StorageTek SL4000 Modular Library System

SCSI Reference Guide

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StorageTek SL4000 Modular Library System SCSI Reference Guide

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Preface

This guide contains information about the Small Computer System Interface (SCSI) command set. It is intended for independent software vendors (ISVs), operating system developers, and engineers responsible for implementing the SCSI over a Fibre Channel (FC) physical interface on Oracle's StorageTek SL4000 modular library system.

> **Note:** Refer to the tape drive documentation for information about SCSI commands for a specific tape drive.

Documentation Accessibility

For information about Oracle's commitment to accessibility, visit the Oracle Accessibility Program website at http://www.oracle.com/pls/topic/lookup?ctx=acc&id=docacc.

Access to Oracle Support

Oracle customers that have purchased support have access to electronic support through My Oracle Support. For information, visit http://www.oracle.com/pls/topic/lookup?ctx=acc&id=info or visit http://www.oracle.com/pls/topic/lookup?ctx=acc&id=trs if you are hearing impaired.

Related Documents

- *American National Standard Dictionary for Information Processing Systems* - X3/TR-1-82
- *SCSI–3 Primary Commands (SPC)* - X3.301–1997
- *SCSI–3 Primary Commands (SPC-2)* - T10/Project 1236D
- *SCSI–3 Medium Changer Commands (SMC)* - T10/Project 1383D
- *SCSI–3 Architecture Model (SAM)* - X3.270–1996
- *SCSI Architecture Model – 2 (SAM–2)* - T10/Project 1157D
- *Fibre Channel Physical and Signaling Interface (FC–PH)* - X3.230–1994 Revision 4.3, X3.230–1996 (Amendment 1), X3.230–1997 (Amendment 2)
- *Fibre Channel Physical and Signaling Interface (FC–PH–2)* - X3.297–1996 Revision 7.4
- *Fibre Channel Physical and Signaling Interface (FC–PH–3)* - X3.303–199x Revision 9.3
- *Fibre Channel Arbitrated Loop (FC–AL)* - X3.272–1996 Revision 4.5

- *Fibre Channel Arbitrated Loop (FC–AL–2)* - X3.272–199x Revision 7.0

SL4000 Documentation

Go to the Tape Storage section of the Oracle Help Center (http://docs.oracle.com/en/storage/#tape) for additional SL4000 documentation:

- *SL4000 Library Guide*
- *SL4000 Security Guide*
- *SL4000 Safety and Compliance Guide*
- *SL4000 Licensing Information User Manual*

1

SL4000 FC Implementation

The FC implementation on the SL4000 conforms to the American National Standards Institute (ANSI) and National Committee for Information Technology Standards (NCITS), formerly X3.

Library Support

- Supports arbitrated loop and direct fabric attach
- FCP (SCSI-3) command set for medium changer devices
- Class 3 level of service
- Private and public loop operations
- Hard-assigned port addresses (AL-PA)
- Basic and extended link services
- Connections to an external hub (or switch)
- Data transfer rates of 100 MB/s
- Standard approved length shortwave fibre optic cables
- Multimode laser operating at 780 nm (shortwave) non-OFC

Hub Support

- Standard approved length fibre optic and copper cables
- Multimode laser operating at 780 nm (shortwave) non-OFC
- Single mode laser operating at 1300 nanometers (longwave)
- Cascading hub attachments
- Gigabit Interface Converter (GBIC) connections in the hub

Switch Support

- Attachment to FL_Ports

Task Management Support

- BLS ABTS
- Abort Task Set
- Clear Task Set
- LUN Reset
- Target Reset

Note: The library does not support Clear ACA.

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SL4000 SCSI Operation and Configuration

Behavior of Unavailable Fibre Channel Ports

The library comes standard with two ports (1 and 2). However, by default only port 1 is active (available). Ports 2 is unavailable until you install the redundant control paths (multi-port) hardware activation file. See the *SL4000 Library Guide* for more information.

The library can receive commands on an unavailable port. However, the library only fully supports the following commands on an unavailable port:

- Inquiry (12h)
- Report LUNs (A0h)
- Report Target Port Groups (A3h)
- Request Sense (03h)

For all other commands, the library:

- Terminates the command with Check Condition (02h) status
- Sets the sense key to Not Ready (02h), ASC to 04h, and ASCQ to 0ch — Not Ready, Logical Unit Not Accessible, Target Port in Unavailable State

Multiple Initiator Support

- The library supports unit reserve, release, and persistent reserve commands. Host software should reserve resources whenever possible.
- The library does not maintain a separate "prevent" or "allow" state for each initiator. There is a single state for all initiators. Therefore, if any initiator sends a Prevent Medium Removal command, the library locks the CAPs. If any initiator sends an Allow Media Removal command, the library unlocks the CAPs. For more information, see "Prevent/Allow Medium Removal (1Eh)" on page 3-46.

Reservation Handling

The library supports the following reservation management methods:

- Reserve and Release — defined by the ANSI SCSI-3 Primary Commands (SPC-2) Standard. See Table 2–1 for command reservation restrictions.
- Persistent Reservation — defined by the ANSI SCSI-3 Primary Commands (SPC-3) Standard. See Table 2–2 for command reservation restrictions.

Table 2–1 and Table 2–2 use the following definitions:

- **Conflict** — The library terminates the command with a Reservation Conflict (18h) status.
- **Allowed** — The library executes the command normally.

Compatible Reservation Handling Bit

The library returns 0 for the Compatible Reservation Handling (CRH) bit in the Persistent Reserve In (5Eh) Report Capabilities Data page.

A CRH value of 0 indicates the library processed the reserve or release command as defined in SPC-2. Therefore, the library will return a Reservation Conflict (18h) when it receives a reserve or release command from the same initiator that holds the persistent reservation.

Reserve and Release Management Method Command Restrictions

Table 2–1 Reserve and Release Management Method Command Restrictions

Command	Action when the Library is Reserved by Another Initiator
Initialize Element Status (07h)	Conflict
Initialize Element Status w/Range (37h)	Conflict
Inquiry (12h)	Allowed
Log Sense (4Dh)	Allowed
Mode Select (15h/55h)	Conflict
Mode Sense (1Ah/5Ah)	Conflict
Move Medium (A5h)	Conflict
Persistent Reserve In (5Eh)	Conflict
Persistent Reserve Out (5Fh)	Conflict
Position to Element (2Bh)	Conflict
Prevent/Allow Media Removal (1Eh)	Prevent = 0, Allowed Prevent = 1, Conflict
Read Element Status (B8h)	Conflict
Release (17h)	Allowed[1]
Report LUNs (A0h)	Allowed
Report Target Port Groups (A3h)	Allowed
Request Sense (03h)	Allowed
Request Volume Element Address (B5h)	Conflict
Reserve (16h)	Conflict
Send Diagnostics (1Dh)	Conflict

Table 2–1 (Cont.) Reserve and Release Management Method Command Restrictions

Command	Action when the Library is Reserved by Another Initiator
Send Volume Tag (B6h)	Conflict
Test Unit Ready (00h)	Conflict

[1] The reservation is not released.

Persistent Reservation Management Method Command Restrictions

Table 2–2 Persistent Reservation Command Restrictions when the Library is Reserved by Another Initiator

Command	Non-Registered Initiator[1]	Registered Initiator: Exclusive Access Reservation[2]	Registered Initiator: Exclusive Access Registrant Only [3]
Initialize Element Status (07h)	Conflict	Conflict	Allowed
Initialize Element Status w/Range (37h)	Conflict	Conflict	Allowed
Inquiry (12h)	Allowed	Allowed	Allowed
Log Sense (4Dh)	Allowed	Allowed	Allowed
Mode Select (15h/55h)	Conflict	Conflict	Allowed
Mode Sense (1Ah/5Ah)	Conflict	Conflict	Allowed
Move Medium (A5h)	Conflict	Conflict	Allowed
Persistent Reserve In (5Eh)	Allowed	Allowed	Allowed
Persistent Reserve Out (5Fh) - SA=Register	Allowed	Allowed	Allowed
Persistent Reserve Out (5Fh) - SA=Reserve	Conflict	Conflict	Conflict
Persistent Reserve Out (5Fh) - SA=Release	Conflict	Allowed[4]	Allowed[4]
Persistent Reserve Out (5Fh) - SA=Clear	Conflict	Allowed	Allowed
Persistent Reserve Out (5Fh) - SA=Preempt	Conflict	Allowed	Allowed
Persistent Reserve Out (5Fh) - SA=Preempt/Abort	Conflict	Allowed	Allowed
Persistent Reserve Out (5Fh) - SA=Register and Ignore	Allowed	Allowed	Allowed
Position to Element (2Bh)	Conflict	Conflict	Allowed
Prevent/Allow Media Removal (1Eh) Prevent = 0	Allowed	Allowed	Allowed
Prevent/Allow Media Removal (1Eh) Prevent = 1	Conflict	Conflict	Allowed
Read Element Status (B8h)	Conflict	Conflict	Allowed
Release (17h)	Conflict	Conflict	Conflict
Report LUNs (A0h)	Allowed	Allowed	Allowed
Report Target Port Groups (A3h)	Allowed	Allowed	Allowed
Request Sense (03h)	Allowed	Allowed	Allowed
Request Volume Element Address (B5h)	Conflict	Conflict	Allowed
Reserve (16h)	Conflict	Conflict	Conflict

Table 2–2 (Cont.) Persistent Reservation Command Restrictions when the Library is Reserved by Another Initiator

Command	Non-Registered Initiator[1]	Registered Initiator: Exclusive Access Reservation[2]	Registered Initiator: Exclusive Access Registrant Only [3]
Send Diagnostics (1Dh)	Conflict	Conflict	Allowed
Send Volume Tag (B6h)	Conflict	Conflict	Allowed
Test Unit Ready (00h)	Conflict	Conflict	Allowed

[1] Action when a non-registered initiator sends a command to a library reserved by another initiator.

[2] Action when a registered initiator sends a command to a library reserved by another initiator that has an Exclusive Access reservation.

[3] Action when a registered initiator sends a command to a library reserved by another initiator that has an Exclusive Access Registrant Only reservation.

[4] The reservation is not released.

Configuring SCSI Access in a Partitioned Library

When you first enable partitioning with a hardware activation file, all resources belong to the DefaultPartition. Any SCSI hosts that had access to the library before installing the activation file will automatically have access to the DefaultPartition.

You can use the SL4000 GUI to configure partitioning and SCSI host access to each partition. To grant access, you must provide the Host World Wide Port Name and a LUN. All hosts must have a connection to LUN 0. Additional LUN configuration will allow access to more than one partition. For more information, see the *SL4000 Library Guide*.

Example 2–1 SCSI Host Access in a Library with Two Partitions

Partition 1 could have the following host access:

Host 1, LUN 0
Host 2, LUN 0
Host 3, LUN 0

Partition 2 could have the following host access:

Host 2, LUN 1
Host 5, LUN 0

When Host 2 sends a command on LUN 0, the library directs the commands to partition 1. When Host 2 send a command on LUN 1, the library directs the command to partition 2.

Command Handling for a SCSI Host without Access to a Partition

If a SCSI host sends a command to a partition it does not have access to, the library will respond with the following:

- Inquiry returns Good (00h) with the Inquiry Data Peripheral Qualifer set to 001b instead of 000b.
- Request Sense returns Good (00h) with the sense data set to LUN Access Not Authorized (02h/74h/71h).
- Report LUNs returns Good (00h) and the Report LUNs Data reports LUN 0.
- All other commands return Check Condition (02h) with the sense data set to LUN Access Not Authorized (02h/74h/71h).

For more information on sense data, see "Additional Sense Codes and Qualifiers" on page 3-68.

Sharing CAPs in a SCSI Partition

In a partitioned library, you can configure CAPs as a shared resource. To use a shared CAP, the partition must "own" the CAP, which reserves exclusive use of the CAP for that partition.

Until the partition owns a CAP, the SCSI interface will report the CAP state as open (even though the CAP may actually be closed). You must use the GUI to reserve ownership of the CAP before entering or ejecting cartridges. Once you complete the CAP operation, you must unassign the CAP to make it available to other partitions (see the GUI help for procedures).

