number of bytes sent for an extended message is three. The extended message format is shown in figure 1 and the data fields are described in table 3.

Figure 1 Extended Message

Bit Byte	7	6	5	4	3	2	1	0
0	Extended Message (01h)							
1	Extended Message Length							
2	Extended Message Code							
3 to n-1	Extended Message Arguments							

Table 3 Extended Message

Field	Description
Extended Message Length	This field specifies the length, in bytes, of the Extended Message Code plus the Extended Message Arguments that follow. Therefore, the total length of the message is equal to the Extended Message Length plus 2. A value of 0 for the Extended Message Length indicates that 256 bytes follow.
Extended Message Code	The SuperLoader supports the following Extended Messages: 01h SYNCHRONOUS DATA TRANSFER REQUEST 03h WIDE DATA TRANSFER REQUEST

Supported SCSI Messages

Following are descriptions of each of the messages supported by the SuperLoader.

Abort (06h)

This message is sent from the initiator to the target to clear the current I/O process on the selected unit. The target goes directly to the BUS FREE phase after successful receipt of this message. Current settings of MODE SELECT parameters and reservations are not affected. Commands, data, and status for other initiators are not affected.

This message can be sent to a logical unit that is not currently performing an operation for the initiator. If no unit has been selected, the target goes to BUS FREE phase and no commands, data, or status on the target are affected.

If a command that causes movement of the media changer has started, the movement will complete and STATUS will not be sent to the initiator.

Bus Device Reset (0Ch)

The BUS DEVICE RESET message is sent from an initiator to direct the SuperLoader to clear all I/O processes on the drive. The message causes the SuperLoader to execute a hard reset, leaving it as if a Bus Reset had occurred.

The SuperLoader creates a Unit Attention condition for all initiators after accepting and processing a Bus Device Reset message. The additional sense code is set to POWER ON, RESET, or BUS DEVICE RESET OCCURRED.

If a command that causes movement of the media changer has started, the movement will complete and STATUS will not be sent to the initiator.

Command Complete (00h)

The COMMAND COMPLETE message is sent by the SuperLoader to an initiator to indicate that an I/O process has completed and that valid status has been sent to the initiator. After successfully sending this message, the SuperLoader goes to the BUS FREE phase by releasing the BSY signal. The SuperLoader considers the message transmission successful when it detects the negation of ACK for the COMMAND COMPLETE message with the ATN signal false. If a COMMAND COMPLETE message is received by the SuperLoader, it is handled as an illegal message: the SuperLoader returns MESSAGE REJECT and enters its STATUS phase, reporting CHECK CONDITION with the sense key set to COMMAND ABORTED.

Disconnect (04h)

The DISCONNECT message is sent from the SuperLoader to inform the initiator that the present connection is going to be broken, such as the SuperLoader plans to disconnect by releasing the BSY signal, and a later reconnect will be required to complete the current I/O process. The message does not cause the initiator to save the data pointer. After sending the message, the SuperLoader goes to the BUS FREE phase by releasing the BSY signal.

The DISCONNECT message can also be sent by the initiator to tell the SuperLoader to suspend the current phase and disconnect from the bus. The SuperLoader's response to and its handling of a DISCONNECT message are based on when, in the I/O process, the initiator introduces the DISCONNECT message. Table 7 summarizes the SuperLoader's response.

Table 4 Response to Disconnect Message

BUS Phase	SuperLoader Response
SELECTION	The SuperLoader discards the DISCONNECT message and goes to BUS FREE.
COMMAND	The SuperLoader discards the DISCONNECT message and goes to BUS FREE. The ATTENTION request is ignored while the Command Descriptor Block is fetched. The SuperLoader does not switch to MESSAGE OUT until the current DMA completes.
DATA	The ATTENTION request is ignored while the current data transfer completes; that is, the SuperLoader does not switch to MESSAGE OUT until after the current DMA completes. The SuperLoader returns a MESSAGE REJECT message and responds with CHECK CONDITION status, indicating the command aborted because of an invalid message.
STATUS	The SuperLoader sends a MESSAGE REJECT message, then sends COMMAND COMPLETE.
MESSAGE IN	The SuperLoader sends a MESSAGE REJECT message and switches to the BUS FREE phase.

Identify (80h-FFh)

The IDENTIFY message is sent by either the initiator or the SuperLoader to establish or re-establish the physical connection path between an initiator and target for a particular logical unit under the conditions listed below. Figure 2 shows the format of the IDENTIFY message and table 5 describes the data field contents.

Figure 2 Identify Message

Bit	7	6	5	4	3	2	1	0
	Identify	DiscPriv	LUNTAR	Reserved		LUNTRN		

Table 5 Identify Message

Field	Description
Identify	The Identify bit must be set to 1. This identifies the message as an IDENTIFY message.
DiscPriv	Disconnect Privilege. The DiscPriv can be 0, provided that no other I/O process is currently active in the SuperLoader. If not set to 1 and other I/O processes are currently active in the SuperLoader, the SuperLoader returns BUSY status.
LUNTAR	The Logical Unit/Target Routine (LUNTAR) field must be set to zero. The SuperLoader does not support target routines. A LUNTAR bit of one causes the drive to send a MESSAGE REJECT message and switch to the BUS FREE phase.
Reserved	The Reserved bits must be zero. If a Reserved bit is non-zero, the SuperLoader returns a MESSAGE REJECT message and switches to the BUS FREE phase.
LUNTRN	Logical Unit Number. The SuperLoader has two logical units. The tape drive is always logical unit 0, and the media changer device is always logical unit 1.

Ignore Wide Residue (23h)

The IGNORE WIDE RESIDUE message is sent by the target to the initiator to indicate that the number of valid bytes sent during the last REQ/ACK handshake and REQB/ACKB handshake of a DATA IN phase is less than the negotiated transfer width. The Ignore field indicates the number of invalid data bytes transferred. This message is sent immediately following that DATA IN phase and prior to any other messages. Figure 3 illustrates the data format of an IGNORE WIDE RESIDUE message. Table 6 describes the Ignore field bit definitions.

Figure 3 Ignore Wide Residue Message

Bit Byte	7	6	5	4	3	2	1	0
0	Message Code (23h)							
1	Ignore (01h)							

Table 6 Ignore Wide Residue

Ignore	Invalid Data Bits (16-bit Transfers)
00h	Reserved
01h	DB(15-8)
02h - FFh	Reserved

Initiator Detected Error (05h)

The INITIATOR DETECTED ERROR message is sent from an initiator to inform the SuperLoader that an error has occurred that does not preclude the SuperLoader from retrying the operation (a bus parity error, for example). The source of the error may either be related to previous activities on the SCSI bus or may be only SuperLoader-related. When received, the SuperLoader attempts to re-transfer the last command, data, or status bytes by using the RESTORE POINTER message mechanism.

The SuperLoader's response to and its handling of an INITIATOR DETECTED ERROR message are based on when, in the I/O process, the initiator introduces the message. Table 7 summarizes the SuperLoader's response.

Table 7 Response to Initiator Detected Error

BUS Phase	SuperLoader Response
SELECTION	The SuperLoader discards the INITIATOR DETECTED ERROR message and then goes to the BUS FREE phase.
COMMAND	The SuperLoader discards any Command Descriptor Block bytes fetched from the initiator, sets the Sense Key to ABORTED COMMAND, sets the Additional Sense Code to INITIATOR DETECTED ERROR MESSAGE RECEIVED. It sends the CHECK CONDITION status and the COMMAND COMPLETE message and then goes to the BUS FREE phase.
DATA	The SuperLoader discards the INITIATOR DETECTED ERROR message and sets the Sense Key to ABORTED COMMAND, sets the Additional Sense Code to INITIATOR DETECTED ERROR MESSAGE RECEIVED. It sends the CHECK CONDITION status and the COMMAND COMPLETE message and then goes to the BUS FREE phase.
STATUS	The SuperLoader sends a RESTORE POINTERS message, returns to the STATUS phase, resends the STATUS command, and continues the I/O process.
MESSAGE IN	The SuperLoader discards the INITIATOR DETECTED ERROR message and sets the Sense Key to ABORTED COMMAND, sets the Additional Sense Code to INITIATOR DETECTED ERROR MESSAGE RECEIVED. It sends the CHECK CONDITION status and the COMMAND COMPLETE message and then goes to the BUS FREE phase.

Linked Command Complete (0Ah)

This message is sent from a target to an initiator to indicate that the execution of a linked command, with the FLAG bit set to zero, is complete and that status has been sent. The initiator then sets the pointers to the initial state for the next command.

If received by a target, this message is handled as an illegal message; the SuperLoader enters the MESSAGE IN phase and returns MESSAGE REJECT.

Linked Command Complete, Flag (0Bh)

This message is sent from a target to an initiator to indicate that the execution of a linked command, with the FLAG bit set to one, is complete and that status has been sent.

Message Parity Error (09h)

This message is sent from the initiator to tell the SuperLoader that the last message byte the SuperLoader passed on to the initiator contained a parity error.

To indicate that it intends to send the message, the initiator sets the ATN signal before it releases ACK for the REQ/ACK handshake of the message that has 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 any other condition, it proceeds directly to the BUS FREE state by releasing the BSY signal, signifying a catastrophic error.

The target's response to this message is to switch to the MESSAGE IN phase and re-send from the beginning all the bytes of the message that precipitated the MESSAGE PARITY ERROR message.

Message Reject (07h)

This message is sent from the initiator or target to indicate that the last message received was inappropriate or has not been implemented.

To indicate its intention to send this message, the initiator asserts the ATN signal before it releases ACK for the REQ/ACK handshake of the message that is to be rejected. MESSAGE REJECT is issued in response to any message the SuperLoader considers to be illegal or not supported. When sending to the initiator, the SuperLoader does so before requesting any additional message bytes.

NoOperation(08h)

If a target requests a message, the initiator sends a NO OPERATION message if it does not currently have any other valid message to send. The message is accepted when the SuperLoader is acting as a target and may be sent when it is an initiator. If a NO OPERATION message is received during a selection, the SuperLoader proceeds to the COMMAND phase, provided ATN does not continue as asserted; the NO OPERATION message is ignored by the SuperLoader.

Restore Pointers (03h)

The RESTORE POINTERS message is sent from the SuperLoader to the initiator to direct the initiator to copy the most recently saved command, data, and status pointers for the I/O process to the corresponding current pointers. The command and status pointers are restored to the beginning of the present command and status areas. 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 point at which the last SAVE DATA POINTER message 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.

Save Data Pointer (02h)

The SAVE DATA POINTER message is sent from the SuperLoader to direct the initiator to copy the current data pointer to the saved data pointer for the current I/O process.

When functioning as a target, the SuperLoader sends this message before a DISCONNECT message during a data transfer. It does not send a SAVE DATA POINTER message if it intends to move directly to STATUS phase. When received as a target, it switches to MESSAGE IN phase and returns MESSAGE REJECT.

Synchronous Data Transfer Request (01h)

This extended message allows the target and initiator to agree on the values of the parameters relevant to synchronous transfers. The SuperLoader will not initiate the SYNCHRONOUS DATA TRANSFER REQUEST message; it relies on the initiator to do so. The SYNCHRONOUS DATA TRANSFER REQUEST message has the format shown in figure 4.

> **Note:** The SuperLoader DLT supports initiating synchronous transfer negotiations with the host, but this feature is disabled by default. To enable it, set the MODE SELECT VU EEROM parameter EnaInitSyncNeg.

Figure 4 Synchronous Data Transfer Request Message

Bit Byte	7	6	5	4	3	2	1	0
0	Extended Message Identifier (01h) (see figure 1)							
1	Length (03h)							
2	SYNCHRONOUS DATA TRANSFER REQUEST (01h)							
3	Transfer Period							
4	Transfer REQ/ACK Offset							

A SYNCHRONOUS DATA TRANSFER REQUEST message exchange is initiated by a SCSI device whenever a previously arranged transfer width agreement may have become invalid. The agreement becomes invalid after any condition that may leave the data transfer agreement in an indeterminate state such as:

- After a hard reset condition

- After a BUS DEVICE RESET Message
- After a power cycle.
- After a WIDE DATA TRANSFER REQUEST message exchange.

The SYNCHRONOUS DATA TRANSFER REQUEST message exchange establishes an agreement between two SCSI devices on the clocking of the data used for DATA phase transfer between them. This agreement applies to DATA IN and DATA OUT phases only. All other information transfer phases must use asynchronous transfers.

The SuperLoader implements both wide data transfer option and synchronous data transfer option. Wide data transfer must be negotiated prior to negotiating the synchronous data transfer agreement. If a synchronous data transfer agreement is in effect, then after accepting a WIDE DATA TRANSFER REQUEST message, it resets the synchronous agreement to asynchronous mode.

If the Transfer Period requested is lower than the minimum value supported by the device, the return value will be adjusted up to the minimum supported value. All possible transfer periods between the minimum and maximum values are not supported. If the Transfer Period requested is between the minimum and maximum supported values, but not exactly achievable by the device, the returned value will be the request value and the SuperLoader will transmit data at the next lower speed it is capable of. The initiator may send data at the request speed. The maximum supported synchronous period is 5Dh (372 nsec). A request with a Transfer Period lower than this will return a request for asynchronous mode.

Table 8 Transfer Rates

Transfer Period	Transfer Rate
0Ah	40 MHz, 25 nsec Transfer Period
0Bh	33 MHz, 30.3 nsec Transfer Period. LTO and SDLT uses 37.5 nsec period.
0Ch	20 MHz, 50 nsec Transfer Period
0Dh – 5Dh	(4 * Transfer Period) nsecs.

The minimum supported value for Transfer Period is 0Ah when the bus is operating in LVD mode. When operating in HVD or Single-Ended mode, the minimum Transfer Period value is 0Ch.

The SuperLoader SDLT 220 and SuperLoader SDLT 320 Transfer REQ/ACK offset may be any value between 0 and 62. A value of 0 indicates asynchronous transfers. A request with a value greater than 62 will cause the device to return a request for 62.

The SuperLoader DLT1 Transfer REQ/ACK offset may be any value between 0 and 15. A value of 0 indicates asynchronous transfers. A request with a value greater than 15 will cause the device to return a request for 15.

The SuperLoader LTO only supports a Transfer REQA/ACK offset of 0. This indicates asynchronous transfers.

Wide Data Transfer Request Extended Message (03h)

The following figure illustrates the message format.

Figure 5 Wide Data Transfer Request Message

Bit Byte	7	6	5	4	3	2	1	0
0	Extended Message Identifier (01h) (see figure 1)							
1	Extended Message Length (02h)							
2	WIDE DATA TRANSFER REQUEST (03h)							
3	Transfer Width Exponent							

A WIDE DATA TRANSFER REQUEST message exchange is initiated by a SCSI device whenever a previously arranged transfer width agreement may have become invalid. The agreement becomes invalid after any condition that may leave the data transfer agreement in an indeterminate state such as

- After a hard reset condition
- After a BUS DEVICE RESET Message
- After a power cycle.

The WIDE DATA TRANSFER REQUEST message exchange establishes an agreement between two SCSI devices on the width of the data path to be used for DATA phase transfer between them. This agreement applies to DATA IN and DATA OUT phases only. All other information transfer phases must use an 8-bit data path.

The SuperLoader implements both wide data transfer option and synchronous data transfer option. It negotiates the wide data transfer agreement prior to negotiating the synchronous data transfer agreement. If a synchronous data transfer agreement is in effect, then after accepting a WIDE DATA TRANSFER REQUEST message, it resets the synchronous agreement to asynchronous mode.

The transfer width is expressed as 2^n where n is the transfer width in bytes. The transfer width that is established applies to all logical units. Valid transfer widths for the SuperLoader are 8 bits (m = 00h) and 16 bits (m = 01h). Values of m greater than 01h are reserved.

Chapter 3

Media Changer Commands

This chapter describes the Media Changer SCSI protocol features implemented by the Media Changer device of the SuperLoader system. Note that the sections included in this chapter do not fully reiterate every ANSI SCSI option and/or command code specification; the sections do describe the supported commands and options.

Overview of Command and Status Processing

The SCSI feature set has been described as “SCSI-2 plus.” This means the SuperLoader supports:

- All of the mandatory features of SCSI-2
- Many of the optional features of SCSI-2
- Some of the mandatory and optional features of SCSI-3

When conflicts arise between the features of SCSI-2 and SCSI-3, the SCSI-2 methods have been chosen in all cases where execution would differ without explicit knowledge of the host. That is, if a command would act differently in SCSI-3 implementation without any difference in the actual CDB, the SCSI-2 functionality is used. If SCSI-3 defined a new functionality of a command but only with a new field or value for a field as defined by a SCSI-3 document, this functionality may have been implemented. Please see individual command descriptions for the SCSI-3 features that have been implemented.

The SuperLoader device supports the Media Changer commands listed in table 9.

