

# StorageTek SL150 Modular Tape Library System

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## Interface Reference Manual



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## Preface

This interface reference manual is intended for independent software vendors (ISVs), operating system designers and developers, hardware engineers, and software engineers responsible for implementing Oracle's StorageTek version of the small computer system interface (SCSI) for the SL150 tape library referred to in this manual as "the SL150 library," or "the library".

This manual contains information about the small computer systems interface (SCSI), including library features, partitioning considerations, SCSI commands, status, and sense data. The SL150 library supports SCSI commands over a Fibre Channel interface (FC) or Serial Attached SCSI interface (SAS).

### Access to Oracle Support

Oracle customers have access to electronic support through My Oracle Support. For information, visit <http://www.oracle.com/support/contact.html> or visit <http://www.oracle.com/accessibility/support.html> if you are hearing impaired.



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## General Information

This manual describes the SCSI Media Changer (SMC) Command set for Oracle's StorageTek SL150 Modular Tape Library System.

The SL150 library uses designated Hewlett-Packard (HP) **LTO-5 tape drives** as the interface to the library or partition. The tape drive determines the destination for commands based on the Logical Unit Number (LUN) that is sent with the command:

- LUN 0: SCSI Stream Commands processed by the **tape drive**.
- LUN 1: SCSI Media Changer commands that are passed to the **library**.

Fibre Channel (FC) and Serial Attached SCSI (SAS) LTO-5 tape drives are both supported on the SCSI interface to the library.

## Serial Attached SCSI

Serial Attached SCSI is a computer bus that moves data to and from devices; for example, tape drives. The SAS interface is a point-to-point serial protocol that uses the standard SCSI command set.

The T10 technical committee of the International Committee for Information Technology Standards (INCITS) develops and maintains the SAS protocol.

### Overview

- Serial connection
- Multiple Initiator Support
- Gigabit per second data transfer rates
- Scalable for media rates, distance, media, and protocols

### Components

A typical Serial Attached SCSI system consists of the following basic components:

1. **Initiators:** A device that originates requests for processing by a target.
2. **Targets:** A device (SL150 library tape drives) containing logical units and target ports that receives requests for processing and sends responses to an initiator. The target device for this document is an LTO5 tape drive.

3. **Expanders:** Devices that provide large storage environments the ability to connect multiple targets and initiators through a switched device for scalability and redundancy. SAS benefits include improved performance, simplified cabling with the mini SAS connectors (iPass), and lower power requirements.

## The Fibre Channel Standard

The SL150's implementation of Fibre Channel conforms to the American National Standards Institute (ANSI), National Committee for Information Technology Standards (NCITS) formerly X3.

### Overview

- Serial connection: Copper (electrical) or Fiber (optical) transmissions
- Multiple Initiator Support
- Information transparent
- 100 MB/s data transfer rates (and higher)
- Scalable for media rates, distance, media, and protocols

### Implementation

#### Library:

- Arbitrated loop
- FCP (SCSI-3) command set for medium changer devices
- Class 3 level of service
- Private Loop operation
- Public Loop operation
- Direct fabric attach operation
- 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 nanometers (shortwave) non-OFC



**Hub:**

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

**Switch:**

- Attachment to FL\_Ports is supported.

## Related Publications

For your convenience, the following section lists publications that provide information about the interfaces and libraries mentioned in this manual.

Listed publications are subject to change without notice.

<b>Publication</b>	<b>Part Number</b>
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 1730D
SCSI-3 Architecture Model (SAM)	X3.270-1996
SCSI Architecture Model – 2 (SAM-2)	T10/Project 1157D
Serial Attached SCSI-2 (SAS-2)	T10/Project 1760D Revision 16
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
Fibre Channel Protocol for SCSI (FCP)	X3.269-1996 Revision 12
Fibre Channel Protocol for SCSI (FCP-2)	T10/Project 1144D Revision 01
Fibre Channel Tape (FC-Tape) NCITS	TR-XX Revision 1.17



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## Host Application Best Practices

### Running on Both Fibre Channel or SAS Ports

When the drive has 2 ports, Oracle recommends that Host Application treat the second SL150 drive port as a fail over port. The library may report a CHECK CONDITION to a command received on one port, when the other port is already busy with a library command. When a host application receives either of the following new CHECK CONDITIONS, it should reissue the command:

- Not Ready, Logical Unit Offline (02/04/12h)
- Aborted Command, Logical Unit Communication Failure (0Bh/08/00)

### Logical Unit Number Addressing

- LUN 0 is used to communicate with the LTO-5 tape drive.
- LUN 1 is used to communicate with the SL150 library.



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## Operation and Configuration Details

This chapter provides details for operation and configuration that are important while writing host applications.

### Multiple Initiator Support

The library architecture supports multiple initiators with the following details:

- Unit - Reserve and Release commands are supported. Persistent Reserve commands are also supported. Host software applications should perform reservations whenever possible.
- If an initiator modifies a mode page, all other initiators will then receive a unit attention indicating the mode parameters have changed.
- The library maintains separate prevent or allow medium removal status for each initiator. If any host/initiator has issued a prevent command, then the mailslot cannot be opened and the magazine(s) cannot be unlatched.

### Host Timeout Characteristics

Host timeout values for SCSI commands may require adjustment based on the configuration of the library.

### Device Reservations

The SL150 tape library support both the Reserve/Release management method and also the Persistent Reservations management method.

- [TABLE 3-1](#) outlines the reservation restrictions placed on commands for the Reserve/Release method, defined in the ANSI SCSI-3 Primary Commands (SPC-2) standard.

- [TABLE 3-2](#) defines the reservation restrictions placed on commands for the Persistent Reservations method, defined in the ANSI SCSI-3 Primary Commands (SPC-3) Standard.

<b>Conflict</b>	Command will not be performed and the library will terminate the command with Reservation Conflict status.
<b>Allowed</b>	Command will be allowed to execute to normal completion.

**TABLE 3-1** Reserve/Release Management Method

<b>Command</b>	<b>Action when Reserved by a different Initiator</b>
Initialize Element (07h)	Conflict
Initialize Element with Range (37h/E7h)	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 Removal (1Eh)	Prevent = 0, allowed Prevent = 1, conflict
Read Element Status (B8h)	Conflict
Release Unit (17h/57h)	Allowed, the reservation is not released.
Report LUNS (A0h)	Allowed
Report Target Port Groups (A3h)	Allowed
Request Sense (03h)	Allowed
Request Volume Element Address (B5h)	Conflict
Reserve Unit (16h/56h)	Conflict
Send Diagnostic (1Dh)	Conflict
Send Volume Tag (B6h)	Conflict
Test Unit Ready (00h)	Conflict

**TABLE 3-2** Persistent Reservation Management Method

Command	Library is Reserved by a different Initiator with a Persistent Reservation		
	Non-Registered Initiators	Registered Initiators	
		Exclusive Access Reservation	ALL Registrants or Exclusive Access Registrants Only
Initialize Element Status (07h)	Conflict	Conflict	Allowed
Initialize Element Status w/Range (37h/E7h)	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 SA=Reserve SA=Release SA=Clear SA=Preempt SA=Preempt/Abort SA=Register and Ignore SA=Register and Move	Allowed Conflict Conflict Conflict Conflict Conflict Allowed Conflict	Allowed Conflict Allowed <sup>1</sup> Allowed Allowed Allowed Allowed Conflict	Allowed Conflict Allowed <sup>1</sup> Allowed Allowed Allowed Allowed Conflict
Position to Element (2Bh)	Conflict	Conflict	Allowed
Prevent/Allow Media Removal (1Eh) Prevent = 0 Prevent = 1	Allowed Conflict	Allowed Conflict	Allowed Allowed
Read Element Status (B8h)	Conflict	Conflict	Allowed
Release (17h/57h)	Conflict	Conflict	Allowed
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/56h)	Conflict	Conflict	Allowed
Send Diagnostics (1Dh)	Conflict	Conflict	Allowed
Send Volume Tag (B6h)	Conflict	Conflict	Allowed
Test Unit Ready (00h)	Allowed	Allowed	Allowed
<b>Note</b> – <sup>1</sup> The reservation is not released.			





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## Command Set

This chapter lists and describes the small computer system interface (SCSI) command set for serial attached SCSI (SAS) and Fibre Channel (FC) interfaces to the SL150 Modular Library System.

**TABLE 4-5** contains a list of the commands, command codes, and page numbers that contain a description of the command.

**Note** – This manual does not describe the commands for tape drives. Refer to the tape drive documentation for information about SCSI commands for a tape drive.

## Implementation Requirements

The structure for all command descriptor blocks is:

The first byte contains a:

- Group Code that provides 8 groups of commands
- Command Code that provides 32 command codes for each group

The second byte in all command descriptor blocks:

- Starts the command parameters

Additional bytes:

- Contains command parameters

Last byte in all command descriptor blocks:

- Control byte

**Note** – The library is SCSI-3 compliant.

- For some commands, a list of parameters accompanies the request during Data Out.
- For all commands, if there is an invalid parameter in the command descriptor block, then the device terminates the command without altering the medium.

## Command Descriptor Block

Initiators use three types of CDBs to communicate commands to the targets:

- 6-Byte commands ([TABLE 4-1](#))
- 10-Byte commands ([TABLE 4-2](#))
- 12-Byte commands ([TABLE 4-3](#))

The first byte in the command descriptor block contains an operation code.

**TABLE 4-1** 6-Byte Command Descriptor Block

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Group Code			Command Code				
1	Reserved			Command Parameters				
2 to 4	(MSB) <div>Command Parameters</div> (LSB)							
5	Control Byte							

**TABLE 4-2** 10-Byte Command Descriptor Block

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code							
1	Reserved			Command Parameters				
2 to 8	(MSB) <div>Command Parameters</div> (LSB)							
9	Control Byte							

**TABLE 4-3** 12-byte Command Descriptor Block

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

## Control Byte

The control byte is the last byte of every Command Descriptor Block and has the following structure:

**TABLE 4-4** Control Byte

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

- **Vendor Specific**  
Provides additional information about the device or a command.
- **NACA**  
The normal auto contingent allegiance bit controls the rules for handling an auto contingent condition caused by a command. This bit is set to 0 to indicate that if a contingent allegiance condition occurs, the command will return a check condition.
- **Flag (not supported)**  
This bit causes an interrupt in the initiator allowing a device to respond with intermediate status. This bit is not supported and should be 0.
- **Link (not supported)**  
Allows devices that support command linking to continue the I/O process. This bit is not supported and should be 0.

# List of Supported Commands

**TABLE 4-5** Supported Commands

Command and Page Number	Hex Code
<a href="#">Initialize Element Status on page 30</a>	07
<a href="#">Initialize Element Status With Range on page 31</a>	37/E7
<a href="#">Inquiry on page 32</a>	12
<a href="#">Log Sense on page 43</a>	4D
<a href="#">Mode Select (6) on page 49</a>	15
<a href="#">Mode Select (10) on page 70</a>	55
<a href="#">Mode Sense (6) on page 91</a>	1A
<a href="#">Mode Sense (10) on page 123</a>	5A
<a href="#">Move Medium on page 153</a>	A5
<a href="#">Persistent Reserve In on page 155</a>	5E
<a href="#">Persistent Reserve Out on page 165</a>	5F
<a href="#">Position to Element on page 169</a>	2B
<a href="#">Prevent/Allow Medium Removal on page 170</a>	1E
<a href="#">Read Element Status on page 171</a>	B8
<a href="#">Release (6) on page 195</a>	17
<a href="#">Release (10) on page 196</a>	57
<a href="#">Report LUNS on page 197</a>	A0
<a href="#">Report Target Port Groups on page 199</a>	A3
<a href="#">Request Sense on page 203</a>	03
<a href="#">Request Volume Element Address on page 215</a>	B5
<a href="#">Reserve (6) on page 218</a>	16
<a href="#">Reserve (10) on page 219</a>	56
<a href="#">Send Diagnostic on page 221</a>	1D
<a href="#">Send Volume Tag on page 222</a>	B6
<a href="#">Test Unit Ready on page 224</a>	00

# SCSI Command Status

## Good

Good status (00h) indicates that the device successfully completed the command.

## Check Condition

Check Condition status (02h) occurs when any error, unit exception, or abnormal condition generates sense data. The initiator should issue a Request Sense command following a Check Condition status to determine the nature of the error.

Check Condition status occurs when one of the following conditions exist:

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

## Busy

Busy status (08h) occurs when the target is unable to accept a command from an otherwise acceptable initiator. The normal initiator recovery from a Busy status is to reissue the command.

## Reservation Conflict

The library returns Reservation Conflict status (18h) whenever a SCSI initiator attempts to access a logical unit or element that is reserved by another initiator.

## Task Aborted

The library returns Task Aborted status (40h) when a task is aborted by another SCSI initiator port.

## Initialize Element Status

The host uses the Initialize Element Status command (07h) to request an inventory of the cartridge tapes held in the library. The library accepts this command for compatibility, but does not perform any action.

At power-on the library performs an audit of and maintains the inventory during operations. The library also performs an audit after someone has opened and closed the front door.

An initiator can obtain inventory information for the library by using the Read Element Status command.

**TABLE 4-6** Initialize Element Status Command

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

## Initialize Element Status With Range

The Initialize Element Status With Range command (37h and E7h) is a request from the host to perform an inventory of a portion of the cartridge tapes within the library. The library accepts this command for compatibility but does not perform any action.

When the library powers-on it performs an audit of and maintains the inventory during operations. The library also performs an audit after someone has opened and closed the front door.

An initiator can obtain inventory information for the library by using the Read Element Status command.

**TABLE 4-7** Initialize Element Status With Range Command

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (37h/E7h)							
1	Ignored			Reserved (00h)			Fast	Range
2 to 3	(MSB) Element Address (LSB)							
4 to 5	(MSB) Reserved (00h) (LSB)							
6 to 7	(MSB) Number of Elements (LSB)							
8	Reserved (00h)							
9	Control Byte (00h)							

### Initialize Element Status with Range Definitions:

<b>Fast</b>	Ignore this field.
<b>Range</b>	Ignore this field.
<b>Element Address</b>	Ignore this field.
<b>Number of Elements</b>	Ignore this field.

# Inquiry

The Inquiry command (12h) requests that the library send to the initiator information regarding the library's parameters.

**TABLE 4-8** Inquiry Command

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

## Inquiry Command Definitions:

<b>CmdDt</b>	Command support data is not supported (0).
<b>EVPD</b>	<p>The enable vital product data bit indicates the type of inquiry data the initiator is requesting. Supported values are:</p> <p>0 = Request for standard inquiry data 1 = Request for vital support product data page</p>
<b>Page Code</b>	<p>If the EVPD value is 0, this field is set to 00h. If the EVPD value is 1, this field must be:</p> <p>00h = Supported vital product pages 80h = Unit serial number page 83h = Device identification page 88h = SCSI ports page</p>
<b>Allocation Length</b>	<p>The allocation length field specifies the number of bytes the initiator has allocated for data returned from the Inquiry command.</p> <p>A value of 0 indicates that no inquiry data is to be transferred. This condition is <i>not</i> considered an error.</p>

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 data length for the standard inquiry data the library returns is 4Ah (74d) bytes.

- The data length for the supported pages (00h) is 8h (8d) bytes.
- The data length for the unit serial number page (80h) is 16h (22d) bytes.
- The data length for the device identification page (83h) is 3Ah (58d) bytes.
- The data length for the SCSI ports page (88h) is 1Ch (28d) or 34h (52d) bytes.



**Note** – The Inquiry command returns check condition status only when the requested data cannot be returned. This command will not clear any pending unit attention conditions.

## Standard Inquiry Data

For the Inquiry command, the library returns 4Ah (74d) bytes of data in this format.

**TABLE 4-9** Standard Inquiry Data

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	RMB (1)	Reserved (0)						
2	Version (05h)							
3	Reserved (0)		Norm ACA (0)	HiSup (1)	Response Data Format (2)			
4	Additional Length							
5	SCCS (0)	ACC (0)	TPGS (1)		3PC (0)	Reserved (1)		Protect (0)
6	BQue (0)	EncServ (0)	VS (0)	MultiP (1)	MChngr (0)	Reserved (1)		ADDR16 <sup>a</sup> (0)
7	Rsvd (0)	Rsvd (0)	WBUS16 <sup>a</sup> (0)	SYNC <sup>a</sup> (0)	LINKED (0)	Rsvd (0)	CmdQue	VS (0)
8 to 15	(MSB) Vendor Identification (LSB)							
16 to 31	(MSB) Product Identification (LSB)							
32 to 35	(MSB) Product Revision Level (LSB)							
36 to 57	(MSB) Reserved (00h) (LSB)							
58 to 59	(MSB) Version Descriptor 1 (LSB)							
	...							
72 to 73	(MSB) Version Descriptor 8 (LSB)							
<b>Note</b> – <sup>a</sup> The meaning of these fields are specific to the SCSI Parallel Interface (SPI-5). For protocols other than the SCSI Parallel Interface, these fields are reserved.								