Command Handling for an Unowned, Shared CAP

The library will process commands that include any unowned CAP elements as if the CAP is open:

- A Move Medium (A5h) command to or from an unowned CAP will return Check Condition (02h) status. The sense data will indicate Not Ready, CAP Open (2h/3Ah/02h).
- A Read Element Status (B8h) command that includes an unowned CAP element will return Good (00h) status. The Import/Export Element descriptor data for the CAP element will return an exception condition indicating the CAP is open (Except = 1, ASC = 3Ah, and ASCQ = 02h).

Locked/Unlocked State for a Shared CAP

You can only open an unlocked CAP. The state of the CAP depends on the "prevent" or "allow" medium removal state. For more information, see "Prevent/Allow Medium Removal (1Eh)" on page 3-46.

Example 2–2 Shared CAP Locked/Unlocked State for a Library with Two Partitions

CAP Assignment	Partition 1 Prevent/Allow Removal State	Partition 2 Prevent/Allow Media Removal State	CAP State
Unassigned	Maintained by the library	Maintained by the library	Locked
Assigned to Partition 1	Allowed	Maintained by the library	Unlocked
Assigned to Partition 1	Prevented	Maintained by the library	Locked
Assigned to Partition 2	Maintained by the library	Allowed	Unlocked
Assigned to Partition 2	Maintained by the library	Prevented	Locked

SCSI Element Addressing

The SCSI element address depends on the element type. Each library or partition uses a fixed starting address for each element type. Then, within each element type, the element addresses are sequential.

Element Type	Starting SCSI Element Address
Medium Transport Element (Robot)	0

Element Type	Starting SCSI Element Address
Import/Export Elements (CAPs and AEMs)	10
Data Transfer Elements (Drives and Empty Drive Slots)	1000
Storage Elements (Cartridge Cells)	2000

You can use the GUI to view the element ID for a particular cell in the library (see *SL4000 Library Guide*).

Empty Drive Slot Element Addressing

Unlike the SL3000, the SL4000 library assigns a SCSI element address to empty drive slots. Therefore, removing or adding a drive tray will not cause the library to renumber the data transfer element addresses.

If you send a Read Element Status (B8h) command for an empty drive slot, the library will return an Element Descriptor with the slot marked as disabled with an exception. The library sets the ASC/ASCQ to 3Bh/1Ah indicating an empty drive slot.

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SL4000 SCSI Commands

Command Descriptor Block (CDB) Structure

- The first byte contains the operation code — a Group Code that provides eight groups of commands and a Command Code that provides 32 command codes for each group.
- The second byte starts the command parameters.
- The last byte is the control byte (see "Control Byte Structure" on page 3-3).

For some commands, a list of parameters accompanies the request during data out. For all commands, if there is an invalid parameter in the CDB, then the library terminates the command without altering the medium.

6-Byte Command Structure

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Group Code			Command Code				
1	Reserved			Command Parameters				
2 to 4	Command Parameters							
5	Control Byte							

SLK_065

10-Byte Command Structure

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Reserved			Command Parameters				
2 to 8	Command Parameters							
9	Control Byte							

SLK_066

12-Byte Command Structure

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Reserved			Command Parameters				
2 to 9	Command Parameters							
10	Reserved							
11	Control Byte							

SLK_067

Control Byte Structure

The control byte is the last byte of every CDB.

	Bit							
Byte	7	6	5	4	3	2	1	0
5, 9, or 11	Vendor Specific		Reserved			NACA (0)	Flag (0)	Link (0)

SLK_068

Vendor Specific
Provides information about the device.

NACA (Normal auto contingent allegiance)
Controls the rules for handling an auto contingent condition caused by a command. When NACA is 0, the command will return a check condition if a contingent allegiance condition occurs.

Flag (not supported)
Causes an interrupt in the initiator allowing a device to respond with intermediate status. This bit is should be 0.

Link (not supported)
Allows devices that support command linking to continue the I/O process. This bit should be 0.

Supported SCSI Command Status Byte Codes

Good (00h)
Indicates the device successfully completed the command.

Check Condition (02h)
Occurs when an error, unit exception, or abnormal condition generates sense data caused by one of the following conditions:

- Issuing an invalid command or parameter
- Issuing a command to a device that is not ready
- Detecting a hardware error
- Sensing an illegal request

Busy (08h)
Occurs when the target cannot accept a command from an otherwise acceptable initiator. Normally, to recover from a Busy status, the initiator reissues the command.

Reservation Conflict (18h)
Occurs whenever a SCSI initiator attempts to access a logical unit that is reserved by another initiator.

Initialize Element Status (07h)

Initialize Element Status (07h) requests an audit of the library. The library accepts this command for compatibility, but it does not perform any action.

At power-on or after the front door opens/closes, the library performs a full audit and then maintains a cartridge inventory during operation. Use Read Element Status (B8h) to obtain the cartridge inventory.

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (07h)							
1	Ignored			Reserved				
2 to 4	Reserved							
5	Control Byte (00h)							

SLK_069

Initialize Element Status with Range (37h)

Initialize Element Status with Range (37h) requests an audit for a range of cells in the library. The library accepts this command for compatibility, but it does not perform any action.

At power-on or after the front door opens/closes, the library performs a full audit and then maintains a cartridge inventory while operating. Use Read Element Status (B8h) to obtain the cartridge inventory.

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (37h)							
1	Ignored			Reserved			Fast (Ignored)	Range(Ignored)
2 to 3	Element Address (Ignored)							
4 to 5	Reserved							
6 to 7	Number of Elements (Ignored)							
8	Reserved							
9	Control Byte (00h)							

SLK_070

Inquiry (12h)

Inquiry (12h) requests information about library parameters.

> **Note:** The Inquiry command returns Check Condition (02h) status only when it cannot return the requested data. This command will not clear any pending unit attention conditions.

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (12h)							
1	Ignored			Reserved			CmdDt (0)	EVPD (0 or 1)
2	Page Code (00h, 80h, or 83h)							
3 to 4	Allocation Length							
5	Control Byte (00h)							

SLK_071

CmdDt (Command Support Data - not supported)
Set this to 0.

EVPD (Enable vital product data)
0 = Requests standard inquiry data

1 = Requests vital support product data

Page Code
If EVPD is 0, set the page code to 00h.

If EVPD is 1, set the page code to:

- 00h = Supported vital product page
- 80h = Unit serial number page
- 83h = Device identification page

Allocation Length
The library transfers either the number of bytes specified by the Allocation Length field or all of the available inquiry data, whichever is less. The page lengths are:

- 38h (56d) bytes for standard inquiry data
- 07h (7d) bytes for the supported vital product page
- 10h (16d) bytes or 16h (22d) bytes for the unit serial number page
- 2Ch (44d) bytes for the device identification page

Standard Inquiry Data Definition

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	RMB (1)	Reserved						
2	Version (05h)							
3	Reserved		NACA (0)	HiSup (1)	Response Data Format (2)			
4	Additional Length (33h)							
5	SCCS (0)	ACC (0)	TPGS (01b)		3PC (0)	Reserved		Protect (1)
6	BQue (0)	EncServ (0)	VS (0)	MultiP (1)	MChngr (0)	Reserved		
7	Reserved				LINKED (0)	Reserved	CmdQue (0)	SftRe (0)
8 to 15	Vendor Identification							
16 to 31	Product Identification							
32 to 55	Product Revision Level							

SLK_072

Peripheral Qualifier
000b = The specified peripheral device type is currently connected to this logical unit.

001b = The device server can support the specified peripheral device type on this logical unit. However, the physical device is not currently connected to this logical unit. The library returns this value when either:

- The redundant control paths (multi-port) hardware activation file is not installed, and the Inquiry command is received on a non-activated port.
- Partitioning is enabled, and the host that issued this command does not have access to a partition. For more information, see "Configuring SCSI Access in a Partitioned Library" on page 2-4.

011b = The command was sent to an unsupported logical unit.

Peripheral Device Type
08h = The library is a medium changer device.

1Fh = The command was sent to an unsupported logical unit.

RMB (Removable Medium)
1 = The medium is removable.

Version
05h = The library complies with SCSI-3.

NACA (Normal Auto Contingent Allegiance - not supported)
0 = The library does not support setting NACA to one in the control byte of a CDB.

HiSup (Hierarchical Addressing Support)
1 = The library uses the hierarchical addressing module to identify logical units.

Response Data Format
2 = The data complies with the SCSI-3 specification.

Additional Length
33h = 51d bytes of remaining Standard Inquiry Data.

SCCS
0 = The library does not contain an embedded storage array controller component.

ACC (Access Control Coordinator)
0 = The library does not contain an ACC that may be addressed through this logical unit.

TPGS (Target Port Group Support)
1 = The library supports implicit asymmetric logical unit access. The library can change target port asymmetric access states without a Set Target Port Groups (which is an unsupported command). The library supports Report Target Port Groups (A3h).

3PC (Third-Party Commands - not supported)
The library returns 0.

Protect (Information Protection - not supported)
The library returns 0.

BQue (Basic Queuing - not supported)
The library returns 0.

VS (Vendor Specific)
0 = There is no vendor specific information with this command.

MultiP
1 = The library has multiple target ports.

MChngr
0 = The library is not embedded in or attached to a medium transport element.

LINKED (Linked commands - not supported)
The library returns 0.

CmdQue (Command Queuing - not supported)
The library returns 0.

SftRe (Soft Reset - not supported)
The library returns 0.

Vendor Identification
Contains the ASCII character sequence “STK” followed by blanks. If the specified logical unit is not supported, this field contains all blanks.

Product Identification
Contains the ASCII character sequence “SL4000” followed by blanks.

Product Revision Level
Contains an ASCII character sequence that represents the product revision level.

Error Conditions
The library returns Check Condition status for the Inquiry command only when a severe error occurs. To recover from a Check Condition status report on the Inquiry command, verify that the Inquiry CDB is correct and then retry the Inquiry command.

Supported Pages

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

SLK_073

Peripheral Qualifier
See Peripheral Qualifier.

Peripheral Device Type
See Peripheral Device Type.

Page Code
00h = The vital page

Additional Page Length
03h (3d) bytes

Supported pages
00h = The first vital page is page 0 (current page)

80h = Unit Serial Number page

83h = Device Identification Page

Unit Serial Number Page

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (80h)							
2	Reserved							
3	Additional Page Length (0Ch or 12h)							
4 to n	Unit Serial Number							

SLK_074

Peripheral Qualifier
See Peripheral Qualifier.

Peripheral Device Type
See Peripheral Device Type.

Page Code
80h = The unit serial number page.

Additional Page Length
0Ch = 12 bytes of unit serial number data.

12h = 18 bytes of unit serial number data.

Unit Serial Number
Contains a unique ASCII Serial Number for the library. For example:

- 571XX0000121 = 12 byte unit serial number
- 464970G+1221XX0005 = 18 byte unit serial number

Where XX indicates the library partition identifier. For nonpartitioned libraries, XX is 00.

Device Identification Page

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (83h)							
2	Reserved							
3	Additional Page Length (28h)							
Node Name Identifier								
4	Protocol Identifier (0)			Code Set (1)				
5	PIV (1)	Reserved		Association (0)		Identifier Type (3)		
6	Reserved							
7	Identifier Length (08h)							
8 to 15	NAA IEEE Registerd Identifier							
Port Name Identifier								
16	Protocol Identifier (0)			Code Set (1)				
17	PIV (1)	Reserved		Association (1)		Identifier Type (3)		
18	Reserved							
19	Identifier Length (08h)							
20 to 27	NAA IEEE Registerd Identifier							
Relative Target Port Identifier								
28	Protocol Identifier (0)			Code Set (1)				
29	PIV (1)	Reserved		Association (1)		Identifier Type (4)		
30	Reserved							
31	Identifier Length (04h)							
32 to 35	Relative Target Port							
Target Port Group Identifier								
36	Protocol Identifier (0)			Code Set (1)				
37	PIV (1)	Reserved		Association (1)		Identifier Type (5)		
38	Reserved							
39	Identifier Length (04h)							
40 to 43	Target Port Group							

SLK_075

Peripheral Qualifier
See Peripheral Qualifier.