Table 9 Supported Media Changer Commands

Command	Operation Code
Initialize Element Status Command (07h) on page 31	07h
Inquiry Command (12h) on page 32	12h
Load Unload Command (1Bh) on page 45	1Bh
Log Sense Command (4Dh) on page 46	4Dh
Mode Select (6) / (10) Command (15h / 55h) on page 66	15h / 55h
Mode Sense (6) / (10) Command (1Ah/ 5Ah) on page 74	1Ah / 5Ah
Move Medium Command (A5h) on page 89	A5h
Persistent Reserve In Command (5Eh) on page 91 (SCSI-3)	5Eh
Persistent Reserve Out Command (5Fh) on page 101 (SCSI-3)	5Fh
Position to Element Command (2Bh) on page 116	2Bh
Prevent/Allow Medium Removal (1Eh) on page 118	1Eh
Read Buffer Command (3Ch) on page 120	3Ch

Command	Operation Code
Read Element Status Command (B8h) on page 126	B8h
Release Element (10) Command (57h) on page 140	57h
Release Unit (6) Command (17h) on page 143	17h
Report Device Identifier Command (A3h) on page 145	A3h
Report LUNS Command (A0h) on page 148	A0h
Request Sense Command (03h) on page 151	03h
Reserve Element (10) Command (56h) on page 160 (SCSI-3)	56h
Reserve Element (6) Command (16h) on page 163	16h
Send Diagnostic Command (1Dh) on page 166	1Dh
Set Device Identifier Command (A4h) on page 168 (SCSI-3)	A4h
Test Unit Ready Command (00h) on page 170	00h
Write Buffer Command (3Bh) on page 171	3Bh

Media Changer Command Descriptions

The Media Changer commands are presented in alphabetical order. Because information about a particular command may span multiple pages, the command name is repeated, at the top of every page that concerns that command.

Throughout this manual, multiple bytes that contain information about specific command parameters are portrayed as shown in the example of the Parameter List Length field (bytes 7 and 8) of the MODE SELECT command shown as follows:

Bit Byte	7	6	5	4	3	2	1	0
(Bytes 0 - 6)								
7 - 8	(MSB) Parameter List Length (LSB)							

As shown, this sample indicates that the most significant bit (MSB) of the field is bit 7 of byte 7; the least significant bit is bit 0 of byte 8.

Initialize Element Status Command (07h)

The INITIALIZE ELEMENT STATUS command allows the media changer to check all assigned element addresses for volume and any other status relevant to that element address. The intent of this command is to enable the Initiator to get a quick response from a subsequent READ ELEMENT STATUS command. It may be useful to issue this command after a power failure, if a volume has been changed by an operator, or if configurations have been changed.

Figure 6 Initialize Element Status Command

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

Inquiry Command (12h)

The INQUIRY command allows the initiator to determine the kind of SCSI devices attached to its SCSI BUS. It causes a device that is attached to a SCSI BUS to return information about itself. The SuperLoader identifies itself as a media changer that implements the SCSI-2 protocol.

The media changer can provide three categories of data in response to an INQUIRY command: Standard Inquiry Data, Vital Product Data, and Command Support Data. Standard Inquiry Data contains basic data about the device. Vital Product Data comprises several pages of additional data. Each Vital Product Data page requires a separate INQUIRY command from the initiator. Command Support Data indicates the fields in the CDB that are supported by opcode. An INQUIRY command is not affected by, nor does it clear, a Unit Attention condition.

Figure 7 Inquiry Command

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (12h)							
1	Logical Unit Number			Reserved			CmdDt	EVPD
2	Page Code							
3	Reserved							
4	Allocation Length							
5	Unused		Reserved				Flag	Link

Figure 8 Inquiry Command

Field	Description
CmdDt	Command Support Data. If CmdDt = 0 and EVPD (see below) = 0, the media changer returns the Standard Inquiry Data. If CmdDt = 1 with EVPD = 0, the media changer returns the Command Data specified by Page Code/ Operation. Information about Command Support Data is provided in figure 15 on page 43 and table 14 on page 43.
EVPD	Enable Vital Product Data. If EVPD = 0 and CmdDt (see above) = 0, the media changer returns the Standard Inquiry Data. If EVPD = 1 and CmdDt = 0, the media changer returns the Vital Product Data Page specified by Page Code/Operation Code.
Page Code or Operation Code	Specifies the Vital Product Data Page which is to be returned by the media changer when EVPD is set. Specifies the SCSI Operation Code for command support data to be returned by the media changer when CmdDt is set. A CHECK CONDITION status is returned if this field specifies an unsupported Page or Operation Code or if both EVPD and CmdDt are set. Figure 11 on page 39 shows the Page Codes for the Vital Product Pages supported by the media changer.
Allocation Length	Specifies the number of bytes of inquiry information the media changer is allowed to return to the initiator during the command's DATA IN phase. Error status is not returned if the value in this field truncates the requested information.

Standard Inquiry Data Page

Figure 9 shows the format of the Standard Inquiry Data page returned by the media changer.

Figure 9 Standard Inquiry Data (LTO)

Bit Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	RMB	Reserved						
2	Version							
3	AERC	Obsolete	NormACA	HiSup	Response Data Format			
4	Additional Length (n-4)							
5	SCCS	Reserved						
6	BQue	EncServ	Reserved	MultiP	MChngr	Obsolete	Obsolete	Add16
7	RelAdr	Obsolete	Wbus16	Sync	Linked	Obsolete	CmdQue	Reserved
8-15	Vendor Identification (QUANTUM)							
16-31	Product Identification (UHDL)							
32-35	Product Revision Level (hhss)							
36	Language							
37	Reserved				Image Type			
38-40	Reserved							
41	Firmware Personality							

Bit Byte	7	6	5	4	3	2	1	0
42	Firmware Subpersonality							
43	Vendor-Specific Subtype							

Figure 10 Standard Inquiry Data (DLT)

Bit Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	RMB	Device Type Modifier						
2	ISO Version		ECMA Version			ANSI Version		
3	AENC	TrmlOP	Reserved		Response Data Format			
4	Additional Length (27h)							
5	Reserved							
6	Rsv'd	MChangr	Reserved					
7	RelAdr	Wbus32	Wbus16	Sync	Linked	Rsv'd	CmdQue	SftRe
8-15	Vendor Identification (QUANTUM)							
16-31	Product Identification (UHDL)							
32-35	Product Revision Level (hhss)							
36-40	Reserved							

Bit Byte	7	6	5	4	3	2	1	0
41	Firmware Personality							
42	Firmware Subpersonality							
43	Vendor-Specific Subtype							

The following table contains field descriptions for the data returned by the media changer.

Table 10 Standard Inquiry Data (LTO and DLT)

Field Name	Value	Description
Peripheral Qualifier	0	Non-zero if initiator selects an invalid logical unit (see below)
Peripheral Device Type	8	8 indicates that this is a media changer device.
RMB	1	Removable Medium Bit. Set to 1.
Device Type Modifier (DLT)	0	This vendor specific field is set to 0.
Version (LTO)	2	ANSI SCSI Level 2 (SCSI-2) is supported.
ISO Version (DLT)	0	International Standardizaation Organization Version level. Set to 0.
ANSI Version (DLT)	2	ANSI SCSI Level 2 (SCSI-2) is supported.
AENC (DLT)	0	Asynchronous Event Notification is not supported.
AERC (LTO)	0	Asynchronous Event Notification is not supported.

Field Name	Value	Description
TrmlOP (DLT)	0	Terminate I/O Process. The media changer does not support the TERMINATE I/O PROCESS message.
NormACA (LTO)	0	The media changer does not support the NACA bit in the control byte of the CDB.
HiSup (LTO)	0	The hierarchical addressing model is not used.
Response Data Format	2	This Standard Inquiry Data is in SCSI-2 format.
Additional Length	27h	This field indicates the number of additional bytes of INQUIRY Response Data available.
SCCS (LTO)	0	This device does not contain an embedded storage array controller.
BQue (LTO)	0	Basic queueing is not supported.
EncServ (LTO)	0	This device does not contain an embedded enclosure services component.
MultiP (LTO)	0	This device does not implement multi-port requirements.
MChangr (LTO)	0	This device is not an attached media changer.
MChnger (DLT)	0	Set to 1 if a Media changer (loader) is present and EEPROM parameter EnblngMedChgr is set to 1. this SCSI-3 bit indicates that the Read Element Status and Move Medium commands can be issued to the drive (LON0). By default, this bit is set to 0.
Add16 (LTO)	1	This devices supports 16-bit wide SCSI addresses.
RelAdr	0	This device does not support relative addressing.
WBUS32 (DLT)	0	Set to 0 since the media changer does not support 32-bit transfer.
WBUS16	1	This device supports 16-bit wide data transfers.
Sync	0	This devices does not support synchronous data transfers.

Field Name	Value	Description
Linked	1	This device supports linked commands.
CmdQue	0	This device does not support command queueing.
SftRe	0	The hard reset option is implemented in response to assertion of the SCSI BUS reset line.
Vendor Identification (QUANTUM)		Identification of vendor.
Product Identification (UHDL)		Identification of the product
Product Revision Level (hhss)		This field contains 4 bytes of ASCII data that provides the media changer's firmware revision level.
Language (LTO)		This field indicates the language used for the front panel and On-board Remote Web Management.
Image Type		This field indicates the type of firmware image required when downloading a new image. SuperLoader LTO reports a 1 and SuperLoader DLT reports a 0.
Firmware Personality		Numeric indicator of firmware personality. Note that when set to 4, this indicates OEM family.
Firmware Subpersonality		Set to 1, indicating standard SCSI device firmware.
Vendor-Specific Subtype		Identification of product.

Vital Product Data Page

The following sections describe the Vital Product Data Pages for the system.

Supported Vital Product Data Page

The Supported Vital Product Data Pages page provides a directory of the Vital Product Data Pages that are supported by the SuperLoader.

Figure 11 Supported Vital Product Data

Bit Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (00h)							
2	Reserved							
3	Page Length (03h)							
4	00h - (this page)							
5	80h - Unit Serial Number Page							
6	83h – Device Identification Page							

Figure 12 Unit Serial Number Page (80h)

Bit Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (80h)							

Bit Byte	7	6	5	4	3	2	1	0
2	Reserved							
3	Page Length (0Eh)							
4 - 17	Serial Number							

Table 11 Unit Serial Number Page Field Descriptions

Field Name	Description
Serial Number	The serial number given is the serial number of the media changer typically starting with “PM” indicating the site of manufacture.

Figure 13 Device Identification Page (83h)

Bit Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (83h)							
2	Reserved							
3	Page Length							
4 - n	Identification Descriptors							

There are three different Identification Descriptors returned, in numerical order of the Identifier Type. Each Identification Descriptor takes the following form:

Figure 14 Identifier Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved				Code Set			
1	Reserved		Association		Identifier Type			
2	Reserved							
3	Identifier Length (n-3)							
4 - n	Identifier							

Table 12 Identifier Descriptor Field Descriptions

Field Name	Field Description
Code Set	Indicates the type of data to be found in the Identifier field. A value of 1 indicates binary data. A value of 2 indicates ASCII data.
Association	Indicates whether the Identifier is associated with the logical unit or the port. Always contains a 0, indicating the Identifier is associated with the logical unit.
Identifier Type	Type of identifier.

Field Name	Field Description	
	Value	**Description**
	1	Concatenation of the Vendor Name, Product ID, and unit serial number
	2	Canonical form of the IEEE Extended Unique Identifier, 64 bit (EIU-64)
	3	FC-PH Name_Identifier
Identifier	Identifier data, based on the Identifier Type.	

The following table describes the identifiers supported by the SuperLoader.

Table 13 Supported Identifiers

Identifier Type	Code Set	Length	Identifier
1	2	24	QUANTUM UHDL, 12 ASCII space characters (20h), followed by the unit serial number in ASCII.
2	1	8	8 bytes of binary data indicating the EUI-64 assigned to the drive.
3	1	8	8 bytes of binary data indicating the 64-bit, type 3, FC-PH Name_Identifer assigned to the drive.

Command Support Data

An application client can request command support data by setting the CmdDt bit of the INQUIRY command to 1, and specifying the SCSI operation code of the Command Descriptor Block (CDB) for which it wants information.

The format of the command support data and definitions of the fields follow.

Figure 15 Command Support Data Page

Bit Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Reserved					Support		
2	ISO Version		ECMA Version			ANSI - Approved Version		
3 - 4	Reserved							
5	CDB Size (m - 5)							
6 - n	CDB Usage Data							

Table 14 Command Support Data Page

Field Name	Description	
Support	The value of the Support field describes the type of support that the tape drive provides for Command Support Data.	
	Value	Description
	000b	Data about the requested SCSI operation code is not currently available. In this case, all data after Byte 1 is undefined.
	001b	The device does not support the SCSI operation code requested. In this case, all data after Byte 1 is undefined.
	010b	Reserved
	011b	The device supports the SCSI operation code in conformance with the SCSI standard.

Field Name	Description	
	100b	Vendor-Specific
	101b	The device supports the SCSI operation code, but in a vendor-specific manner.
	110b	Vendor-Specific
	111b	Reserved
ISO-Version	Must be 0.	
ECMA-Version	Must be 0.	
ANSI-Approved Version	2.	
CDB Size	This field contains the number of bytes in the CDB for the Operation Code being requested and the size of the CDB Usage Data in the data that is returned in response to the INQUIRY.	
CDB Usage Data	This field contains information about the CDB for the Operation Code being queried. Note that the first byte of the CDB Usage Data contains the OpCode for the operation specified. All of the other bytes of the CDB Usage Data contain a map for bits in the CDB of the OpCode specified.	
NOTE: The bits in the map have a 1-to-1 correspondence to the CDB for the OpCode being queried. That is, if the device senses a bit as the entire field or as part of the field of the operation, the map in CDB Usage Data contains a 1 in the corresponding bit position. If the device ignores a bit or declares a bit as “reserved” in the CDB for the OpCode being queried, the map has a 0 in that corresponding bit position.		

Load Unload Command (1Bh)

The LOAD UNLOAD command tells the target to eject all magazines. If no magazines are present, UNLOAD returns a CHECK CONDITION status with an ILLEGAL REQUEST sense key.

This command will eject the magazine(s) regardless of the setting via the PREVENT/ALLOW MEDIUM REMOVAL command.

Figure 16 Load Unload Command Descriptor Block

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Bh)							
1	Logical Unit Number			Reserved				Immed
2 - 4	Reserved							
5	Unused			Reserved			Flag	Link

Table 15 Unload Command Descriptor Block

Field Name	Description
Immed	Immediate. If this bit is set to 1, status is returned as soon as the operation is started. If set to 0, status is returned after the operation has completed.

Log Sense Command (4Dh)

The LOG SENSE command allows the host to retrieve statistical information maintained by the media changer about its own hardware parameters.

Figure 17 LOG SENSE Command Descriptor Block

Bit Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (4Dh)							
1	Logical Unit Number			Reserved			PPC (0)	SP(0)
2	PC		Page Code					
3 - 4	Reserved							
5 - 6	(MSB) Parameter Pointer (LSB)							
7 - 8	(MSB) Allocation Length (LSB)							
9	Unused		Reserved				Flag	Link

Table 16 Log Sense Command Descriptor Block

Field Name	Description	
PPC	Parameter Pointer Control. A PPC of 0 indicates that the parameter data requested from the device starts with the parameter code specified in the Parameter Pointer field (Bytes 5 - 6) and returns the number of bytes specified in the Allocation Length field (Bytes 7 - 8) in ascending order of parameter codes from the specified log page. Request for changed parameters is not supported. This field must be 0.	
SP	Save Parameters. Not supported, must be set to 0. If for some reason the Save Parameters bit is set, the command terminates with a CHECK CONDITION status with a sense key of ILLEGAL REQUEST and an ASC of INVALID FIELD IN CDB.	
PC	Page Control. This field defines the type of parameter values to be returned:	
	PC	**Type of Parameter Values**
	00b	Threshold Values
	01b	Cumulative Values
	10b	Default Threshold Values
	11b	Default Cumulative Values
	The Default Threshold Values are the maximum values that each parameter can attain. The Current Cumulative Values are the values computed since the last reset of the device (either via power-cycle, BUS DEVICE RESET, or SCSI RESET.) The Default Cumulative Values are the values to which each parameter is initialized at a reset condition. Default values are zero. By default, Current Threshold Values = Default Threshold Values.	
Page Code	The Page Code field identifies which log page is being requested by the initiator. If the page is not supported, then the command terminates with a CHECK CONDITION status, sense key set to ILLEGAL REQUEST, and additional sense code of INVALID FIELD IN CDB. Supported pages are:	

<table>
<tr><th>Field Name</th><th colspan="2">Description</th></tr>
<tr><td></td><td>Page Code</td><td>Page Definition</td></tr>
<tr><td></td><td>00h</td><td>Supported Pages Log Page (Page 00h) on page 49</td></tr>
<tr><td></td><td>07h</td><td>Last n Error Events Page (07h) on page 50</td></tr>
<tr><td></td><td>2Eh</td><td>TapeAlert Page (2Eh) on page 52 (LTO only)</td></tr>
<tr><td></td><td>30h</td><td>Move Statistics Page (30h) on page 54</td></tr>
<tr><td></td><td>31h</td><td>Hard/Soft Error Statistics Page (31h) on page 56</td></tr>
<tr><td></td><td>33h</td><td>Device Wellness Page (33h) on page 59</td></tr>
<tr><td></td><td>3Eh</td><td>Device Status Page (3Eh) on page 62</td></tr>
<tr><td>Parameter Pointer</td><td colspan="2">SDLT and DLT must be 0.