**Standard Inquiry Data Definitions:**

<b>Peripheral Qualifier</b>	<p>The library returns a value of:</p> <p>000b= Indicates the specified peripheral device type is currently connected to this logical unit.</p> <p>011b = If the command is sent to an unsupported logical unit.</p> <p><b>Note</b> – b = binary notation</p>
<b>Peripheral Device Type</b>	<p>The library returns a value of:</p> <p>8h = Indicates that the library is a medium changer device.</p> <p>1Fh = If the command is sent to an unsupported logical unit.</p>
<b>RMB</b>	<p>Removable Medium;</p> <p>The library returns a value of 1 indicating the medium is removable.</p>
<b>Version</b>	The library returns a value of 5h, which indicates compliance to SCSI-3.
<b>NormACA</b>	<p>The Normal Auto Contingent Allegiance (NACA) bit controls the rules for handling an auto contingent condition caused by a command.</p> <p>The library returns a value of 0, indicating it does not support setting the NACA bit to one in the control byte of a CDB.</p>
<b>HiSup</b>	The library returns a value of 1, indicating the library uses the hierarchical addressing model to identify logical units.
<b>Response Data Format</b>	A value of 2 indicates the data found is in accordance with the SCSI-3 specification.
<b>Additional Length</b>	<p>1Fh = The library has 31 additional bytes of Standard Inquiry Data available to the initiator.</p> <p>45h = The library has 69 additional bytes of Standard Inquiry Data available to the initiator. This value is returned if the Allocation Length in the CDB is 36 bytes or larger.</p>
<b>SCCS</b>	The library returns a value of 0, indicating the library does not contain an embedded storage array controller component.
<b>ACC</b>	The library returns a value of 0, indicating it does not contain an access control coordinator that may be addressed through this logical unit.
<b>TPGS</b>	<p>The library returns a value of 01b, which indicates that implicit asymmetric logical unit access is supported.</p> <p>The library is capable of changing target port asymmetric access states without a Set Target Port Groups command.</p> <p>The Report Target Port Groups command is supported and the Set Target Port Groups command is not supported.</p>
<b>3PC</b>	<p>The library returns a value of:</p> <p>0 indicating third-party commands are not supported.</p>
<b>Protect</b>	<p>The library returns a value of:</p> <p>0 indicating that it does not support protection information.</p>
<b>BQUE</b>	<p>The library returns a value of:</p> <p>0 indicating that basic queuing is not supported.</p>

<b>VS</b>	Vendor Specific bit is set to: 0 indicating that there is no vendor-specific information with this command.
<b>MultiP</b>	Multiple Ports 00b indicates there are no multiple target ports. 01b indicates there are multiple target ports.
<b>MChngr</b>	The library is not embedded in or attached to a medium transport element and returns a value of 0.
<b>ADDR16<sup>a</sup></b>	The library returns a value of 0.
<b>WBUS16<sup>a</sup></b>	The library returns a value of 0.
<b>SYNC<sup>a</sup></b>	The library returns a value of 0.
<b>LINKED</b>	The library returns a value of: 0 = LINKED command bit, indicating linked commands are not supported.
<b>CmdQue</b>	<ul style="list-style-type: none"> <li>• 0 = The library does not support command queuing.</li> <li>• 1 = The library supports command queuing (for example, the library is bridged, and the LTO-5 tape drive supports command queuing).</li> </ul>
<b>Vendor Identification</b>	Contains the ASCII character sequence “STK” followed by blanks. If the specified logical unit is not supported, this field contains all blanks.
<b>Product Identification</b>	Contains the ASCII character sequence “SL150” followed by blanks.
<b>Product Revision Level</b>	Contains an ASCII character sequence that represents the product revision.
<b>Version Descriptors</b>	The bridged drive returns up to eight Version Descriptors that are used to identify up to eight standards to which the drive conforms.

**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 OK, and retry the Inquiry command.

## Supported Pages

The library returns 8h (8d) bytes of supported page data in this format.

**TABLE 4-10** Supported Pages

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (00h)							
2	Reserved (00h)							
3	Additional Page Length (04h)							
4	Supported Page (00h)							
5	Serial Number Page (80h)							
6	Device Identification Page (83h)							
7	SCSI Ports Page (88h)							

### Inquiry: Supported Pages Definitions:

<b>Peripheral Qualifier</b>	<p>The library returns a value of:</p> <p>000b indicates that the specified peripheral device type is currently connected to this logical unit.</p> <p>011b indicates if the command is sent to an unsupported logical unit.</p> <p><b>Note</b> – b = binary notation.</p>
<b>Peripheral Device Type</b>	<p>The library returns a value of:</p> <p>8h indicating that the library is a medium changer device.</p> <p>1Fh indicating if the command is sent to an unsupported logical unit.</p>
<b>Page Code</b>	Identifies the page as a supported page (00h)
<b>Additional Page Length</b>	This field is set to 04h (4d) bytes.
<b>Supported Page</b>	<p>00h = Indicates the first vital page is page 0 (current page)</p> <p>80h = <a href="#">Unit Serial Number Page</a></p> <p>83h = <a href="#">Device Identification Page</a></p> <p>88h = <a href="#">SCSI Ports Page</a></p>

## Unit Serial Number Page

The library returns 16h (22d) bytes of unit serial number page data in this format.

**TABLE 4-11** Unit Serial Number Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (80h)							
2	Reserved (00h)							
3	Additional Page Length (12h)							
4 to 21	(MSB)  Unit Serial Number  							

### Unit Serial Number Page Definitions:

<b>Peripheral Qualifier</b>	<p>The library returns a value of:</p> <p>000b = Indicates the specified peripheral device type is currently connected to this logical unit.</p> <p>011b = If the command is sent to an unsupported logical unit. (b = binary notation).</p>
<b>Peripheral Device Type</b>	<p>The library returns a value of:</p> <p>8h = Indicates that the library is a medium changer device.</p> <p>011b = If the command is sent to an unsupported logical unit.</p>
<b>Page Code</b>	<p>This field is set to:</p> <p>80h = Identifying the page as the unit serial number page.</p>
<b>Additional Page Length</b>	<p>This field is set to:</p> <p>12h = The number of bytes in the product serial number.</p>
<b>Unit Serial Number</b>	<p>This field contains a unique 18 character ASCII identifier for the library.</p> <p>For example: 464970G+1221XX0005</p> <p>Where: XX indicates the library partition number, when the library is partitioned.</p> <p>P1: Partition 1 P2: Partition 2</p> <p>The serial number is not modified, when the library is non-partitioned.</p>

## Device Identification Page

The library returns 46h (70d) bytes of device identification page data:

**TABLE 4-12** Device Identification Page Data

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (83h)							
2	Reserved (00h)							
3	Additional Page Length (42h)							
T10 Vendor Identifier								
4	Protocol Identifier (0)				Code Set (2)			
5	PIV (0)	Rsvd	Association (0)	Identifier Type (1)				
6	Reserved (00h)							
7	Identifier Length (2Ah)							
8 to 15	(MSB)	Vendor Identification						(LSB)
16 to 31	(MSB)	Product Identification						(LSB)
32 to 49	(MSB)	Unit Serial Number						(LSB)
Node Name Identifier								
50	Protocol Identifier (0)				Code Set (1)			
51	PIV (0)	Rsvd	Association (0)	Identifier Type (3)				
52	Reserved (00h)							
53	Identifier Length (08h)							
54 - 61	Identifier							
Relative Target Port Identifier								
62	Protocol Identifier (0h or 6h)				Code Set (1)			
63	PIV (1)	Rsvd	Association (1)	Identifier Type (4)				
64	Reserved (00h)							
65	Identifier Length (04h)							
66 - 69	(MSB)	Relative Target Port Identifier						(LSB)

**Device Identification Page Definitions:**

<b>Peripheral Qualifier</b>	<p>The library returns a value of:</p> <ul style="list-style-type: none"> <li>• 000b= Indicating the specified peripheral device type is currently connected to this logical unit.</li> <li>• 011b = If the command is sent to an unsupported logical unit. (b = binary notation)</li> </ul>
<b>Peripheral Device Type</b>	<p>The library returns a value of:</p> <ul style="list-style-type: none"> <li>• 8h = Indicates that the library is a medium changer device.</li> <li>• 1Fh = If the command is sent to an unsupported logical unit.</li> </ul>
<b>Additional Page Length</b>	<p>A value of: 36h = indicates there are 54 (decimal) additional bytes of Device ID Inquiry Data available to the initiator.</p>
<b>Protocol Identifier</b>	<ul style="list-style-type: none"> <li>• 0h = Fibre Channel</li> <li>• 6h = Serial Attached SCSI</li> </ul>
<b>Code Set</b>	<p>1h = The identifier field contains binary values 2h = The identifier field contains ASCII printable characters</p>
<b>Identifier Type</b>	<p>1h = The identifier field contains T10 Vendor ID data 3h = The identifier field contains a 64-bit IEEE Registered Address 4h = The identifier field contains the Relative Target Port Identifier</p>
<b>Identifier Length</b>	<p>4h = The identifier length for the Relative Target Port Identifier 2Ah = The identifier length for the T10 Vendor ID data</p>
<b>Association</b>	<p>00b = The identifier field is associated with the addressed logical unit. 01b = The identifier field is associated with the target port that received the request.</p>
<b>PIV</b>	<p>0b = The protocol identifier field contents are reserved. 1b = The protocol identifier field is valid.</p>
<b>Vendor Identification</b>	<p>Contains the ASCII character sequence “STK” followed by blanks. If the specified logical unit is not supported, this field contains all blanks.</p>
<b>Product Identification</b>	<p>This field contains the ASCII character sequence “SL150” followed by blanks.</p>
<b>Relative Target Port Identifier</b>	<ul style="list-style-type: none"> <li>• 1 = Target Port 1</li> <li>• 2 = Target Port 2</li> </ul>
<b>Unit Serial Number</b>	<p>This field contains a unique 18 character ASCII identifier for the library.</p> <p>For example: 464970G+1221XX0005 Where: XX indicates the library partition number, when the library is partitioned.</p> <p>P1: Partition 1 P2: Partition 2</p> <p>The serial number is not modified, when the library is non-partitioned.</p>
<b>NAA Identifier</b>	<p>This field contains the IEEE Registered name for the library. See <a href="#">TABLE 4-13</a>.</p>

**TABLE 4-13** IEEE Registered Name

<b>63</b> <b>(MSB)</b>			<b>Bits</b>	<b>0</b> <b>(LSB)</b>
<b>NAA</b>	<b>IEEE Company ID</b>	<b>Vendor Specific Identifier</b>		
5h	00 10 4f (h)	Different for every library or partition		



## SCSI Ports Page

The library returns 1Ch (28d) or 34h (52d) bytes of SCSI Ports data in this format:

**TABLE 4-14** SCSI Ports Page Data

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (88h)							
2	Reserved (00h)							
3	Additional Page Length							
4 to 27	(MSB) SCSI Port Identification Descriptor (LSB)							
28 to 51	(MSB) SCSI Port Identification Descriptor (included if the drive has 2 ports and both ports are enabled) (LSB)							

### SCSI Ports Page Definitions:

<b>Peripheral Qualifier</b>	<p>The library returns a value of:</p> <ul style="list-style-type: none"> <li>• 000b = Indicates the specified peripheral device type is currently connected to this logical unit.</li> <li>• 011b = If the command is sent to an unsupported logical unit. (b = binary notation).</li> </ul>
<b>Peripheral Device Type</b>	<p>The library returns a value of:</p> <ul style="list-style-type: none"> <li>• 8h = Indicates that the library is a medium changer device.</li> <li>• 1Fh = If the command is sent to an unsupported logical unit.</li> </ul>
<b>Additional Page Length</b>	<p>The library has:</p> <ul style="list-style-type: none"> <li>• 18h = 24d additional bytes of SCSI Ports Data available to the initiator.</li> <li>• 30h = 48d additional bytes of SCSI Ports Data available to the initiator.</li> </ul> <p><b>Note:</b> This value is returned, if the drive has 2 SCSI ports and both SCSI ports are enabled.</p>
<b>SCSI Port Identification Descriptor</b>	See <a href="#">TABLE 4-15</a> for more information.

**SCSI Port Identification Descriptor Data****TABLE 4-15** SCSI Port Identification Descriptor Data

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Reserved (00h)							
1	Reserved (00h)							
2 to 3	(MSB)	Relative Port Identifier						(LSB)
4 to 9	(MSB)	Reserved (00h)						(LSB)
10 to 11	(MSB)	Target Port Descriptor Length (0Ch)						(LSB)
12	Protocol Identifier (0h or 6h)				Code Set (1)			
13	PIV (1)	Rsvd	Association (1)		Identifier Type (3)			
14	Reserved (00h)							
15	Identifier Length (8h)							
16 to 23	(MSB)	Port Name Identification						(LSB)

**SCSI Port Identification Descriptor Data Definitions:**

<b>Relative Port Identifier</b>	1 = Port 1 2 = Port 2
<b>Protocol Identifier</b>	0 = Fibre Channel 6 = Serial Attached SCSI
<b>Code Set</b>	The library returns a value of: 1 = indicates the identifier contains binary values.
<b>Identifier Type</b>	The library returns a value of: 3 = indicates the identifier field contains a 64-bit IEEE formatted address.
<b>Association</b>	The library returns a value of: 1 = indicates the identifier field is associated with the port that received the request.
<b>PIV</b>	The library returns a value of 1= indicates the protocol identifier is valid
<b>Port Name Identification</b>	Contains the 64-bit IEEE formatted address for the Port Name.

# Log Sense

The Log Sense command (4Dh) enables the library to report its error logs and statistics to the initiator.

**TABLE 4-16** Log Sense Command

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

## Log Sense Command Definitions:

<b>PPC</b>	Parameter Pointer Control is not supported (0).
<b>SP</b>	Save Parameters feature is not supported (0).
<b>PC</b>	The library accepts values of 0 or 1 in the Page Control field.
<b>Page Code</b>	00h = List Supported pages 07h = List Last <i>n</i> Error Events page 2Eh = Informational Exceptions TapeAlert page (0 or 1 in the PC field)
<b>Parameter Pointer</b>	The Parameter Pointer allows an initiator to request data starting at a specific parameter code. This value is set to 00h for page code 0h.
<b>Allocation Length</b>	Specifies the number of bytes the initiator has allocated for data returned from the Log Sense command. A value of 0 is considered an error. The maximum data length for the log sense data that the library can return is 3C4h bytes. The length varies based on the Page Code selected. 00h = List Supported pages—length is 7h 07h = List Last <i>n</i> Error Events page—length is 3C4h 2Eh = Informational Exceptions TapeAlert page—length is 144h

## Supported Pages Format Page

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

**TABLE 4-17** Supported Pages Format Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Page Code (00h)							
1	Reserved (00h)							
2 to 3	(MSB) Page Length (03h) (LSB)							
4	Supported Pages Page Code (00h)							
5	Last n Errors Events Page Code (07h)							
6	Informational Exceptions TapeAlert Page Code (2Eh)							

## Last $n$ Errors Events Page

The Last  $n$  Errors Events page provides a list of the most recent errors events logged on the library. Each event is an ASCII string that includes a time stamp, a fault symptom code (FSC), and an optional mechanism.

**Note** – Each error event is 48 bytes long, and can contain up to 20 events.

**TABLE 4-18** Last  $n$  Errors Events Page Format

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Page Code (07h)							
1	Reserved (00h)							
2 to 3	(MSB) Page Length ( $n - 3$ ) (LSB)							
ASCII String for Event Specified by Parameter Pointer:								
4 to 7	Result Code							
8 to 11	Activity Code							
12 to 15	Request Id							
16 to 19	Op State							
20 to 23	Module							
24 to 27	Row							
28 to 31	Column							
32 to 33	Month							
34 to 35	Day							
36 to -37	Hour							
38 to 39	Minute							
40 to 42	Second							
43 to 51	Pad (ASCII spaces)							
Additional Events (48d bytes per event)								
n to 47 to n	Additional Log Parameters							

**Note** – Time is specified as universal time.

## Informational Exceptions TapeAlert Page

**Note** – This TapeAlert page is not fully implemented yet.

The Informational Exceptions TapeAlert page is read from the library at a minimum of:

- At the beginning of a write/read job occurring on a device inside the library, even if media is not loaded in that device
- Immediately after a fatal error during a write/read job occurring on a device inside the library
- At the end of a write/read job occurring on a device inside the library.

Though not mandatory, the host software may also poll the Log Sense page every 60 seconds while the tape library is idle.

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

- At library power on
- When the TapeAlert Log page is read
- On a reset

[TABLE 4-19](#) lists information about the Informational Exceptions TapeAlert Page format. The TapeAlert page returns A4h bytes in this format.

The  $n$  represents a TapeAlert flag: currently, all values are set to default. Unsupported flags are also returned as defaults.