Peripheral Device Type
See Peripheral Device Type.

Protocol Identifier
0h = FC protocol.

Code Set
1 = Binary values

PIV (Protocol Identifier Valid)
1 = The protocol identifier is valid

Association
0 = The identifier field is associated with the addressed logical unit

1 = The identifier field is associated with the port that received the request

Identifier Type
3 = Contains a 64-bit IEEE formatted address

4 = Contains the Relative Target Port Identifier

5 = Contains the Target Port Group Identifier

Identifier Length
04h = 4-bytes long

08h = 8-bytes long

NAA IEEE Registered Identifier
An 8-byte identifier. The first 4 bits are the Name Address Authority — NAA (5h). The next 24 bits are the Oracle company ID (00 10 4Fh). The remaining bits are the vendor-specific identifier. The NAA IEEE Registered Identifier is unique for each library and Fibre Channel port.

Relative Target Port
01h = Port 1

02h = Port 2

03h = Port 3

04h = Port 4

Target Port Group
01h = Target Port Group 1

02h = Target Port Group 2

Log Sense (4Dh)

Log Sense (4Dh) returns library error logs and statistics.

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (4Dh)							
1	Ignored			Reserved			PPC (0)	SP (0)
2	PC (0)		Page Code					
3 to 4	Reserved							
5 to 6	Parameter Pointer (00h)							
7 to 8	Allocation Length							
9	Control Byte (00h)							

SLK_076

PPC (Parameter Pointer Control - not supported)
Set this to 0.

SP (Save Parameters - not supported)
Set this to 0.

PC (Page Control)
Set this to 0. The library only supports a PC value of 0 (threshold values).

Page Code
00h = List supported pages

07h = List last *n* error events page

Parameter Pointer
Set this to 0.

Allocation Length
The library transfers either the number of bytes specified by the Allocation Length field or all of the available log sense data, whichever is less. The page lengths are:

- 06h (6d) bytes for supported pages data
- 28h (40d) bytes for the last n errors events page

Supported Pages Page

The Supported Pages Page lists all the Log Sense page codes supported by the library.

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Page Code (00h)							
1	Reserved							
2 to 3	Page Length (02h)							
4	Supported Pages Page Code (00h)							
5	Last n Errors Events Page Code (07h)							

SLK_077

Last n Errors Events Page

The Last *n* Errors Event Page does not return specific error information. Instead, the operator should gather the log/error information from the GUI.

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Page Code (07h)							
1	Reserved							
2 to 3	Page Length (24h)							
4 to 39	"Refer to GUI for log information"							

SLK_078

Mode Select 6-byte (15h) and Mode Select 10-byte (55h)

The Mode Select commands specify operating parameters for the library. The library uses the configuration parameters during power-on or after a logical unit reset. If you set the parameter list length field to 0, then no Mode Select data is required. Otherwise, you must provide the following mode parameter data in a parameter list:

- A 4-byte or 8-byte Mode Select Parameter Header
- An 8-byte Fibre Channel Logical Unit Page
- An 8-byte Fibre Channel Port Control Page
- A 20-byte Element Address Assignment Mode Page

The library accepts the Mode Select command for compatibility, but the library does not support changing Mode parameters. The library returns a check condition if a SCSI host issues a Mode Select command and attempts to change a mode page. When the library receives a Mode Select command, the library validates all parameters. If a value is invalid, the library returns an error.

Mode Select 6-Byte Command

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (15h)							
1	Ignored			PF (1)	Reserved			SP (0)
2 to 3	Reserved							
4	Parameter List Length							
5	Control Byte (00h)							

SLK_079

Mode Select 10-byte Command

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (55h)							
1	Ignored			PF (1)	Reserved			SP (0)
2 to 6	Reserved							
7 to 8	Parameter List Length							
9	Control Byte (00h)							

SLK_084

Command Definitions

PF (Page Format)
Set this to 1 to indicate the page format supports the SCSI-3 specification

SP (not supported)
Set this to 0.

Parameter List Length
00h = Transfers no data. This is not an error.

18h (for 6-byte) or 1Ch (for 10-byte) = Transfers Mode Parameter Header and Element Address Assignment Page

0Ch (for 6-byte) or 10h (for 10-byte) = Transfers the Mode Parameter Header and Fibre Channel Logical Unit Page

0Ch (for 6-byte) or 10h (for 10-byte) = Transfers the Mode Parameter Header and Fibre Channel Port Control Page

Any other value is an error and is not supported.

Mode Select Parameter Header

The header definitions for the library must all be 00h.

Mode Select 6-byte Parameter Header

	Bit							
Byte	7	6	5	4	3	2	1	0
0 to 3	Reserved							

SLK_080

Mode Select 10-byte Parameter Header

	Bit							
Byte	7	6	5	4	3	2	1	0
0 to 7	Reserved							

SLK_085

Fibre Channel Logical Unit Page

	Bit							
Byte	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (18h)					
1	Page Length (06h)							
2	Reserved				Protocol Identifier (0h)			
3	Reserved							EPDC (0)
4 to 7	Reserved							

SLK_061

PS (Parameters Savable)
Set this to 0.

SPF (SubPage Format)
Set this to 0 to indicate page_0 format.

Protocol Identifier
0h = FC protocol.

EPDC (Enable Precise Delivery Checking - not supported)
Set this to 0.

Fibre Channel Port Control Page

	Bit							
Byte	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (19h)					
1	Page Length (06h)							
2	Reserved				Protocol Identifier (0h)			
3	DTFD (0)	PLPB (0)	DDIS (0)	DLM (0)	RHA (0)	ALWI (0)	DTIPE (0)	DTOLI (0)
4 to 5	Reserved							
6	Reserved					RR_TOV Units (100b)		
7	RR_TOV Values (1Eh)							

SLK_082

PS (Parameters Savable)
Set this to 0.

SPF (SubPage Format)
SubPage Format. Set this to 0 to indicate page_0 format.

Protocol Identifier
0h = FC protocol.

DTFD (Disable Target Fabric Discovery)
Set this to 0.

PLPB (Prevent Loop Port Bypass)
Set this to 0.

DDIS (Disable Discovery)
Set this to 0.

DLM (Disable Loop Master)
Set this to 0.

RHA (Require Hard Address)
Set this to 0.

ALWI (Allow Login without Loop Initialization)
Set this to 0.

DTIPE (Disable Target Initiated Port Enable)
Set this to 0.

DTOLI (Disable Target Originated Loop Initialization)
Set this to 0.

RR_TOV Units (Resource Recovery Timeout Units)
Set this to 100b = 10 second units.

RR_TOV Values (Resource Recovery Timeout Value)
Set this to 1Eh = 300 seconds.

Element Address Assignment Mode Page

	Bit							
Byte	7	6	5	4	3	2	1	0
0	PS (0)	Reserved	Page Code (1Dh)					
1	Page Length (12h)							
2 to 3	First Medium Transport Element Address							
4 to 5	Number of Medium Transport Elements							
6 to 7	First Storage Element Address							
8 to 9	Number of Storage Elements							
10 to 11	First Import/Export Element Address							
12 to 13	Number of Import/Export Elements							
14 to 15	First Data Transfer Element Address							
16 to 17	Number of Data Transfer Elements							
18 to 19	Reserved							

SLK_083

PS (Parameters Savable)
Set this to 0.

Page Code
1Dh = Element Address Assignment mode page.

Parameter Length
12h = 18d bytes of parameter data following this byte

First Medium Transport Element Address
0000h = The address of the robot in the library.

Number of Medium Transport Elements
The number of the robots in the library. The number must be the same number returned by Mode Sense.

First Storage Element Address
7D0h (2000d) = The address of the first data cartridge cell in the library or partition.

Number of Storage Elements
The number of data cartridge cells in the library or partition. This number depends on the configuration of the library or partition. The number must be the same number returned by Mode Sense. To obtain this value, use Mode Sense of mode page 1Dh.

First Import/Export Element Address
000Ah (10d) = The address of the first CAP in the library or partition.

Number of Import/Export Elements
The number of CAPs in the library or partition. This number depends on the configuration of the library or partition. The number must be the same number returned by Mode Sense. To obtain this value, use Mode Sense of mode page 1Dh.

First Data Transfer Element Address
3E8h (1000d) = The address of the first drive or empty drive slot in the library or partition.

Number of Data Transfer Elements

The number of drives and empty drive slots in the library. This number depends on the configuration of the library. The number must be the same number returned by Mode Sense. To obtain this value, use Mode Sense of mode page 1Dh.

Mode Sense 6-byte (1Ah) and Mode Sense 10-byte (5Ah)

The Mode Sense commands return information about the library's operating mode parameters. The data can be truncated to the length specified in the allocation length field. The library returns a Mode Sense Parameter Header followed by one or more of the following mode pages:

- FC Logical Unit Control Page
- FC Port Control Page
- Element Address Assignment Page
- Transport Geometry Mode Page
- Device Capabilities Page

Mode Sense 6-byte Command

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Ah)							
1	Ignored			Reserved	DPD (Ignored)	Reserved		
2	Page Control		Page Code					
3	SubPage Code (00h)							
4	Allocation Length							
5	Control Byte (00h)							

SLK_086

Mode Sense 10-byte Command

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (5Ah)							
1	Ignored			LLBA (0)	DPD (Ignored)	Reserved (0)		
2	Page Control		Page Code					
3	SubPage Code (00h)							
4 to 6	Reserved (00h)							
7 to 8	Allocation Length							
9	Control Byte (00h)							

SLK_087

Command Definitions

LLBA (10-byte only)
Set this to 0. The library will return 0 for LONGBLA in the parameter data.

DBD (Disable Block Descriptor)
The library ignores this field.

Page Control
0h (00b) = Current Values. The library returns the requested pages with each supported parameter set to its current value.

1h (01b) = Changeable Parameter Values. The library returns the requested pages indicating which parameters the initiator can change (1 indicates a changeable parameters and 0 indicates an unchangeable parameter).

Note: The library does not support any changeable mode values.

2h (10b) = Default Values. The library returns the requested pages with each supported parameter set to its default. The default values are the same as the current values.

3h (11b) = Saved Values. The library does not support any savable pages. If you request Saved Values, the library returns a check condition.

Page Code

18h = Fibre Channel Logical Unit page

19h = Fibre Channel Port Control page

1Dh = Element Address Assignment page

1Eh = Transport Geometry page

1Fh = Device Capabilities page

3Fh = All pages (in the above order)

SubPage Code (not supported)

Set this to 0.

Allocation Length

The length of the parameter list returned by the library. The maximum length for Mode Sense 6-byte is 40h (64d) bytes. The maximum length for Mode Sense 10-byte is 44h (68d) bytes.

The library transfers the number of bytes specified by the Allocation Length or the available Mode Sense data, whichever is less. The length varies based on the Page Code selected:

- 4 bytes (for Mode Sense 6-byte) or 8 bytes (for Mode Sense 10-byte) for the parameter list header which is always present.
- 8 additional bytes for the Fibre Channel Logical Unit Control page
- 8 additional bytes for the Fibre Channel Port Control page
- 20 additional bytes for the Element Address Assignment page
- 4 additional bytes for the Transport Geometry page
- 20 additional bytes for the Device Capabilities page

Mode Sense Parameter Header

Mode Sense 6-byte Parameter Header

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Mode Data Length							
1 to 2	Reserved							
3	Block Descriptor Length (00h)							

SLK_068

Mode Sense 10-byte Parameter Header

	Bit							
Byte	7	6	5	4	3	2	1	0
0 to 1	Mode Data Length							
2 to 5	Reserved							
6 to 7	Block Descriptor Length (00h)							

SLK_069

Mode Data Length
The bytes of parameter information available regardless of the allocation length. This value excludes the Mode Data Length byte, but includes three additional bytes (for Mode Sense 6-byte) or six additional bytes (for Mode Sense 10-byte) and the length of any mode pages that follow.