For LTO only: The Parameter Pointer field allows the host to specify at which parameter within a log page the requested data should begin. For example, if a page supports parameters 0 through 5, and the Parameter Pointer contains 3, then only parameters 3, 4, and 5 are returned to the initiator. Similarly, if a page supports parameters 1, 3, and 6, and the Parameter Pointer contains 2, then only parameters 3 and 6 are returned to the initiator.

If the Parameter Pointer is larger than the highest numbered parameter on the page, then the target terminates the command with CHECK CONDITION status, sense key set to ILLEGAL REQUEST, and additional sense code set to INVALID FIELD IN CDB.

Note that parameters within a page are always returned in ascending order according to parameter code.

If the target does not support a parameter code within this page, then it does not return any data associated with this parameter.</td></tr>
<tr><td>Allocation Length</td><td colspan="2">This field specifies the maximum number of bytes that the initiator has allocated for returning data. The host uses this field to limit the size of data transfers to its own internal buffer size.</td></tr>
</table>

Supported Pages Log Page (Page 00h)

When page 00h is requested, the 4-byte page header is returned, followed by the pages supported in ascending order, one byte for each.

Figure 18 Supported Pages Page

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code (00h)					
1	Reserved							
2 – 3	(MSB) Page Length (7h) (LSB)							
4	00h							
5	07h							
6	2Eh							
7	30h							
8	31h							
9	33h							
10	3Eh							

Last n Error Events Page (07h)

This page returns the ASCII text for the hard error event log. This page consists of a page header, a parameter header and parameter value. The parameter value returned consists of the ASCII text for the EEROM Hard Error Log.

Figure 19 Last n Error Events Log Sense Header

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code (07h)					
1	Reserved							
2 - 3	(MSB) Page Length (n) (LSB)							

Table 17 Last n Error Events Log Sense Header

Field Name	Description
Page Code	The Page Code echoes the page code that was specified in the LOG SENSE command descriptor block.
Page Length	The Page Length field specifies the total number of bytes contained in this log page, not including the four bytes that make up the header.

Figure 20 Format for Last n Error Events Log Sense

Bit Byte	7	6	5	4	3	2	1	0
0 -1	(MSB) Parameter Code (LSB)							
2	DU	DS	TSD	ETC	TMC		Rsv'd	LP
3	Parameter Length							
4 - n	(MSB) ASCII String for Event n (LSB)							

Table 18 Parameters Last n Error Events Log Sense

Field Name	Description
Parameter Code	The Parameter Code value represents the relative time at which the error occurred. It identifies the log parameter being transferred for that log page. Only the most recent 10 events are reported in the SuperLoader LTO and 5 events for the SuperLoader DLT..
DU	Disable Update. Not supported, always 0.
DS	Disable Save. Not supported, always 1.
TSD	Target Save Disable. Not supported, always 1.
ETC	Enable Threshold Comparison. Not supported, always 0.
TMC	Threshold Met Criteria. Not supported, always 0.

Field Name	Description
LP	List Parameter. This bit is set to 1.
Parameter Length	The length in bytes of the following parameter value.
ASCII Strong for Event n	The text includes the time of the event, the error code indentifying the event, and additional data specific to the event.

TapeAlert Page (2Eh)

The TapeAlert Log page defines error and informational flags for detailed device diagnostics. The TapeAlert data is event-based and the page control bits in the LOG SENSE command are not applicable and are ignored.

The SuperLoader LTO supports the definition of the flags for media changer devices as defined in SMC-2.

The SuperLoader DLT only supports the reporting of the TapeAlert Log page on logical unit 0. It supports the combined drive and media changer flags are defined in SSC-2.

Figure 21 TapeAlert Log Sense Header Format

Bit Byte	7	6	5	4	3	2	1	0
0	Page Code (2Eh)							

Bit Byte	7	6	5	4	3	2	1	0
1	Reserved							
2 - 3	(MSB) Page Length (LSB)							

Table 19 TapeAlert Log Sense Header Field Descriptions

Field Name	Description
Page Code	The Page Code echoes the page code that was specified in the LOG SENSE command descriptor block.
Page Length	The Page Length field specifies the total number of bytes contained in this log page, not including the four bytes that make up the header.

Figure 22 TapeAlert Page Log Parameters Format

Bit Byte	7	6	5	4	3	2	1	0
5*n* – 1 to 5*n*	MSB Parameter Code (*n*) (LSB)							
5*n* + 1	DU	DS	TSD	ETC	TMC		Rsv'd	LP

Bit Byte	7	6	5	4	3	2	1	0
5*n* + 2	Parameter Length							
5n + 3	Value of TapeAlert Flag (Flag is set when Bit 0 = 1; Bits 1 - 7 are Reserved)							

Table 20 TapeAlert Page Log Parameters

Field Name	Description
Parameter Code	This field contains the Flag code.
Parameter Length	This field is set to 1.
Value of TapeAlert Flag	If Bit 0 is set to 1, indicates that TapeAlert has sensed a problem. If Bit 0 is 0, the Flag is not set and no problem has been sensed.

Move Statistics Page (30h)

This page consists of the Log Page Header followed by a count of various movements of cartridges within the system. The entries in the log page are cumulative throughout the life of the unit and cannot be reset via SCSI or power cycle. Log Parameters are not supported for this page.

Figure 23 Move Statistics Format

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code (30h)					
1	Reserved							

Bit Byte	7	6	5	4	3	2	1	0
2 - 3	(MSB) Page Length (18h) (LSB)							
4-7	(MSB) Total Moves (LSB)							
8-11	(MSB) Drive Loads (LSB)							
12-15	(MSB) Mail Slot Imports (LSB)							
16-19	(MSB) Mail Slot Exports (LSB)							
20-23	(MSB) Magazine Moves (LSB)							
24-27	(MSB) Magazine Loads (LSB)							

Table 21 Move Statistics

Field Name	Description
Page Code	The page code is 30h.
Page Length	The page length is 18h bytes.
Total Moves	Total number of SuperLoader moves.
Drive Loads	Number loads to the drive from magazines and mail slot.
Mail Slot Imports	Number times a cartridge was importing into the system.
Mail Slot Exports	Number of times a cartridge was exported from the system.
Magazine Moves	Number of moves between storage slots.
Magazine Loads	Number of times a cartridge was moved from a storage slot to the drive.

Hard/Soft Error Statistics Page (31h)

This page consists of the Log Page Header followed by a count of recovery actions performed. The entries in this log page are cumulative throughout the life of the unit and cannot be reset via SCSI or power cycle. Log Parameters are not supported for this page. These numbers, in relation to the total number of moves performed, can provide an indication as to the health of the servo system.

Figure 24 Hard/Soft Move Error Statistics Format

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code (31h)					
1	Reserved							
2 - 3	(MSB) Page Length (22h) (LSB)							
4-5	(MSB) Servo Hard Errors (LSB)							
6-9	(MSB) Drive Soft Error (LSB)							
10-13	(MSB) Left Magazine Soft Error (LSB)							
14-17	(MSB) Right Magazine Soft Error (LSB)							
18-21	(MSB) Mail Slot Soft Error (LSB)							

Bit Byte	7	6	5	4	3	2	1	0
22-25	(MSB) Rotation Recovery Actions (LSB)							
26-29	(MSB) Translation Recovery Actions (LSB)							
30-33	(MSB) Left Magazine Recovery Actions (LSB)							
34-37	(MSB) Right Magazine Recovery Actions (LSB)							

Table 22 Hard/Soft Error

Field Name	Description
Page Code	The page code is 31h.
Page Length	The page length is 22h bytes.
Servo Hard Errors	The number of unrecoverable errors.
Soft Errors	Each field is a count of the number of times high-level recoverable error was reported for that component.
Recovery Actions	Each field is a count of the number of times recovery actions were required in that axis to perform an operation.

Device Wellness Page (33h)

The Device Wellness Page returns information about any check conditions related to Sense Keys 4 and 9 logged by the media changer. Up to 16 entries (parameter code 0000h to 000Fh) can be contained in the page. Each entry records a hardware error (Sense Key = 4) or a code update event (Sense Key = 9). Note that parameter code 000h contains the oldest log information while parameter 000Fh contains the most recent.

This page begins with a 4-byte header followed by the log parameter blocks.

Figure 25 Device Wellness Log Sense Header

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code (33h)					
1	Reserved							
2 - 3	(MSB) Page Length (LSB)							

Table 23 Device Wellness Log Sense Header

Field Name	Description
Page Code	The Page Code echoes the page code that was specified in the LOG SENSE command descriptor block.
Page Length	The Page Length field specifies the number of bytes available and depends on the parameters requested.

Figure 26 Device Wellness Log Sense (0000h-000Fh)

Bit Byte	7	6	5	4	3	2	1	0
0-1	(MSB) Parameter Code (LSB)							
2	DU	DS	TSD	ETC	TMC		Rsv'd	LP
3	Parameter Length (0Ch)							
4-7	(MSB) Time Stamp (LSB)							
8 - 9 (LTO only)	(MSB) Source Element (LSB)							
10 - 11 (LTO only)	(MSB) Destination Element (LSB)							
8-11 (SDLT/ DLT only)	Media ID							
12	Sense Key							
13	Additional Sense Code							

Bit Byte	7	6	5	4	3	2	1	0
14	Additional Sense Code Qualifier							
15	Additional Error Information							

Figure 27 Log Parameters for Device Wellness Log Sense

Field Name	Description
Parameter Code	Parameter Codes 0000h through 000Fh are supported. This provides 16 log entries for error information capture.
DU	Disable Update. Always 0.
DS	Disable Save. Not supported. This bit always set to 1.
TSD	Target Save Disable. Not supported. This bit always set to 1.
ETC	Enable Threshold Comparison. Threshold checking is not supported on this page. Always set to 0.
TMC	Threshold Met Criteria. Always 0.
LP	List Parameter. Always set to 0.
Parameter Length	The number of bytes to follow (0Ch).
Time Stamp	LTO: The Time Stamp is represented as number of power cycles and total power on hours. SDLT/DLT: Tape motion hours when check condition occurred (note that this is the number of power-on hours since the last time the unit was powered on, not total number of hours during the lifetime of the drive). The time stamp counter is updated once per hour; if the tape drive is powered down before the hourly update occurs, the update will not occur until a full hour after power is reapplied.

Field Name	Description
Media ID	SDLT/DLT only: Internal media identifier being used when check condition occurred. 0 = no media or unknown media when event occurred. Note that this is not an applicable means of tracing media.
Source Element/ Destination Element	LTO only: These fields report the element addresses that were involved in the failure. These fields will be zero (0) if the failure did not involve a move command.

Device Status Page (3Eh)

The Device Status Page describes the current status of the media changer.

Figure 28 Device Status Log Sense Header

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code (3Eh)					
1	Reserved							
2 - 3	(MSB) Page Length (LSB)							

Table 24 Device Status Log Sense Header

Field Name	Description
Page Code	The Page Code echoes the page code that was specified in the LOG SENSE command descriptor block.
Page Length	The Page Length field specifies the number of bytes available and depends on the parameters requested.

Figure 29 Parameters for Device Status Log Sense Page

Bit Byte	7	6	5	4	3	2	1	0
0 - 1	Parameter Code							
2	DU	DS	TSD	ETC	TMC		Rsv'd	LP
3	Parameter Length (04h)							
4 - 7	(MSB) Parameter Value (LSB)							

Table 25 Parameters for Device Status Log Sense Page

Field Name		Description
Parameter Code		Parameter Codes 0000h through 0004h are supported:
	Code	**Description**

Field Name		Description
	0000h	Specifies device type. This value is always 0h.
	0001h	Specifies device status (figure 30).
	0002h	Specifies the number of move operations over the lifetime of the device.
	0003h	Reserved for media changer device and shall contain 0.
	0004h	Vendor specific
DU		Disable Update. Always 0.
DS		Disable Save. Not supported. This bit always set to 1.
TSD		Target Save Disable. Not supported. This bit always set to 1.
ETC		Enable Threshold Comparison. Threshold checking is not supported on this page. Always set to 0.
TMC		Threshold Met Criteria. Always 0.
LP		List Parameter. Always set to 0 (parameter codes treated as data counter).

Figure 30 Device Status Log Sense Page (0001h)

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							
1	Reserved				Temperature		Status	
2 - 3	Reserved							

Table 26 Device Status Log Sense (0001h)

Field Name	Description		
Temperature	These two bits indicate the temperature of the device. This field follows the following format:		
	Bit 3	Bit 2	Description
	0	0	Not supported
	0	1	OK
	1	0	Warning: Safe temperature exceeded.
	1	1	Maximum temperature exceeded.
Status	These two bits indicate the overall condition of the device. The status of the device follows the following format:		
	Bit 1	Bit 0	Description
	0	0	Not supported
	0	1	OK
	1	0	Degraded
	1	1	Failed

Mode Select (6) / (10) Command (15h / 55h)

The MODE SELECT command (available in either 6- or 10-byte format) enables the host to configure the media changer. Implementing MODE SELECT and MODE SENSE requires "handshaking" between the host and the media changer. Before configuring the media changer, the host should issue a MODE SENSE command to the media changer to obtain a report of the current configuration and determine what parameters are configurable. The host interprets this information and then may issue MODE SELECT to set the media changer to the host's preferred configuration. The Mode Parameter List described in Mode Parameter List on page 68 is passed from the initiator to the media changer during the command's DATA OUT phase. The media changer device does not allow the host to save any values on any page.

Information for the media changer is carried on a number of pages, each of which serves to set the media changer's operating parameters. The MODE SELECT pages supported, and the page within this manual that details each, are:

Page Code	Description
1Ch	TapeAlert Page (1Ch) on page 79 (LTO only)
1Dh	Element Address Assignment Page on page 82
1Eh	Transport Geometry Parameters Page on page 85
1Fh	Device Capabilities Page on page 86

Figure 31 Mode Select (6) Command Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (15h)							
1	Logical Unit Number			PF	Reserved			SP (0)
2 – 3	Reserved							
4	Parameter List Length							
5	Unused (00)		Reserved				Flag	Link

Figure 32 Mode Select (10) Command Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (55h)							
1	Logical Unit Number			PF	Reserved			SP (0)
2 – 6	Reserved							
7 - 8	Parameter List Length							
9	Unused (00)		Reserved				Flag	Link

Table 27 Mode Select (6)/(10) Command Descriptor

Field Name	Description
PF	Page Format. The Page Format bit indicates that the data sent by the host after the MODE SELECT header and block descriptors complies with the definition of pages in the SCSI-2 specification. The SCSI-1 format will not be implemented so this bit must be set to 1. It is an ILLEGAL REQUEST to have page parameters while the PF bit is 0.
SP	Save Parameters. Must be 0. If set, this bit instructs the SuperLoader to save all savable pages, and this is not supported.

Mode Parameter List

The following figure shows the format of the Mode Parameter List that is passed by the initiator to the media changer during the command's DATA OUT phase.

Figure 33 Mode Select (6) Mode Parameter List

Bit Byte	7	6	5	4	3	2	1	0
0 - 3	Mode Parameter Header							
4 - 11	Mode Parameter Block Descriptor (Optional)							
4 – 11 or 12 - n	Page(s) (Optional)							

Figure 34 Mode Select (10) Mode Parameter List

Bit Byte	7	6	5	4	3	2	1	0
0 - 7	Mode Parameter Header							
8 - 15	Mode Parameter Block Descriptor (Optional)							
8 - n or 16 - n	Page(s) (Optional)							

Table 28 Mode Select Parameter List

Field Name	Description
Mode Parameter Header	4 or 8 bytes in length, contains information about the remainder of the Parameter List and is always present.
Mode Parameter Block Descriptor	8 bytes in length; not applicable to a media changer device.
Page(s)	The Page Code(s) of the pages that are a part of this MODE SELECT command.

Mode Parameter Header

The figures and table that follow provide an illustration and description of the fields that make up the MODE SELECT command's Mode Parameter header.

Figure 35 Mode Select (6) Parameter Header

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							
1	Reserved							
2	Reserved							
3	Block Descriptor Length							

Figure 36 Mode Select (10) Parameter Header

Bit Byte	7	6	5	4	3	2	1	0
0 - 1	Reserved							
2	Reserved							
3	Reserved							
4 - 5	Reserved							
6 - 7	Block Descriptor Length							

Table 29 Mode Select Parameter Header

Field Name	Description
Block Descriptor Length	This field specifies the length in bytes of all the block descriptors. Since the media changer only allows one block descriptor, the value must be either 0 or 8. A value of 0 indicates no block description is included; a value of 8 indicates a block descriptor is present and precedes the mode page data. Any other value other than 0 or 8 causes a CHECK CONDITION status with sense key of ILLEGAL REQUEST to be returned.