**TABLE 4-19** Informational Exceptions TapeAlert Page Format

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Page Code (2Eh)							
1	Reserved (00h)							
2 to 3	(MSB)  Page Length ( $5n$ )  (LSB)							
TapeAlert Flags: n goes from 1 to 32								
$5n - 1$ to $5n$	Parameter Code ( $n$ )							
$5n + 1$	DU (0)	DS (1)	TSD (0)	ETC (0)	TMC (0)	Rsvd (0)	LBIN (0)	LP (0)
$5n + 2$	Parameter Length							
$5n + 3$	Value of Flag							Flag

**Note** – The entire TapeAlert page should be read to obtain all the information.

**Informational Exceptions TapeAlert Page Definitions:**

<b>Parameter Code</b>	A 2-byte field which represents the TapeAlert Flag number.
<b>DU</b>	Disable Update is always 0, which indicates that the target updates the log parameter value instead of the initiator.
<b>DS</b>	Disable Save is always 1, which indicates saving the log is not supported.
<b>TSD</b>	Target Save Disable is always 0.
<b>ETC</b>	Enable Threshold Comparison is always 0.
<b>TMC</b>	Threshold Met Criteria is always 0.
<b>LBIN</b>	The library returns 0 indicating it is not used.
<b>LP</b>	List Parameter is always 0, which indicates the log parameter is a data counter.
<b>Parameter Length</b>	Parameter Length is always 0x01. All are 1-byte flags.
<b>Flag</b>	A value of 0x01 indicates that the flag the Parameter Code is pointed to is active; all other values are off.

**TapeAlert Flags**

[TABLE 4-20](#) lists information about the TapeAlert flags. Flags are:

- in sequential order
- have valid values of 0 (off) or 1 (on)
- reports all 32

Type codes indicate:

- C = Critical
- W = Warning
- I = Informational

**TABLE 4-20** TapeAlert Flags

<b>Code</b>	<b>Flag Name</b>	<b>Type</b>
0001h	Media changer/data transfer device communication fault	C
0002h	Hardware Warning	W
0003h	Mechanical Hardware Fault	C
0004h	Hardware Fault	C
0005h	Diagnostics Requested	I
0006h	Host Interface Failure	C
0007h	Predictive Failure	W
0008h	Preventative Maintenance	W
0009h	Humidity Limits	C

**TABLE 4-20** TapeAlert Flags (Continued)

<b>Code</b>	<b>Flag Name</b>	<b>Type</b>
000Ah	Temperature Limits	C
000Bh	Voltage Limits	C
000Ch	Unexpected Volume	W
000Dh	Pick Retry	W
000Eh	Place Retry	W
000Fh	Load Retry	W
0010h	Door Open	C
0011h	Import/Export Element Fault	C
0012h	Magazine Inaccessible	C
0013h	Obsolete	
0014h	Obsolete	
0015h	Media Changer Offline	I
0016h	Data Transfer Device Offline	I
0017h	Barcode Scan Retry	W
0018h	Inventory Information Inconsistent	C
0019h	Media Changer Illegal Operation	W
001Ah	Multi-port Interface Error on a Primary Port	W
001Bh	Cooling Fan failure	W
001Ch	Power Supply	W
001Dh	Power Consumption	W
001Eh	Pass-through Mechanism Failure	C
001Fh	Obsolete	
0020h	Unreadable Bar Code Labels	I



## Mode Select (6)

The 6-byte Mode Select command (15h) enables an initiator to specify certain operating parameters for the library. The library uses the saved or default versions of these parameters to configure itself during power-on or after a logical unit reset.

The mode values sent to the library apply to all initiators. If an initiator issues a Mode Select command that changes any parameters, the library generates a Check Condition status to all other initiators with a sense key of Unit Attention and an Additional Sense Code (ASC) and Additional Sense Code Qualifier (ASCQ) of Mode Parameters Changed.

When the library receives a Mode Select (6) command, the library validates all parameters before it performs any changes. If a value is not valid, the library returns the appropriate error message and does not change the parameters.

**TABLE 4-21** Mode Select (6) Command

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

### Mode Select (6) Command Definitions:

<b>PF</b>	Page Format supports SCSI-3 specification and requires a value of 1.
<b>SP</b>	<p>The library supports the saved page (SP) function. The values are:</p> <p>0 = Current mode values are changed to the values specified by this command. Saved values are not affected.</p> <p>1 = Current mode values and saved mode values are changed to the values specified by this command.</p>
<b>Parameter List Length</b>	<p>00h = No data transferred</p> <p><b>Note</b> – A value of 00h is not considered an error.</p> <p>Any other value is considered an error and is not supported.</p> <p>The <b>Mode Parameter Header</b> and the following pages are transferred:</p> <ul style="list-style-type: none"> <li>• 14h = Disconnect Reconnect Page are transferred.</li> <li>• 0Ch = Logical Unit Page are transferred.</li> <li>• 0Ch = Fibre Channel Port Control Page are transferred.</li> <li>• 14h = SAS Port Control Page are transferred.</li> <li>• 68h = SAS Phy Control and Discover Mode Subpage are transferred.</li> <li>• 10h = Informational Exceptions Tape Alert Mode Page are transferred.</li> <li>• 18h = Element Address Assignment Page are transferred.</li> </ul>

## Mode Select (6) Data

The initiator must provide mode parameter data in a parameter list including:

- “Mode Select (6) Parameter Header” on page 50
- “Fibre Channel Disconnect/Reconnect Page” on page 51
- “SAS Disconnect/Reconnect Page” on page 53
- “Fibre Channel Logical Unit Page” on page 55
- “SAS Logical Unit Page” on page 56
- “Fibre Channel Port Control Page” on page 57
- “SAS Port Control Page” on page 60
- “SAS Phy Control and Discover Mode Subpage” on page 62
- “Informational Exceptions TapeAlert Page” on page 65 or
- “Element Address Assignment Mode Page” on page 67

If the parameter list length field in the command is 0, then no Mode Select data is required.

**Note** – Before issuing any Mode Select commands, an initiator should issue a Mode Sense command with the Page Control field set to 01h, and the Page Code field set to 3Fh to determine which pages are supported, which parameters within the pages are changeable, and the supported length of each page.

## Mode Select (6) Parameter Header

The library returns a four-byte Mode Select parameter header as follows:

**TABLE 4-22** Mode Select Parameter (6) Header

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Reserved (00h)							
1	Reserved (00h)							
2	Reserved (00h)							
3	Reserved (00h)							

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

## Fibre Channel Disconnect/Reconnect Page

TABLE 4-23 shows the format of the Mode Sense Fibre Channel Disconnect/Reconnect page.

**TABLE 4-23** Fibre Channel Disconnect/reconnect Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS	SPF	Page Code (02h)					
1	Page length (0Eh)							
2	Buffer Full Ratio							
3	Buffer Empty Ratio							
4 to 5	(MSB)	Bus Inactivity Limit						(LSB)
6 to 7	(MSB)	Disconnect Time Limit						(LSB)
8 to 9	(MSB)	Connect Time Limit						(LSB)
10 to 11	(MSB)	Maximum Burst Size						(LSB)
12	EMPD	FAA	FAB	FAC	Restricted			
13	Reserved							
14 to 15	(MSB)	First Burst Size						(LSB)

### Mode Sense: Fibre Channel Disconnect/Reconnect Page Definitions

<b>PS</b>	The parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of: 0 = the SubPage Format bit, indicating that page_0 format is being used.
<b>Page Code</b>	This field is set to: 02h identifies the page as the Disconnect/Reconnect page.
<b>Buffer Full Ratio</b>	This field indicates the device server, during read operations, how full the buffer should be prior to requesting an interconnect tenancy.
<b>Buffer Empty Ratio</b>	This field indicates the device server, during write operations, how empty the buffer should be prior to transmitting an FCP_XFER_RDY IU that requests the initiator to send data.
<b>Bus Inactivity Limit</b>	This field indicates the maximum time that the target is permitted to maintain an interconnect tenancy without data or information transfer, measured in transmission word increments.  <ul style="list-style-type: none"> <li>0000h indicates that there is no bus inactivity limit.</li> </ul>
<b>Disconnect Time Limit</b>	This field indicates the minimum delay between interconnect tenancies measured in increments of 128 transmission words.  <ul style="list-style-type: none"> <li>0000h indicates that the disconnect time limit does not apply.</li> </ul>

<b>Connect Time Limit</b>	<p>The field indicates the maximum duration of a single interconnect tenancy, measured in increments of 128 transmission words.</p> <ul style="list-style-type: none"> <li>• 0000h indicates that there is no connect time limit.</li> </ul>
<b>Maximum Burst Size</b>	<p>This field indicates the maximum size of FCP_DATA IU that the device server shall transfer to the initiator or request from the initiator. This value is expressed in increments of 512 bytes.</p> <ul style="list-style-type: none"> <li>• 0000h indicates there is no limit on the amount of data transferred per data transfer operation.</li> </ul>
<b>EMPD</b>	<p>The Enable Modify Data Pointers bit indicates whether or not the target may use the random buffer access capability to reorder FCP_DATA IUs for a single SCSI command.</p> <ul style="list-style-type: none"> <li>• 0 = The target shall generate continuously increasing relative offset values for each FCP_DATA IU for a single SCSI command.</li> <li>• 1 = The target may transfer the FCP_DATA IUs for a single SCSI command in any order.</li> </ul>
<b>FAA, FAB, FAC</b>	<p>The fairness access (FA) bits, FAA, FAB, and FAC, indicate whether a target in a loop configuration shall use the access fairness algorithm. A value of 0 indicates that the target does not use fairness, while a value of 1 indicates that the target does use a fairness algorithm.</p> <ul style="list-style-type: none"> <li>• The <b>FAA bit</b> controls arbitration when the target wishes to send one or more FCP_DATA IU frames to an initiator.</li> <li>• The <b>FAB bit</b> controls arbitration when the initiator wishes to send one or more FCP_XFER_RDY IU frames to a target.</li> <li>• The <b>FAC bit</b> controls arbitration when the target wishes to send an FCP_RSP IU frame to an initiator.</li> </ul>
<b>First Burst Size</b>	<p>This field value is expressed in increments of 512. n 0000h indicates that there is no first burst size limit.</p>

## SAS Disconnect/Reconnect Page

TABLE 4-24 shows the format of the Mode Sense Serial Attached SCSI Disconnect/Reconnect page.

**TABLE 4-24** SAS Disconnect/Reconnect Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS	SPF	Page Code (02h)					
1	Page Length (0Eh)							
2	Reserved (00h)							
3	Reserved (00h)							
4 to 5	(MSB)	Bus Inactivity Time Limit						(LSB)
6	Reserved (00h)							
7	Reserved (00h)							
8 to 9	(MSB)	Maximum Connect Time Limit						(LSB)
10 to 11	(MSB)	Maximum Burst Size						(LSB)
12	Reserved (00h)							
13	Reserved (00h)							
14 to 15	(MSB)	First Burst Size						(LSB)

### Mode Sense: SAS Disconnect/Reconnect Page Definitions:

<b>PS</b>	The parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of: 0 = SubPage Format bit, indicating page_0 format is being used.
<b>Page Code</b>	This field is set to: 02h = identifies the page as the Disconnect/Reconnect page.
<b>Bus Inactivity Time Limit</b>	This field contains the maximum time in 100 $\mu$ s increments that an SSP target port is permitted to maintain a connection without transferring a frame to the SSP initiator port. <ul style="list-style-type: none"> <li>0000h indicates that there is no bus inactivity limit.</li> </ul>
<b>Maximum Connect Time Limit</b>	This field contains the maximum duration of a connection in 100 $\mu$ s increments. <ul style="list-style-type: none"> <li>0000h specifies that there is no maximum connection time limit.</li> </ul>

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<b>Maximum Burst Size</b>	<p>For read data, this field contains the maximum amount of data in 512-byte increments that is transferred during a connection by an SSP target port per I_T_L_Q nexus without transferring at least one frame for a different I_T_L_Q nexus.</p> <p>For write data, the value shall specify the maximum amount of data that an SSP target port requests via a single XFER_RDY frame.</p> <ul style="list-style-type: none"><li>• 0000h in this field specifies that there is no maximum burst size.</li></ul>
<b>First Burst Size</b>	<p>If the ENABLE FIRST BURST bit in the COMMAND frame is set to zero, then the FIRST BURST SIZE field is ignored.</p> <p>If the ENABLE FIRST BURST bit in the COMMAND frame is set to one, then the value in the FIRST BURST SIZE field contains the maximum amount of write data in 512-byte increments that may be sent by the SSP initiator port to the SSP target port without having to receive an XFER_RDY frame from the SSP target port.</p>

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## Fibre Channel Logical Unit Page

TABLE 4-25 shows the format of the Fibre Channel Logical Unit page.

**TABLE 4-25** Fibre Channel Logical Unit Page

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

### Fibre Channel Logical Unit Page Definitions:

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of 0 for the SubPage Format bit, indicating page_0 format is being used.
<b>Protocol Identifier</b>	This field is set to 0h indicating the Fibre Channel protocol.
<b>EPDC</b>	<p>The Enable Precise Delivery Checking bit is defined as follows:</p> <p>0 = The target shall not use the precise delivery function and shall ignore the contents of the CRN field</p> <p>1 = The logical unit shall use precise delivery function defined in the FCP-2 standard.</p>

## SAS Logical Unit Page

TABLE 4-26 shows the format of the Serial Attached SCSI (SAS) Logical Unit page.

**TABLE 4-26** SAS Logical Unit Page

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

### Serial Attached SCSI Logical Unit Page Definitions:

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of; 0 = SubPage Format bit, indicating page_0 format is being used.
<b>Protocol Identifier</b>	The field is set to: 06h indicating Serial Attached SCSI protocol.
<b>TLR</b>	0b = Transport Layer Retries are disabled.  1b = Transport Layer Retries are enabled for Transfer Ready and Data Frames for the logical unit.



## Fibre Channel Port Control Page

TABLE 4-27 shows the format of the Fibre Channel Port Control page.

**TABLE 4-27** Fibre Channel Port Control Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (19h)					
1	Page Length (06h)							
2	Reserved				Protocol Identifier (0)			
3	DTFD	PLPB	DDIS	DLM	RHA	ALWI	DTIPE	DTOLI
4	Reserved							
5	Reserved							
6	Reserved					RR_TOV units		
7	Resource Recovery Time Out Value (RR_TOV)							

### Fibre Channel Port Control Page Definitions:

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of:  0 = SubPage Format bit, indicating page_0 format is being used.
<b>Protocol Identifier</b>	This field is set to:  0h indicating Fibre Channel protocol
<b>DTFD</b>	Disabled Target Fabric Discovery. If the library is not attached to an arbitrated loop, it shall ignore the DTFD bit.  0 = The target attached by an arbitrated loop shall discover a fabric loop port if present on the loop and perform the public loop functions defined for targets by FC-FLA.  1 = The target attached by an arbitrated loop shall not recognize the presence of a fabric loop port on the loop.
<b>PLPB</b>	Prevent Loop Port Bypass. If the library is not attached to an arbitrated loop, it shall ignore the PLPB bit.  0 = The target allows the Loop Port Bypass (LPB) and Loop Port Enable (PBE) primitive sequences to control the port bypass circuit and participation on the loop as specified by FC-AL-2.  1 = The target attached to an FC-AL-2 loop shall ignore any Loop Port Bypass (LPB) and Loop Port Enable (LPE) primitive sequences.

<b>DDIS</b>	<p>Disable Discovery. If the library is not attached to an arbitrated loop, it shall ignore the DDIS bit.</p> <p>0 = The target shall wait to complete target discovery as defined by FC-PLDA, FC-FLA, and FC-TAPE before allowing processing of tasks to resume.</p> <p>1 = The target without a valid FLOGI attached to an arbitrated loop shall not require receipt of Address or Port Discovery (ADISC or PDISC ELSs) following loop initialization as described in FC-PLDA and FC-FLA.</p>
<b>DLM</b>	<p>Disable Loop Master. If the library is not attached to an arbitrated loop, it shall ignore the DLM bit.</p> <p>0 = The target may participate in loop master arbitration in the normal manner and, if successful, may become loop master during the loop initialization process.</p> <p>1 = The target attached to an FC-AL-2 loop shall not participate in loop master arbitration and shall not become loop master. The target shall only repeat LISM frames it receives.</p>
<b>RHA</b>	<p>Require Hard Address. If the library is not attached to an arbitrated loop, it shall ignore the RHA bit.</p> <p>0 = The target follows the normal initialization procedure, including the possibility of obtaining a soft address during the loop initialization process.</p> <p>1 = The target attached to an arbitrated loop shall only attempt to obtain its hard address. If there is a conflict for the hard address selection during loop initialization or the target does not have a valid hard address available, the target shall enter the nonparticipating state.</p>
<b>ALWI</b>	<p>Allow Login Without Loop Initialization. If the library is not attached to an arbitrated loop, it shall ignore the ALWI bit.</p> <p>0 = The target shall perform the normal loop initialization procedure before entering the monitoring mode and accepting a login ELS.</p> <p>1 = The target attached to an FC-AL-2 loop shall use the hard address available in the connector or in device address jumpers, enter the monitoring state in participating mode, and accept logins without using the loop initialization procedure (see FC-AL-2).</p>
<b>DTIPE</b>	<p>Disabled Target Initiated Port Enabled. If the library is not attached to an arbitrated loop, it shall ignore the DTIPE bit.</p> <p>0 = The target shall enable itself onto the loop in accordance to the rules specified in FC-AL-2.</p> <p>1 = The target attached to an arbitrated loop shall wait for an initiator to send the Loop Port Enable (LPE) primitive sequence before inserting itself into a loop (see FC-AL-2)</p>

<b>DTOLI</b>	<p>Disable Target Originated Loop Initialization. If the library is not attached to an arbitrated loop, it shall ignore the <b>DTOLI</b> bit.</p> <p>0 = The target attached by an arbitrated loop shall generate LIP(F7,xx) after it enables a port into a loop.</p> <p>1 = The target attached by an arbitrated loop shall not generate a LIP following insertion into the loop.</p>
<b>RR_TOV units</b>	<p>Resource Recovery Time Out Value Units will always be:</p> <p>011b = 0.1 second units</p>
<b>RR_TOV</b>	<p>Resource Recovery Time Out Value will always be:</p> <p>F0h = 24 seconds</p>

## SAS Port Control Page

TABLE 4-28 shows the format of the Serial Attached SCSI (SAS) Port Control page.