Block Descriptor Length (not supported)
The library returns 0.

FC Logical Unit Control Page

	Bit							
Byte	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (18h)					
1	Page Length (06h)							
2	Reserved				Protocol Identifier (0h)			
3	Reserved							EPDC (0)
4 to 7	Reserved							

SLK_081

PS (Parameters Saveable)
The library returns 0.

SPF (SubPage Format)
The library returns 0 to indicate page_0 format.

Protocol Identifier
0h = FC protocol.

EPDC (Enable Precise Delivery Checking)
The library returns 0.

FC Port Control Page

	Bit							
Byte	7	6	5	4	3	2	1	0
0	PS (0)	Reserved	Page Code (19h)					
1	Page Length (06h)							
2	Reserved				Protocol Identifier (0h)			
3	DTFD	PLPB (0)	DDIS (0)	DLM (0)	RHA (0)	ALWI (0)	DTIPE (0)	DTOLI (0)
4 to 5	Reserved							
6	Reserved					RR_TOV Units (100b)		
7	RR_TOV Values (1Eh)							

SLK_090

PS (Parameters Savable)
The library returns 0.

Protocol Identifier
0h = FC protocol.

DTFD (Disable Target Fabric Discovery)
0 = Public Loop supported

1 = Private Loop only supported

PLPB (Prevent Loop Port Bypass)
The library returns 0.

DDIS (Disable Discovery)
The library returns 0.

DLM (Disable Loop Master)
The library returns 0.

RHA (Require Hard Address)
The library returns 0.

ALWI (Allow Login without Loop Initialization)
The library returns 0.

DTIPE (Disable Target Initiated Port Enable)
The library returns 0.

DTOLI (Disable Target Originated Loop Initialization)
The library returns 0.

RR_TOV Units (Resource Recovery Timeout Units)
The library always returns 100b = 10 second units.

RR_TOV Values (Resource Recovery Timeout Value)
The library always returns 1Eh = 300 seconds.

Element Address Assignment Page

	Bit							
Byte	7	6	5	4	3	2	1	0
0	PS (0)	Reserved	Page Code (1Dh)					
1	Page Length (12h)							
2 to 3	First Medium Transport Element Address							
4 to 5	Number of Medium Transport Elements							
6 to 7	First Storage Element Address							
8 to 9	Number of Storage Elements							
10 to 11	First Import/Export Element Address							
12 to 13	Number of Import/Export Elements							
14 to 15	First Data Transfer Element Address							
16 to 17	Number of Data Transfer Elements							
18 to 19	Reserved							

SLK_083

PS (Parameters Savable)
The library returns 0.

Page Code
1Dh = The Element Address Assignment mode page.

Parameter Length
12h = 18d bytes of parameter data following this byte

First Medium Transport Element Address
00h = The address of the robot in the library.

Number of Medium Transport Elements
The number of the robots in the library.

First Storage Element Address
7D0h (2000d) = The address of the first data cartridge cell in the library or partition.

Number of Storage Elements
The number of data cartridge cells in the library or partition.

First Import/Export Element Address
000Ah (10d) = The address of the first CAP in the library or partition.

Number of Import/Export Elements
The number of CAPs in the library or partition.

First Data Transfer Element Address
3E8h (1000d) = The address of the first drive or empty drive slot in the library or partition.

Number of Data Transfer Elements
The number of drives and empty drive slots in the library.

Transport Geometry Mode Page

	Bit							
Byte	7	6	5	4	3	2	1	0
0	PS (0)	Reserved	Page Code (1Eh)					
1	Page Length (02h)							
2	Reserved							Rotate (0)
3	Member Number in Transport Element Set (00h)							

SLK_091

PS (Parameters Savable)
The library returns 0.

Page Code
1Eh = the Transport Geometry mode page.

Page Length
The number of additional types of transport geometry descriptor data to follow the header. Each descriptor has two bytes of information.

02h = The library has one transport mechanism.

Rotate
0 = The library does not use multiple-sided media.

Member Number in Transport Element Set
Identifies the transport element in the system.

00h = The library has one transport element.

Device Capabilities Page

- DT — Data Transfer Element (drive)
- I/E — Import/Export Element (CAP cells)
- ST — Storage Element (cartridge storage cell)
- MT — Medium transport (robot hand)

	Bit							
Byte	7	6	5	4	3	2	1	0
0	PS (0)	Reserved	Page Code (1Fh)					
1	Page Length (12h)							
2	Reserved				StorDT (1)	StorI/E (1)	StorST (1)	StorMT (0)
3	Reserved							
4	Reserved				MT > DT (0)	MT > I/E (0)	MT > ST (0)	MT > MT (0)
5	Reserved				ST > DT (1)	ST > I/E (1)	ST > ST (1)	ST > MT (0)
6	Reserved				I/E > DT (1)	I/E > I/E (1)	I/E > ST (1)	I/E > MT (0)
7	Reserved				DT > DT (1)	DT > I/E (1)	DT > ST (1)	DT > MT (0)
8 to 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)
15	Reserved				DT <> DT (0)	DT< > I/E (0)	DT <> ST (0)	DT <> MT (0)
16 to 19	Reserved							

SLK_092

PS (Parameters Savable)
The library returns 0.

Page Code
1Fh = The Device Capabilities mode page.

Page Length
12h = 18 bytes of device capabilities data to follow.

StorDT
1 = A tape drive can function as element storage.

StorI/E
1 = A CAP cell can function as element storage.

StorST
1 = A cartridge cell can function as element storage.

StorMT
0 = The robot hand cannot function as element storage. You cannot use the robot as the source or destination of a move.

MT > DT, MT > I/E, MT > ST, MT > MT, ST > MT, I/E > MT, DT > MT
0 = The robot hand (MT) cannot be the source or destination of a move.

ST > DT, ST > I/E, ST > ST, I/E > DT, I/E > I/E, I/E > ST, DT > DT, DT > I/E, DT > ST
1 = Tape drives (DT), CAP cells (I/E), and cartridge cells (ST) are valid sources or destinations for a move.

All <> Parameters

0 = The library does not support the exchange medium command.

Move Medium (A5h)

Move Medium (A5h) moves a cartridge tape from one element location to another. Device Capabilities Page of the Mode Sense command provides a matrix with the valid source and destination element combinations for Move Medium.

The Fast Load option on the library controls the completion of the move command when the destination element is a tape drive. If the fast load option is disabled, the library performs the move motion and waits until the tape drive load operation completes before returning status for the move command. When the fast load option is enabled, the library performs the move motion and verifies the tape drive load starts before returning status for the move command.

Note: If you issue a Move command from a CAP cell that contains an upside down cartridge, the library will return a check condition and set the sense data to Illegal Request (05h), ASC to 3Bh, and ASCQ to 18h.

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (A5h)							
1	Ignored			Reserved				
2 to 3	Transport Element Address							
4 to 5	Source Element Address							
6 to 7	Destination Element Address							
8 to 9	Reserved							
10	Reserved							Invert (0)
11	Move Option		Control Byte (00h)					

SLK_093

Transport Element Address
00h = The default robot hand. All other values will be ignored.

Source Element Address
The element address for the cartridge, which can be a storage cell, a CAP slot, or a tape drive.

Destination Element Address
The element address for the cartridge move, which can be a storage cell, a CAP cell, or a tape drive.

Invert (not supported)
Set this to 0.

Move Option
00b = The library performs a normal move operation

01b = Not supported

10b = The library performs a mount operation with write protection enabled. This is only valid if the destination is a drive. If the drive does not support this feature or fails to acknowledge the write-protected mount option, the mount fails and the library returns the Hardware Error sense key (04) with an ASC of 40 and an ASCQ of 02 (Drive Error).

11b = The drive performs a rewind, unload, and then move operation. This option is valid only when the source element address is a drive.

Caution: The 11b option might interfere with operations on the drive data path.

Persistent Reserve In (5Eh)

Persistent Reserve In (5Eh) returns information about active registrations or an active reservation. You can use Persistent Reserve In to help resolve contention among multiple initiators and multiple-port targets within the system.

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (5Eh)							
1	Ignored			Service Action				
2 to 6	Reserved							
7 to 8	Allocation Length							
9	Control Byte (00h)							

SLIK_094

Service Action

00h = Returns Read Keys Data

01h = Returns Read Reservation Data

02h = Returns Report Capabilities Data

03h through 1Fh are reserved.

Allocation Length

Indicates the space reserved for the returned parameter list. If the length is not sufficient to contain the entire parameter list, the parameter list will be incomplete. However, a partial list is not an error

Read Keys Data

The Read Keys Data is a list of all the currently registered reservation keys.

	Bit							
Byte	7	6	5	4	3	2	1	0
0 to 3	PRGeneration							
4 to 7	Additional Length (*n* - 7)							
Reservation Key List								
8 to 15	First Reservation Key							
More	Additional Reservation Keys							
n - 7 to *n*	Last Reservation Key							

SLK_095

PR Generation
A 32-bit counter that increments each time a Persistent Reserve Out command requests a Register, a Register and Ignore, a Clear, a Preempt, or a Preempt and Abort operation. The counter allows the application client to determine if another application client has changed the configuration.

A Power-On-Reset sets the counter to zero.

Additional Length
The number of bytes in the reservation key list.

Reservation Key List
Contains the eight-byte reservation keys registered with the library through a Persistent Reserve Out command.

Read Reservation Data

The Read Reservation Data is a description of all currently registered reservation keys.

	Bit							
Byte	7	6	5	4	3	2	1	0
0 to 3	PRGeneration							
4 to 7	Additional Length (*n* - 7)							
8 to *n*	Reservation Descriptor							

SLK_096

PR Generation
A 32-bit counter that increments each time a Persistent Reserve Out command requests a Register, a Register and Ignore, a Clear, a Preempt, or a Preempt and Abort operation. The counter allows the application client to determine if another application client has changed the configuration.

A Power-On-Reset sets the counter to zero.

Additional Length
The number of bytes in the reservation descriptor list.

0 = No reservation held

16 = Active reservation data

Reservation Descriptor

Each persistent reservation for a logical unit has one reservation descriptor that has the format shown below.

	Bit							
Byte	7	6	5	4	3	2	1	0
0 to 7	Reservation Key							
8 to 11	Obsolete							
12	Reserved							
13	Scope				Type			
14 to 15	Obsolete							

SLK_097

Reservation Key
The reservation key for the descriptor data that follows.

Scope
Indicates whether a persistent reservation applies to an entire logical unit or to an element. The only valid value is 0h.

0h = The persistent reservation applies to the logical unit

Type
3h = Exclusive access. The initiator holding the persistent reservation has exclusive access. Some commands (such as Move Medium) are only allowed for the persistent reservation holder.

6h = Exclusive Access, Registrants Only. Any currently registered initiator has exclusive access. Some commands (such as Move Medium) are only allowed for registered I_T nexuses.

Report Capabilities Data

	Bit							
Byte	7	6	5	4	3	2	1	0
0 to 1	Length (0008h)							
2	Reserved			CRH (0)	SIP_C (0)	ATP_C (0)	Reserved	PTPL_C (0)
3	TMV (0)	Reserved						PTPL_A (0)
Persistent Reservation Mask								
4	WR_EX_AR(0)	EX_AC_RO(0)	WR_EX_RO(0)	Reserved	EX_AC (0)	Reserved	WR_EX (0)	Reserved
5	Reserved							EX_AC_AR(0)
6 to 7	Reserved							

SLK_098

Length
The length in bytes of the parameter data.

CRH (Compatibility Reservation Handling)
0 = The library processes the Reserve and Release commands as defined in SPC-2.

SIP_C (Specify Initiator Ports Capable)
0 = The library does not support the SPEC_I_PT bit in the Persistent Reserve Out (5Fh) command parameter data.

ATP_C (All Target Ports Capable)
0 = The library does not support the ALL_TG_PT bit in the Persistent Reserve Out (5Fh) command parameter data.

PTPL_C (Persist Through Power Loss Capable)
0 = The library does not support the persist through power loss capability for persistent reservations and the APTPL bit in the Persistent Reserve Out (5Fh) command parameter data.