Mode Parameter Block Descriptor

The figure and table that follow provide an illustration and description of the fields that make up the MODE SELECT command's Mode Parameter Block Descriptor.

Figure 37 Mode Select Parameter

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							
1 - 3	(MSB) Number of Blocks (LSB)							
4	Reserved							
5 - 7	(MSB) Block Length (LSB)							

Table 30 Mode Select Parameter Block

Field Name	Description
Number of Blocks	This field is sent as 0. It is not applicable to media changer devices.
Block Length	This field is sent as 0. It is not applicable to media changer devices.

Mode Page Descriptors

Following the MODE SELECT command's Mode Parameter Block Descriptor are the MODE SELECT pages, each of which sets a different device parameter. Each mode page has a 2-byte header that identifies the page code and indicates the number of bytes in that page.

Figure 38 Mode Select Page Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code					
1	Additional Page Length							
2 - *n*	Page-Defined or Vendor Specific Parameter List							

Table 31 Mode Select Page Descriptor

Field Name	Description
PS	Parameters Savable. For the MODE SELECT (6) (10) commands, this field is reserved (0).
Additional Page Length	Indicates number of bytes in that page (not including bytes 0 and 1).
Page-Defined or Vendor Specific Parameter List	Information in this field depends on the mode page. Refer to Element Address Assignment Page on page 82 to Device Capabilities Page on page 86.

Mode Sense (6) / (10) Command (1Ah/ 5Ah)

The MODE SENSE command allows the media changer to report its current or changeable configuration parameters to the host. It is a complementary command to MODE SELECT.

The command descriptor block for the 6-byte MODE SENSE (1Ah) is shown below. An illustration of the command descriptor block for the 10-byte MODE SENSE (5Ah) follows on the next page.

Figure 39 Mode Sense (6) Command Descriptor Block

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Ah)							
1	Logical Unit Number			Rsv'd	DBD	Reserved		
2	PC		Page Code					
3	Reserved							
4	Allocation Length							
5	Unused		Reserved				Flag	Link

The MODE SENSE (10) command returns descriptor data in a different format than MODE SENSE (6).

Figure 40 Mode Sense (10) Command Descriptor Block

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (5Ah)							
1	Logical Unit Number			Rsv'd	DBD	Reserved		
2	PC		Page Code					
3 – 6	Reserved							
7 - 8	(MSB) Allocation Length (LSB)							
9	Unused		Reserved				Flag	Link

Table 32 Mode Sense Command Descriptor Block

Field Name	Description	
DBD	Disable Block Descriptors. This field is ignored. This device does not return a block descriptor regardless of this field.	
PC	Page Control. The Page Control field indicates the type of page parameter values to be returned to the host:	
	PC	**Type of Parameter Values**
	00	Report Current Values
	01	Report Changeable Values

Field Name	Description	
	10	Report Default Values
	11	Report Saved Values
	Note that the media changer device does not support saved values.	
Page Code	This field allows the host to select any specific page or all of the pages supported by the media changer.	
	Page Code	**Description**
	1Ch	TapeAlert Page (1Ch) on page 79 (LTO only)
	1Dh	Element Address Assignment Page on page 82
	1Eh	Transport Geometry Parameters Page on page 85
	1Fh	Device Capabilities Page on page 86
	3Fh	Return all pages
Allocation Length	This field specifies the number of bytes that the host has allocated for returned MODE SENSE data. An allocation length of zero indicates that the media changer will return no MODE SENSE data. This is not considered an error, and GOOD status is returned.	

MODE SENSE may be either MODE SENSE (6) or MODE SENSE (10). MODE SENSE (6) data contains a 4-byte header followed by one 8-byte block descriptor, followed by zero or more variable length pages, depending on the Page Code and Allocation Length.

Mode Sense Data Headers

The MODE SENSE (6) and MODE SENSE (10) headers are illustrated in the following figures.

Figure 41 Mode Sense (6) Data Header

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

Figure 42 Mode Sense (10) Data Header

Bit Byte	7	6	5	4	3	2	1	0
0 - 1	(MSB) Mode Sense Data Length (LSB)							
2	Reserved							
3	Reserved							
4 - 5	Reserved							
6 - 7	(MSB) Block Descriptor Length (0) (LSB)							

Table 33 Mode Sense Data Heade

Field Name	Description
Mode Sense Data Length	This field specifies the length (in bytes) of the MODE SENSE data that is available to be transferred during the DATA IN phase. Note that the Mode Sense Data Length does not include itself.
Block Descriptor Length	This field specifies the length (in bytes) of all of the block descriptors. This value will be 0, indicating no Block Descriptors were sent.

Mode Sense Mode Pages

The following figure depicts the variable length page descriptor.

Figure 43 Mode Sense Page Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	PS	0	Page Code					
1	Additional Page Length							
2	Page Defined or Vendor Specific Parameter Bytes							

Descriptions of the MODE SENSE page descriptor fields are provided in the following table. Detailed descriptions of each of the MODE SENSE Pages follow.

Table 34 Mode Sense Page Descriptor

Field Name	Description
PS	Parameters Savable. When 0, the supported parameters cannot be saved (savable pages are not supported). When set to 1, it indicates that the page can be saved in nonvolatile memory by the media changer.
Additional Page Length	This field indicates the number of bytes in the page. Note that this value does not include bytes 0 and 1. The length is returned on MODE SENSE and must subsequently be set to the same value when performing MODE SELECT.

TapeAlert Page (1Ch)

LTO only: The SuperLoader supports the TapeAlert Page that is used to set/change the supported TapeAlert configuration options. Use the MODE SENSE command to read the settings of the TapeAlert page.

Figure 44 TapeAlert Page Format Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code (1Ch)					
1	Additional Page Length (0Ah)							
2	Perf	Reserved			DExcpt	Test	Rsvd	LogErr
3	Reserved				MRIE			

Bit Byte	7	6	5	4	3	2	1	0
4 - 7	(MSB) Interval Timer (LSB)							
8 - 11	MSB) Report Count/Test Flag Number (LSB)							

Table 35 TapeAlert Page Format Descriptor

Field Name	Description
PS	Parameters Savable. Not supported, this bit must be 0.
Additional Page Length	This field indicates the number of bytes in the page. However, this value does not include bytes 0 and 1. The length is returned on MODE SENSE and must subsequently be set to the same value when performing MODE SELECT. If the page length does not match that expected by the drive, a CHECK CONDITION status is returned, sense key set to ILLEGAL REQUEST. The device returns a CHECK CONDITION status with sense key set to ILLEGAL REQUEST if it receivees an unsupported Page Code or a Page field with values not supported or changeable. In such cases, no parameters are changed as a result of the command.
Perf	Performance bit. Performance Impacting Exceptions are acceptable. This bit is ignored.
DExcpt	Disable Information Exception Operations. If = 0, the reporting method specified by the contents of MRIE is selected. When this bit is set to 1, all information exception conditions are disabled regardless of the contents for the MRIE field. To enable CHECK CONDITION mode, DExcpt should = 0. Default setting = 1.

Field Name	Description	
Test	Test bit. Used to generate false TapeAlert conditions to test the response to failure conditions. See the Report Count/Test Flag Number description for more information. If both Test and DExcpt are set to 1, the drive will return CHECK CONDITION status, with a send key ILLEGAL REQUEST, and additional sense data of INVALID FIELD IN PARAMETER LIST.	
LogErr	Error Log. Not supported.	
MRIE	Method for Reporting Information Exceptions. The tape drive uses the contents of this field to report information about exception conditions.	
	Value	**Method**
	00h	No reporting of Informational Exception Conditions. The device server does not report information exception conditions.
	03h	Conditionally Generate Recovered Error. The device server reports information exception conditions, if such reports of recovered errors is allowed, by returning CHECK CONDITION status on the next SCSI command (except INQUIRY and REQUEST SENSE commands) following detection of the condition. The Sense Key is set to RECOVERED ERROR with an additional sense code of 5D 00 (TapeAlert Event). The SCSI command with CHECK CONDITION completes without error prior to the report of any exception condition, and does not need to be repeated.
	04h	Unconditionally Generate Recoevered Error. The drive reports information exception conditions by returning CHECK CONDITION status on the next SCSI command (except INQUIRY and REQUEST SENSE commands) following detection of the condition. The Sense Key is set to RECOVERED ERROR with an additional sense code of 5D 00 (TapeAlert Event). The SCSI command with CHECK CONDITION completes without error prior to the report of any exception condition, and does not need to be repeated.

Field Name	Description	
	06h	Only Report Informational Exception Condition on Request. The device server preserves informational exception data. To access the data, a poll can be taken by issuing an unsolicited REQUEST SENSE command. The Sense Key is set to NO SENSE with an additional sense code of 5D 00 (TapeAlert Event). The additional sense code of 5D 00 for values 03h, 04h, and 06h signals that a TapeAlert event has occurred. Information about the event is stored in the TapeAlert Log Page. The setting of MRIE does not impact logging of events in the TapeAlert Log Page.
Interval Timer	Not supported.	
Report Count/Test Flag Number	Report Count or Test Flag Number. This field must be set to 0 unless the Test bit is set. When the Test bit is set, this field indicates that a test condition to be generated as follows:	
	Value	Result
	0	Change no TapeAlert Flag but report an exception condition based on the setting of the MRIE field.
	1 to 64	Set the TapeAlert flag indicated in the value and generate an exception condition based on the MRIE field.
	-1 to -64	Clear the TapeAlert flag in an equivalent manner to taking corrective action of indicated by the absolute number of the value.
	32767	Set all TapeAlert flags and generate and exception condition based on the setting of the MRIE field.

Element Address Assignment Page

The element address assignment page is used to report element address assignments to the host. This page also defines the number of each type of element present. None of the fields in this page are changeable.

Figure 45 Element Address Assignment Page

Bit Byte	7	6	5	4	3	2	1	0
0	PS (0)	RSVD	Page Code (1Dh)					
1	Parameter List Length (12h)							
2-3	(MSB) First Medium Transport Element Address (LSB)							
4-5	(MSB) Number of Medium Transport Elements (LSB)							
6-7	(MSB) First Storage Element Address (LSB)							
8-9	(MSB) Number of Storage Elements (LSB)							
10-11	(MSB) First Import/Export Element Address (LSB)							
12-13	(MSB) Number of Import/Export Address (LSB)							

Bit Byte	7	6	5	4	3	2	1	0
14-15	(MSB) First Data Transfer Element Address (LSB)							
16-17	(MSB) Number of Data Transfer Elements (LSB)							
18-19	Reserved							

Table 36 Element Address Assignment Page

Field Name	Description
First Medium Transport Element Address	Identifies the address of the first medium transport element contained in the media changer. The SuperLoader uses the default address of 0.
Number of Medium Transport Elements	Defines the total number of medium transport elements contained in the media changer. The SuperLoader contains 1.
First Storage Element Address	Identifies the address of the first medium storage element contained in the media changer.
Number of Storage Elements	Defines the total number of storage elements contained in the media changer. There are 16 total, although since the magazines are removable, 8 of them may be “inaccessible” at times.
First Import/Export Element Address	Identifies the address of the first import/export element that is accessible both by the medium transport device and also by an operator from outside the media changer.
Number of Import/Export Elements	Defines the total number of import/export elements contained in the media changer.

Field Name	Description
First Data Transfer Element Address	Identifies the address of the first data transfer element contained in the media changer. The first element is 0020h.
Number of Data Transfer Elements	Defines the total number of data transport elements contained in the media changer. The SuperLoader contains 1.

Transport Geometry Parameters Page

The transport geometry parameters page defines whether each medium transport element of a media changer is a member of a set of elements that share a common robotics subsystem and whether the element is capable of media rotation. One transport geometry descriptor is transferred for each medium transport element, beginning with the first medium transport element. None of the fields in the page are changeable.

Figure 46 Transport Geometry Parameters Page

Bit Byte	7	6	5	4	3	2	1	0
0	PS (0)	RSVD	Page Code (1Eh)					
1	Parameter Length (02h)							
2-n	Transport Geometry Descriptor(s)							

The geometry of each medium transport element is defined using a two-byte field as defined in figure 47.

Figure 47 Transport Geometry Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							Rotate
1	Member Number In Transport Element Set							

Table 37 Transport Geometry Parameters Page

Field Name	Description
Parameter length	Specifies the number of bytes of transport geometry descriptors to follow. This field has a value of 2.
Rotate	This bit is sent as 0. Rotation of the medium transport element is not supported.
Member Number in Transport Element Set	This field is sent as 0. There is only one medium transport element and robotic subsystem.

Device Capabilities Page

The device capabilities page defines characteristics of the element types of a media changer. This information may be employed by the initiator to determine functions permitted by the MOVE MEDIUM command. None of the fields in the page are changeable.

Figure 48 Device Capabilities Page

Bit Byte	7	6	5	4	3	2	1	0
0	PS (0)	RSVD	Page Code (1Fh)					
1	Parameter Length (12h)							
2	Reserved				STORDT (1)	STORI/E (0)	STORST (1)	STORMT (1)
3	Reserved							
4	Reserved				MT->DT (1)	MT->I/E (0)	MT->ST (1)	MT->MT (1)
5	Reserved				ST->DT (1)	ST->I/E (0)	ST->ST (1)	ST->MT (1)
6	Reserved				I/E->DT (0)	I/E->I/E (0)	I/E->ST (0)	I/E->MT (0)
7	Reserved				DT->DT (1)	DT->I/E (0)	DT->ST (1)	DT->MT (1)
8-11	Reserved							
12	Reserved				MT<>DT (0)	MT<>I/E (0)	MT<>ST (0)	MT<>MT (0)
13	Reserved				ST<>DT (0)	ST<>I/E (0)	ST<>ST (0)	ST<>MT (0)
14	Reserved				I/E<>DT (0)	I/E<>I/E (0)	I/E<>ST (0)	I/E<>MT (0)

Bit Byte	7	6	5	4	3	2	1	0
15	Reserved				DT<>DT (0)	DT<>I/E (0)	DT<>ST (0)	DT<>MT (0)
16-19	Reserved							

The field names in figure 48 on page 87 use the following element type abbreviations:

- MT — a medium transport element
- ST — a storage element
- I/E — an import/export element
- DT — a data transfer element

In the descriptions, XX and YY are any of the element type abbreviations.

Table 38 Device Capabilities Page

Field Name	Description
PS	Parameters Savable. This bit is reserved for MODE SELECT and must be 0. Saved parameters are not supported and must be 0 for MODE SENSE.
STORXX	These bits are sent as 1 for all element types to indicate that each element type provides storage for a unit of media.
XX->YY	These bits are sent as 1 for all element types to indicate that the media changer supports all MOVE MEDIUM commands between all types of elements.
XX<>YY	These bits are sent as 0 to indicate that the media changer does not support the EXCHANGE MEDIUM command for any combination of element types.

Move Medium Command (A5h)

The MOVE MEDIUM command requests that the SuperLoader move a volume from a source element to a destination element.

Figure 49 Move Medium Descriptor Block

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (A5h)							
1	Logical Unit Number			Reserved				
2-3	(MSB) Medium Transport Address (LSB)							
4-5	(MSB) Source Address (LSB)							
6-7	(MSB) Destination Address (LSB)							
8-9	Reserved							
10	Reserved							INV
11	Unused		Reserved				Flag	Link

If the Source Address element is empty, the target shall return CHECK CONDITION status. The sense key shall be ILLEGAL REQUEST and the additional sense code Medium Source Element Empty. If the Destination Address element is full, and different from the Source Address element, the target shall return CHECK CONDITION status. The sense key shall be ILLEGAL REQUEST and the additional sense code Medium Destination Element Full.

Table 39 Move Medium Command

Field Name	Description
Medium Transport Address	Must be set to 0. Specifies the medium transport element that is to be used in executing this command.
Source Address Destination Address	These fields can be any valid element address. If it is not valid, the media changer shall return CHECK CONDITION status. The sense key shall be ILLEGAL REQUEST and the additional sense code INVALID ELEMENT ADDRESS.
INV	Must be set to 0. Inverting and rotating are not supported.

The device capabilities MODE SENSE page provides a matrix with the supported source element or destination element combinations for the MOVE MEDIUM command.

Persistent Reserve In Command (5Eh)

The PERSISTENT RESERVE IN command is a 10-byte command used to obtain information about persistent reservations and registrations that are active within a device server. It is used in conjunction with the PERSISTENT RESERVE OUT command.

The following figure illustrates the format of the PERSISTENT RESERVE IN command; the table that follows explains the data fields of the command.