**TABLE 4-28** SAS Port Control Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (19h)					
1	Page Length (0Eh)							
2	RSVD	Continue AWT	BAE	LED	Protocol Identifier (6h)			
3	Reserved							
4 to 5	(MSB) I_T Nexus Loss Time (LSB)							
6 to 7	(MSB) Initiator Response Timeout (LSB)							
8 to 9	(MSB) Reject to Open Limit (LSB)							
10 to 15	(MSB) Reserved (00h) (LSB)							

**Serial Attached SCSI Port Control Page Definitions:**

<b>PS</b>	The parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of: 0 = SubPage Format bit, indicating page_0 format is being used.
<b>Page Code</b>	This field is set to: 19h that identifies the page as the SAS Port Control mode page
<b>Protocol Identifier</b>	This field is set to: 06h indicating the Serial Attached SCSI protocol
<b>Continue AWT</b>	Continuous Arbitration Wait Time (AWT)  0 = The SAS port shall stop the AWT timer and set the AWT timer to zero when it receives an OPEN_REJECT (RETRY).  1 = The SAS port shall not stop the AWT timer and shall not set the AWT timer to zero when the SAS port receives an OPEN_REJECT (RETRY).
<b>BAE</b>	Broadcast Asynchronous Event (BAE). The device server shall:  0 = Disable origination of Broadcast (Asynchronous Event).  1 = Enable origination of Broadcast (Asynchronous Event).
<b>Ready LED Meaning</b>	The Ready LED Meaning bit specifies the READY LED signal behavior.
<b>I_T Nexus Loss Time</b>	This field contains the minimum time that the SSP Target Port shall retry connection requests to an SSP initiator port that are rejected with responses indicating the SSP initiator port may no longer be present before recognizing an I_T nexus loss:  0000h = Vendor-specific amount of time.  0001h - FFFFh = Time in milliseconds.  FFFFh = The SSP target port shall never recognize an I_T nexus loss.
<b>Initiator Response Timeout</b>	This field contains the minimum time in milliseconds that the SSP target port shall wait for the receipt of a frame before aborting the command associated with that frame.  0000h indicates that the SSP target port shall wait forever.
<b>Reject to Open Limit</b>	This field contains the minimum time in 10 microsecond increments that the target port shall wait to establish a connection request with an initiator port on an I_T nexus after receiving an OPEN_REJECT (RETRY), OPEN_REJECT (RESERVED CONTINUE 0), or OPEN_REJECT (RESERVED CONTINUE 1)  0000h indicates that minimum time is vendor specific.

## SAS Phy Control and Discover Mode Subpage

[TABLE 4-29](#) shows the format of the Serial Attached SCSI Phy Control and Discover Mode Subpage.

**TABLE 4-29** SAS Phy Control and Discover Mode Subpage

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	SPF (1)	Page Code (19h)					
1	Subpage Code (01h)							
2 to 3	(MSB)	Page Length (64h)						(LSB)
4	Reserved							
5	Reserved				Protocol Identifier (6h)			
6	Generation Code							
7	Number of Phys							
SAS Phy Mode Descriptor List								
8 to 55	(MSB)	First SAS Phy Mode Descriptor						(LSB)
56 to 103	(MSB)	Second SAS Phy Mode Descriptor						(LSB)

### Serial Attached SCSI Phy Control and Discover Mode Subpage Definitions:

<b>PS</b>	The parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of: 1 = SubPage Format bit, indicates this page uses the sub_page mode.
<b>Page Code</b>	19h identifies the page as the SAS Port Control mode page.
<b>Sub-Page Code</b>	A value of:  01h identifies the sub-page as the SAS Phy Control and Discover Mode Subpage.
<b>Protocol Identifier</b>	The value 06h indicates the Serial Attached SCSI protocol.
<b>Generation Code</b>	This field is a one-byte counter that shall be incremented by one by the device server every time the values in this mode page are changed.
<b>Number of Phy</b>	This field contains the number of phys in the SAS target device and indicates the number of SAS Phy Mode Descriptors in the SAS Phy Mode descriptor list.
<b>SAS Phy Mode Descriptor Data</b>	See <a href="#">TABLE 4-30</a> for more information.

**SAS Phy Mode Descriptor Data****TABLE 4-30** SAS Phy Mode Descriptor Data

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Reserved (00h)							
1	Phy Identifier							
2	Reserved (00h)							
3	Reserved (00h)							
4	RSVD	Attached Device Type			Reserved (0)			
5	Reserved				Negotiated Physical Link Rate			
6	Reserved				Attach SSP Init Port	Attach STP Init Port	Attach SMP Init Port	RSVD
7	Reserved				Attach SSP Tgt Port	Attach STP Tgt Port	Attach SMP Tgt Port	RSVD
8 to 15	(MSB)	SAS Address						(LSB)
16 to 23	(MSB)	Attached SAS Address						(LSB)
24	Attached Phy Address							
25 to 31	Reserved (00h)							
32	Programmed Minimum Physical Link Rate				Hardware Minimum Physical Link Rate			
33	Programmed Maximum Physical Link Rate				Hardware Maximum Physical Link Rate			
34 to 41	Reserved (00h)							
42 to 43	(MSB)	Vendor Specific						(LSB)
44 to 47	Reserved (00h)							

**Serial Attached SCSI Phy Mode Descriptor Data Definitions:**

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>Phy Identifier</b>	A unique identifier is returned for each Phy.
<b>Attached Device Type</b>	This field indicates the device type attached to this Phy: 000b = No device attached 001b = SAS device 010b = Expander device 011b = Expander device compliant with a previous version of the SAS standard

<b>Negotiated Physical Link Rate</b>		This field indicates the logical link rate being used by the Phy: 0h = UNKNOWN. Phy is enabled. Unknown Physical link rate. 1h = DISABLED. Phy is disabled. 2h = PHY_RESET_PROBLEM 3h = SPINUP_HOLD 4h = PORT_SELECTOR 8h = G1. Physical link rate is 1.5 Gb/s 9h = G2. Physical link rate is 3.0 Gb/s Ah = G3. Physical link rate is 6.0 Gb/s
<b>Attached SSP Initiator Port</b>	<b>Initiator</b>	This bit indicates the value of the SSP Initiator Port field received in the IDENTIFY address frame during the identification sequence.
<b>Attached STP Initiator Port</b>	<b>Initiator</b>	This bit indicates the value of the STP Initiator Port field received in the IDENTIFY address frame during the identification sequence.
<b>Attached SMP Initiator Port</b>		This bit indicates the value of the SMP Initiator Port field received in the IDENTIFY address frame during the identification sequence.
<b>Attached SSP Target Port</b>	<b>Target</b>	This bit indicates the value of the SSP Target Port field received in the IDENTIFY address frame during the identification sequence.
<b>Attached STP Target Port</b>		This bit indicates the value of the STP Target Port field received in the IDENTIFY address frame during the identification sequence.
<b>Attached SMP Target Port</b>		This bit indicates the value of the SMP Target Port field received in the IDENTIFY address frame during the identification sequence.
<b>SAS Address</b>		This field indicates the SAS Address of the LTO-5 drive that is the bridged interface for the library or partition.
<b>Attached SAS Address</b>		This field contains the value of the SAS Address field transmitted in the IDENTIFY address frame during the identification sequence.
<b>Attached Phy Address</b>		This field indicates the value of Attached Phy Address field received in the IDENTIFY address frame during the identification sequence.
<b>Programmed Minimum Physical Link Rate</b>		8h = 1.5 Gb/s 9h = 3.0 Gb/s Ah = 6.0 Gb/s
<b>Hardware Minimum Physical Link Rate</b>		8h = 1.5 Gb/s 9h = 3.0 Gb/s Ah = 6.0 Gb/s
<b>Programmed Maximum Physical Link Rate</b>		8h = 1.5 Gb/s 9h = 3.0 Gb/s Ah = 6.0 Gb/s
<b>Hardware Maximum Link Rate</b>		8h = 1.5 Gb/s 9h = 3.0 Gb/s Ah = 6.0 Gb/s



## Informational Exceptions TapeAlert Page

**Note** – This TapeAlert page is not fully implemented yet.

TABLE 4-31 defines the Informational Exceptions TapeAlerts.

**TABLE 4-31** Informational Exceptions TapeAlerts Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (1Ch)					
1	Page Length (0Ah)							
2	Perf (0)	Rsvd (0)	EBF(0)	EWasc	DExcpt (1)	Test	Rsvd (0)	LogErr (0)
3	Reserved (0)				MRIE (3h)			
4 to 7	(MSB)	Interval Timer						(LSB)
8 to 11	(MSB)	Report Counter / Test Flag Number						(LSB)

### Informational Exceptions TapeAlerts Page Definitions:

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>SPF</b>	The library accepts a value of 0 for the SubPage Format bit, indicating page_0 format is being used.
<b>Perf</b>	Performance bit is set to 0, which indicates acceptance of informational exception operations that cause delays.
<b>EBF</b>	Enable Background Functions bit will always be 0.
<b>EWasc</b>	This should be set to 0 for the enable warning bit, indicating warning reporting shall be disabled.
<b>DExcpt</b>	The library accepts a value of 1, which indicates the target Disables All Information Exception operations and <i>ignores</i> the MRIE field. In this mode, the software must poll the TapeAlert Log page.
<b>Test</b>	<ul style="list-style-type: none"> <li>0 = The library does not generate false/test informational exceptions.</li> <li>1 = The library generates false/test informational exception conditions.</li> </ul>
<b>LogErr</b>	The Log Error information exception conditions is set to 0, which indicates this is vendor-specific.
<b>MRIE</b>	Method the library uses to Report Informational Exceptions must be 3h, which indicates that the library reports any informational exception conditions by returning Check Condition status.
<b>Interval Timer</b>	Bytes 4 through 7 must be 00h. The library will only report informational exception condition one time.
<b>Report Counter / Test Flag Number</b>	<p>This is a dual purpose field:</p> <ul style="list-style-type: none"> <li>When the Test Flag bit is 0, this field is the report counter. Bytes 8 through 11 must be set to 00h to indicate there is no limit to the number of times the library will report the informational exception condition. This value is returned with Mode Sense.</li> <li>When the Test bit is 1, this field is the test flag number.</li> </ul>

## Test Modes

Two test mode options are supported in the current TapeAlert implementation.

### ***Test Mode for All Bits Supported***

Using the mode select command to initiate this test will set all of the flags supported by the TapeAlert implementation in the TapeAlert log page. The TapeAlert log sense page then can be read to give the host a snapshot of the supported flags.

The flags will be cleared when the page is read. To do this, set the test mode flag in the TapeAlert mode select page. This indicates that the Report Count/Test Flag Number field is in Test Flag Number mode. Next, set the test flag number to 0x7FFF and issue the Mode Select command. When the command is complete, the TapeAlert log sense page can be read.

### ***Test Mode for Individual Bits***

Another test mode allows individual bits to be turned on. This can be useful for the host to debug/test operator interfaces.

Any flag set must be a supported flag. If the flag is not supported, a check condition with an incorrect parameter code is returned. The TapeAlert log sense page then can be read to allow the host to get a log page with the flag of interest set. The flag will be cleared when the page is read.

To test a flag, set the Test Flag in the TapeAlert mode select page. This indicates that the Report Count/Test Flag Number field is in Test Flag mode. Set the number of the flag to be tested. Issue the Mode Select command. When the command is complete, the TapeAlert log sense page can be read.

## Element Address Assignment Mode Page

This table defines the Element Address Assignment Mode page.

**TABLE 4-32** Mode Select (6) Element Address Assignment Mode Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	Rsvd (0)	Page Code (1Dh)					
1	Parameter Length (12h)							
2 to 3	(MSB)	First Medium Transport Element Address						(LSB)
4 to 5	(MSB)	Number of Medium Transport Elements (0001h)						(LSB)
6 to 7	(MSB)	First Storage Element Address						(LSB)
8 to 9	(MSB)	Number of Storage Elements						(LSB)
10 to 11	(MSB)	First Import/Export Element Address						(LSB)
12 to 13	(MSB)	Number of Import/Export Elements						(LSB)
14 to 15	(MSB)	First Data Transfer Element Address						(LSB)
16 to 17	(MSB)	Number of Data Transfer Elements						(LSB)
18 to 19	(MSB)	Reserved						(LSB)

**Mode Select (6) Element Address Assignment Mode Page Definitions:**

<b>PS</b>	The Parameters Saveable bib is set to 0.
<b>Page Code</b>	Identifies the Element Address Assignment mode page.
<b>Parameter Length</b>	Indicates the length of the element address assignment parameter list. This field must be 12h, which indicates that there are an additional 12h (18d) bytes of parameter data following this byte.
<b>First Medium Transport Element Address</b>	Identifies the address of the hand in the library. The library has only one hand, so the default value is 0000h.
<b>Number of Medium Transport Elements</b>	Identifies the number of hands in the library. The library has only one hand, so this field must be 0001h (1d).
<b>First Storage Element Address</b>	Identifies the starting address of the cartridge tape storage cells in the library, and the default starting address is 03E8h (1000d).
<b>Number of Storage Elements</b>	Identifies the number of cartridge tape storage cells in the library. This number is based on the configuration of the library and is obtained when the library performs a Mode Sense of mode page 1Dh. The number in the Mode Select command must be the same number returned by the Mode Sense command.
<b>First Import/Export Element Address</b>	Identifies the address of the first Import/Export element. The default starting address of the first mailslot element is 000Ah (10d).
<b>Number of Import/Export Elements</b>	Identifies the number of Import/Export storage locations. This value is obtained when the library performs a Mode Sense of mode page 1Dh. The number in the Mode Select command must be the same number returned by the Mode Sense command.
<b>First Data Transfer Element Address</b>	Identifies the address of the first tape drive; the default starting address is 1F4h (500d).
<b>Number of Data Transfer Elements</b>	Identifies the total number of tape drives installed in the library. This number varies depending on the configuration. Obtain this value by requesting a Mode Sense of mode page 1Dh. The number in the Mode Select command must be the same number returned by the Mode Sense command.

## Element Address Assignments

An initiator can modify the element addresses in the library using a Mode Select command. The four element types are:

- Medium transport (the hand)
  - Storage element (storage cells)
  - Import/export (mailslot cells)
  - Data transfer (tape drives)

Each element type is defined as a range of consecutive elements based on a starting element and a count. The ranges may be configured in any order, but one element type range may not overlap another element type range, and gaps between ranges are allowed.

To change the element address assignments, an initiator should first perform a Mode Sense of mode page 1Dh (Element Address Assignment Page). This provides the count of each element type. The count of each element type cannot be changed and must be used as obtained from the Mode Sense command. Only the starting element number can be modified. The initiator must calculate the starting addresses of each type to ensure no overlaps.

Because the library supports the saved page function, the element address assignments can be saved in non-volatile memory. These values are used to configure the library:

- During power-on
- After a logical unit reset

## Mode Select (10)

The 10-byte Mode Select command (55h) enables an initiator to specify certain operating parameters for the library. The library uses the saved or default versions of these parameters to configure itself during power-on or after a logical unit reset.

The mode values sent to the library apply to all initiators. If an initiator issues a Mode Select command that changes any parameters, the library generates a Check Condition status to all other initiators with a sense key of Unit Attention and an Additional Sense Code (ASC) and Additional Sense Code Qualifier (ASCQ) of Mode Parameters Changed.

When the library receives a Mode Select (10) command, the library validates all parameters before it performs any changes. If a value is not valid, the library returns the appropriate error message and does not change the parameters.