TMV (Type Mask Valid)
0 = Ignore the persistent reservation type mask.

1 = The persistent reservation type mask field contains a bit map indicating which persistent reservation types the library supports.

PTPL_A (Persist Through Power Loss Activated)
0 = The library does not support the Persist Through Power Loss Activated bit.

WR_EX_AR (Write Exclusive-All Registrants)
0 = The library does not support the Write Exclusive-All Registrants persistent reservation type.

EX_AC_RO (Exclusive Access Registrants Only)
1 = The library supports this persistent reservation type.

WR_EX_RO (Write Exclusive Registrants Only)
0 = The library does not support the Write Exclusive-Registrants Only persistent reservation type.

EX_AC (Exclusive Access)
1 = The library supports this persistent reservation type.

WR_EX (Write Exclusive)
0 = The library does not support the Write Exclusive persistent reservation type.

EX_AC_AR (Exclusive Access All Registrants)
0 = The library does not support the Exclusive Access-All Registrants persistent reservation type.

Persistent Reserve Out (5Fh)

Persistent Reserve Out (5Fh) uses service actions to create, manage, or remove a persistent reservation.

The application client provides a registered reservation key that identifies the initiator. An application client may use the Persistent Reserve In (5Eh) command to obtain the reservation key for the initiator holding a persistent reservation. The client may use the Persistent Reserve Out command to preempt that persistent reservation.

> **Note:** For more information on command processing when the library has a persistent reservation, see "Reservation Handling" on page 2-2.

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (5Fh)							
1	Ignored			Service Action				
2	Scope				Type			
3 to 4	Reserved							
5 to 8	Parameter List Length							
9	Control Byte (00h)							

SLK_125

Service Action

00h = Register — registers or unregisters a reservation key.

01h = Reserve — creates a persistent reservation of the scope and type specified in Byte 2.

02h = Release — removes an active persistent reservation, if the initiator holds the persistent reservation.

03h = Clear — clears all persistent reservations for all initiators and reset all reservation keys to 0.

04h = Preempt — removes all reservations and registrations for the initiators associated with the service action reservation key in the parameter list.

05h = Preempt and Abort. Perform a Preempt action and terminate all commands by initiators associated with the cleared service action reservation key. This also clears any CAP locks and contingent allegiance in effect for these initiators.

06h = Register and Ignore Existing Key. Registers or unregisters a reservation key with the library.

Scope

Indicates whether a persistent reservation applies to an entire logical unit or to an element.

0h = The persistent reservation applies to the logical unit (library or partition). This is the only valid value.

Type
3h = Exclusive access. The initiator holding the persistent reservation has exclusive access. Some commands (such as Move Medium) are only allowed for the persistent reservation holder.

6h = Exclusive Access, Registrants Only. Any currently registered initiator has exclusive access. Some commands (such as Move Medium) are only allowed for registered initiators.

Parameter List Length
Always 18h (24d) bytes. The parameter data for the Persistent Reserve Out command includes all fields, even when a field is not required for the specified service action.

Persistent Reserve Out Parameter List

	Bit							
Byte	7	6	5	4	3	2	1	0
0 to 7	Reservation Key							
8 to 15	Service Action Reservation Key							
16 to 19	Obsolete							
20	Reserved				SPEC_I_PT (0)	ALL_TGT_PT (0)	Reserved (0)	APTPL (0)
21	Reserved							
22 to 23	Obsolete							

SLK_126

Reservation Key
An 8-byte value that identifies the initiator.

Service Action Reservation Key
If the service action is *Register* or *Register and Ignore Existing Key*, this field must contain the new reservation key.

If the service action is *Preempt* or *Preempt and Abort*, this field must contain the reservation key of the persistent reservation or registration being preempted.

SPEC_I_PT (Specify Initiator Ports - not supported)
Set this to 0.

ALL_TG_PT (All Target Ports - not supported)
Set this to 0.

APTPL (Activate Persist Through Power Loss - not supported)
Set this to 0.

Table 3–1 Persistent Reserve Out Service Actions and Parameters

Persistent Reserve Action	Service Action	Scope	Type	Reservation Key	Service Action (SA) Res. Key	SPEC_I_PT, ALL_TG_PT, and APTPL	Unit Attention Notes
Register a Key	0	Ignored	Ignored	0	SA Key	0	N/A
Register a New Key	0	Ignored	Ignored	Key	SA Key	0	N/A
Unregister a Key	0	Ignored	Ignored	Key	0	0	See 1.
Reserve: Exclusive Access	1	0	3	Key	Ignored	Ignored	N/A
Reserve: Exclusive Access Registrants Only	1	0	6	Key	Ignored	Ignored	N/A
Release: Exclusive Access Reservation	2	0	3	Key	Ignored	Ignored	N/A
Release: Exclusive Access Registrants Only Reservation	2	0	6	Key	Ignored	Ignored	See 2.
Clear: Reservation and All Host Keys	3	Ignored	Ignored	Key	Ignored	Ignored	See 3.
Preempt: No Active Reservation	4	Ignored	0, 3, or 6	Key	SA Key	Ignored	See 4.
Preempt: Active Reservation	4	Ignored	3 or 6	Key	SA Key	Ignored	See 5.
Preempt and Abort: No Active Reservation	5	Ignored	0, 3, or 6	Key	SA Key	Ignored	See 4.

Table 3–1 (Cont.) Persistent Reserve Out Service Actions and Parameters

Persistent Reserve Action	Service Action	Scope	Type	Reservation Key	Service Action (SA) Res. Key	SPEC_I_PT, ALL_TG_PT, and APTPL	Unit Attention Notes
Preempt and Abort: Active Reservation	5	Ignored	3 or 6	Key	SA Key	Ignored	See 5.
Register and Ignore Existing Key	6	Ignored	Ignored	Ignored	SA Key	Ignored	N/A
Unregister and Ignore Existing Key	6	Ignored	Ignored	Ignored	0	0	See 1.

Unit Attention Notes

1. If the initiator unregistering the reservation key also holds a persistent reservation, then the library releases the reservation and removes the registration key. If the initiator had an Exclusive Access Registrants Only reservation, the library sends a Reservations Released Unit Attention (06h/2Ah/04h) to all other registered initiators.
2. When an initiator releases an Exclusive Access Registrants Only reservation, the library sends a Reservations Released Unit Attention (06h/2Ah/04h) to all other registered initiators.
3. When an initiator requests a Clear service action, the library clears the persistent reservation (if present) and unregisters all initiators. The library sends a Reservations Preempted Unit Attention (06h/2Ah/03h) to the other registered initiators.

   Note: You should only clear reservations for error recovery.

4. When an initiator requests a Preempt or Preempt and Abort service action and there is no active persistent reservation, the library unregisters all reservation keys matching the service action key. The library sends Registrations Preempted Unit Attention (06h/2Ah/05h) to the affected initiators.
5. When an initiator requests a Preempt or Preempt and Abort service action and there is an active persistent reservation matching the service action key, the library:
   - Modifies the persistent reservation with the requesting initiator's reservation key and type. If the preempting initiator modified the persistent reservation type, the library sends a Reservations Released Unit Attention (06/2Ah/04h) all other initiators that still have a persistent registration.
   - Unregisters all other initiators with a reservation key matching the service action key and sends a Registrations Preempted Unit Attention (06h/2Ah/03h) to the affected initiators.

Position to Element (2Bh)

Position to Element (2Bh) moves the robot to the destination element.

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (2Bh)							
1	Ignored			Reserved				
2 to 3	Transport Element Address							
4 to 5	Destination Element Address							
6 to 7	Reserved							
8	Reserved							Invert (0)
9	Control Byte (00h)							

SLK_099

Transport Element Address
0000h = The element address of the robot.

Destination Element Address
The element address of the storage cell, CAP cell, or drive. The robot positions the hand at this location.

Invert (not supported)
Set this to 0.

Prevent/Allow Medium Removal (1Eh)

Prevent/Allow Medium Removal (1Eh) locks or unlocks the CAPs. The library does not maintain a separate "prevent" or "allow" state for each initiator. There is a single state for all initiators. Therefore, if any initiator sends a Prevent Medium Removal command, the library locks the CAPs. If any initiator sends an Allow Media Removal command, the library unlocks the CAPs.

Note: You can also lock or unlock the CAPs from the GUI.

Additionally, the library unlocks the CAPs:

- During a library power-on or reset
- After a LUN reset or a target reset
- After a Persistent Reservation Preempt & Abort command

If a partition has no CAPs, the Prevent/Allow Media command has no effect and returns Good (00h) status. In a partitioned library with a shared CAPs, the library maintains the Prevent/Allow state until the partition owns the CAPs (see Example 2–2 on page 2-5).

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Eh)							
1	Ignored			Reserved				
2 to 3	Reserved							
4	Reserved							Prevent
5	Control Byte (00h)							

SLK_100

Prevent
0 = Allow — The library unlocks the CAPs. You can open the CAP using the operator panel.

Note: When Prevent = 0, the library disregards device reservations and executes the command. For more information, see "Reservation Handling" on page 2-2.

1 = Prevent — The library locks the CAPs.

Read Element Status (B8h)

Read Element Status (B8h) returns the status of elements in the library or partition.

The library returns an eight-byte Element Status Data Header, followed by an element page (or four element pages if you set the type code to All Element Types). Each element page consists of an eight-byte Element Status Page Header, followed by the element type descriptor. Supported element type descriptors include:

- Medium Transport Element Descriptor
- Storage Element Descriptor
- Import/Export Element Descriptor
- Data Transfer Element Descriptor (DvcID = 0)
- Data Transfer Element Descriptor (DvcID = 1)

Read Element Status Command

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (B8h)							
1	Ignored			VolTag	Element Type Code			
2 to 3	Starting Element Address							
4 to 5	Number of Elements							
6	Reserved						CurData	DvcID
7 to 9	Allocation Length							
10	Reserved							
11	Control Byte (00h)							

SLK_101

VolTag
0 = The library does not report Volume Tag information

1 = The library reports Volume Tag information

Element Type Code
0h = All Element Types

1h = Medium Transport Element (robot hand)

2h = Storage Element (cartridge cells)

3h = Import/Export Element (CAP cells)

4h = Data Transfer Element (drives or empty drive slots)

Starting Element Address
Specifies the minimum element address. The library reports elements with an element address greater than or equal to the Starting Element Address.

Number of Elements
The maximum number of element descriptors to transfer. This is not an element address range.

CurData
The library ignores the CurData bit and will use the robots to obtain information if needed.

0 = The library can use the robots to gather data

1 = The library will not perform mechanical operations to obtain the data

DvcID
0 = The library will not return device identification information

1 = The library returns device identification information for data transfer elements.

Allocation Length
The length in bytes of the space allocated by the initiator for the transfer of element descriptors. Only complete element descriptors are transferred. Data can be truncated based on the length specified in the allocation field.

Element Status Data Header

	Bit							
Byte	7	6	5	4	3	2	1	0
0 to 1	First Element Address Reported							
2 to 3	Number of Elements Available							
4	Reserved							
5 to 7	Byte Count of Report Available (all pages, *n* - 7)							
8 to *n*	Element Status Page							

SLK_102

First Element Address Reported
The lowest element address found for the specified Element Type Code that is greater than or equal to the Starting Element Address.

Number of Elements Available
The number of elements found for the specified Element Type Code that are greater than or equal to the Starting Element Address. This number is always less than or equal the Number of Elements specified in the CBD.

Byte Count of Report Available
The number of bytes of element status data available. This count does not include the Element Status Data header bytes. The count is not adjusted to match the allocation length you specified in the Read Element Status command.

Element Status Page Header

Byte	Bit 7	6	5	4	3	2	1	0
0	Reserved				Element Type Code			
1	PVolTag	AVolTag (0)	Reserved					
2 to 3	Element Descriptor Length							
4	Reserved							
5 to 7	Byte Count of Report Available (all pages, *n* - 7)							
8 to *n*	Element Descriptor							

SLK_103

Element Type Code
1h = Medium Transport Element (robot hand)

2h = Storage Element (cartridge cells)

3h = Import/Export Element (CAP cells)

4h = Data Transfer Element (drives or empty drive slots)

PVolTag
0 = The library omits Primary Volume Tag information from the element descriptors.