Figure 50 Persistent Reserve In Descriptor Block

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (5Eh)							
1	Reserved			Service Action				
2 - 6	Reserved							
7 – 8	(MSB) Allocation Length (LSB)							
9	Unused		Reserved				Flag	Link

Table 40 Persistent Reserve In Command

Field Name	Description		
Service Action	Service actions that require information about persistent reservation and registrations may require enabling of nonvolatile memory within the logical unit. Service action codes available are:		
	Code	**Name**	**Description**
	00h	Read Keys	Reads all registered reservation keys
	01h	Read Reservations	Reads all current persistent reservations
	02-1Fh	Reserved	Reserved
	A "Read Keys" service action requests that the device server return a parameter list that includes a header and a complete list of all of the reservation keys currently registered with the device server. If multiple initiators have registered with the same key, then the key is listed multiple times, once for each registration. Refer to figure 51 on page 93 and table 41 on page 94 for information about Read Keys parameter data. A "Read Reservation" service action requests that the device server return a parameter list that contains a header and a complete list of all persistent reservations that are presently active in the device server. Refer to figure 52 on page 95 and table 42 on page 96 for information about Read Reservations parameter data.		
Allocation Length	This field indicates how much space has been reserved for the returned parameter list (Read Keys or Read Reservations parameters). The actual length of the parameter data is indicated in the parameter data field for those parameters. If the Allocation Length is not sufficient to contain the entire list of parameters, the first portion of the list that does fit is returned. If it is determined that the remainder of the list is required, the client should send a new PERSISTENT RESERVE IN command with an Allocation Length field large enough to contain the entire list of parameters.		

The figure and table below illustrate and describe the data fields of Read Key data parameters.

Figure 51 Read Keys Parameters

Bit Byte	7	6	5	4	3	2	1	0
0 - 3	(MSB) Generation (LSB)							
4 - 7	(MSB) Additional Length (*n* – 7) (LSB)							
	(Reservation Key List Follows in Bytes 8 – *n*)							
8 - 15	(MSB) First Reservation Key (LSB)							
â								
***n* – 7 to n**	(MSB) Last Reservation Key (LSB)							

Table 41 Read Keys Parameters

Field Name	Description
Generation	The value in this field is a 32-bit counter in the device server that is incremented each time a PERSISTENT RESERVE OUT command requests a Register, Clear, Pre-empt, or Pre-empt and Clear operation. Note that PERSISTENT RESERVE IN commands do not increment the counter, nor do PERSISTENT RESERVE OUT commands that perform a Reserve or Release service action, or by a PERSISTENT RESERVE OUT command that is not done due to an error or a reservation conflict. The value in the Generation field is set to 0 as part of the power on or reset processes. The value in the Generation field allows the application client that examines the value to verify that the configuration of the initiators attached to a logical unit has not been modified by another application client without any notification of the application client doing the examination.
Additional Length	This field contains the count of the number of bytes that are in the Reservation Key list (bytes 8 – *n*). Note that this field contains the number of bytes in the reservation key list regardless of the value prescribed by the Allocation Length field in the command's CDB.
Reservation Keys	Each of the Reservation Keys appear as items in a list as bytes 8 through *n*. Each entry reflects an 8-byte reservation key registered with the device server via the PERSISTENT RESERVE OUT, Register or Register and Ignore Existing Key service actions. Each key can be examined by the application client for correlation with a set of initiators and SCSI ports.

The following figure and table illustrate and describe the data fields of Read Reservations data parameters.

Figure 52 Read Reservations Parameters

Bit Byte	7	6	5	4	3	2	1	0
0 - 3	(MSB) Generation (LSB)							
4 - 7	(MSB) Additional Length (*n* – 7) (LSB)							
8 - *n*	(MSB) Reservation Descriptors (LSB)							

Table 42 Read Reservations Parameters

Field Name	Description
Generation	The value in this field is a 32-bit counter in the device server that is incremented each time a PERSISTENT RESERVE OUT command requests a Register, Clear, Pre-empt, or Pre-empt and Clear operation. Note that PERSISTENT RESERVE IN commands do not increment the counter, nor do PERSISTENT RESERVE OUT commands that perform a Reserve or Release service action, or by a PERSISTENT RESERVE OUT command that is not done due to an error or a reservation conflict. The value in the Generation field is set to 0 as part of the power on or reset processes. The value in the Generation field allows the application client that examines the value to verify that the configuration of the initiators attached to a logical unit has not been modified by another application client without any notification of the application client doing the examination.
Additional Length	This field contains the count of the number of bytes of Reservation descriptors (bytes 8 – *n*). Note that this field contains the number of bytes regardless of the value prescribed by the Allocation Length field in the command's CDB.
Reservations Descriptors	One Reservation descriptor is reported for each unique persistent reservation on the logical unit when the PERSISTENT RESERVE IN command has indicated a Read Reservations action. Figure 53 on page 97 and table 43 on page 97 detail the contents of each Reservation Descriptors field.

The figure and table below illustrate and describe the data fields of each Read Reservations descriptor's data fields.

Figure 53 Persistent Reserve In Read Reservations

Bit Byte	7	6	5	4	3	2	1	0
0 - 7	(MSB) Reservation Key (LSB)							
8 - 11	(MSB) Scope-Specific Address (LSB)							
12	Reserved							
13	Scope				Type			
14 - 15	Obsolete							

Table 43 Persistent Reserve In Read Reservations Descriptor

Field Name	Description
Reservation Key	The Reservation key field contains an 8-byte value that identifies the reservation key under which the persistent reservation is held.
Scope-Specific Address	Used to indicate the element that is the reservation affects when a reservation is for an element rather than a logical unit. The SuperLoader does not support reservations of elements, so this field is always 0.

<table>
<tr><th>Field Name</th><th colspan="3">Description</th></tr>
<tr><td>Scope</td><td colspan="3">The value in this field indicates whether a persistent reservation applies to an entire logical unit, to a part of the logical unit (defined as an extent), or to an element.

The values for the Scope field are:</td></tr>
<tr><td></td><td>Code</td><td>Name</td><td>Description</td></tr>
<tr><td></td><td>0h</td><td>LU</td><td>Logical Unit. Persistent reservation applies to the full logical unit. The LU scope is therefore implemented by all device servers that implement PERSISTENT RESERVE OUT.</td></tr>
<tr><td></td><td>1h</td><td>Obsolete</td><td></td></tr>
<tr><td></td><td>2h</td><td>Element</td><td>Persistent reservation applies to an element. Reservations of elements. Is not supported.</td></tr>
<tr><td></td><td>3h - Fh</td><td>Reserved</td><td>Reserved</td></tr>
<tr><td>Type</td><td colspan="3">The value of the Type field specifies the characteristics of the persistent reservation being established for all data blocks within the extent or within the logical unit. Refer to table 46 on page 110 for the applicable Type codes and their meanings.</td></tr>
</table>

The following table describes the available “Type” values from the Type field of the PERSISTENT RESERVE IN Read Reservations parameters.

Each of the codes provides handling instructions for READ operations, for WRITE operations, and for subsequent attempts to establish persistent reservations, referred to as “Additional Reservations Allowed” in the table.

Table 44 Persistent Reservation Type Codes

Code	Name	Description
0h	Obsolete	
1h	WRITE Exclusive	READS: Shared; any application client on any initiator may execute commands that perform transfers from the target to the initiator. WRITES: Exclusive; any command from any initiator other than the initiator that holds the persistent reservation that attempts a transfer to the target results in a reservation conflict ADDITIONAL RESERVATIONS: Allowed; any initiator may reserve the logical unit, extents, or elements as long as the persistent reservations do not conflict with any reservations already known to the device server.
2h	Obsolete	
3h	Exclusive Access	READS: Exclusive; any command from any initiator other than the initiator holding the persistent reservation that attempts a transfer from the target results in a reservation conflict. WRITES: Exclusive; any command from any initiator other than the initiator holding the persistent reservation that attempts a transfer to the target results in a reservation conflict. ADDITIONAL RESERVATIONS: Restricted; any PERSISTENT RESERVE OUT command with the Reserve service action from any initiator other than the initiator holding the persistent reservation results in a reservation conflict. The initiator that holds the persistent reservation can reserve the logical unit, extents, or elements as long as the persistent reservations do not conflict with any reservations already known to the device server.
4h	Obsolete	

Code	Name	Description
5h	WRITE Exclusive, Registrants Only	READS: Shared; any application client on any initiator may execute commands that perform transfers from the target to the initiator. WRITES: Exclusive; any command from an initiator that has not previously performed a Register service action with the device server that attempts a transfer to the target results in a reservation conflict ADDITIONAL RESERVATIONS: Allowed; any initiator may reserve the logical unit, extents, or elements as long as the persistent reservations to not conflict with any reservations already known to the device server.
6h	Exclusive Access, Registrants Only	READS: Exclusive; any command from an initiator that has not previously performed a Register service action with the device server that attempts a transfer from the target results in a reservation conflict. WRITES: Exclusive; any command from an initiator that has not previously performed a Register service action with the device server that attempts a transfer to the target results in a reservation conflict ADDITIONAL RESERVATIONS: Allowed; any initiator may reserve the logical unit, extents, or elements as long as the persistent reservations to not conflict with any reservations already known to the device server.
7h-Fh	Reserved	Not applicable

Persistent Reserve Out Command (5Fh)

The PERSISTENT RESERVE OUT command is a 10-byte command used to reserve a logical unit for the exclusive or shared use by an initiator. The command is used in conjunction with the PERSISTENT RESERVE IN command; it is not used with the RESERVE and RELEASE commands.

Persistent reservations conflict with reservations made via the RESERVE command. Initiators that perform PERSISTENT RESERVE OUT actions are identified by a reservation key assigned by the application client. The client may use the PERSISTENT RESERVE IN command to identify which other initiators within a system hold conflicting or invalid persistent reservations and use the PERSISTENT RESERVE OUT command to preempt those reservations if necessary.

Note that since persistent reservations are not reset by the TARGET RESET task management function or other global actions, they can be used to enact device sharing among multiple initiators. The PERSISTENT RESERVE OUT and PERSISTENT RESERVE IN commands provide the means for resolving contentions in multiple-initiator systems with multiple port target. By using the reservation key to identify persistent reservations, it is possible to determine which ports hold conflicting persistent reservations and to take over such reservations from failing or “greedy” initiators.

The figure that follows illustrates the format of the PERSISTENT RESERVE OUT command; the table that follows explains the data fields of the command.

Figure 54 Persistent Reserve Out Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (5Fh)							
1	Reserved				Service Action			
2	Scope				Type			
3 - 6	Reserved							
7 – 8	(MSB) Parameter List Length (18h) (LSB)							
9	Unused		Reserved				Flag	Link

Figure 55 Persistent Reserve Out Command

Field Name	Description		
Service Action	Service actions that require information about persistent reservation and registrations may require enabling of nonvolatile memory within the logical unit. Service action codes available are:		
	Code	**Name**	**Description**
	00h	Register	Register a reservation key with the device server

Field Name	Description		
	01h	Reserve	Create a persistent reservation using a reservation key
	02h	Release	Release a persistent reservation
	03h	Clear	Clear all reservation keys and all persistent reservations
	04h	Pre-empt	Pre-empt persistent reservations from another initiator
	05h	Pre-empt & Clear	Pre-empt persistent reservations from another initiator and clear the task set for the pre-empted initiator
	06h	Register and Ignore Existing Key	Register a reservation key with the device server. Existing reservation key is ignored.
	07-1Fh	Reserved	Reserved
	Refer to table 47 on page 113 for detailed descriptions of each of the service action codes.		
Scope	The value in this field indicates whether a persistent reservation applies to an entire logical unit or to an element. The values for the Scope field are:		
	Code	**Name**	**Description**
	0h	LU	Logical Unit. Persistent reservation applies to the full logical unit. The LU scope is therefore implemented by all device servers that implement PERSISTENT RESERVE OUT.
	1h	Obsolete	

Field Name	Description		
	2h	Element	Persistent reservation applies to the specified element. When Element is the scope, it indicates that the persistent reservation applies to the element of the logical unit defined by the Scope-Specific Address field in the PERSISTENT RESERVE OUT parameter list. Element reservations are not supported.
	3h–3F	Reserved	Reserved
Type	The value of the Type field specifies the characteristics of the persistent reservation being established for all data blocks within the extent or within the logical unit. Refer to table 44 on page 99 for the applicable Type codes and their meanings.		
Parameter List Length	Fields contained in the PERSISTENT RESERVE OUT parameter list specify the reservation keys and extent information required to perform a persistent reservation service action. The parameter list is 24 bytes in length; the Parameter List Length field contains 24 (18h) bytes.		

The following table provides detailed descriptions of each of the PERSISTENT RESERVE OUT command's seven possible service actions. Service Action codes appear in bits 0–4 of Byte 1.

Table 45 Persistent Reserve Out Command Service Action

Code	Name	Description
00h	Register	When the command executes a Register service action, it registers a reservation key with a device server without generating a reservation. The device server holds these reservation keys from each initiator that performs a PERSISTENT RESERVE OUT command with a Register service action until the key is changed by a new PERSISTENT RESERVE OUT command with Register service action from the same initiator, or until the initiator registration is removed by: Powering down the logical unit, if the last Activate Persist Through Power Loss (APTPL; see figure 56 on page 112 and table 47 on page 113) received by the device server was 0; Performing a Clear service action; Performing a Pre-empt service action; Performing a Pre-empt and Clear service action; or Performing a Register service action from the same initiator with the value of the service action reservation key set to 0. When a reservation key has not yet been established or when the reservation key has been removed, a reservation key of 0 is used when the initiator performs a PERSISTENT RESERVE OUT with the Register service action. When the reservation has been removed, no information is reported for the initiator in the Read Keys service action of the resulting PERSISTENT RESERVE IN command.
01h	Reserve	A PERSISTENT RESERVE OUT command with Reserve service action creates a persistent reservation with a specified Scope and Type. Persistent reservations are not superseded by a new persistent reservation from any initiator except by the execution of a PERSISTENT RESERVE OUT command that specifies a Release, Clear, Pre-empt, or Pre-empt and Clear service action.

Code	Name	Description
02h	Release	A PERSISTENT RESERVE OUT command with Release service action removes a persistent reservation held by the same initiator. The fields associated with a Release service action match fields of the active persistent reservation. Sending of a PERSISTENT RESERVE OUT command that specifies a Release service action when no persistent reservation exists from that initiator does not result in an error. Instead, the device server returns a GOOD message without altering any other reservation: the reservation key is not changed by the Release service action. The device server returns a CHECK CONDITION status for any PERSISTENT RESERVE OUT command that specifies the release of a persistent reservation held by the requesting initiator that does not match the Scope and Type. The sense key is set to ILLEGAL REQUEST and additional sense data is set to INVALID RELEASE OF ACTIVE PERSISTENT RESERVATION. Attempts to release persistent reservations in which none of the Scope, Type, Reservation Key, and extent values match an existing persistent reservation held by the initiator making the request are not errors. An active persistent reservation may also be released by: Powering off. When the most recent APTPL value received by the device server is 0, a power-off performs a hard reset, clears all persistent reservations, and removes all registered reservation keys; or Executing a PERSISTENT RESERVE OUT command from another initiator with a persistent reserve service action of Clear, Pre-empt, or Pre-empt and Clear. Note that a Release service action should not be performed if any operations interlocked by the persistent reservation have not yet completed. Powering off. When the most recent APTPL value received by the device server is 0, a power-off performs a hard reset, clears all persistent reservations, and removes all registered reservation keys; or Executing a PERSISTENT RESERVE OUT command from another initiator with a persistent reserve service action of Clear, Pre-empt, or Pre-empt and Clear. Note that a Release service action should not be performed if any operations interlocked by the persistent reservation have not yet completed.

Code	Name	Description
03h	Clear	A PERSISTENT RESERVE OUT command with a successful Clear service action removes all persistent reservations for all initiators. All reservation keys are also removed. Any commands from any initiator that have been accepted by the device server as non-conflicting continue their normal executions. A UNIT ATTENTION condition is established for all registered initiators for the logical unit. The sense key is set to UNIT ATTENTION; the additional sense data is set to RESERVATIONS PREEMPTED. Note that applications should not use the Clear action service except during recoveries associated with initiator or system reconfiguration, since data integrity may be compromised.
04h	Pre-empt	A PERSISTENT RESERVE OUT command with a successful Pre-empt service action removes all persistent reservations for all initiators that have been registered with the Service action Reservation key specified in the PERSISTENT RESERVE OUT command's parameter list. A persistent reservation is also established for the pre-empting initiator. Any commands from any initiator that have been accepted by the device server as non-conflicting continue their normal executions. If a PERSISTENT RESERVE OUT command is sent that specifies a Pre-empt service action and no persistent reservation exists for the initiator identified by the Service action Reservation key, it is not an error condition. A UNIT ATTENTION condition is established for the pre-empted initiators. The sense key is set to UNIT ATTENTION; the additional sense data is set to RESERVATIONS PREEMPTED. Commands that follow are subject to the persistent reservation restrictions set by the pre-empting initiator.