**TABLE 4-33** Mode Select (10) Command

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

### Mode Select (10) Command Definitions:

<b>PF</b>	Page Format supports SCSI-3 specification and requires a value of 1.
<b>SP</b>	<p>The library supports the saved page (SP) function. The values are:</p> <ul style="list-style-type: none"> <li>0 = Current mode values are changed to the values specified by this command. Saved values are not affected.</li> <li>1 = Current mode values and saved mode values are changed to the values specified by this command.</li> </ul>
<b>Parameter List Length</b>	<ul style="list-style-type: none"> <li>00h = No data transferred A value of 00h is not considered an error. Any other value is considered an error and is not supported.</li> <li>The <b>Mode Parameter Header</b> and the following pages are transferred: <ul style="list-style-type: none"> <li>18h = Disconnect Reconnect Page are transferred</li> <li>10h = Logical Unit Page are transferred</li> <li>10h = Fibre Channel Port Control Page are transferred</li> <li>18h = SAS Port Control Page are transferred</li> <li>6Ch = SAS Phy Control and Discover Mode Subpage are transferred</li> <li>14h = Informational Exceptions Tape Alert Mode Page are transferred</li> <li>1Ch = Element Address Assignment Page are transferred</li> </ul> </li> </ul>

## Mode Select (10) Data

The initiator must provide mode parameter data in a parameter list including:

“Mode Select Parameter Header” on page 71

“Fibre Channel Disconnect/Reconnect Page” on page 72

“SAS Disconnect/Reconnect Page” on page 74

“Fibre Channel Logical Unit Page” on page 76

“SAS Logical Unit Page” on page 77

“Fibre Channel Port Control Page” on page 78

“SAS Port Control Page” on page 81

“SAS Phy Control and Discover Mode Subpage” on page 83

“Informational Exceptions TapeAlert Page” on page 86 or

“Element Address Assignment Mode Page” on page 88

## Mode Select (10) Parameter Header

The library returns a 8-byte Mode Select parameter header as follows:

**TABLE 4-34** Mode Select Parameter Header

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Reserved (00h)							
1	Reserved (00h)							
2	Reserved (00h)							
3	Reserved (00h)							
4	Reserved (00h)							
5	Reserved (00h)							
6	Reserved (00h)							
7	Reserved (00h)							

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

## Fibre Channel Disconnect/Reconnect Page

TABLE 4-35 shows the format of the Mode Sense Fibre Channel Disconnect/Reconnect page.

**TABLE 4-35** Fibre Channel Disconnect/reconnect Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS	SPF	Page Code (02h)					
1	Page length (0Eh)							
2	Buffer Full Ratio							
3	Buffer Empty Ratio							
4 to 5	(MSB)	Bus Inactivity Limit						(LSB)
6 to 7	(MSB)	Disconnect Time Limit						(LSB)
8 to 9	(MSB)	Connect Time Limit						(LSB)
10 to 11	(MSB)	Maximum Burst Size						(LSB)
12	EMPD	FAA	FAB	FAC	Restricted			
13	Reserved							
14 to 15	(MSB)	First Burst Size						(LSB)

### Mode Sense: Fibre Channel Disconnect/Reconnect Page Definitions

<b>PS</b>	The parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of: 0 = SubPage Format bit, indicating that page_0 format is being used
<b>Page Code</b>	This field is set to: 02h that identifies the page as the Disconnect/Reconnect page
<b>Buffer Full Ratio</b>	This field indicates the device server, during read operations, how full the buffer should be prior to requesting an interconnect tenancy.
<b>Buffer Empty Ratio</b>	This field indicates the device server, during write operations, how empty the buffer should be prior to transmitting an FCP_XFER_RDY IU that requests the initiator to send data.
<b>Bus Inactivity Limit</b>	This field indicates the maximum time that the target is permitted to maintain an interconnect tenancy without data or information transfer, measured in transmission word increments.  The value 0000h indicates that there is no bus inactivity limit.



<b>Disconnect Time Limit</b>	<p>This field indicates the minimum delay between interconnect tenancies measured in increments of 128 transmission words.</p> <p>The value 0000h indicates that the disconnect time limit does not apply.</p>
<b>Connect Time Limit</b>	<p>The field indicates the maximum duration of a single interconnect tenancy, measured in increments of 128 transmission words.</p> <p>The value 0000h indicates that there is no connect time limit.</p>
<b>Maximum Burst Size</b>	<p>This field indicates the maximum size of FCP_DATA IU that the device server shall transfer to the initiator or request from the initiator. This value is expressed in increments of 512 bytes.</p> <p>0000h indicates there is no limit on the amount of data transferred per data transfer operation.</p>
<b>EMPD</b>	<p>The Enable Modify Data Pointers bit indicates whether or not the target may use the random buffer access capability to reorder FCP_DATA IUs for a single SCSI command.</p> <p>0 = The target shall generate continuously increasing relative offset values for each FCP_DATA IU for a single SCSI command.</p> <p>1 = The target may transfer the FCP_DATA IUs for a single SCSI command in any order.</p>
<b>FAA, FAB, FAC</b>	<p>The fairness access (FA) bits, FAA, FAB, and FAC, indicate whether a target in a loop configuration shall use the access fairness algorithm. A value of 0 indicates that the target does not use fairness, while a value of 1 indicates that the target does use a fairness algorithm.</p> <ul style="list-style-type: none"> <li>• The <b>FAA bit</b> controls arbitration when the target wishes to send one or more FCP_DATA IU frames to an initiator.</li> <li>• The <b>FAB bit</b> controls arbitration when the initiator wishes to send one or more FCP_XFER_RDY IU frames to a target.</li> <li>• The <b>FAC bit</b> controls arbitration when the target wishes to send an FCP_RSP IU frame to an initiator.</li> </ul>
<b>First Burst Size</b>	<p>This field value is expressed in increments of 512.</p> <p>The value 0000h indicates that there is no first burst size limit.</p>

## SAS Disconnect/Reconnect Page

TABLE 4-36 shows the format of the Mode Sense Serial Attached SCSI Disconnect/Reconnect page.

**TABLE 4-36** SAS Disconnect/Reconnect Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS	SPF	Page Code (02h)					
1	Page Length (0Eh)							
2	Reserved (00h)							
3	Reserved (00h)							
4 to 5	(MSB)	Bus Inactivity Time Limit						(LSB)
6	Reserved (00h)							
7	Reserved (00h)							
8 to 9	(MSB)	Maximum Connect Time Limit						(LSB)
10 to 11	(MSB)	Maximum Burst Size						(LSB)
12	Reserved (00h)							
13	Reserved (00h)							
14 to 15	(MSB)	First Burst Size						(LSB)

### Mode Sense: SAS Disconnect/Reconnect Page Definitions:

<b>PS</b>	The parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of: 0 = SubPage Format bit, indicating page_0 format is being used
<b>Page Code</b>	This field is set to: 02h that identifies the page as the Disconnect/Reconnect page
<b>Bus Inactivity Time Limit</b>	This field contains the maximum time in 100 $\mu$ s increments that an SSP target port is permitted to maintain a connection without transferring a frame to the SSP initiator port.  The value 0000h indicates that there is no bus inactivity limit.
<b>Maximum Connect Time Limit</b>	This field contains the maximum duration of a connection in 100 $\mu$ s increments.  The value 0000h specifies that there is no maximum connection time limit.

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<b>Maximum Burst Size</b>	<p>For read data, this field contains the maximum amount of data in 512-byte increments that is transferred during a connection by an SSP target port per I_T_L_Q nexus without transferring at least one frame for a different I_T_L_Q nexus.</p> <p>For write data, the value shall specify the maximum amount of data that an SSP target port requests through a single XFER_RDY frame.</p> <p>The value 0000h in this field specifies that there is no maximum burst size.</p>
<b>First Burst Size</b>	<p>If the ENABLE FIRST BURST bit in the COMMAND frame is set to zero, then the FIRST BURST SIZE field is ignored.</p> <p>If the ENABLE FIRST BURST bit in the COMMAND frame is set to one, then the value in the FIRST BURST SIZE field contains the maximum amount of write data in 512-byte increments that may be sent by the SSP initiator port to the SSP target port without having to receive an XFER_RDY frame from the SSP target port.</p>

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## Fibre Channel Logical Unit Page

TABLE 4-37 shows the format of the Fibre Channel Logical Unit page.

**TABLE 4-37** Fibre Channel Logical Unit Page

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

### Fibre Channel Logical Unit Page Definitions:

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of 0 for the SubPage Format bit, indicating page_0 format is being used.
<b>Protocol Identifier</b>	This field is set to 0h indicating the Fibre Channel protocol.
<b>EPDC</b>	<p>The Enable Precise Delivery Checking bit is defined as follows:</p> <p>0 = The target shall not use the precise delivery function and shall ignore the contents of the CRN field.</p> <p>1 = The logical unit shall use precise delivery function defined in the FCP-2 standard.</p>

## SAS Logical Unit Page

TABLE 4-38 shows the format of the Serial Attached SCSI (SAS) Logical Unit page.

**TABLE 4-38** SAS Logical Unit Page

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

### Serial Attached SCSI Logical Unit Page Definitions:

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of 0 for the SubPage Format bit, indicating page_0 format is being used.
<b>Protocol Identifier</b>	The field is set to 6h indicating the Serial Attached SCSI (SAS) protocol.
<b>TLR</b>	0b = Transport Layer Retries are disabled.  1b = Transport Layer Retries are enabled for Transfer Ready and Data Frames for the logical unit

## Fibre Channel Port Control Page

TABLE 4-39 shows the format of the Fibre Channel Port Control page.

**TABLE 4-39** Fibre Channel Port Control Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (19h)					
1	Page Length (06h)							
2	Reserved				Protocol Identifier (0)			
3	DTFD	PLPB	DDIS	DLM	RHA	ALWI	DTIPE	DTOLI
4	Reserved							
5	Reserved							
6	Reserved					RR_TOV units		
7	Resource Recovery Time Out Value (RR_TOV)							

### Fibre Channel Port Control Page Definitions:

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of: 0 = SubPage Format bit, indicating page_0 format is being used
<b>Protocol Identifier</b>	This field is set to: 0h indicating the Fibre Channel protocol
<b>DTFD</b>	Disabled Target Fabric Discovery. If the library is not attached to an arbitrated loop, it shall ignore the DTFD bit.  0 = The target attached by an arbitrated loop shall discover a fabric loop port if present on the loop and perform the public loop functions defined for targets by FC-FLA.  1 = The target attached by an arbitrated loop shall not recognize the presence of a fabric loop port on the loop.
<b>PLPB</b>	Prevent Loop Port Bypass. If the library is not attached to an arbitrated loop, it shall ignore the PLPB bit.  0 = The target allows the Loop Port Bypass (LPB) and Loop Port Enable (PBE) primitive sequences to control the port bypass circuit and participation on the loop as specified by FC-AL-2.  1 = The target attached to an FC-AL-2 loop shall ignore any Loop Port Bypass (LPB) and Loop Port Enable (LPE) primitive sequences.

<b>DDIS</b>	<p>Disable Discovery. If the library is not attached to an arbitrated loop, it shall ignore the DDIS bit.</p> <p>0 = The target shall wait to complete target discovery as defined by FC-PLDA, FC-FLA, and FC-TAPE before allowing processing of tasks to resume.</p> <p>1 = The target without a valid FLOGI attached to an arbitrated loop shall not require receipt of Address or Port Discovery (ADISC or PDISC ELSs) following loop initialization as described in FC-PLDA and FC-FLA.</p>
<b>DLM</b>	<p>Disable Loop Master. If the library is not attached to an arbitrated loop, it shall ignore the DLM bit.</p> <p>0 = The target may participate in loop master arbitration in the normal manner and, if successful, may become loop master during the loop initialization process.</p> <p>1 = The target attached to an FC-AL-2 loop shall not participate in loop master arbitration and shall not become loop master. The target shall only repeat LISM frames it receives.</p>
<b>RHA</b>	<p>Require Hard Address. If the library is not attached to an arbitrated loop, it shall ignore the RHA bit.</p> <p>0 = The target follows the normal initialization procedure, including the possibility of obtaining a soft address during the loop initialization process.</p> <p>1 = The target attached to an arbitrated loop shall only attempt to obtain its hard address. If there is a conflict for the hard address selection during loop initialization or the target does not have a valid hard address available, the target shall enter the nonparticipating state.</p>
<b>ALWI</b>	<p>Allow Login Without Loop Initialization. If the library is not attached to an arbitrated loop, it shall ignore the ALWI bit.</p> <p>0 = The target shall perform the normal loop initialization procedure before entering the monitoring mode and accepting a login ELS.</p> <p>1 = The target attached to an FC-AL-2 loop shall use the hard address available in the connector or in device address jumpers, enter the monitoring state in participating mode, and accept logins without using the loop initialization procedure (see FC-AL-2).</p>
<b>DTIPE</b>	<p>Disabled Target Initiated Port Enabled. If the library is not attached to an arbitrated loop, it shall ignore the DTIPE bit.</p> <p>0 = The target shall enable itself onto the loop according to the rules specified in FC-AL-2.</p> <p>1 = The target attached to an arbitrated loop shall wait for an initiator to send the Loop Port Enable (LPE) primitive sequence before inserting itself into a loop (see FC-AL-2)</p>

<b>DTOLI</b>	<p>Disable Target Originated Loop Initialization. If the library is not attached to an arbitrated loop, it shall ignore the <b>DTOLI</b> bit.</p> <p>0 = The target attached by an arbitrated loop shall generate LIP(F7,xx) after it enables a port into a loop.</p> <p>1 = The target attached by an arbitrated loop shall not generate a LIP following insertion into the loop.</p>
<b>RR_TOV units</b>	<p>Resource Recovery Time Out Value Units will always be</p> <p>011b = 0.1 second units</p>
<b>RR_TOV</b>	<p>Resource Recovery Time Out Value will always be</p> <p>F0h = 24 seconds</p>



## SAS Port Control Page

TABLE 4-40 shows the format of the Serial Attached SCSI (SAS) Port Control page.

**TABLE 4-40** SAS Port Control Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (19h)					
1	Page Length (0Eh)							
2	RSVD	Continue AWT	BAE	LED	Protocol Identifier (6h)			
3	Reserved							
4 to 5	(MSB)  I_T Nexus Loss Time   							

### Serial Attached SCSI Port Control Page Definitions:

<b>PS</b>	The parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of: 0 = SubPage Format bit, indicating page_0 format is being used.
<b>Page Code</b>	This field is set to: 19h = identifies the page as the SAS Port Control mode page.
<b>Protocol Identifier</b>	This field is set to: 06h = indicates the Serial Attached SCSI protocol.
<b>Continue AWT</b>	Continuous Arbitration Wait Time (AWT)  0 = The SAS port shall stop the AWT timer and set the AWT timer to zero when it receives an OPEN_REJECT (RETRY).  1 = The SAS port shall not stop the AWT timer and shall not set the AWT timer to zero when the SAS port receives an OPEN_REJECT (RETRY).
<b>BAE</b>	Broadcast Asynchronous Event (BAE). The device server shall:  0 = Disable origination of Broadcast (Asynchronous Event).  1 = Enable origination of Broadcast (Asynchronous Event).
<b>Ready LED Meaning</b>	The Ready LED Meaning bit specifies the READY LED signal behavior.

<b>I_T Nexus Loss Time</b>	<p>This field contains the minimum time that the SSP Target Port shall retry connection requests to an SSP initiator port that are rejected with responses indicating the SSP initiator port may no longer be present before recognizing an I_T nexus loss:</p> <p>0000h = Vendor-specific amount of time.</p> <p>0001h - FFFFh = Time in milliseconds.</p> <p>FFFFh = The SSP target port shall never recognize an I_T nexus loss.</p>
<b>Initiator Response Timeout</b>	<p>This field contains the minimum time in milliseconds that the SSP target port shall wait for the receipt of a frame before aborting the command associated with that frame.</p> <p>The value 0000h indicates that the SSP target port shall wait forever.</p>
<b>Reject to Open Limit</b>	<p>This field contains the minimum time in 10 microsecond increments that the target port shall wait to establish a connection request with an initiator port on an I_T nexus after receiving an OPEN_REJECT</p> <p>(RETRY), OPEN_REJECT (RESERVED CONTINUE 0), or OPEN_REJECT (RESERVED CONTINUE 1)</p> <p>The value 0000h indicates that minimum time is vendor specific.</p>

## SAS Phy Control and Discover Mode Subpage

[TABLE 4-41](#) shows the format of the Serial Attached SCSI Phy Control and Discover Mode Subpage.