1 = The library includes Primary Volume Tag information in the element descriptors.

AVolTag
0 = The library does not support Alternative Volume Tags.

Element Descriptor Length
The total number of bytes contained in a single element descriptor.

Byte Count of Descriptor Data Available
The number of bytes of element descriptor data available. This count does not include the Element Status Page header bytes. The count is not adjusted to match the allocation length you specified in the Read Element Status command.

Element Descriptors
Medium Transport Element Descriptor

Storage Element Descriptor

Import/Export Element Descriptor

Data Transfer Element Descriptor (DvcID = 0)

Data Transfer Element Descriptor (DvcID = 1)

Element Descriptors

Medium Transport Element Descriptor

Byte		Bit							
PVolTag=0	PVolTag=1	7	6	5	4	3	2	1	0
0 to 1	0 to 1	Element Address							
2	2	Reserved					Except	Reserved	Full
3	3	Reserved							
4	4	Additional Sense Code							
5	5	Additional Sense Code Qualifier							
6 to 8	6 to 8	Reserved							
9	9	SValid	Invert (0)	Reserved		ED	Medium Type		
10 to 11	10 to 11	Source Storage Element Address							
--	12 to 47	Primary Volume Tag Information (omitted if PVolTag = 0)							
12	48	Reserved				Code Set (0)			
13	49	Reserved				Identifier Type (0)			
14	50	Reserved							
15	51	Identifier Length (0)							
16	52	Media Domain							
17	53	Media Type							
18 to 19	54 to 55	Reserved							

SLK_104

Storage Element Descriptor

Byte		Bit							
PVolTag=0	PVolTag=1	7	6	5	4	3	2	1	0
0 to 1	0 to 1	Element Address							
2	2	Reserved				Access (1)	Except	Reserved	Full
3	3	Reserved							
4	4	Additional Sense Code							
5	5	Additional Sense Code Qualifier							
6 to 8	6 to 8	Reserved							
9	9	SValid	Invert (0)	Reserved		ED	Medium Type		
10 to 11	10 to 11	Source Storage Element Address							
--	12 to 47	Primary Volume Tag Information (omitted if PVolTag = 0)							
12	48	Reserved				Code Set (0)			
13	49	Reserved				Identifier Type (0)			
14	50	Reserved							
15	51	Identifier Length (0)							
16	52	Media Domain							
17	53	Media Type							
18 to 19	54 to 55	Reserved							

SLK_105

Import/Export Element Descriptor

Byte		Bit							
PVolTag=0	PVolTag=1	7	6	5	4	3	2	1	0
0 to 1	0 to 1	Element Address							
2	2	OIR	CMC (0)	InEnab (1)	ExEnab(1)	Access	Except	ImpExp	Full
3	3	Reserved							
4	4	Additional Sense Code							
5	5	Additional Sense Code Qualifier							
6 to 8	6 to 8	Reserved							
9	9	SValid	Invert (0)	Reserved		ED	Medium Type		
10 to 11	10 to 11	Source Storage Element Address							
--	12 to 47	Primary Volume Tag Information (omitted if PVolTag = 0)							
12	48	Reserved				Code Set (0)			
13	49	Reserved				Identifier Type (0)			
14	50	Reserved							
15	51	Identifier Length (0)							
16	52	Media Domain							
17	53	Media Type							
18 to 19	54 to 55	Reserved							

SLK_106

Data Transfer Element Descriptor (DvcID = 0)

Byte		Bit							
PVolTag=0	PVolTag=1	7	6	5	4	3	2	1	0
0 to 1	0 to 1	Element Address							
2	2	Reserved				Access	Except	Reserved	Full
3	3	Reserved							
4	4	Additional Sense Code							
5	5	Additional Sense Code Qualifier							
6 to 8	6 to 8	Reserved							
9	9	SValid	Invert (0)	Reserved		ED	Medium Type		
10 to 11	10 to 11	Source Storage Element Address							
--	12 to 47	Primary Volume Tag Information (omitted if PVolTag = 0)							
12	48	Reserved				Code Set (0)			
13	49	Reserved				Identifier Type (0)			
14	50	Reserved							
15	51	Identifier Length (0)							
16	52	Media Domain							
17	53	Media Type							
18	54	Transport Domain							
19	55	Transport Type							
20 to 51	56 to 87	Transport Serial Number							

SLK_107

Data Transfer Element Descriptor (DvcID = 1)

Byte		Bit							
PVolTag=0	PVolTag=1	7	6	5	4	3	2	1	0
0 to 1	0 to 1	Element Address							
2	2	Reserved				Access	Except	Reserved	Full
3	3	Reserved							
4	4	Additional Sense Code							
5	5	Additional Sense Code Qualifier							
6 to 8	6 to 8	Reserved							
9	9	SValid	Invert (0)	Reserved		ED	Medium Type		
10 to 11	10 to 11	Source Storage Element Address							
--	12 to 47	Primary Volume Tag Information (omitted if PVolTag = 0)							
12	48	Reserved				Code Set (2)			
13	49	Reserved				Identifier Type (0)			
14	50	Reserved							
15	51	Identifier Length (*n*)							
16 to 16+*n*-1	52 to 52+*n*-1	Identifier (Drive ASCII Serial Number)							
32 - *n* bytes	32 - *n* bytes	Identifier Pad							
48	84	Media Domain							
49	85	Media Type							
50	86	Transport Domain							
51	87	Transport Type							

SLK_108

Element Descriptor Definitions

Element Address
The address of the element (robot hand, cartridge cell, CAP cell, drive, or empty drive slot).

OIR
0 = No operator intervention required to make the CAP accessible

1 = Operator intervention required to make the CAP accessible

CMC
0 = The import/export element is a CAP. The cartridge will not leave the library when prevented by the Prevent/Allow Medium Removal (1Eh) command.

InEnab
1 = The CAP supports importing cartridges.

ExEnab
1 = The CAP supports exporting cartridges.

Access
0 = The robot cannot access the element. For Import/Export elements, this can occur when the CAP is open or a CAP magazine was removed. For Data transfer elements, this can occur when a cartridge is loaded in a drive.

1 = The robot can access the element

Except
0 = The element is in a normal state

1 = The element is in an abnormal state. The Additional Sense Code (ASC) and the Additional Sense Code Qualifier (ASCQ) fields contain information regarding the abnormal state. Other fields in the descriptor might be invalid and should be ignored.

ImpExp
0 = The robot placed the cartridge in the CAP for an export operation.

1 = An operator placed the cartridge in the CAP for an import operation.

Full
0 = The element does not contain a cartridge

1 = The element contains a cartridge

ASC (Additional Sense Code)
This field is valid only if the Except bit is set. In the case of an exception, it contains an ASC as defined for Request Sense data.

ASCQ (Additional Sense Code Qualifier)
This field is valid only if the Except bit is set. In the case of an exception, it contains an ASCQ as defined for Request Sense data.

Condition	ASC Value	ASCQ Value
CAP Open	3Ah	02h
Empty Drive Slot (no drive installed)	3Bh	1Ah
Drive Hardware Error	40h	02h

SValid
0 = The Source Element Address and Invert fields are not valid.

1 = The Source Element Address and Invert fields are valid.

Invert (not supported)
0 = The library does not support multi-sided media.

ED
0 = The element is enabled.

1 = The element is disabled (for example an open CAP, a drive hardware error, or empty drive slot).

Medium Type
The type of medium currently present in the element as determined by the medium changer.

0h = Unspecified - the medium changer cannot determine the medium type.

1h = Data Medium

2h = Cleaning Medium

Source Storage Element Address
This field is valid only if the SValid field is 1. This field provides the address of the last storage element this cartridge occupied. The element address value may or may not be the same as this element.

Primary Volume Tag Information

When PVolTag is 1, the library returns volume tag information. When PVolTag is 0, the library omits volume tag information.

The Primary Volume Tag field contains the null-terminated ASCII barcode label on the tape cartridge. If the label on the cartridge tape is not readable or if the element is empty, the Primary Volume Tag field is filled with 36 bytes of zeros. The "Volume Label Format" controls the presentation of the volser in the Primary Volume Tag field. The library supports the following settings:

- Full Label
- No Type Checking
- Prepend Last Two Characters
- Trim Last Character
- Trim Last Two Characters
- Trim First Two Characters
- Trim First Character

For more information, see the SL4000 GUI help.

Code Set

0h = Reserved (not supported) for the Medium Transport Element, Storage Element, Import/Export Element, or Data Transfer Element (DvcID = 0) descriptors.

2h = The identifier contains ASCII graphic codes (code values 20h through 7Eh) for Data Transfer Element (DvcID = 1) descriptor.

Identifier Type

The format and assignment authority for the identifier.

0h = The library returns vendor specific data.

Identifier Length

The combined length of the Identifier and the Identifier Pad.

00h = The library returns 0 bytes of identifier data in the descriptors for Medium Transport Elements, Storage Elements, Import/Export Elements, or Data Transfer Elements (DvcID = 0).

20h = The library returns 32 bytes of identifier data for the Data Transfer Element (DvcID = 1).

Identifier (for Data Transfer Element DvcID = 1 Only)

The ASCII Serial Number for the tape drive associated with this data transfer element.

Identifier Pad (for Data Transfer Element DvcID = 1 Only)

Contains ASCII blanks. The number of blanks depends on the length of the Identifier field. The combined length of the Identifier field and the Identifier Pad is 32 bytes.

Media Domain

43h (’C’) = The element contains a cleaning cartridge.

4Ch (’L’) = The element contains an LTO cartridge.

54h (’T’) = The element contains a T10000 cartridge.

FFh = The media domain cannot be determined or the element is empty.

Media Type

FFh = The media type cannot be determined or the element is empty.

If the Media Domain is 43h (C):

- C = The element contains a T10000 Version 2 cleaning cartridge
- L = The element contains a T10000 Universal cleaning cartridge.
- T = The element contains a T10000 Version 1 cleaning cartridge.
- U = The element contains a Universal LTO cleaning cartridge.

If the Media Domain is 4Ch (L):

- 3 = The element contains a 400 GB Generation 3 LTO cartridge.
- 4 = The element contains an 800 GB Generation 4 LTO cartridge.
- 5 = The element contains a 1.5 TB Generation 5 LTO cartridge.
- 6 = The element contains a 2.5 TB Generation 6 LTO cartridge.
- 7 = The element contains a 6 TB Generation 7 LTO cartridge.
- 8 = The element contains a 12 TB Generation 8 LTO cartridge.
- T = The element contains a 400 GB Generation 3 LTO WORM cartridge.
- U = The element contains an 800 GB Generation 4 LTO WORM cartridge.
- V = The element contains a 1.5 TB Generation 5 LTO WORM cartridge.
- W = The element contains a 2.5 TB Generation 6 LTO WORM cartridge.
- X = The element contains a 6 TB Generation 7 LTO WORM cartridge.
- Y = The element contains a 12 TB Generation 8 LTO WORM cartridge.

If the Media Domain is 54h (T):

- 1 = The element contains a T10000 Version 1 cartridge.
- 2 = The element contains a T10000 Version 2 cartridge.
- S = The element contains a T10000 Version 1 Sport cartridge.
- T = The element contains a T10000 Version 2 Sport cartridge.

Transport Domain

4Ch (L) = The drive supports LTO cartridges.

54h (T) = The drive supports T10000 cartridges.

FFh = The element domain cannot be determined.

Transport Type

FFh = The type cannot be determined.

If the Transport Domain is 4Ch (L):

- 3Bh = HP Generation 5 LTO drive
- 3Ch = IBM Generation 5 LTO drive
- 3Dh = HP Generation 6 LTO drive.
- 3Eh = IBM Generation 6 LTO drive.
- 2Dh = IBM Generation 7 LTO drive.
- 2Eh = IBM Generation 8 LTO drive.