Code	Name	Description
04h (cont)	Pre-empt	The persistent reservation thus created by the pre-empting initiator is defined by the Scope and Type fields of the PERSISTENT RESERVE OUT command and the corresponding fields of the command's parameter list. The registration keys for the pre-empted initiators are removed by the Pre-empt service action; the reservation key for an initiator that has performed a Pre-empt service action with its own Reservation key specified in the Service action Reservation key remains unchanged, although all other specified releasing actions and reservation actions are performed. Note that persistent reservations are not superseded by a new persistent reservation from any initiator except by the execution of a PERSISTENT RESERVE OUT that specifies either the Pre-empt or the Pre-empt and Clear service actions. New persistent reservations that do not conflict with an existing persistent reservation execute normally.

Code	Name	Description
05h	Pre-empt & Clear	A PERSISTENT RESERVE OUT command with a Pre-empt & Clear service action removes all persistent reservations for all initiators that have been registered with the Service action Reservation key specified in the PERSISTENT RESERVE OUT command's parameter list. It also establishes a persistent reservation for the pre-empting initiator. Any commands from the initiators being pre-empted are terminated as if an ABORT TASK management function had been performed by the pre-empted initiator. If a PERSISTENT RESERVE OUT command is sent that specifies a Pre-empt & Clear service action and no persistent reservation exists for the initiator identified by the Service action Reservation key, it is not an error condition. If the key is registered, however, the Clear portion of the action executes normally. A UNIT ATTENTION condition is established for the pre-empted initiators. The sense key is set to UNIT ATTENTION; the additional sense data is set to RESERVATIONS PREEMPTED. Commands that follow, and retries of commands that timed out because there were cleared are subject to the persistent reservation restrictions set by the pre-empting initiator. The persistent reservation thus created by the pre-empting initiator is defined by the Scope and Type fields of the PERSISTENT RESERVE OUT command and the corresponding fields of the command's parameter list. The Pre-empt & Clear service action clears any ACA or CA condition associated with the initiator that is pre-empted and clears any tasks with an ACA attribute from that initiator. The reservation key for the other initiators pre-empted are removed by the Pre-empt & Clear service action. The reservation key for an initiator that has sent a Pre-empt & Clear action with its own reservation key specified in the service action's reservation key remains unchanged, although all other specified clearing actions, releasing actions, and reservation actions are performed. Persistent reservations are not superseded by a new persistent reservation from any initiator except via execution of a PERSISTENT RESERVE OUT that specifies either the Pre-empt or Pre-empt & Clear service action. New persistent reservations not in conflict with an existing persistent reservation execute normally.

Code	Name	Description
06h	Register and Ignore Keys	This service action functions the same as the Register (00h) action except the reservation key in the parameter list is ignored and treated as if it matched the current registration, if one exists for the initiator.

The following table presents the definitions of the characters of the available "Type" values from the Type field of the PERSISTENT RESERVE IN Read Reservations parameters.

Each of the codes provides handling instructions for READ operations, for WRITE operations, and for subsequent attempts to establish persistent reservations, referred to as "Additional Reservations Allowed" in the table.

Table 46 Persistent Reservation Type Codes

Code	Name	Description
0h	Obsolete	
1h	WRITE Exclusive	READS: Shared; any application client on any initiator may execute commands that perform transfers from the storage medium to the initiator. WRITES: Exclusive; any command from any initiator other than the initiator that holds the persistent reservation that attempts a transfer to the storage medium results in a reservation conflict.
2h	Obsolete	
3h	Exclusive Access	READS: Exclusive; any command from any initiator other than the initiator holding the persistent reservation that attempts a transfer from the storage medium results in a reservation conflict. WRITES: Exclusive; any command from any initiator other than the initiator holding the persistent reservation that attempts a transfer to the storage medium results in a reservation conflict.

Code	Name	Description
4h	Obsolete	
5h	WRITE Exclusive, Registrants Only	READS: Shared; any application client on any initiator may execute commands that perform transfers from the storage medium to the initiator. WRITES: Exclusive; any command from an initiator that has not previously performed a Register service action with the device server that attempts a transfer to the storage medium results in a reservation conflict.
6h	Exclusive Access, Registrants Only	READS: Exclusive; any command from an initiator that has not previously performed a Register service action with the device server that attempts a transfer from the storage medium results in a reservation conflict. WRITES: Exclusive; any command from an initiator that has not previously performed a Register service action with the device server that attempts a transfer to the storage medium results in a reservation conflict
7h - Fh	Reserved	N/A

The PERSISTENT RESERVE OUT command requires a parameter list, illustrated in the following figure and defined in the following table. Each of the fields of the parameter list are sent for every PERSISTENT RESERVE OUT command, even if the field is not required for the specific Service action and/or Scope values.

Figure 56 Persistent Reserve Out Parameter List

Bit Byte	7	6	5	4	3	2	1	0
0-7	(MSB) Reservation Key (LSB)							
8-15	(MSB) Service Action Reservation Key (LSB)							
16-19	(MSB) Scope-Specific Address (LSB)							
20	Reserved							APTPL
21	Reserved							
22-23	Obsolete							

Table 47 Persistent Reserve Out Parameter List

Field Name	Description
Reservation Key	This field contains an 8-byte token that is provided by the application client to the device server to identify which initiator is the source of the PERSISTENT RESERVE OUT command. For all service actions except Register and Ignore Existing Key, the device server verifies that the Reservation Key in the PERSISTENT RESERVE OUT command matches the Reservation Key that is registered for the initiator from which the command is received. If there is no match, the device server returns a RESERVATION CONFLICT status. The Reservation Key of the initiator is valid for all Service action and Scope values.
Service Action Reservation Key	This field contains information needed for 3 service actions: the Register service action, the Pre-empt service action, and the Pre-empt & Clear service action. The Service Action Reservation Key is ignored for all other service actions. For the Register service action, the Service Action Reservation Key field contains the new Reservation Key to be registered. For the Pre-empt and the Pre-empt & Clear service actions, the Service Action Reservation Key contains the reservation key of the persistent reservations that are being pre-empted. For the Pre-empt and the Pre-empt & Clear actions, any failure of the Service Action Reservation Key to match any registered keys results in the device server returning a RESERVATION CONFLICT status.

Field Name	Description
Scope-Specific Address	Ignored.
APTPL	Activate Persist Through Power Loss. This bit is valid only for Register and Register and Ignore Existing Key service actions; it is ignored for all other types of service actions. If the last valid APTPL bit value received by the device server is 0, the loss of power in the target releases any persistent reservations and removes all reservation keys. If the last valid APTPL bit value is 1, the logical unit retains all persistent reservations and all reservation keys for all initiators even if power is lost and later returned. The most recently received valid APTPL value from any initiator governs the logical unit's behavior in the event of a power loss.

The following table illustrates which fields are set by the application client and interpreted by the device server for each Service and Scope value.

Table 48 Device Server Interpretation of Service and Scope Value

Service Action	Allowed Scope	Parameters		
		Type	Service Action Reservation Key	Reservation Key
Register	Ignored	Ignored	Valid	Valid
Reserve	LU	Valid	Ignored	Valid
Release	LU	Valid	Ignored	Valid
Clear	Ignored	Ignored	Ignored	Valid
Pre-empt	LU	Valid	Valid	Valid
Pre-empt & Clear	LU	Valid	Valid	Valid
Register and Ignore Existing Key	Ignored	Ignored	Valid	Ignored

Position to Element Command (2Bh)

The POSITION TO ELEMENT command shall position the Medium Transport Address element such that further motion of the Medium Transport Address element is unnecessary to execute an appropriate MOVE MEDIUM command between the Medium Transport Address element and the Destination Address element.

Figure 57 Position to Element Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (2Bh)							
1	Logical Unit Number			Reserved				
2-3	(MSB) Medium Transport Address (LSB)							
4-5	(MSB) Destination Address (LSB)							
6-7	Reserved							
8	Reserved							Invert (0)
9	Unused		Reserved				Flag	Link

Table 49 Position to Element Command

Field Name	Description
Medium Transport Address	Address of the medium transport element to position. Must be set to 0.
Destination Address	Address of the element in which to position the medium transport element. This can be any valid element address.
Invert	Must be set to 0. Inverting or rotating of the Medium Transport Element is not supported.

Prevent/Allow Medium Removal (1Eh)

This command enables or disables the removal of the magazines as well as removal of tape cartridges through the mail slot via front panel and On-board Remote Management control. It does not prevent removal via the SCSI Load Unload command.

Figure 58 Prevent/ Allow Medium Removal

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Eh)							
1	Logical Unit Number			Reserved				
2 - 3	Reserved							
4	Reserved							Prevent
5	Unused		Reserved				Flag	Link

Table 50 Prevent/ Allow Medium Removal Command Descriptor Block

Field Name	Description
Prevent	When set to 1, removal via operator control is disabled. A MOVE MEDIUM command with a destination address equal to the mail slot would return a CHECK CONDITION status. The sense key shall be ILLEGAL REQUEST with the additional sense code MEDIA REMOVAL PREVENTED. The PREVENT/ALLOW status in the device is maintained separately by each initiator. When set to 0, the prevent state corresponding to that initiator is cleared. By default, after power up, a hard reset, or BUS DEVICE RESET message, the prevent medium removal function is cleared.

Read Buffer Command (3Ch)

The READ BUFFER command is used in conjunction with WRITE BUFFER as a diagnostic function for testing the device's data buffer for possible diagnostic data and for checking the integrity of the SCSI bus.

Figure 59 Read Buffer Command Descriptor Block

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (3Ch)							
1	Logical Unit Number			Reserved	Mode			
2	Buffer ID							
3 - 5	(MSB) Buffer Offset (LSB)							
6 - 8	(MSB) Allocation Length (LSB)							
9	Unused		Reserved				Flag	Link

Table 51 Read Buffer Command Descriptor Block

Field Name	Description	
Mode	The SuperLoader supports the following values within this field. If any non-supported value is set, the drive terminates the command with a CHECK CONDITION status, ILLEGAL REQUEST sense key set:	
	Mode	**Description**
	0000b	Combined Header and Data Mode (000b) on page 122 (LTO only)
	0010b	Data Mode (0010b) on page 123 (LTO only)
	0011b	Descriptor Mode (0011b) on page 123 (LTO only)
	1010b	Read Data from Echo Buffer (1010b) on page 123
	1011b	Echo Buffer Descriptor Mode (1011b) on page 124
Buffer ID	This field is ignored in some modes and reserved in others. Refer to the specific mode description for more detail.	
Buffer Offset	This field is ignored in some modes, reserved in others, and valid in mode 0010b. Refer to the specific mode description for more detail.	
Allocation Length	This field specifies the maximum number of bytes that the initiator has allocated for returning data. The host uses this field to limit the size of data transfers to its own internal buffer size.	

The host should first send a READ BUFFER command, in Descriptor mode, to determine the size of the buffer being returned. In response to the READ BUFFER command, the device returns four bytes of data, three of which contain the size of the buffer. The host can then use this data to establish the Buffer Offset/Allocation Length fields of the CDB. Once the size of the buffer is known, Mode 2 (Data Only, see Data Mode (0010b) on page 123) can be used to transfer the data across the SCSI Bus.

Combined Header and Data Mode (000b)

LTO only: In this mode, the device returns a 4-byte header followed by data bytes. The device terminates the DATA IN phase when the Allocation Length bytes of header and data have been transferred or when all available data has been transferred to the initiator, whichever is less. The 4-byte READ BUFFER header is followed by data bytes from the target data buffer. The figure below illustrates the format of the header. The buffer ID must be set to 0. The buffer offset must be less than the size of the buffer.

Figure 60 Read Buffer Header

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							
1 - 3	(MSB) Available Length (LSB)							

Table 52 Read Buffer Header

Field	Description
Available Length	This field specifies the total number of data bytes available in the target's buffer. This number is not reduced to reflect the allocation length, nor is it reduced to reflect the actual number bytes written using the WRITE BUFFER command. Following the READ BUFFER header, the target transfers data from its data buffer.

Data Mode (0010b)

LTO Only: In this mode, the DATA IN phase contains only buffer data.The buffer ID must be set to 0. The buffer offset must be less than the size of the buffer.

Descriptor Mode (0011b)

In this mode, a maximum of four bytes of READ BUFFER descriptor information is returned. The device returns the descriptor information for the buffer specified by the Buffer ID. In this mode, the device does not reject the invalid Buffer IDs with a CHECK CONDITION status, but returns all zeros in the READ BUFFER descriptor.

Figure 61 Read Buffer Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Offset Boundaries (0h)							
1 - 3	(MSB) Buffer Capacity (LSB)							

Read Data from Echo Buffer (1010b)

In this mode the device transfers data to the application client from the Echo Buffer. The Echo Buffer will transfer the same data as when the WRITE BUFFER command with the mode field set to Echo Buffer was issued. The Buffer ID and Buffer Offset fields are ignored in this mode.

The READ BUFFER command will return the same number of bytes of data as received in the prior echo buffer mode WRITE BUFFER command from the same initiator. If a prior Echo Buffer mode WRITE BUFFER command was not successfully completed, the Echo Buffer mode READ BUFFER command will terminate with a CHECK CONDITION status, the sense key shall be set to ILLEGAL REQUEST and the additional sense code to COMMAND SEQUENCE ERROR. If the data in the Echo Buffer has been overwritten by another initiator the drive will terminate the command with a CHECK CONDITION status, the sense key will be set to ABORTED COMMAND and the additional sense code to ECHO BUFFER OVERWRITTEN.

Echo Buffer Descriptor Mode (1011b)

In this mode, a maximum of four bytes of READ BUFFER descriptor information is returned. The device will return the descriptor information for the Echo Buffer. The Buffer Offset field is reserved in this mode. The allocation length should be set to four or greater. The device shall transfer the lesser of the allocation length or four bytes of READ BUFFER descriptor.

Figure 62 Echo Buffer Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							EBOS
1	Reserved							
2	Reserved				Buffer Capacity			
3	Buffer Capacity							

Table 53 Echo Buffer Descriptor

Field Name	Description
EBOS	Echo Buffer Overwritten Supported. Set to 1 to indicate the drive will return the ECHO BUFFER OVERWRITTEN additional sense code if the data being read from the Echo Buffer is not the data previously written by the same initiator.
Buffer Capacity	Returns 252 indicating the size of the Echo Buffer in bytes.

Read Element Status Command (B8h)

The READ ELEMENT STATUS command requests that the target report the status of its internal elements to the initiator.

Figure 63 Read Element Status Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (B8h)							
1	Logical Unit Number			VOLTAG	Element Type Code			
2-3	(MSB) Starting Element Address (LSB)							
4-5	(MSB) Number Of Elements (LSB)							
6	Reserved						CURDATA	DVCID
7-9	(MSB) Allocation Length (LSB)							
10	Reserved							
11	Unused		Reserved				Flag	Link

Table 54 Read Element Status Command Descriptor Block

Field Name	Description	
VOLTAG	When set to 1, the SuperLoader will report volume tag information. When set to 0, no volume tag information will be reported.	
Element Type Code	Specifies the particular element type(s) selected for reporting by this command. The element type codes are defined as follows.	
	Code	**Description**
	0h	All element types reported (valid in CDB only)
	1h	Medium transport element
	2h	Storage element
	3h	Import/export element
	4h	Data transfer element
	5h-Fh	Reserved
Starting Element Address	Specifies the minimum element address to report. Only elements with an element type code permitted by the Element Type Code field, and an element address greater than or equal to this address shall be reported. Element descriptor blocks are not generated for undefined element addresses.	
Number of Elements	Specifies the maximum number of element descriptors to be reported.	
CURDATA	When set to 1, the SuperLoader will return the current element status information. When set to 0, the SuperLoader may cause device motion to confirm element status data.	

Field Name	Description
DVCID	Must be set to 0. Reporting of device identifiers is not supported.
Allocation Length	Specifies the number of bytes to be returned. If it is not sufficient to transfer all the requested element descriptors, the SuperLoader will only transfer those descriptors that can be completely transferred and this shall not be considered an error.

Element Status Data

The data returned by the READ ELEMENT STATUS command is defined in figure 64 and Element Status Page on page 130 through Data Transfer Element Descriptor on page 137. Element status data consists of an eight-byte header, followed by zero or more element status pages.

Figure 64 Element Status Data Header

Bit Byte	7	6	5	4	3	2	1	0
0-1	First Element Address Reported							
2-3	(MSB) Number Of Elements Available (LSB)							
4	Reserved							

Bit Byte	7	6	5	4	3	2	1	0
5-7	(MSB) Byte Count Of Report Available (all pages, n-7) (LSB)							
8-n	Element status page(s)							

Note: The READ ELEMENT STATUS command can be issued with an Allocation Length of eight bytes in order to determine the Allocation Length required to transfer all the element status data specified by the command.

Table 55 Element Status Data

Field Name	Description
First Element Address Reported	Indicates the element address of the element with the smallest element address found to meet the CDB request.
Number Of Elements Available	Indicates the number of elements meeting the request in the command descriptor block. The status for these elements is returned if sufficient Allocation Length was specified.
Byte Count Of Report Available	Indicates the number of bytes of element status page data available for all elements meeting the request in the command descriptor block. This value shall not be adjusted to match the Allocation Length available.