**TABLE 4-41** SAS Phy Control and Discover Mode Subpage

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	SPF (1)	Page Code (19h)					
1	Subpage Code (01h)							
2 to 3	(MSB)	Page Length (64h)						(LSB)
4	Reserved							
5	Reserved				Protocol Identifier (6h)			
6	Generation Code							
7	Number of Phys							
SAS Phy Mode Descriptor List								
8 to 55	(MSB)	First SAS Phy Mode Descriptor						(LSB)
56 to 103	(MSB)	Second SAS Phy Mode Descriptor						(LSB)

### SAS Phy Control and Discover Mode Subpage Definitions:

<b>PS</b>	The parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of: 1 = SubPage Format bit, indicates this page uses the sub_page mode.
<b>Page Code</b>	The value 19h identifies the page as the SAS Port Control mode page.
<b>Sub-Page Code</b>	The value 01h identifies the sub-page as the SAS Phy Control and Discover Mode Subpage.
<b>Protocol Identifier</b>	The value 06h indicates the Serial Attached SCSI protocol.
<b>Generation Code</b>	This field is a one-byte counter that shall be incremented by one by the device server every time the values in this mode page are changed.
<b>Number of Phy</b>	This field contains the number of phys in the SAS target device and indicates the number of SAS Phy Mode Descriptors in the SAS Phy Mode descriptor list.
<b>SAS Phy Mode Descriptor Data</b>	See <a href="#">TABLE 4-42</a> for more information.

**SAS Phy Mode Descriptor Data****TABLE 4-42** SAS Phy Mode Descriptor Data

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Reserved (00h)							
1	Phy Identifier							
2	Reserved (00h)							
3	Reserved (00h)							
4	RSVD	Attached Device Type			Reserved (0)			
5	Reserved				Negotiated Physical Link Rate			
6	Reserved				Attach SSP Init Port	Attach STP Init Port	Attach SMP Init Port	RSVD
7	Reserved				Attach SSP Tgt Port	Attach STP Tgt Port	Attach SMP Tgt Port	RSVD
8 to 15	(MSB) SAS Address (LSB)							
16 to 23	(MSB) Attached SAS Address (LSB)							
24	Attached Phy Address							
25 to 31	Reserved (00h)							
32	Programmed Minimum Physical Link Rate				Hardware Minimum Physical Link Rate			
33	Programmed Maximum Physical Link Rate				Hardware Maximum Physical Link Rate			
34 to 41	Reserved (00h)							
42 to 43	(MSB) Vendor Specific (LSB)							
44 to 47	Reserved (00h)							

**Serial Attached SCSI Phy Mode Descriptor Data Definitions:**

**PS** The parameters Saveable bit is set to 0.

**Phy Identifier** A unique Phy Identifier is returned for each Phy.

<b>Attached Device Type</b>	This field indicates the device type attached to this Phy: 000b = No device attached 001b = SAS device 010b = Expander device 011b = Expander device compliant with a previous version of the SAS standard
<b>Negotiated Physical Link Rate</b>	This field indicates the logical link rate being used by the Phy: 0h = UNKNOWN. Phy is enabled. Unknown Physical Link Rate. 1h = DISABLED. Phy is disabled. 2h = PHY_RESET_PROBLEM 3h = SPINUP_HOLD 4h = PORT_SELECTOR 8h = G1. Physical Link Rate is 1.5 Gb/s 9h = G2. Physical Link Rate is 3.0 Gb/s Ah =G3. Physical Link Rate is 6.0 Gb/s
<b>Attached SSP Initiator Port</b>	This bit indicates the value of the SSP Initiator Port field received in the IDENTIFY address frame during the identification sequence.
<b>Attached STP Initiator Port</b>	This bit indicates the value of the STP Initiator Port field received in the IDENTIFY address frame during the identification sequence.
<b>Attached SMP Initiator Port</b>	This bit indicates the value of the SMP Initiator Port field received in the IDENTIFY address frame during the identification sequence.
<b>Attached SSP Target Port</b>	This bit indicates the value of the SSP Target Port field received in the IDENTIFY address frame during the identification sequence.
<b>Attached STP Target Port</b>	This bit indicates the value of the STP Target Port field received in the IDENTIFY address frame during the identification sequence.
<b>Attached SMP Target Port</b>	This bit indicates the value of the SMP Target Port field received in the IDENTIFY address frame during the identification sequence.
<b>SAS Address</b>	This field indicates the SAS Address of the LTO-5 drive that is the bridged interface for the library or partition.
<b>Attached SAS Address</b>	This field contains the value of the SAS Address field transmitted in the IDENTIFY address frame during the identification sequence.
<b>Attached Phy Address</b>	This field indicates the value of Attached Phy Address field received in the IDENTIFY address frame during the identification sequence.
<b>Programmed Minimum Physical Link Rate</b>	8h = 1.5 Gb/s 9h = 3.0 Gb/s Ah = 6.0 Gb/s
<b>Hardware Minimum Physical Link Rate</b>	8h = 1.5 Gb/s 9h = 3.0 Gb/s Ah = 6.0 Gb/s
<b>Programmed Maximum Physical Link Rate</b>	8h = 1.5 Gb/s 9h = 3.0 Gb/s Ah = 6.0 Gb/s
<b>Hardware Maximum Physical Link Rate</b>	8h = 1.5 Gb/s 9h = 3.0 Gb/s Ah = 6.0 Gb/s

## Informational Exceptions TapeAlert Page

**Note** – This TapeAlert page is not fully implemented yet.

TABLE 4-43 defines the Informational Exceptions TapeAlert page.

**TABLE 4-43** Informational Exceptions TapeAlert Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (1Ch)					
1	Page Length (0Ah)							
2	Perf (0)	Rsvd (0)	EBF (0)	EWasc	DExcpt (1)	Test	Rsvd (0)	LogErr (0)
3	Reserved (0)				MRIE (3h)			
4 to 7	(MSB)				Interval Timer (LSB)			
8 to 11	(MSB)				Report Counter / Test Flag Number (LSB)			

### Informational Exceptions TapeAlert Definitions:

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>SPF</b>	The library accepts a value of 0 for the SubPage Format bit, indicating page_0 format is being used.
<b>Perf</b>	Performance bit is set to 0, which indicates acceptance of informational exception operations that cause delays.
<b>EBF</b>	Enable Background Functions bit will always be 0.
<b>EWasc</b>	This should be set to 0 for the enable warning bit, indicating warning reporting shall be disabled.
<b>DExcpt</b>	The library accepts a value of 1, which indicates the target Disables All Information Exception operations and <i>ignores</i> the MRIE field. In this mode, the software must poll the TapeAlert Log page.
<b>Test</b>	0 = The library does not generate false/test informational exceptions. 1 = The library generates false/test informational exception conditions.
<b>LogErr</b>	The Log Error information exception conditions is set to 0, which indicates this is vendor-specific.
<b>MRIE</b>	Method the library uses to Report Informational Exceptions must be 3h, which indicates that the library reports any informational exception conditions by returning Check Condition status.
<b>Interval Timer</b>	Bytes 4 through 7 must be 00h. The library will only report informational exception condition one time.

**Report Counter /  
Test Flag Number**

This is a dual purpose field:

When the Test Flag bit is 0, this field is the report counter. Bytes 8 through 11 must be set to 00h to indicate there is no limit to the number of times the library will report the informational exception condition. This value is returned with Mode Sense.

When the Test bit is 1, this field is the test flag number.

**Test Modes**

Two test mode options are supported in the current TapeAlert implementation.

***Test Mode for All Bits Supported***

Using the mode select command to initiate this test will set all of the flags supported by the TapeAlert implementation in the TapeAlert log page. The TapeAlert log sense page then can be read to give the host a snapshot of the supported flags.

The flags will be cleared when the page is read. To do this, set the test mode flag in the TapeAlert mode select page. This indicates that the Report Count/Test Flag Number field is in Test Flag Number mode. Next, set the test flag number to 0x7FFF and issue the Mode Select command. When the command is complete, the TapeAlert log sense page can be read.

***Test Mode for Individual Bits***

Another test mode allows individual bits to be turned on. This can be useful for the host to debug/test operator interfaces.

Any flag set must be a supported flag. If the flag is not supported, a check condition with an incorrect parameter code is returned. The TapeAlert log sense page then can be read to allow the host to get a log page with the flag of interest set. The flag will be cleared when the page is read.

To test a flag, set the Test Flag in the TapeAlert mode select page. This indicates the Report Count/Test Flag Number field is in Test Flag mode. Set the number of the flag to be tested. Issue the Mode Select command. When the command is complete, the TapeAlert log sense page can be read.

## Element Address Assignment Mode Page

TABLE 4-44 defines the Element Address Assignment Mode page.

**TABLE 4-44** Mode Select (6) Element Address Assignment Mode Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	Rsvd (0)	Page Code (1Dh)					
1	Parameter Length (12h)							
2 to 3	(MSB)	First Medium Transport Element Address						(LSB)
4 to 5	(MSB)	Number of Medium Transport Elements (0001h)						(LSB)
6 to 7	(MSB)	First Storage Element Address						(LSB)
8 to 9	(MSB)	Number of Storage Elements						(LSB)
10 to 11	(MSB)	First Import/Export Element Address						(LSB)
12 to 13	(MSB)	Number of Import/Export Elements						(LSB)
14 to 15	(MSB)	First Data Transfer Element Address						(LSB)
16 to 17	(MSB)	Number of Data Transfer Elements						(LSB)
18	Reserved (00h)							
19	Reserved (00h)							



**Mode Select (10) Element Address Assignment Mode Page Definitions:**

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>Page Code</b>	Identifies the Element Address Assignment mode page.
<b>Parameter Length</b>	Indicates the length of the element address assignment parameter list. This field must be 12h, which indicates that there are an additional 12h (18d) bytes of parameter data following this byte.
<b>First Medium Transport Element Address</b>	Identifies the address of the hand in the library. The library has only one hand, so the default value is 0000h.
<b>Number of Medium Transport Elements</b>	Identifies the number of hands in the library. The library has only one hand, so this field must be 0001h (1d).
<b>First Storage Element Address</b>	Identifies the starting address of the cartridge tape storage cells in the library, and the default starting address is 03E8h (1000d).
<b>Number of Storage Elements</b>	Identifies the number of cartridge tape storage cells in the library. This number is based on the configuration of the library and is obtained when the library performs a Mode Sense of mode page 1Dh. The number in the Mode Select command must be the same number returned by the Mode Sense command.
<b>First Import/Export Element Address</b>	Identifies the address of the first Import/Export element. The default starting address of the first mailslot element is 000Ah (10d).
<b>Number of Import/Export Elements</b>	Identifies the number of Import/Export storage locations. This value is obtained when the library performs a Mode Sense of mode page 1Dh. The number in the Mode Select command must be the same number returned by the Mode Sense command.
<b>First Data Transfer Element Address</b>	Identifies the address of the first tape drive; the default starting address is 1F4h (500d).
<b>Number of Data Transfer Elements</b>	Identifies the total number of tape drives installed in the library. This number varies depending on the configuration. Obtain this value by requesting a Mode Sense of mode page 1Dh. The number in the Mode Select command must be the same number returned by the Mode Sense command.

## Element Address Assignments

An initiator can modify the element addresses in the library using a Mode Select command. The four element types are:

- Medium transport (the hand):
  - Storage element (storage cells)
  - Import/export (mailslot cells)
  - Data transfer (tape drives)

Each element type is defined as a range of consecutive elements based on a starting element and a count. The ranges may be configured in any order, but one element type range may not overlap another element type range, and gaps between ranges are allowed.

To change the element address assignments, an initiator should first perform a Mode Sense of mode page 1Dh (Element Address Assignment Page). This provides the count of each element type. The count of each element type cannot be changed and must be used as obtained from the Mode Sense command. Only the starting element number can be modified. The initiator must calculate the starting addresses of each type to ensure no overlaps.

Because the library supports the saved page function, the element address assignments can be saved in non-volatile memory. These values are used to configure the library:

- During power-on
  - After a logical unit reset

## Mode Sense (6)

The 6-byte Mode Sense command (1Ah) enables the library to report its operating mode parameters to the initiator.

- The initiator can request one page or all pages of the mode parameters.
- The initiator can use the Mode Select command to change the values of certain mode parameters.
- Before issuing any Mode Select commands, an initiator should issue a Mode Sense command with the Page Control field set to 01h, and the Page Code field set to 3Fh to determine:
  - Supported pages
  - Changeable parameters within the pages
  - Supported length of each page

**TABLE 4-45** Mode Sense Command

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

### Mode Sense (6) Command Definitions:

<b>DBD</b>	Disable Block Descriptors is ignored.
<b>Page Control</b>	<p>Defines the type of parameters to be returned for the Mode Sense command, values include:</p> <hr/> <p><b>0h (00b) = Current Values:</b>            The library returns the current parameter values, including:            Parameters set in the last successful Mode Select command            Default values if saved values are unavailable or invalid            Saved values if a MODE command has not been executed since the last power-on, interface reset, or Task Management Reset</p> <hr/> <p><b>1h (01b) = Changeable Values:</b>            The library returns the changeable parameter masks.            All requested pages are returned.            Pages indicate which parameters are changeable by the initiator.            All bits of changeable parameters are set to 1.            All bits of parameters that are not changeable are set to 0.</p>

<b>Page Control</b> (continued)	<p><b>2h (10b) = Default Values:</b>          The library returns the default values.          Requested pages are returned with each supported parameter set to its default.          Parameters not supported by the library are set to 0.          Default values for the Element Address Assignment page are based on the configuration of the library.</p>
	<p><b>3h (11b) = Saved Values:</b>          The library returns the saved values.          Requested pages are returned with supported parameters set to its saved value.          Parameters not supported by the library are set to 0.          This option is valid only with mode pages that can be saved.</p>
<b>Page Code</b>	<p>Specifies which pages the library returns, including:</p> <p>02h = Protocol Specific Disconnect/Reconnect page          18h = Protocol Specific Logical Unit page          19h = Protocol Specific Port Control page          1Ch = Informational Exceptions TapeAlert page          1Dh = Element Address Assignment page          1Eh = Transport Geometry page          1Fh = Device Capabilities page          3Fh = All pages (in the above order)</p>
<b>SubPage Code</b>	<p>The field indicates the Serial Attached SCSI Port Control Subpage, when the protocol is Serial Attached SCSI and the Page Code is set to 19h.</p> <p>01h = Serial Attached SCSI Phy Control and Discover Mode Subpage          02h = Serial Attached SCSI Shared Port Control Mode Subpage          03h = Serial Attached SCSI Enhanced Phy Control Mode Subpage</p>
<b>Allocation Length</b>	<p>Specifies the length of the parameter list the library returns.          The maximum length is 68h (104d) bytes.          The length varies based on the Page Code and Sub-Page Code selected:</p> <p>8 bytes for the parameter list header (always present)          16 additional bytes for the Fibre Channel Disconnect/Reconnect page          16 additional bytes for the SAS Disconnect/Reconnect page          8 additional bytes for the Fibre Channel Logical Unit Control page          8 additional bytes for the SAS Logical Unit Control page          8 additional bytes for the Fibre Channel Port Control page          16 additional bytes for the SAS Port Control page          104 additional bytes for the SAS Phy Control and Discover Mode Subpage          16 additional bytes for the SAS Shared Port Control Mode Subpage          48 additional bytes for the SAS Enhanced Phy Control Mode Subpage          12 additional bytes for the Informational Exceptions TapeAlert 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</p> <p>The library transfers the number of bytes specified by the Allocation Length or the available Mode Sense data, whichever is less.</p>

## Mode Sense (6) Data

The library returns the following mode sense data:

- A four-byte Mode Parameter Header
- One mode page or all mode pages in the order specified in the Page Code list

Mode pages available include:

“Fibre Channel Disconnect/Reconnect Page”

“SAS Disconnect/Reconnect Page”

“Fibre Channel Logical Unit Page”

“SAS Logical Unit Page”

“Fibre Channel Port Control Page”

“SAS Port Control Page”

“SAS Port Control Page”

“SAS Phy Control and Discover Mode Subpage”

“SAS Shared Control Mode Subpage”

“SAS Enhanced Phy Control Subpage”

“Informational Exceptions TapeAlert Control Page”

“Element Address Assignment Page Definition”

“Transport Geometry Mode Page Definition”

“Device Capabilities Page Definition”

The data can be truncated to the length specified in the allocation length field.

## Mode Sense (6) Parameter Header Definition

TABLE 4-46 shows the Mode Sense Parameter Header page.

**TABLE 4-46** Mode Sense (6) Parameter Header

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

### Mode Sense (6) Parameter Header Page Definitions:

<b>Mode Data Length</b>	This field indicates the number of bytes of parameter information available to be transferred to the initiator, regardless of the allocation length. This field excludes the Mode Data Length byte but includes three additional Mode Parameter Header bytes and any mode pages that follow.
<b>Block Descriptor Length</b>	The library does not support block descriptors (00h).

## Fibre Channel Disconnect/Reconnect Page

TABLE 4-47 shows the format of the Mode Sense Fibre Channel Disconnect/Reconnect page.