If the Transport Domain is 54h (T):

- 0Dh = StorageTek T10000A drive.
- 0Eh = StorageTek T10000A drive in 3590 emulation mode.
- 18h = StorageTek T10000A Encrypting drive.
- 19h = StorageTek T10000A Encrypting drive in 3590 emulation mode.
- 1Ah = StorageTek T10000B drive.
- 1Bh = StorageTek T10000B drive in 3590 emulation mode.
- 1Ch = StorageTek T10000B Encrypting drive.
- 1Dh = StorageTek T10000B Encrypting drive in 3590 emulation mode.
- 22h = StorageTek T10000C drive.
- 23h = StorageTek T10000C drive in 3590 emulation mode.
- 24h = StorageTek T10000C Encrypting drive.
- 25h = StorageTek T10000C Encrypting drive in 3590 emulation mode.
- 26h = StorageTek T10000D drive.
- 27h = StorageTek T10000D drive in 3590 emulation mode.
- 28h = StorageTek T10000D Encrypting drive.
- 29h = StorageTek T10000D Encrypting drive in 3590 emulation mode.
- 2Ah = StorageTek T10000D Fibre Channel over Ethernet.
- 2Bh = StorageTek T10000D Fibre Channel over Ethernet Encrypting drive.

Transport Serial Number

The 32-byte ASCII serial number for the drive.

For drives with a serial number less than 32 bytes, the library left-justifies the value by returning ASCII blanks for the unused less-significant bytes. If the serial number is not available from a drive that should support an ASCII serial number, the library returns all ASCII blanks.

Release (17h)

Release (17h) releases a unit reservation of the library. Only the initiator that made the reservation can release the reservation. If another initiator attempts to release a unit reservation, the library returns Good (00h) status, but does not release the reservation. If the library has no active reservations, requesting a release does not cause an error.

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (17h)							
1	Ignored			Obsolete (0h)				
2	Obsolete (00h)							
3 to 4	Reserved							
5	Control Byte (00h)							

SLK_109

Report LUNs (A0h)

Report LUNS (A0h) returns the known LUNs to which the initiator can send commands.

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (A0h)							
1	Ignored			Reserved				
2	Select Report							
3 to 5	Reserved							
6 to 9	Allocation Length							
10	Reserved							
11	Control Byte (00h)							

SLK_110

Select Report
00h = The library returns LUN addresses limited to the LUN addressing method, peripheral device addressing method, and the flat space addressing method.

02h = The library returns all LUNs accessible to the initiator.

Allocation Length
The number of bytes allocated for data to be returned from the Report LUNs command.

The Allocation must be at least 16 bytes. If it is less, the library returns a check condition with the sense key set to "illegal request" and the additional sense data set to "invalid field" in the command descriptor block (CDB).

Report LUNs Data

	Bit							
Byte	7	6	5	4	3	2	1	0
0 to 3	LUN List Length							
4 to 7	Reserved							
LUN Descriptor								
8	Address Method (00b)				Bus ID (0h)			
9	Single Level LUN Address							
10 to 11	Second Level LUN Address (00h)							
12 to 13	Third Level LUN Address (00h)							
14 to 15	Fourth Level LUN Address (00h)							
n-7 to *n*	Last LUN Descriptor							

SLK_111

LUN List Length
The library returns the length in bytes of the LUN list available for transfer. It is equal to 8 times the number of available logical units for the initiator.

For example: If the allocation length is 16 bytes and 2 logical units are available, this command will return the 8-byte header and 1 logical unit descriptor; however, the LUN list length will still be 16 because 16 bytes were available if the allocation length was sufficient.

Address Method
00b = The library is using single level LUN addressing

Bus ID
0h = There is a logical unit at the current level

Single Level LUN Address
The value of the LUN.

Second, Third, and Fourth Level LUN Address
00h = The library only uses single level addressing.

Report Target Port Groups (A3h)

Report Target Port Groups (A3h) returns the Target Port Group data for all ports.

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (A3h)							
1	Ignored			Service Action (0Ah)				
2 to 5	Reserved							
6 to 9	Allocation Length							
10	Reserved							
11	Control Byte (00h)							

SLK_112

Service Action
0Ah

Allocation Length
The length of the parameter list the library returns. The library transfers either the number of bytes specified by the Allocation Length field or all of the available Report Target Port Group data, whichever is less.

The minimum allocation length required to return all data depends on the number of FC ports and the redundant control paths activation file.

If the library has the redundant control paths (multi-port) activation file:

- 14h (20d) = The library has two active FC ports (1 and 2).
- 1Ch (28d) = The library has four active FC ports (1, 2, 3 and 4).

If the library does not have the redundant control paths (multi-port) activation file:

- 1Ch (28d) = The library has one active FC ports (1) and one unavailable port (2).
- 24h (36d) = The library has two active FC ports (1 and 3) and two unavailable ports (2 and 4).

For more information on port activation, see "Behavior of Unavailable Fibre Channel Ports" on page 2-1.

Report Target Port Group Data

	Bit							
Byte	7	6	5	4	3	2	1	0
0 to 3	Returned Data Length (*n* - 3)							
Target Port Group Descriptors								
4 to *x*	First Target Port Group Descriptor							
x+1 to *n*	Last Target Port Group Descriptor							

SLK_113

Returned Data Length

The number of bytes of Report Target Port Group data available. The length depends on the number of ports in the library and the redundant control paths (multi-port) activation file.

Target Port Group Descriptor Data

	Bit							
Byte	7	6	5	4	3	2	1	0
0	PREF	Reserved			Asymmetric Access State			
1	T_Sup (0)	Reserved			U_Sup (1)	S_Sup (0)	AN_Sup (0)	AO_Sup (1)
2 to 3	Target Port Group							
4	Reserved							
5	Status Code (02h)							
6	Reserved							
7	Target Port Group Count							
Target Port Descriptors								
8 to 11	First Target Port Descriptor							
n-3 to *n*	Last Target Port Descriptor							

SLK_114

PREF
0 = The target port group is not a preferred target port

1 = The target port group is a preferred target port. All ports in the Active/Optimized group are preferred.

Asymmetric Access State
0h = Active/Optimized — the ports in the group are fully operational.

3h = Unavailable — The library does not have the redundant control paths (multi-port) activation file installed.

T_Sup
0 = The library does not support the transitioning asymmetric access state.

U_Sup
1 = The library supports the unavailable asymmetric access state.

S_Sup
0 = The library does not support the standby asymmetric access state.

AN_Sup
0 = The library does not support the active/non-optimized asymmetric access state.

AO_Sup
1 = The library supports the active/optimized asymmetric access state.

Target Port Group
01h = Target Port Group 1

02h = Target Port Group 2

Status Code
2 = The target port group asymmetric access state is altered by implicit asymmetrical logical unit access behavior.

Target Port Group Count
The number of target ports that are in the target port group and the number of target port descriptors in the target port group descriptor. This can range from 1 to 4.

Target Port Descriptor Data

	Bit							
Byte	7	6	5	4	3	2	1	0
0 to 1	Reserved							
2 to 3	Relative Target Port Identifier							

SLK_115

Relative Target Port Identifier
The port number. This can range from 1 to 4.

Request Sense (03h)

Request Sense (03h) returns sense data. The library generates sense data if the previous command terminated with Check Condition (02h) status. Multiple errors might occur during the processing of a single SCSI command. The sense key reflects the first error that occurred.

If you issue a Request Sense command to an unsupported LUN, the library does not return a check condition. Instead, the library returns sense data with Sense Key set to Illegal Request (05h), ASC set to LUN Not supported (25h), and ASCQ set to 00h.

If the library is partitioned and you issue a Request Sense command from an initiator that has not been configured with access, the library does not return a check condition. Instead, the library returns sense data for LUN Access not Authorized with the Sense Key set to Not Ready (02h), ASC set to 74h and ASCQ set to 71h.

If no sense data is available, the library returns sense data with the Sense Key set to No Sense (0h), ASC set to Not Additional Sense information (00h), and the ASCQ set to 00h.

The library returns Check Condition (02h) status for a Request Sense command only to report errors specific to the command itself — for example, if the library detects a nonzero reserved bit in the CDB. If the library returns a Check Condition (02h) status for a Request Sense command, the sense data might be invalid.

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (03h)							
1	Ignored			Reserved				Desc (0b)
2 to 3	Reserved							
4	Allocation Length							
5	Control Byte (00h)							

SLK_116

Desc
0 = The library will return fixed format sense data.

Allocation Length
The number of bytes allocated for returned sense data. The library provides a maximum of 14h (20d) bytes of sense data.

Request Sense Data

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Valid (0)	Error Code (70h)						
1	Segment Number (00h)							
2	Reserved				Sense Key			
3 to 6	Information (00h)							
7	Additional Sense Length (0Ch)							
8 to 11	Command Specific Information (00h)							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Field Replaceable Unit Code (00h)							
15	SKSV	C/D	Reserved (0)		BPV (0)	Bit Pointer (000b)		
16 to 17	Field Pointer							
18 to 19	Reserved							

SLK_117

Valid
0 = The library does not return data in the Information field.

Error Code
70h = The library returns only current errors.

Segment Number
00h = The library does not support segment numbers.

Sense Key
Describes the error, along with ASC and ASCQ. See Additional Sense Codes and Qualifiers.

0h = No Sense, indicating a successful command.

2h = Not Ready

3h = Medium Error

4h = Hardware Error

5h = Illegal Request

6h = Unit Attention

Bh = Aborted Command

Information
00h = The library does not support this field.

Additional Sense Length
0Ch = Indicates there are 12d bytes of additional sense bytes to follow. This value is not truncated to reflect the actual transfer length.

Command Specific Information
00h = The library does not support this field.

Additional Sense Code (ASC)
Describes the error. See Additional Sense Codes and Qualifiers.

Additional Sense Code Qualifier (ASCQ)
Describes the error. See Additional Sense Codes and Qualifiers.

Field Replaceable Unit Code
00h = The library does not support this field.

SKSV (Sense Key Specific Valid)
1 = The C/D and field pointer are valid

0 = Ignore the C/D and field pointer

C/D (Command/Data)
0 = The check condition status resulted from illegal parameter in the parameter list.

1 = The check condition status resulted from illegal parameter in the CDB.

BPV (Bit Pointer Valid)
0 = The library does not support this field.

Bit Pointer
0h = The library does not support this field.

Field Pointer
The number of the byte where the error occurred. When a multiple-byte field is in error, the Field Pointer contains the value of the most significant byte of the field, which is lowest byte number. Byte numbers start at 00.

Additional Sense Codes and Qualifiers

Not Ready Sense Key (2h) Codes

The library generates a Not Ready error code if you send a command when the library is in a not ready state.

Description	Sense Key	ACS	ASCQ
Not Ready, Cause Not Reportable	2h	04h	00h
Not Ready, In Process of Becoming Ready	2h	04h	01h
Not Ready, Manual Intervention Required	2h	04h	03h
Not Ready, Maintenance Mode	2h	04h	82h
Not Ready, Logical Unit Not Accessible, Target Port In Unavailable State	2h	04h	0ch
Not Ready, Cleaning Cartridge Installed	2h	30h	03h
Not Ready, Insufficient Resources	2h	55h	03h
Not Ready, Cartridge Access Port Open	2h	3Ah	02h
Not Ready, LUN Access Not Authorized	2h	74h	71h

Not Ready, Cause Not Reportable

The library detected a not ready state after execution of the command was started.

Not Ready, In Process of Becoming Ready

The library is initializing and performing an audit. Initialization occurs at:

- Power-on
- After the door opens and closes
- When requested from the operator panel or GUI
- As part of a recovery during certain failures

Not Ready, Manual Intervention Required

The library is in an inoperable state. The operator should check the user interface to determine what action is required.

Not Ready, Maintenance Mode

The library was placed in maintenance mode from the operator panel or user interface.

Not Ready, Logical Unit Not Accessible, Target Port in Unavailable State

The FC port is in an unavailable access state and has not been enabled with a hardware activation file. The port only supports a limited set of commands. See "Behavior of Unavailable Fibre Channel Ports" on page 2-1.