Element Status Page

The element status page is defined in figure 65. Each element status page includes an eight-byte header followed by zero or more element descriptor blocks. The header includes the element type code, the length of each descriptor block and the number of bytes of element descriptor information that follow the header for this element type.

Figure 65 Element Status Page

Bit Byte	7	6	5	4	3	2	1	0
0	Element Type Code							
1	PVOLTAG	AVOLTAG (0)	Reserved					
2-3	Element Descriptor Length							
4	Reserved							
5-7	(MSB) Byte Count Of Descriptor Data Available (all pages, y-7) (LSB)							
8-y	(MSB) Element descriptor(s) (LSB)							

Figure 66 Data

Field Name	Description
Element Type Code	Indicates the element type (see table 54 on page 127) reported by this page.
PVOLTAG	When set to 1, indicates that the Primary Volume Tag Information field is present in each of the following element descriptor blocks. A value of zero indicates that these bytes are omitted from the element descriptors that follow.
AVOLTAG	This field is sent as 0. Alternate volume tag information is not supported.
Element Descriptor Length	Indicates the number of bytes in each element descriptor.
Byte Count Of Descriptor Data Available	Indicates the number of bytes of element descriptor data available for elements of this element type meeting the request in the CDB. This value shall not be adjusted to match the Allocation Length available.

Each element descriptor includes the element address and status flags; it may also contain sense code information as well as other information depending on the element type (see Medium Transport Element Descriptor on page 131 through Data Transfer Element Descriptor on page 137).

Medium Transport Element Descriptor

Figure 67 defines the medium transport element descriptor.

Figure 67 Medium Transport Element Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0-1	Element Address							
2	Reserved					Except	RSVD	Full
3	Reserved							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6-8	Reserved							
9	SVALID	Invert (0)	Reserved					
10-11	Source Storage Element Address							
	• • •							
(36 bytes)	Primary Volume Tag Information (field omitted if PVOLTAG=0)							
	• • •							
(1 byte)	Reserved					Code Set		
(1 byte)	Reserved					Identifier Type		
(1 byte)	Reserved							
(1 byte)	Identifier Length							

Table 56 Medium Transport Element Descriptor

Field Name	Description
Element Address	Specifies the address of the media changer element whose status is reported by this element descriptor block.
Except	An exception bit of 0 indicates the element is in a normal state. If this bit is 1, information on the abnormal state may be available in the Additional Sense Code and Additional Sense Code Qualifier fields.
Full	When set to 1, indicates that the element contains a unit of media. A value of zero indicates that the element does not contain a unit of media. When the Except bit is one, the value of the Full bit is not valid.
Additional Sense Code	Provides specific information on an abnormal element state. The values in this field are as defined for the Additional Sense Code field of REQUEST SENSE command response data. This field is valid only if the Except bit is one.
Additional Sense Code Qualifier	Provides more detailed information on an abnormal element state. The values in this field are as defined for the Additional Sense Code Qualifier field of REQUEST SENSE command response data. This field is valid only if the Except bit is one.
SVALID	When set to 1, indicates that the Source Storage Element Address field and the Invert bit information are valid. A value of zero indicates that the values in these fields are not valid.
Invert	This field is sent as 0. Inverting and rotating of media is not supported.
Source Storage Element Address	Provides the address of the last storage element this unit of media occupied. This field is valid only if the SVALID bit is one.
Primary Volume Tag Information	This field contains the bar code label information of the media currently stored in this element. This is only included if VOLTAG was set and label information is available. In which case, the PVOLTAG field shall be set on the Element Status page header.
Code Set	This field is 0.

Field Name	Description
Identifier Type	This field is 0.
Identifier Length	This field contains the length in byes of the Identifier field. Reporting of device identifiers is not supported. This field is always 0.

Storage Element Descriptor

Figure 68 defines the storage element descriptor.

Figure 68 Storage Element Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0-1	Element Address							
2	Reserved				Access	Except	RSVD	Full
3	Reserved							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6-8	Reserved							
9	SVALID	Invert	Reserved					
10-11	Source Storage Element Address							
• • •								
(36 bytes)	Primary Volume Tag Information (field omitted if PVOLTAG=0)							

Bit Byte	7	6	5	4	3	2	1	0
				• • •				
(1 byte)	Reserved				Code Set			
(1 byte)	Reserved				Identifier Type			
(1 byte)	Reserved							
(1 byte)	Identifier Length							

Table 57 Storage Element Descriptor

Field Name	Description
Access	Indicates that access to the element by a medium transport element is allowed. An Access bit of zero indicates that access to the element by the medium transport element is denied. When a magazine is removed from the SuperLoader, the corresponding storage elements shall have an Access bit of 0. Access will also be denied if the storage element is configured as the location of a cleaning tape when auto clean is enabled. When the Except bit is one, the value of the Access bit is not valid.
Source Storage Element Address	Provides the address of the last storage element this unit of media occupied. This element address value may or may not be the same as this element. This field is valid only if the SVALID bit is one.
NOTE: For fields not defined in this table, see table 56 on page 133.	

Import/Export Element Descriptor

Figure 69 defines the import/export element descriptor.

Figure 69 Import/ Export Element Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0-1	Element Address							
2	Reserved		INENAB (1)	EXENAB (1)	Access	Except	IMPEXP	Full
3	Reserved							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6-8	Reserved							
9	SVALID	Invert	Reserved					
10-11	Source Storage Element Address							
	• • •							
(36 bytes)	Primary Volume Tag Information (filed omitted if PVOLTAG=0)							
	• • •							
(1 byte)	Reserved						Code Set	
(1 byte)	Reserved						Identifier Type	
(1 byte)	Reserved							
(1 byte)	Identifier Length							

Table 58 Import/ Export Element Descriptor

Field Name	Description
INENAB	This field is sent as 1 to indicate that the import/ export element supports movement of media into the scope of the media changer device.
EXENAB	This field is sent as 1 to indicate that the import/ export element supports movement of media out of the scope of the media changer.
Access	When set to 1 it indicates that access to the element by a medium transport is allowed. When set to 0 it indicates that access is denied. This may occur if the user is performing an operation from the front panel or Ethernet connection that prohibits access from SCSI.
IMPEXP	When set to 1 it indicates that the unit of media in the import/export element was placed there by an operator. When set to 0, it indicates that it was placed there by the medium transport element. When the Except bit is 1, the value of the IMPEXP bit is invalid.
NOTE: For fields not defined in this table, see table 56 on page 133.	

Data Transfer Element Descriptor

Figure 70 defines the data transfer element descriptor.

Figure 70 Data Transfer Element Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0-1	Element Address							
2	Reserved				Access	Except	RSVD	Full
3	Reserved							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Not BUS (0)	RSVD	ID Valid	LU Valid	RSVD	Logical Unit Number		
7	SCSI BUS Address							
8	Reserved							
9	SVALID	Invert	Reserved					
10-11	Source Storage Element Address							
• • •								
(36 bytes)	Primary Volume Tag Information (field omitted if PVOLTAG=0)							
• • •								
(1 byte)	Reserved					Code Set		
(1 byte)	Reserved					Identifier Type		

Bit Byte	7	6	5	4	3	2	1	0
(1 byte)	Reserved							
(1 byte)	Identifier Length							

Table 59 Data Transfer Element Descriptor

Field Name	Description
Access	When set to 1 it indicates access to the data transfer element by the medium transport element is allowed. When set to 0 it indicates access is denied. This may occur if the device is performing an auto clean operation.
Not Bus	This field is sent as 0. The data transfer element is on the same bus as the media changer device.
ID Valid	When set to 1, it indicates that the SCSI BUS address field contains valid information.
LU Valid	When set to 1, it indicates that thee Logical Unit Number field contains valid information.
Logical Unit Number	If it is valid, it provides the logical unit number within the SCSI bus device of the primary device served by the media changer at this element address. This field is always 0.
SCSI BUS Address	If valid, it provides the SCSI address of the primary device served by the media changer at this element address.
NOTE: For fields not defined in this table, see table 56 on page 133.	

Release Element (10) Command (57h)

The RELEASE and the RESERVE commands are used for contention resolution in multiple-initiator systems. The RELEASE (10) command is used to release a previously reserved logical unit. The media changer will not return an error if the initiator attempts to release a reservation that is not currently valid.

Figure 71 Release (10) Descriptor Block

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (57h)							
1	Reserved			3rdPty	Reserved		LongID	Element
2	Reservation Identification							
3	Third Party Device ID							
4 - 6	Reserved							
7 - 8	(MSB) Parameter List Length (LSB)							
9	Unused		Reserved				Flag	Link

Table 60 Release (10) Command

Field Name	Description
3rdPty	3rdPty Release allows an initiator to release a logical unit that was previously reserved. If the value in this field is 0, third party release is not requested. If 3rdPty = 1, then the device server shall release the specified logical unit, but only if the initiator ID, 3rdPty bit, and third party device ID are identical when compared to the RESERVE command that established the reservation.
Long ID	If the Long ID bit is set to 1, the Parameter List Length is 8 and the eight bytes of the parameter list carry the device ID of the third party device; the contents of the Third Party Device ID in the CDB (byte 3) are ignored.
Element	The SuperLoader supports reservations only on entire logical units. The value must be 0.
Reservation Identification	Any value in this field is ignored by the SuperLoader.
Third Party Device ID	If the Third Party Device ID value that is connected with the reservation release is smaller than 255, the LongID bit may be 0 and the ID value sent in the CDB. If LongID bit = 0, the Parameter List Length field also = 0. If the Third Party Device ID value is greater than 255, LongID = 1. Device servers that support device IDs greater than 255 will accept commands with LongID = 1; device servers that do not support IDs greater than 255 may reject commands with LongID set = 1. Device ID formats are protocol-specific.

Field Name	Description
Parameter List Length	The contents of this field specify the length, in bytes, of the parameter list that will be transferred from the initiator to the target.

NOTE: Assuming that the RELEASE Command Descriptor Block is valid, the SuperLoader always returns a GOOD status for this command. An actual release only happens if the initiator has the unit reserved for itself or a third-party initiator.

If the LongID bit = 1 and the Element bit = 0, then the parameter list length is eight and the parameter list has the following format.

Figure 72 Release (10) ID Only Parameter List

Bit Byte	7	6	5	4	3	2	1	0
0 - 7	(MSB) Third Party Device ID (LSB)							

Release Unit (6) Command (17h)

The RELEASE UNIT command releases the media changer if it is currently reserved by the requesting initiator. It is not an error to release the media changer if it is not currently reserved by the requesting initiator. If the media changer is reserved by another initiator, however, it is not released; the media changer is only released from the initiator that issued the RELEASE command. Element reservations are not supported.

The SuperLoader LTO implements this command as specified in SMC-2. Third party reservations are not supported by this command. RELEASE ELEMENT (10) should be used instead.

Figure 73 Release Unit (6) Descriptor Block (LTO)

Bit Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (17h)							
1	Logical Unit Number			Obsolete				Rsv'd
2 - 4	Reserved							
5	Unused		Reserved				Flag	Link

Figure 74 Release Unit (6) Descriptor Block (DLT)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (17h)							
1	Logical Unit Number			3rdPty	Third Party Device ID			Rsv'd
2 - 4	Reserved							
5	Unused		Reserved				Flag	Link

Report Device Identifier Command (A3h)

The REPORT DEVICE IDENTIFIER command requests that the device server send device identification information to the applicable client.

Figure 75 Report Device Identifier Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (A3h)							
1	Reserved			Service Action (05h)				
2 - 5	Reserved							
6 - 9	(MSB) Allocation Length (LSB)							
10	Reserved							
11	Unused		Reserved				Flag	Link

Table 61 Report Device Identifier Command Descriptor Block

Field	Description
Service Action	Must be 05h. Any other value will return Check Condition, Illegal request.
Allocation Length	If the Allocation Length is not sufficient to contain all the parameter data, the first portion of the data shall be returned. This shall not be considered an error. The actual length of the parameter data is available in the Identifier Length field in the parameter data. If the remainder of the parameter data is required, the application client should send a new REPORT DEVICE IDENTIFIER command with an Allocation Length field large enough to contain all the data.

The REPORT DEVICE IDENTIFIER parameter list contains a four-byte field that contains the length in bytes of the parameter list and the logical unit's identifier.

Figure 76 Report Device Identifier

Bit Byte	7	6	5	4	3	2	1	0
0 - 3	(MSB) Identifier Length (n – 4) (LSB)							
4 - n	Identifier							

Table 62 Report Device Identifier Parameter Data

Field	Description
Identifier Length	Specifies the length in bytes of the Identifier field. If the Allocation Length field in the CDB is too small to transfer all of the identifier, the length is not adjusted to reflect the truncation. The identifier length is initially equal to zero, and is changed only by a successful SET DEVICE IDENTIFIER command.
Identifier	The value reported is the last value written by a successful SET DEVICE IDENTIFIER command. The value of the identifier is changed only by a successful SET DEVICE IDENTIFIER command. The identifier value persists through resets, and power cycles.

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 applications client. The command only returns information about the logical units to which commands may be sent.

Figure 77 Report LUNS Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (A0h)							
1 - 5	Reserved							
6 – 9	(MSB) Allocation Length (LSB)							
10	Reserved							
11	Unused		Reserved				Flag	Link

Table 63 Report LUNS Command Descriptor Block

Field	Description
Allocation Length	If the Allocation Length is not sufficient to contain the logical unit number values for all configured logical units, the device server still reports as many logical number values as will fit in the Allocation Length. The format of the report of configured logical units is shown in figure 78.

Figure 78 LUN Reporting Parameter List

Bit Byte	7	6	5	4	3	2	1	0
0 - 3	(MSB) LUN List Length (n – 7) (LSB)							
4 - 7	Reserved							
8 - 15	(MSB) LUN (first LUN) (LSB)							
n-7 – n	LUN (last LUN, if more than one)							

The LUN List Length field contains the length in bytes of the LUN list that can be transferred. The LUN list length equals the number of logical unit numbers reported multiplied by eight. If the allocation length in the CDB is too small to allow transfer of information about all of the logical units configured, the LUN list length value is not adjusted to reflect the truncation.

Request Sense Command (03h)

The REQUEST SENSE command causes the media changer to transfer detailed sense data to the initiator.

Figure 79 Request Sense Command Descriptor Block

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (03h)							
1	Logical Unit Number			Reserved				
2 - 3	Reserved							
4	Allocation Length							
5	Unused		Reserved				Flag	Link

Figure 80 Request Sense Command Data

Field	Description
Allocation Length	This field specifies the maximum number of sense bytes to be returned. The media changer terminates the transfer when this number of bytes has been transferred or when all available sense data has been transferred to the host, whichever is less.

The sense data is valid for a CHECK CONDITION or RESERVATION CONFLICT status returned on the previous command. The sense data bytes are preserved by the media changer until retrieved by a REQUEST SENSE command, or until the receipt of any other command from the same initiator, though some commands, such as INQUIRY, do not change sense data.

If the media changer receives an unsolicited REQUEST SENSE, it returns sense data with the appropriate values in the Sense Key, Additional Sense Code, and Additional Sense Code Qualifier.

The following illustration portrays the format of REQUEST SENSE DATA.

Figure 81 Request Sense

Bit Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Valid	Error Code						
1	Obsolete							
2	Filemark	EOM	ILI	Reserved	Sense Key			
3 - 6	(MSB) Information Bytes (LSB)							
7	Additional Sense Length (0Ah)							
8 - 11	(MSB) Command-Specific Information Bytes (LSB)							
12	Additional Sense Code (ASC)							

Bit Byte	7	6	5	4	3	2	1	0
13	Additional Sense Code Qualifier (ASCQ)							
14	Sub-Assembly Code (0)							
15	SKSV	C/D	Reserved		BPV	Bit Counter		
16 - 17	(MSB) Field Pointer (LSB)							

Table 64 Request Sense Data

Field	Description
Valid	When set to 1, this field indicates that the information bytes contain valid information as defined in the ANSI SCSI-2 specification.
Error Code	A value of 70h indicates a current error – the report is associated with the most recently received command. A value of 71h indicates a deferred error – the report is associated with a previous command and not as a result of the current command. No other values are returned in this field.
Filemark	This bit indicates that the current command has read a Filemark. Not applicable to a media changer device.
EOM	End of Medium. Not applicable to a media changer device.
ILI	Incorrect Length Indicator. Not applicable to a media changer device.
Sense Key	Indicates generic information describing an error or exception condition. Sense keys are defined in table 65 on page 155.
Information Bytes	Not applicable to a media changer device. This field should always be 0.