**TABLE 4-47** Fibre Channel Disconnect/reconnect Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS	SPF	Page Code (02h)					
1	Page length (0Eh)							
2	Buffer Full Ratio							
3	Buffer Empty Ratio							
4 to 5	(MSB)	Bus Inactivity Time Limit						(LSB)
6 to 7	(MSB)	Disconnect Time Limit						(LSB)
8 to 9	(MSB)	Connect Time Limit						(LSB)
10 to 11	(MSB)	Maximum Burst Size						(LSB)
12	EMPD	FAA	FAB	FAC	Restricted			
13	Reserved							
14 to 15	(MSB)	First Burst Size						(LSB)

### Mode Sense: Fibre Channel Disconnect/Reconnect Page Definitions

<b>PS</b>	The parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of: 0 = SubPage Format bit, indicating page_0 format is being used
<b>Page Code</b>	This field is set to: 02h that identifies the page as the Disconnect/Reconnect page
<b>Buffer Full Ratio</b>	This field indicates the device server, during read operations, how full the buffer should be prior to requesting an interconnect tenancy.
<b>Buffer Empty Ratio</b>	This field indicates the device server, during write operations, how empty the buffer should be prior to transmitting an FCP_XFER_RDY IU that requests the initiator to send data.
<b>Bus Inactivity Time Limit</b>	This field indicates the maximum time that the target is permitted to maintain an interconnect tenancy without data or information transfer, measured in transmission word increments.  0000h indicates that there is no bus inactivity limit.
<b>Disconnect Time Limit</b>	This field indicates the minimum delay between interconnect tenancies measured in increments of 128 transmission words.  0000h indicates that the disconnect time limit does not apply.

<b>Connect Time Limit</b>	<p>The field indicates the maximum duration of a single interconnect tenancy, measured in increments of 128 transmission words.</p> <p>0000h indicates that there is no connect time limit.</p>
<b>Maximum Burst Size</b>	<p>This field indicates the maximum size of FCP_DATA IU that the device server shall transfer to the initiator or request from the initiator. This value is expressed in increments of 512 bytes.</p> <p>0000h indicates there is no limit on the amount of data transferred per data transfer operation.</p>
<b>EMPD</b>	<p>The Enable Modify Data Pointers bit indicates whether or not the target may use the random buffer access capability to reorder FCP_DATA IUs for a single SCSI command.</p> <ul style="list-style-type: none"> <li>• 0 = The target shall generate continuously increasing relative offset values for each FCP_DATA IU for a single SCSI command.</li> <li>• 1 = The target may transfer the FCP_DATA IUs for a single SCSI command in any order.</li> </ul>
<b>FAA, FAB, FAC</b>	<p>The fairness access (FA) bits, FAA, FAB, and FAC, indicate whether a target in a loop configuration shall use the access fairness algorithm. A value of 0 indicates that the target does not use fairness, while a value of 1 indicates that the target does use a fairness algorithm.</p> <ul style="list-style-type: none"> <li>• The <b>FAA bit</b> controls arbitration when the target wishes to send one or more FCP_DATA IU frames to an initiator.</li> <li>• The <b>FAB bit</b> controls arbitration when the initiator wishes to send one or more FCP_XFER_RDY IU frames to a target.</li> <li>• The <b>FAC bit</b> controls arbitration when the target wishes to send an FCP_RSP IU frame to an initiator.</li> </ul>
<b>First Burst Size</b>	<p>This field value is expressed in increments of 512.</p> <p>0000h indicates that there is no first burst size limit.</p>



## SAS Disconnect/Reconnect Page

TABLE 4-48 shows the format of the Mode Sense SAS Disconnect/Reconnect page.

**TABLE 4-48** SAS Disconnect/Reconnect Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS	SPF	Page Code (02h)					
1	Page Length (0Eh)							
2	Reserved (00h)							
3	Reserved (00h)							
4 to 5	(MSB)	Bus Inactivity Time Limit						(LSB)
6	Reserved (00h)							
7	Reserved (00h)							
8 to 9	(MSB)	Maximum Connect Time Limit						(LSB)
10 to 11	(MSB)	Maximum Burst Size						(LSB)
12	Reserved (00h)							
13	Reserved (00h)							
14 to 15	(MSB)	First Burst Size						(LSB)

### Mode Sense: SAS Disconnect/Reconnect Page Definitions:

<b>PS</b>	The parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of: 0 = SubPage Format bit, indicating page_0 format is being used.
<b>Page Code</b>	This field is set to: 02h = identifies the page as the Disconnect/Reconnect page.
<b>Bus Inactivity Time Limit</b>	This field contains the maximum time in 100 $\mu$ s increments that an SSP target port is permitted to maintain a connection without transferring a frame to the SSP initiator port.  <ul style="list-style-type: none"> <li>0000h indicates that there is no bus inactivity limit.</li> </ul>
<b>Maximum Connect Time Limit</b>	This field contains the maximum duration of a connection in 100 $\mu$ s increments.  <ul style="list-style-type: none"> <li>0000h specifies that there is no maximum connection time limit.</li> </ul>

---

<b>Maximum Burst Size</b>	<p>For read data, this field contains the maximum amount of data in 512-byte increments that is transferred during a connection by an SSP target port per I_T_L_Q nexus without transferring at least one frame for a different I_T_L_Q nexus.</p> <p>For write data, the value shall specify the maximum amount of data that an SSP target port requests via a single XFER_RDY frame.</p> <p>0000h in this field specifies that there is no maximum burst size.</p>
<b>First Burst Size</b>	<p>If the ENABLE FIRST BURST bit in the COMMAND frame is set to zero, then the FIRST BURST SIZE field is ignored.</p> <p>If the ENABLE FIRST BURST bit in the COMMAND frame is set to one, then the value in the FIRST BURST SIZE field contains the maximum amount of write data in 512-byte increments that may be sent by the SSP initiator port to the SSP target port without having to receive an XFER_RDY frame from the SSP target port.</p>

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## Fibre Channel Logical Unit Page

TABLE 4-49 shows the format of the Fibre Channel Logical Unit page.

**TABLE 4-49** Fibre Channel Logical Unit Page

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

### Fibre Channel Logical Unit Page Definitions:

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of 0 for the SubPage Format bit, indicating page_0 format is being used.
<b>Protocol Identifier</b>	This field is set to 0h indicating the Fibre Channel protocol.
<b>EPDC</b>	Enable Precise Delivery Checking bit is set to 0 (not supported)

## SAS Logical Unit Page

TABLE 4-50 shows the format of the SAS Logical Unit Page.

**TABLE 4-50** SAS Logical Unit Page

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

### Serial Attached SCSI Logical Unit Page Definitions:

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of 0 for the SubPage Format bit, indicating page_0 format is being used.
<b>Protocol Identifier</b>	The field is set to 06h indicating Serial Attached SCSI protocol.
<b>TLR</b>	<ul style="list-style-type: none"> <li>0b = Transport Layer Retries are disabled.</li> <li>1b = Transport Layer Retries are enabled for Transfer Ready and Data Frames for the logical unit.</li> </ul>

## Fibre Channel Port Control Page

TABLE 4-51 shows the format of the Fibre Channel Port Control page.

**TABLE 4-51** Fibre Channel Port Control Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (19h)					
1	Page Length (06h)							
2	Reserved				Protocol Identifier (0)			
3	DTFD	PLPB	DDIS	DLM	RHA	ALWI	DTIPE	DTOLI
4	Reserved							
5	Reserved							
6	Reserved					RR_TOV units		
7	Resource Recovery Time Out Value (RR_TOV)							

**Fibre Channel Port Control Page Definitions:**

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of:  0 = SubPage Format bit, indicating page_0 format is being used.
<b>Protocol Identifier</b>	This field is set to:  0h that indicates the Fibre Channel protocol.
<b>DTFD</b>	Disabled Target Fabric Discovery. If the library is not attached to an arbitrated loop, it shall ignore the DTFD bit.  0 = The target attached by an arbitrated loop shall discover a fabric loop port if present on the loop and perform the public loop functions defined for targets by FC-FLA.  1 = The target attached by an arbitrated loop shall not recognize the presence of a fabric loop port on the loop.
<b>PLPB</b>	Prevent Loop Port Bypass. If the library is not attached to an arbitrated loop, it shall ignore the PLPB bit.  0 = The target allows the Loop Port Bypass (LPB) and Loop Port Enable (PBE) primitive sequences to control the port bypass circuit and participation on the loop as specified by FC-AL-2.  1 = The target attached to an FC-AL-2 loop shall ignore any Loop Port Bypass (LPB) and Loop Port Enable (LPE) primitive sequences.
<b>DDIS</b>	Disable Discovery. If the library is not attached to an arbitrated loop, it shall ignore the DDIS bit.  0 = The target shall wait to complete target discovery as defined by FC-PLDA, FC-FLA, and FC-TAPE before allowing processing of tasks to resume.  1 = The target without a valid FLOGI attached to an arbitrated loop shall not require receipt of Address or Port Discovery (ADISC or PDISC ELSS) following loop initialization as described in FC-PLDA and FC-FLA.
<b>DLM</b>	Disable Loop Master. If the library is not attached to an arbitrated loop, it shall ignore the DLM bit.  0 = The target may participate in loop master arbitration in the normal manner and, if successful, may become loop master during the loop initialization process.  1 = The target attached to an FC-AL-2 loop shall not participate in loop master arbitration and shall not become loop master. The target shall only repeat LISM frames it receives.

<b>RHA</b>	<p>Require Hard Address. If the library is not attached to an arbitrated loop, it shall ignore the RHA bit.</p> <p>0 = The target follows the normal initialization procedure, including the possibility of obtaining a soft address during the loop initialization process.</p> <p>1 = The target attached to an arbitrated loop shall only attempt to obtain its hard address. If there is a conflict for the hard address selection during loop initialization or the target does not have a valid hard address available, the target shall enter the nonparticipating state.</p>
<b>ALWI</b>	<p>Allow Login Without Loop Initialization. If the library is not attached to an arbitrated loop, it shall ignore the ALWI bit.</p> <p>0 = The target shall perform the normal loop initialization procedure before entering the monitoring mode and accepting a login ELS.</p> <p>1 = The target attached to an FC-AL-2 loop shall use the hard address available in the connector or in device address jumpers, enter the monitoring state in participating mode, and accept logins without using the loop initialization procedure (see FC-AL-2).</p>
<b>DTIPE</b>	<p>Disabled Target Initiated Port Enabled. If the library is not attached to an arbitrated loop, it shall ignore the DTIPE bit.</p> <p>0 = The target shall enable itself onto the loop in according to the rules specified in FC-AL-2.</p> <p>1 = The target attached to an arbitrated loop shall wait for an initiator to send the Loop Port Enable (LPE) primitive sequence before inserting itself into a loop (see FC-AL-2)</p>
<b>DTOLI</b>	<p>Disable Target Originated Loop Initialization. If the library is not attached to an arbitrated loop, it shall ignore the <b>DTOLI</b> bit.</p> <p>0 = The target attached by an arbitrated loop shall generate LIP(F7,xx) after it enables a port into a loop.</p> <p>1 = The target attached by an arbitrated loop shall not generate a LIP following insertion into the loop.</p>
<b>RR_TOV units</b>	<p>Resource Recovery Time Out Value Units will always be:</p> <p>011b = 0.1 second units</p>
<b>RR_TOV</b>	<p>Resource Recovery Time Out Value will always be:</p> <p>F0h = 24 seconds</p>

## SAS Port Control Page

TABLE 4-52 shows the format of the SAS Port Control page.

**TABLE 4-52** SAS Port Control Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (19h)					
1	Page Length (0Eh)							
2	RSVD	Continue AWT	BAE	LED	Protocol Identifier (6h)			
3	Reserved							
4 to 5	(MSB)  I_T Nexus Loss Time  <							

### SAS Port Control Page Definitions:

<b>PS</b>	The parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of: 0 = SubPage Format bit, indicating page_0 format is being used.
<b>Page Code</b>	This field is set to: 19h that identifies the page as the SAS Port Control mode page.
<b>Protocol Identifier</b>	This field is set to: 06h to indicate the Serial Attached SCSI (SAS) protocol.
<b>Continuous AWT</b>	0 = The SAS port shall stop the Arbitration Wait Time timer and set the Arbitration Wait Time timer to zero when it receives an OPEN_REJECT (RETRY).  1 = The SAS port shall not stop the Arbitration Wait Time timer and shall not set the Arbitration Wait Time timer to zero when the SAS port receives an OPEN_REJECT (RETRY).



<b>Broadcast Asynchronous Event</b>	<p>The device server shall:</p> <p>0 = Disable origination of Broadcast (Asynchronous Event).</p> <p>1 = Enable origination of Broadcast (Asynchronous Event).</p>
<b>Ready LED Meaning</b>	The Ready LED Meaning bit specifies the READY LED signal behavior.
<b>I_T Nexus Loss Time</b>	<p>This field contains the minimum time that the SSP Target Port shall retry connection requests to an SSP initiator port that are rejected with responses indicating the SSP initiator port may no longer be present before recognizing an I_T nexus loss:</p> <p>0000h = Vendor-specific amount of time.</p> <p>0001h - FFFFh = Time in milliseconds.</p> <p>FFFFh = The SSP target port shall never recognize an I_T nexus loss.</p>
<b>Initiator Response Timeout</b>	<p>This field contains the minimum time in milliseconds that the SSP target port shall wait for the receipt of a frame before aborting the command associated with that frame.</p> <p>The value 0000h indicates that the SSP target port shall wait forever.</p>
<b>Reject to Open Limit</b>	<p>This field contains the minimum time in 10 microsecond increments that the target port shall wait to establish a connection request with an initiator port on an I_T nexus after receiving an OPEN_REJECT (RETRY), OPEN_REJECT (RESERVED CONTINUE 0), or OPEN_REJECT (RESERVED CONTINUE 1)</p> <p>The value 0000h indicates that minimum time is vendor specific.</p>

## SAS Phy Control and Discover Mode Subpage

[TABLE 4-53](#) shows the format of the Serial Attached SCSI Phy Control and Discover Mode Subpage.

**TABLE 4-53** SAS Phy Control and Discover Mode Subpage

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	SPF (1)	Page Code (19h)					
1	Subpage Code (01h)							
2 to 3	(MSB)	Page Length (64h)						(LSB)
4	Reserved							
5	Reserved				Protocol Identifier (6h)			
6	Generation Code							
7	Number of Phys							
SAS Phy Mode Descriptor List								
8 to 55	(MSB)	First SAS Phy Mode Descriptor						(LSB)
56 to 103	(MSB)	Second SAS Phy Mode Descriptor						(LSB)

### Serial Attached SCSI Phy Control and Discover Mode Subpage Definitions:

<b>PS</b>	The parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of: 1 = SubPage Format bit, indicates this page uses the sub_page mode
<b>Page Code</b>	19h that identifies the page as the SAS Port Control mode page
<b>Sub-Page Code</b>	A value of 01h identifies the sub-page as the SAS Phy Control and Discover Mode Subpage.
<b>Protocol Identifier</b>	The value 06h indicates the Serial Attached SCSI protocol.
<b>Generation Code</b>	This field is a one-byte counter that shall be incremented by one by the device server every time the values in this mode page are changed.
<b>Number of Phys</b>	This field contains the number of phys in the SAS target device and indicates the number of SAS Phy Mode Descriptors in the SAS Phy Mode descriptor list.
<b>SAS Phy Mode Descriptor Data</b>	See <a href="#">TABLE 4-54</a> for more information.

**SAS Phy Mode Descriptor Data****TABLE 4-54** SAS Phy Mode Descriptor Data

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Reserved (00h)							
1	Phy Identifier							
2	Reserved (00h)							
3	Reserved (00h)							
4	RSVD	Attached Device Type			Reserved (0)			
5	Reserved				Negotiated Physical Link Rate			
6	Reserved				Attach SSP Init Port	Attach STP Init Port	Attach SMP Init Port	RSVD
7	Reserved				Attach SSP Tgt Port	Attach STP Tgt Port	Attach SMP Tgt Port	RSVD
8 to 15	(MSB)	SAS Address						(LSB)
16 to 23	(MSB)	Attached SAS Address						(LSB)
24	Attached Phy Address							
25 to 31	Reserved (00h)							
32	Programmed Minimum Physical Link Rate				Hardware Minimum Physical Link Rate			
33	Programmed Maximum Physical Link Rate				Hardware Maximum Physical Link Rate			
34 to 41	Reserved (00h)							
42 to 43	(MSB)	Vendor Specific						(LSB)
44 to 47	Reserved (00h)							

**Serial Attached SCSI Phy Mode Descriptor Data Definitions:**

<b>PS</b>	The parameters Saveable bit is set to 0.
<b>Phy Identifier</b>	A unique Phy Identifier is returned for each Phy.
<b>Attached Device Type</b>	This field indicates the device type attached to this Phy: 000b = No device attached 001b = SAS device 010b = Expander device 011b = Expander device compliant with a previous version of the SAS standard

<b>Negotiated Physical Link Rate</b>	This field indicates the logical link rate being used by the Phy: 0h = UNKNOWN. Phy is enabled. Unknown Physical Link Rate. 1h = DISABLED. Phy is disabled. 2h = PHY_RESET_PROBLEM 3h = SPINUP_HOLD 4h = PORT_SELECTOR 8h = G1. Physical Link Rate is 1.5 Gb/s 9h = G2. Physical Link Rate is 3.0 Gb/s Ah =G3. Physical Link Rate is 6.0 Gb/s
<b>Attached SSP Initiator Port</b>	This bit indicates the value of the SSP Initiator Port field received in the IDENTIFY address frame during the identification sequence.
<b>Attached STP Initiator Port</b>	This bit indicates the value of the STP Initiator Port field received in the IDENTIFY address frame during the identification sequence.
<b>Attached SMP Initiator Port</b>	This bit indicates the value of the SMP Initiator Port field received in the IDENTIFY address frame during the identification sequence.
<b>Attached SSP Target Port</b>	This bit indicates the value of the SSP Target Port field received in the IDENTIFY address frame during the identification sequence.
<b>Attached STP Target Port</b>	This bit indicates the value of the STP Target Port field received in the IDENTIFY address frame during the identification sequence.
<b>Attached SMP Target Port</b>	This bit indicates the value of the SMP Target Port field received in the IDENTIFY address frame during the identification sequence.
<b>SAS Address</b>	This field indicates the SAS Address of the LTO-5 drive that is the bridged interface for the library or partition.
<b>Attached SAS Address</b>	This field contains the value of the SAS Address field transmitted in the IDENTIFY address frame during the identification sequence.
<b>Attached Phy Address</b>	This field indicates the value of Attached Phy Address field received in the IDENTIFY address frame during the identification sequence.
<b>Programmed Minimum Physical Link Rate</b>	8h = 1.5 Gb/s 9h = 3.0 Gb/s Ah = 6.0Gb/s
<b>Hardware Minimum Physical Link Rate</b>	8h = 1.5 Gb/s 9h = 3.0 Gb/s Ah = 6.0 Gb/s
<b>Programmed Maximum Physical Link Rate</b>	8h = 1.5 Gb/s 9h = 3.0 Gb/s Ah = 6.0 Gb/s
<b>Hardware Maximum Physical Link Rate</b>	8h = 1.5 Gb/s 9h = 3.0 Gb/s Ah = 6.0 Gb/s

## SAS Shared Control Mode Subpage

TABLE 4-55 shows the format of the SAS Shared Control Mode Subpage.