Not Ready, Cleaning Cartridge Installed
The library is performing an Auto Clean function on the tape drive requested.

Not Ready, Cartridge Access Port Open
The library detected that the CAP is open and a SCSI command was issued to access the CAP.

Not Ready, Insufficient Resources
The library was not able to complete the command. The host should reissue the command.

Not Ready, LUN Access Not Authorized
The library has the partitioning activation file installed, and the host that issued the command does not have access to a partition. For more information, see "Configuring SCSI Access in a Partitioned Library" on page 2-4.

Medium Error (3h) Codes

The library generates a Medium Error when a SCSI move command terminates with a non-recovered error condition, which may have been caused by a flaw in the medium or an error in the recorded data.

Description	Sense Key	ASC	ASCQ
Medium Error, Cleaning Cartridge Expired	3h	30h	13h

Medium Error, Cleaning Cartridge Expired
The source cartridge for a SCSI move to a drive is an expired cleaning cartridge.

Hardware Error Sense Key (4h) Codes

The library generates a Hardware Error if it detects a hardware or firmware error during command execution.

Description	Sense Key	ASC	ASCQ
Hardware Error, General	4h	40h	01h
Hardware Error, Tape Drive	4h	40h	02h
Hardware Error, Cartridge Access Port	4h	40h	03h
Hardware Error, Embedded Software	4h	44h	00h
Hardware Error, Media Load/Eject Failed	4h	53h	00h

Hardware Error, General
The library detected an internal electronics error during a command. This includes the electronics, vision system, and robotics of the library.

Hardware Error, Tape Drive
An operation to the drive failed. The problem could be the tape drive or the interface between the library and tape drive.

Hardware Error, CAP
The CAP failed.

Hardware Error, Embedded Software
The embedded software that controls the SCSI interface detected an unexpected condition. This error is used for arbitrary limitations of the embedded software.

Hardware Error, Media Load/Eject Failed
A cartridge mount or dismount failed to complete.

Illegal Request Sense Key (5h) Codes

Any illegal parameters in the CDB or parameter list for a particular command generates an Illegal Request sense key.

In some cases, additional information is available in Byte 15 of the sense data, which includes the sense-key-specific-value (SKSV) and command/data (C/D) fields. This information indicates the byte in the command descriptor block or the parameter list that is in error. If available, the SKSV bit in the sense data is set to 1.

Description	Sense Key	ASC	ASCQ	SKSV
Parameter Length Error	5h	1Ah	00h	Yes
Invalid Command	5h	20h	00h	Yes
Invalid Element	5h	21h	01h	No
Invalid Field in CDB	5h	24h	00h	Yes
Logical Unit Not Supported	5h	25h	00h	No
Invalid Field in Parameters	5h	26h	00h	Yes
Invalid Release of Persistent Reservation	5h	26h	04h	No
Incompatible Medium	5h	30h	00h	No
Saving Parameters Not Supported	5h	39h	00h	Yes
Medium Not Present, Drive Not Unloaded	5h	3Ah	00h	No
Destination Element Full	5h	3Bh	0Dh	No
Source Element Empty	5h	3Bh	0Eh	No
Magazine Removed	5h	3Bh	12h	No
Empty Tape Drive Slot	5h	3Bh	1Ah	No
Upside-down Cartridge Move from CAP Not Allowed	5h	3Bh	18h	No

Unit Attention Sense Key (06h) Codes

The library generates a Unit Attention sense key for all initiators if the library needs to inform the host of an asynchronous event.

Description	Sense Key	ASC	ASCQ
Not Ready-to-Ready Transition	06h	28h	00h
CAP Element Accessed	06h	28h	01h
Power On Occurred	06h	29h	01h
LUN Reset	06h	29h	03h
Target Reset	06h	29h	03h
Mode Parameters Changed	06h	2Ah	01h

Description	Sense Key	ASC	ASCQ
Reservations Preempted	06h	2Ah	03h
Reservations Released	06h	2Ah	04h
Registrations Preempted	06h	2Ah	05h
Asymmetric Access State Changed	06h	2Ah	06h
Commands Cleared by Another Initiator	06h	2Fh	00h
Data Transfer Device Removed	06h	3Bh	1Ah
Data Transfer Device Inserted	06h	3Bh	1Bh
LUNs Data Has Changed	06h	3Fh	0Eh

Not Ready to Ready Transition
The library transitioned to a Ready state from a Not Ready state. The library sends this unit attention to all initiators.

CAP Element Accessed
The operator opened and closed the CAP. The library sends this unit attention to all initiators. You can issue a Read Element Status command to obtain an updated inventory (see "Read Element Status (B8h)" on page 3-47).

Power On
Occurs after the library powers-on, after an IPL (initial program load) from the operator panel, or after a reset over the interface. The library sends this unit attention to all initiators.

LUN Reset
The library is clear of all I/O processes following the LUN reset. The library sends this unit attention to all initiators.

Target Reset
The library is clear of all I/O processes following the Target reset. The library sends this unit attention to all initiators.

Mode Parameters Changed
The operator added or removed elements from a partition. Send a Read Element Status (B8h) command to obtain an updated inventory. Send a Mode Sense command with Element Address page code to request the current count of each element type.

Persistent Reservations/Registrations Preempted or Released
A different initiator issued a Persistent Reservation Out command that cleared the registration for this initiator or cleared a reservation that affects this initiator.

Asymmetric Access State Changed
The redundant control paths (multi-port) hardware activation files was added or removed from the library. This unit attention alerts the host that the Report Target Ports Group Data has changed.

Commands Cleared by Another Initiator
A different initiator sent a Clear Task Set Task Management function, which cleared all commands for this initiator.

Data Transfer Device Removed

The operator physically removed a drive. If partitioned, the library only sends this unit attention to hosts associated with the affected partition.

Data Transfer Device Inserted

The operator physically inserted a drive. If partitioned, the library only sends this unit attention to the hosts associated with the affected partition.

LUNs Data Has Changed

The LUN configuration for the initiator has changed. The library sends this unit attention when the operator adds or removes a LUN connection from a partition for the initiator.

Aborted Command Sense Key (0Bh) Codes

The library generates an Aborted Command error code when a SCSI command is aborted.

Description	Sense Key	ASC	ASCQ
Mechanical Positioning Error	0Bh	15h	01h
Initiator Detected Error	0Bh	48h	00h
Command Phase Error	0Bh	4Ah	00h
Data Phase Error	0Bh	4Bh	00h
Command Overlap	0Bh	4Eh	00h

Request Volume Element Address (B5h)

Request Volume Element Address (B5h) returns the results of a previous Send Volume Tag command.

The returned data consists of an eight-byte Volume Element Address Header, followed by to four element pages (one page per element type). Each element page consists of an eight-byte Element Status Page Header, followed by the element type descriptor. Supported element type descriptors include:

- Medium Transport Element Descriptor
- Storage Element Descriptor
- Import/Export Element Descriptor
- Data Transfer Element Descriptor (DvcID = 0)
- Data Transfer Element Descriptor (DvcID = 1)

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (B5h)							
1	Ignored			VolTag	Reserved			
2 to 3	Starting Element Address							
4 to 5	Number of Elements							
6	Reserved							
7 to 9	Allocation Length							
10	Reserved							
11	Control Byte							

SLK_118

VolTag
0 = The library will not report Volume Tag information in the Element Descriptor data.

1 = The library will report Volume Tag information in the Element Descriptor data.

Starting Element Address
Specifies the minimum element address. The library reports elements with an element address greater than or equal to the Starting Element Address.

Number of Elements
The maximum number of element descriptors to transfer. This is not an element address range.

Allocation Length
The length in bytes of the space allocated by the initiator for the transfer of element descriptors. Only complete element descriptors are transferred. Data can be truncated based on the length specified in the allocation field.

Volume Element Address Header

	Bit							
Byte	7	6	5	4	3	2	1	0
0 to 1	First Element Address Reported							
2 to 3	Number of Elements Available							
4	Reserved				Send Action Code (5h)			
5 to 7	Byte Count of Report Available (all pages, *n* - 7)							
8 to *n*	Element Status Pages							

SLK_119

First Element Address Reported
The lowest element address found for the specified Element Type Code that is greater than or equal to the Starting Element Address.

Number of Elements Available
The number of elements found for the specified Element Type Codes that is greater than or equal to the Starting Element Address. This number is always less than or equal the Number of Elements.

Send Action Code
5h = The action code from the previous Send Volume Tag command.

Byte Count of Report Available
The number of bytes of element status data available. This count does not include the Element Status Data header bytes. The count is not adjusted to match the allocation length you specified in the Read Element Status command.

Element Status Pages
These pages are in the same format as the Read Element Status (B8h) command pages. See "Element Status Page Header" on page 3-50 and "Element Descriptors" on page 3-51.

Reserve (16h)

Reserve (16h) allows the initiator to reserve the entire library or partition.

Note: For more information on command processing when the library has a Unit Reservation, see "Reservation Handling" on page 2-2.

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (16h)							
1	Ignored			Reserved (0h)				
2 to 4	Reserved (00h)							
5	Control Byte (00h)							

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Send Diagnostic (1Dh)

Send Diagnostic (1Dh) requests a self-diagnostic test. The library accepts this command for compatibility, but performs no action.

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Dh)							
1	Ignored			PF (1)	Reserved	SelfTest (0)	DevOfl (0)	UnitOfl (0)
2	Reserved							
3 to 4	Parameter List Length							
5	Control Byte (00h)							

SLK_121

PF
1 = Page format specified by SCSI-3.

SelfTest
1 = The library will run the default self test.

DevOfl (not supported)
Set this to 0.

UnitOfl (not supported)
Set this to 0.

Parameter List Length
0h = For the default self test.

8h = For extended diagnostics (not supported).

Send Volume Tag (B6h)

Send Volume Tag (B6h) requests a VOLSER label template. The library uses the template to search for cartridges. You can send a subsequent Request Volume Element Address (B5h) command to transfer the results of this search.

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (B6h)							
1	Ignored			Reserved	Element Type Code			
2 to 3	Starting Element Address							
4	Reserved							
5	Reserved			Send Action Code (5h)				
6 to 7	Reserved							
8 to 9	Parameter List Length							
10	Reserved							
11	Control Byte (00h)							

SLK_122

Element Type Code
0h = All Element Types

1h = Medium Transport Element (robot hand)

2h = Storage Element (cartridge cells)

3h = Import/Export Element (CAP cells)

4h = Data Transfer Element (drive)

Starting Element Address
Specifies the minimum element address. The library reports elements with an element address greater than or equal to the Starting Element Address.

Send Action Code
5h = The library supports the translate and search primary volume tag function.

Parameter List Length
00h = No data. The library does not consider this an error.

28h = A volume identification template

Send Volume Tag Parameter List

	Bit							
Byte	7	6	5	4	3	2	1	0
0 to 31	Volume Identification Template							
32 to 33	Reserved							
34 to 35	Minimum Volume Sequence Number							
36 to 37	Reserved							
38 to 39	Maximum Volume Sequence Number							

SLK_123

Volume Identification Template
This ASCII field specifies a volume identification search template. The first 00 hexadecimal terminates the volume identification search template. The remaining characters are set to 0.

Allowed characters are A through Z, digits 0 through 9, and special characters that include the dollar sign ($), the pound character (#), and the ASCII space character. The wild-card characters "*" and "?" (2Ah and 3Fh) also may be used.

Minimum Volume Sequence Number (not supported)
Ignore this field.

Maximum Volume Sequence Number (not supported)
Ignore this field.

Test Unit Ready (00h)

Test Unit Ready (00h) allows the initiator to determine if the library is powered on and ready to accept additional commands. This is not a request for a library self-test.

The Test Unit Ready command returns a Good (00h) status if the library is ready to accept additional commands or returns a Check Condition (02h) if the library is not ready or if there are pending Unit Attentions.

	Bit							
Byte	7	6	5	4	3	2	1	0
0	Operation Code (00h)							
1	Ignored			Reserved				
2 to 4	Reserved							
5	Control Byte (00h)							

SLK_124