Field	Description
Additional Sense Length	This field specifies the number of additional sense bytes to follow. If the Allocation Length of the Command Descriptor Block is too small to transfer all of the Additional Sense bytes, the Additional Sense Length is not adjusted to reflect the truncation.
Command Specific Information Bytes	Command Specific Information Bytes depend on the command executed. This field is not used.
Additional Sense Code (ASC)	This field (and the field for Additional Sense Code Qualifier) provides additional information about the Sense Key and cause of a CHECK CONDITION status. Additional Sense Codes are discussed in detail later in this section.
Additional Sense Code Qualifier (ASCQ)	This field (and the field for Additional Sense Code) provides additional information about the Sense Key and cause of a CHECK CONDITION status. Additional Sense Code Qualifiers are discussed in detail later in this chapter.
Sub-Assembly Code	Not used. Returned as 0.
SKSV	Sense-Key Specific Valid. When = 1, indicates that the Sense Key specific field is as defined by the International Standard.
C/D	Command / Data. When set to 1, this field indicates that the illegal parameter is contained in the Command Descriptor Block. A C/D set to 0 indicates that the illegal parameter is in the Parameter List from the initiator.
BPV	Bit Pointer Valid. When set to 1, this field indicates that the Bit Pointer field is valid and designates which bit of the byte designated by the field pointer is in error. For a multi-bit field, it points to the most significant bit of the field.
Field Pointer	This field indicates which byte of the Command Descriptor Block or Parameter List is in error. For a multi-byte field, the most significant byte is indicated.

Table 65 Supported Sense Keys for Request Sense

Sense Key	Description
0h	NO SENSE.
1h	RECOVERED ERROR. This can be caused by rounding of Mode Parameters on a MODE SELECT, or may report that recovery algorithms were required to complete a move operation. The device may still be able to continue to function without any unrecovered errors for a long period of time, however.
2h	NOT READY. The media changer is not ready for move operation commands. Initialization or calibration may be in-progress or may have failed.
4h	HARDWARE ERROR. The Additional Sense Code / Additional Sense Code Qualifier fields may present more specific information.
5h	ILLEGAL REQUEST. The Command Descriptor Block or supplied parameter data had an unsupported or illegal operation specified. Check bytes 15, 16, and 17.
6h	UNIT ATTENTION. Unit Attentions are created after a device reset, if the medium asynchronously becomes ready to the initiator, if another initiator changes Mode Parameters, and/or if the firmware is updated.
Bh	COMMAND ABORTED. This key is generated when a command has been aborted by the media changer for some reason. Check the Additional Sense Code / Additional Sense Code Qualifier bytes.

The following table provides the additional sense codes (ASCs) and additional sense code qualifiers (ASCQs) that may be reported. Additional information, explanations, or suggestions for action are included in some of the descriptions.

Table 66 Supported ASC / ASCQ (Hex) for Request Sense

Sense Key	ASC	ASCQ	Description
00 NO SENSE	00	00	No Additional Sense Code
01 RECOVERED ERROR			
	47	00	SCSI Parity Error
	48	00	IDE Message Received
	5D	00	Failure Predictive Threshold Exceeded
	5D	FF	Failure Predictive Threshold Exceeded (False)
02h NOT READY			
	04	01	Unit Not Ready, Calibration/Initialization in Process
	04	03	Unit Not Ready, Manual Intervention Needed (no magazine is present or a mechanical failure has occurred)
	04	07	Unit Not Ready, Operation in Progress
04h HARDWARE ERROR	08	00	LUN Communication Failure
	08	01	LUN Communication Timeout Failure
	0B	01	Over Temperature Condition Error
	15	01	Mechanical Positioning Error
	40	83	Diagnostic Failure

Sense Key	ASC	ASCQ	Description
	40	84	POST Soft Error
	53	00	Media Load Failure
	53	01	Media Unload Failure
05h ILLEGAL REQUEST	1A	00	Parameter List Length Error
	20	00	Illegal Opcode
	21	01	Invalid Element Address
	24	00	Invalid CDB Field
	24	86	Invalid Offset
	24	87	Invalid Size
	24	89	Image Data Over Limit
	24	8B	Image/Personality is Bad
	24	8C	Not Immediate Command during Code Update
	24	91	Bad Autoloader Image EDC
	25	00	Illegal LUN
	26	00	Parameter List Error, Invalid Field
	26	01	Parameter List Error, Parameter Not Supported
	26	02	Parameter List Error, Parameter Value Invalid
	26	03	Threshold Parameters Not Supported
	26	04	Invalid Release of Persistent Reservation
	39	00	Saving Parameters Not Supported
	3B	0D	Media Destination Element Full

Sense Key	ASC	ASCQ	Description
	3B	0E	Media Source Element Empty
	3B	11	Magazine Not Accessible
	3B	12	Magazine Removed
	53	02	Media Removal Prevented
	55	04	Insufficient Registration Resources
06h UNIT ATTENTION	28	00	Not Ready To Ready Transition
	28	01	Import/Export Element Accessed
	29	00	Reset Occurred
	29	01	Power On Occurred
	29	02	SCSI BUS Reset Occurred
	29	03	BUS Device Reset Function Occurred
	29	04	Device Internal Reset
	29	05	Transceiver Mode Changed to Single-Ended
	29	06	Transceiver Mode Changed to LVD
	2A	01	Mode Parameters Changed
	2A	02	Log Parameters Changed
	2A	03	Reservations Preempted
	2A	04	Reservations Released
	2A	05	Registrations Preempted
	3B	12	Magazine Removed
	3B	13	Magazine Inserted
	3F	01	Microcode has been Changed

Sense Key	ASC	ASCQ	Description
	3F	05	Device Identifier Changed
0Bh COMMAND ABORTED	3F	00	Operating Conditions have Changed
	3F	0F	Echo Buffer Overwritten
	43	00	Message Error
	44	80	Unexpected Selection Interrupt
	44	82	Command Complete Sequence Failure
	44	83	SCSI Chip, Gross Error/ Illegal – Command Status
	44	84	Unexpected/Unexplained Residue Count in Transfer Register
	44	87	Disconnect/ SDP Sequence Failed
	45	00	Select/Reselect Failure
	47	00	SCSI Parity Error (check SCSI bus configuration and connections)
	48	00	IDE Message Error
	49	00	Invalid Message Error
	4A	00	Command Phase Error
	4B	00	Data Phase Error
	4E	00	Overlapped Commands Attempted

Reserve Element (10) Command (56h)

The RESERVE and RELEASE commands are used for contention resolution in multiple-initiator systems. The RESERVE command is used to reserve a logical unit. The RESERVE (10) Command Descriptor Block is shown in figure 82, and the data fields are described in table 67 on page 161.

Figure 82 Reserve Element (10) Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (56h)							
1	Reserved			3rdPty	Reserved		LongID	Element
2	Reservation Identification							
3	Third Party Device ID							
4 - 6	Reserved							
7 - 8	(MSB) Parameter List Length (LSB)							
9	Unused		Reserved				Flag	Link

Table 67 Reserve Element (10) Command

Field	Description
3rd Pty	When set to 1, it indicates that the Third Party Device ID field is valid.
LongID	When 0, indicates that the third party device associated with the reservation release has a number smaller than 255 and the ID value can be sent within the CDB. If set = 1, indicates that the third party device ID is greater than 255, the ID value within the CDB is ignored, and the parameter list length is at least eight.
Element	Not supported. Must be 0.
Reservation Identification	Ignored.
Third Party Device ID	Required and used only when the 3rdPty bit is set, in which case this field specifies the SCSI ID of the initiator to be granted the reservation of the logical unit. The drive preserves the reservation until one of the following occurs: • It is superseded by another valid RESERVE command from the initiator; • It is released by the same initiator; • It is released by a TARGET RESET message from any initiator; • It is released by a TARGET RESET message from any initiator; or • It is released by a hard reset condition. The media changer ignores any attempt to release the reservation made by any other initiator. For example, if ID7 sends ID2 a Third Party reservation on behalf of ID6 (the target at ID2 gets reserved for the initiator ID6), then only ID7 can release the target at ID2 (using a Third Party release). ID6 cannot release the reservation even though the reservation was made on its behalf.
Parameter List Length	This field specifies the length, in bytes, of the parameter list that will be transferred from the initiator.

If the LongID bit = 1 and the Element bit = 0, then the parameter list length is eight and the parameter list has the following format.

Figure 83 Reserve (10) ID Only Parameter List

Bit Byte	7	6	5	4	3	2	1	0
0 - 7	(MSB) Third Party Device ID (LSB)							

Reserve Element (6) Command (16h)

The RESERVE ELEMENT command reserves the specified media changer for exclusive use by the requesting initiator or for another specified SCSI device. Element reservations are not supported.

The SuperLoader LTO implements this command as specified in SMC-2. Third party reservations are not supported by this command. The Reserve Element (10) must be used instead.

Figure 84 Reserve Element (6) Descriptor (LTO)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (16h)							
1	Logical Unit Number			Obsolete				Rsv'd
2 - 4	Reserved							
5	Unused		Reserved				Flag	Link

Figure 85 Reserve Element (6) Descriptor (DLT)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (16h)							
1	Logical Unit Number			3rdPty	Third Party Device ID			Rsv'd
2 - 4	Reserved							
5	Unused		Reserved				Flag	Link

A reservation via the RESERVE ELEMENT command remains in effect until one of the following conditions is met:

- The initiator that made the reservation sends another RESERVE ELEMENT command.
- The device is released via a RELEASE ELEMENT command from the same initiator.
- A BUS DEVICE RESET message is received from any initiator.
- A hard reset occurs.

The occurrence of the last two conditions is indicated by the media changer returning a CHECK CONDITION status, sense key of UNIT ATTENTION on the next command following the condition. It is not an error to issue a RESERVE ELEMENT command to a media changer that is currently reserved by the requesting initiator.

If another initiator has previously reserved the logical unit, the target returns a RESERVATION CONFLICT status.

If, after honoring the reservation, any other initiator attempts to perform any command except INQUIRY, REQUEST SENSE, or RELEASE ELEMENT, the command is rejected with a

RESERVATION CONFLICT status. That logical unit ignores a RELEASE ELEMENT command issued by another initiator.

Send Diagnostic Command (1Dh)

The SEND DIAGNOSTIC command directs the media changer to perform its self-diagnostic tests.

Figure 86 Send Diagnostic Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Dh)							
1	Logical Unit Number			PF (0)	Reserved		Selftst	DevOfl	UnitOfl
2	Reserved							
3 - 4	(MSB) Parameter List Length (LSB)							
5	Unused		Reserved				Flag	Link

Table 68 Send Diagnostic Command Data

Field	Description
PF	Page Format. Not supported; must be 0.
Selftst	Self Test. A Selftst bit of 1 directs the media changer to perform its default self test. A Selftst bit of 0 is not supported.
DevOfl	Device Offline. This bit is used in conjunction with Selftst and UnitOfl to specify the type of testing to be done. This bit must be set to 0.

Field	Description
UnitOfl	Unit Offline. This bit is used in conjunction with Selftst and DevOfl to specify the type of testing to be done. This bit must be set to 0.
Parameter List Length	Not supported; must be 0.

Set Device Identifier Command (A4h)

The SET DEVICE IDENTIFIER command requests that the device identifier information in the logical unit be set to the value received in the SET DEVICE IDENTIFIER parameter list. This command is optional for all device types.

On successful completion of a SET DEVICE IDENTIFIER command, a unit attention shall be generated for all initiators except the one that issued the service action. When reporting the unit attention condition, the additional sense code shall be set to DEVICE IDENTIFIER CHANGED.

Figure 87 Set Device Identifier Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (A4h)							
1	Reserved			Service Action (06h)				
2 - 5	Reserved							
6 - 9	(MSB) Parameter List Length (LSB)							
10	Reserved							
11	Unused		Reserved				Flag	Link

The Identifier field shall be a vendor specific value, to be returned in subsequent REPORT DEVICE IDENTIFIER commands.

Table 69 Set Device Identifier Command Descriptor Block

Field	Description
Service Action	Must be 06h. Any other value will return Check Condition, Illegal request.
Parameter List Length	Specifies the length in bytes of the Identifier that shall be transferred from the application client to the device server. The maximum value for this field shall be 64 bytes. A parameter list length of zero indicates that no data shall be transferred, and that subsequent REPORT DEVICE IDENTIFIER commands shall return an Identifier length of zero. If the parameter list length exceeds 64 bytes, then the drive will return CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and an additional sense code of INVALID FIELD IN CDB.

The SET DEVICE IDENTIFIER parameter list contains the identifier to be set by the addressed logical unit.

Figure 88 Set Device Identifier Parameter List

Bit Byte	7	6	5	4	3	2	1	0
0 - n	Identifier							

Table 70 Set Device Identifier Parameter List

Field	Description
Identifier	Data to be returned by all subsequent REPORT DEVICE IDENTIFIER commands, until replaced by another valid SET DEVICE IDENTIFIER command.

Test Unit Ready Command (00h)

The TEST UNIT READY command checks the media changer to ensure that the unit is ready for commands involving cartridge movement. If the media changer has successfully completed its initialization process and the unit is not in an error state, the command returns a GOOD status. Otherwise, CHECK CONDITION is reported. Some conditions that would cause a CHECK CONDITION include overtemperature, no magazines installed, or user access via front panel or On-board Remote Management interfaces.

Due to power cycle and code update, it is possible to get multiple check conditions on a TEST UNIT READY command.

Figure 89 Test Unit Ready Descriptor

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

Write Buffer Command (3Bh)

The WRITE BUFFER command is used with READ BUFFER as a diagnostic function and for downloading and updating microcode (firmware).

Figure 90 Write Buffer Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (3Bh)							
1	Logical Unit Number			Reserved	Mode			
2	Buffer ID							
3 - 5	(MSB) Buffer Offset (LSB)							
6 - 8	(MSB) Transfer Length (LSB)							
9	Unused		Reserved				Flag	Link

Table 71 Write Buffer Command Data

Field	Description	
Mode	The media changer supports the following values within the field. If any other value is set, the media changer terminates the command with CHECK CONDITION status and an ILLEGAL REQUEST sense key set.	
	Mode	**Description**
	0000b	Write Combined Header and Data Mode (0000b) on page 172 (LTO only)
	0010b	Write Data Mode (0010b) on page 172 (LTO only)
	0100b	Download Microcode Mode (0100b) on page 173
	0101b	Download Microcode and Save Mode (0101b) on page 173
	1010b	Write Data to Echo Buffer (1010b) on page 173
Buffer ID	For all of the modes described for the Mode field, only a Buffer ID of 0 is supported. If the Buffer ID field is a value other than 0, the command is rejected. The target detects and rejects commands that would overrun the buffer.	
Buffer Offset	See Download Microcode Mode (0100b) on page 173 and Download Microcode and Save Mode (0101b) on page 173 for the appropriate settings.	

Write Combined Header and Data Mode (0000b)

LTO only: The data to be transferred is preceded by a 4-byte header consisting entirely of reserved bytes. This header is discarded (not stored within the buffer). The buffer offset field must be 0 for this mode.

Write Data Mode (0010b)

LTO only: Similar to Header and Data Mode, except there is no header in the data passed to the target. Any potential buffer overruns are detected and the command is rejected.

Download Microcode Mode (0100b)

Using buffer offsets, the host can download the firmware image into the target's buffer in pieces. These commands do not cause the new image to become active. A Download and Save Mode WRITE BUFFER command must be issued for the image to become active.

Any error on a WRITE BUFFER command causes any downloaded image data to be discarded and the download must be restarted from the beginning.

Caution: During the actual reprogramming of the FLASH EEPROM, if any type of powerfail occurs, or if the reprogramming fails before completion, the SuperLoader subsystem may become unusable and the unit must be replaced.

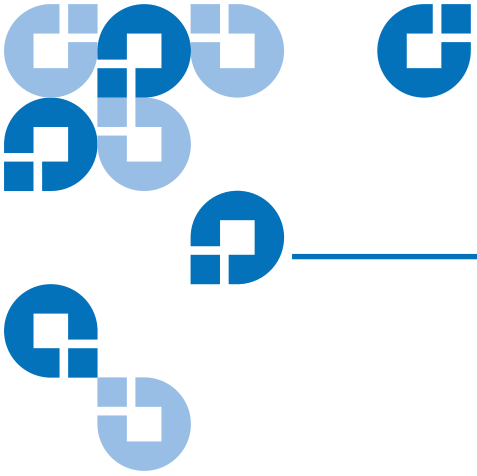
Download Microcode and SaveMode(0101b)

This mode is used to download and save the entire image at once, or to download the image and save it, or to cause a save operation after the image data has been downloaded using the Download Microcode mode (without the Save).

This mode of the WRITE BUFFER command causes the image data to be verified and the Flash EEPROM firmware area to be updated. During the reprogramming front panel displays progress information. Also, when it is updating the Flash, it disconnects from the SCSI bus and will not respond until the update is complete and the system has reset.

Write Data to Echo Buffer (1010b)

In this mode the drive transfers data from the application client and stores it in an Echo Buffer. The Buffer ID and Buffer Offset fields are ignored in this mode. Upon successful completion of a WRITE BUFFER command the data shall be preserved in the Echo Buffer unless there is an intervening command to write the Echo Buffer or the device is reset in anyway.



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