**TABLE 4-55** SAS Shared Control Mode Subpage

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	SPF (1)	Page Code (19h)					
1	Sub-Page Code (02h)							
2 to 3	MSB	Page Length (0Ch)						LSB
4	Reserved (00h)							
5	Reserved				Protocol Identifier (6h)			
6 to 7	MSB	Power Loss Timeout						LSB
8 to 15	Reserved (00h)							

### Serial Attached SCSI Shared Port Control Mode Subpage Definitions:

<b>PS</b>	The parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of 1 for the SubPage Format bit, indicating this page uses the sub_page mode page format.
<b>Page Code</b>	The value 19h identifies the page as the SAS Port Control mode page.
<b>Sub-Page Code</b>	The value 02h identifies the sub-page as the SAS Shared Port Control Mode Subpage.
<b>Protocol Identifier</b>	The value 06h indicates the Serial Attached SCSI protocol.
<b>Power Loss Timeout</b>	<p>This field contains the maximum time, in one millisecond increments, that a target port shall respond to connection requests with OPEN_REJECT (RETRY) after receiving NOTIFY (POWER LOSSEXPECTED).</p> <p>The value 0000h indicates that maximum time is vendor-specific.</p>

## SAS Enhanced Phy Control Subpage

[TABLE 4-56](#) shows the format of the Serial Attached SCSI Enhanced Phy Control Mode Subpage.

**TABLE 4-56** SAS Enhanced Phy Control Mode Subpage

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	SPF (1)	Page Code (19h)					
1	Sub-Page Code (03h)							
2 to 3	MSB	Page Length (2Ch)					LSB	
4	Reserved							
5	Reserved				Protocol Identifier (6h)			
6	Generation Code							
7	Number of Phys							
Enhanced Phy Control Mode Descriptor List								
8 to 27	MSB	First Enhanced Phy Control Mode Descriptor						LSB
28 to 47	MSB	Second Enhanced Phy Control Mode Descriptor						LSB

### SAS Enhanced Phy Control Mode Subpage Definitions:

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of 1 for the SubPage Format bit, indicating this page uses the sub_page mode page format.
<b>Page Code</b>	The value 19h identifies the page as the SAS Port Control mode page.
<b>Sub-Page Code</b>	The value 03h identifies the sub-page as the SAS Enhanced Phy Control Mode Subpage.
<b>Protocol Identifier</b>	The value 06h indicates the Serial Attached SCSI protocol.
<b>Generation Code</b>	This field is a one-byte counter that shall be incremented by one by the device server every time the values in this mode page are changed.
<b>Number of Phys</b>	This field contains the number of phys in the SAS target device and indicates the number of Enhanced Phy Control Mode Descriptors in the Enhanced Phy Control Mode descriptor list.
<b>SAS Phy Mode Descriptors</b>	See <a href="#">TABLE 4-57</a> for more information.

**Enhanced Phy Control Mode Descriptor Data****TABLE 4-57** Enhanced Phy Control Mode Descriptor Data

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Reserved (00h)							
1	Phy Identifier							
2 to 3	(MSB)	Descriptor Length (10h)						(LSB)
4 to 7	(MSB)	Programmed Phy Capabilities						(LSB)
8 to 11	(MSB)	Current Phy Capabilities						(LSB)
12 to 15	(MSB)	Attached Phy Capabilities						(LSB)
16	Reserved (00h)							
17	Reserved (00h)							
18	Reserved			Neg. SSC		Negotiated Physical Link Rate		
19	Reserved							Hdware Muxing Support

**Enhanced Phy Control Mode Descriptor Data Definitions:**

<b>Phy Identifier</b>	A unique Phy Identifier is returned for each Phy.
<b>Descriptor Length</b>	The library returns a value of 10h (16d) bytes.
<b>Programmed Phy Capabilities</b>	This field indicates the SNW-3 (Speed Negotiation Window) Phy capabilities bits that are going to be transmitted in the next link reset sequence containing SNW-3 as defined in <a href="#">TABLE 4-58</a> .
<b>Current Phy Capabilities</b>	This field indicates the outgoing SNW-3 Phy capabilities bits transmitted in the last link reset sequence as defined in <a href="#">TABLE 4-58</a> . If the last link reset sequence did not include SNW-3, then the Current Phy Capabilities field shall be set to 00000000h.
<b>Attached Phy Capabilities</b>	This field indicates the incoming SNW-3 Phy capabilities bits received in the last SNW-3 as defined in <a href="#">TABLE 4-58</a> . If the last link reset sequence did not include SNW-3, then the Attached Phy Capabilities field shall be set to 00000000h.
<b>Negotiated SSC</b>	The Negotiated SSC bit is only valid when the Negotiated Physical Link Rate is great than or equal to 8h. When valid: 0 = SSC is enabled. 1 = SSC is disabled.
<b>Hardware Muxing Supported</b>	0 = The Phy does not support multiplexing. 1 = The Phy supports multiplexing.

## Phy Capabilities Data

**TABLE 4-58** Phy Capabilities Data

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Start (1B)	TX SSC Type	Reserved		Requested Logical Link Rate			
Supported Settings								
1	G1 Without SSC	G1 With SSC	G2 Without SSC	G2 With SSC	G3 Without SSC	G3 With SSC	Reserved	
2	Reserved (00h)							
3	Reserved							Parity

### Phy Capabilities Data Definitions:

<b>TX SSC Type</b>	<p>The value 0 indicates that the phy's transmitter uses down-spreading SSC when SSC is enabled (for example, the phy is a SAS phy), or that the phy does not support SSC.</p> <p>The value 1 indicates that the phy's transmitter uses center-spreading SSC when SSC is enabled (for example, the phy is an expander phy).</p>
<b>Requested Logical Link Rate</b>	This field indicates if the Phy device supports multiplexing and, if so, the logical link rate that the Phy device is requesting.
<b>G1 Without SSC</b>	<p>The Phy:</p> <p>0 = Does not support G1 – 1.5 Gbps without SSC 1 = Supports G1 – 1.5 Gbps without SSC.</p>
<b>G1 With SSC</b>	<p>The Phy:</p> <p>0 = Does not support G1 – 1.5 Gbps with SSC. 1 = Supports G1 – 1.5 Gbps with SSC.</p>
<b>G2 Without SSC</b>	<p>The Phy:</p> <p>0 = Does not support G2 – 3 Gbps without SSC. 1 = Supports G2 – 3 Gbps without SSC.</p>
<b>G2 With SSC</b>	<p>The Phy:</p> <p>0 = Does not support G2 – 3 Gbps with SSC. 1 = Supports G2 – 3 Gbps with SSC.</p>
<b>G3 Without SSC</b>	<p>The Phy:</p> <p>0 = Does not support G3 – 6 Gbps without SSC. 1 = Supports G3 – 6 Gbps without SSC.</p>
<b>G3 With SSC</b>	<p>The Phy:</p> <p>0 = Does not support G3 – 6 Gbps with SSC. 1 = Supports G3 – 6 Gbps with SSC.</p>



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<b>Parity</b>	The Parity bit shall be set to one or zero such that the total number of SNW-3 Phy device capabilities bits that are set to one is even, including the Start bit and the Parity bit.
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## Informational Exceptions TapeAlert Control Page

**Note** – This TapeAlert page is not fully implemented yet.

TABLE 4-59 shows the format of the Mode Sense (6) Informational Exceptions TapeAlert Control page.

**TABLE 4-59** Informational Exceptions TapeAlert Control Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (1Ch)					
1	Page Length (0Ah)							
2	Perf (0)	Rsvd (0)	EBF (0)	EWasc (0)	DExcpt (1)	Test	Rsvd (0)	LogErr (0)
3	Reserved (0h)				MRIE (3h)			
4 to 7	(MSB) Interval Timer (LSB)							
8 to 11	(MSB) Report Count (LSB)							

### Informational Exceptions TapeAlert Page Definitions:

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of: 0 = SubPage Format bit, indicating page_0 format is being used
<b>Perf</b>	The performance bit is: 0 indicating acceptance of informational exception operations that cause delays.
<b>EBF</b>	Enable Background Functions bit will always be 0.
<b>EWasc</b>	Enable Warning bit will always be 0.
<b>DExcpt</b>	The exception bit is 1, which indicates that the library disables all information exception operations ignoring the MRIE field. In this mode, the software must poll the TapeAlert Log page.
<b>Test</b>	The test operations bit is 0, which requests the library to not generate any false/test informational exception conditions.
<b>LogErr</b>	The log information exception conditions bit is 0, which indicates that logging of informational exception conditions is vendor-specific.
<b>MRIE</b>	This field indicates the method the tape library uses to report informational exception conditions. The field is set to 3h but is ignored because the DExcpt bit is on.
<b>Interval Timer</b>	Bytes 4 through 7 are set to 00h, which indicates that the library will only report the informational exception condition one time.

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<b>Report Count</b>	Bytes 8 through 11 are set to the current report counter value.
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## Element Address Assignment Page Definition

**TABLE 4-60** defines the Element Address Assignment page of the Mode Sense (6) command.

**TABLE 4-60** Mode Sense (6) Element Address Assignment Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (1)	Rsvd (0)	Page Code (1Dh)					
1	Parameter Length (12h)							
2 to 3	(MSB)	First Medium Transport Element Address						(LSB)
4 to 5	(MSB)	Number of Medium Transport Elements						(LSB)
6 to 7	(MSB)	First Storage Element Address						(LSB)
8 to 9	(MSB)	Number of Storage Elements						(LSB)
10 to 11	(MSB)	First Import/Export Element Address						(LSB)
12 to 13	(MSB)	Number Import/Export Elements						(LSB)
14 to 15	(MSB)	First Data Transfer Element Address						(LSB)
16 to 17	(MSB)	Number Data Transfer Elements						(LSB)
18 to 19	(MSB)	Reserved (00h)						(LSB)

**Mode Sense (6) Element Address Assignment Page Definitions:**

<b>PS</b>	The Parameters Saveable bit specifies that the library can save this page to non-volatile memory and returns a value of 1.
<b>Page Code</b>	Identifies the Element Address Assignment mode page and returns a value of 1Dh.
<b>Parameter Length</b>	12h = Indicates the amount of element address data following this byte.
<b>First Medium Transport Element Address</b>	Identifies the address of the robot and returns a value of 0h.
<b>Number of Medium Transport Elements</b>	0001h = Identifies the number of hands within the library
<b>First Storage Element Address</b>	03E8h = Identifies the starting address of the cartridge tape storage cells. (The default starting address)
<b>Number of Storage Elements</b>	Identifies the number of cartridge tape storage cells within the library. The total number of cartridge tape storage cells depends on how the library is configured.
<b>First Import / Export Element Address</b>	000Ah = Identifies the address of the first Import/Export element. (The default starting address)
<b>Number of Import / Export Elements</b>	Identifies the total number of import/export cells.
<b>First Data Transfer Element Address</b>	1F4h = Identifies the address of the first tape transport installed (The default address)
<b>Number of Data Transfer Elements</b>	Identifies the number of tape drives in the library, and the library returns the configured count.

## Transport Geometry Mode Page Definition

This table defines the Mode Sense Transport Geometry Mode page.

**TABLE 4-61** Transport Geometry Mode Page

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

### Transport Geometry Mode Page Definitions:

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>Page Code</b>	This field identifies the Transport Geometry mode page; the library returns a value of 1Eh.
<b>Parameter Length</b>	This field indicates the number of additional types of transport geometry descriptor data to follow the header. Each descriptor has two bytes of information. The library has one transport mechanism and returns a value of 02h.
<b>Rotate</b>	This field identifies the ability of the transport mechanism to handle two-sided media. The library does not use multiple-sided media and returns a value of 0.
<b>Member Number in Transport Element Set</b>	This field identifies the specific transport element in the system to which this descriptor is applied. The library has one transport element and returns a value of 00h.

## Device Capabilities Page Definition

TABLE 4-62 defines the Device Capabilities page of the Mode Sense command.

**TABLE 4-62** Device Capabilities Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	Rsvd (0)	Page Code (1Fh)					
1	Parameter Length (12h)							
2	Reserved (0h)				StorDT <sup>1</sup> (1)	StorI/E <sup>2</sup> (1)	StorST <sup>3</sup> (1)	StorMT <sup>4</sup> (0)
3	Reserved (0h)							
4	Reserved (0h)				MT->DT (0)	MT->I/E (0)	MT->ST (0)	MT->MT (0)
5	Reserved (0h)				ST->DT (1)	ST->I/E (1)	ST->ST (1) (0)	ST->MT (0)
6	Reserved (0h)				I/E->DT (1)	I/E->I/E (1)	I/E->ST (1)	I/E->MT (0)
7	Reserved (0h)				DT->DT (1)	DT->I/E (1)	DT->ST (1)	DT->MT (0)
8 to 11	Reserved (00h)							
12	Reserved (0h)				MT<>DT (0)	MT<>I/E (0)	MT<>ST (0)	MT<>MT (0)
13	Reserved (0h)				ST<>DT (0)	ST<>I/E (0)	ST<>ST (0)	ST<>MT (0)
14	Reserved (0h)				I/E<>DT (0)	I/E<>I/E (0)	I/E<>ST (0)	I/E<>MT (0)
15	Reserved (0h)				DT->DT (0)	DT<>I/E (0)	DT<>ST (0)	DT<>MT (0)
16 to 19	Reserved (00h)							
<b>Notes:</b> DT - Data Transfer Element (tape drive) I/E = Import/Export Element (mailslot) ST = Storage Element (cartridge tape storage cell) MT= Medium Transport (hand)								

### Device Capabilities Page Definitions:

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>Page Code</b>	This field identifies the Device Capabilities mode page and always contains a value of 1Fh.

**Device Capabilities Page Definitions:**

<b>Parameter Length</b>	This field indicates the amount of device capabilities data following this byte. The library returns a value of 12h (18d).
<b>StorDT</b>	This field identifies the ability of a tape drive to perform the function of element storage. The library returns a value of 1.
<b>StorI/E</b>	This field identifies the ability of a mailslot cell to perform the function of element storage. The library returns a value of 1.
<b>StorST</b>	This field identifies the ability of the cartridge tape storage cells to perform the function of element storage. The library returns a value of 1.
<b>StorMT</b>	This field identifies the ability of the hand to perform the function of element storage. The hand cannot be used as the source or destination of a move. The library returns a value of 0.
<b>MT -&gt; DT</b>	This field identifies the support for the Move Medium command, where the source is the hand, and the destination is a tape drive. The library returns a value of 0.
<b>MT -&gt; I/E</b>	This field identifies the support for the Move Medium command, where the source is the hand, and the destination is a mailslot cell. The library returns a value of 0.
<b>MT -&gt; ST</b>	This field identifies the support for the Move Medium command, where the source is the hand, and the destination is a cartridge tape storage cell. The library returns a value of 0.
<b>MT -&gt; MT</b>	This field identifies the support for the Move Medium command, where both the source and the destination is the hand. The library returns a value of 0.
<b>ST -&gt; DT</b>	This field identifies the support for the Move Medium command, where the source is a cartridge tape storage cell, and the destination is a tape drive. The library returns a value of 1.
<b>ST -&gt; I/E</b>	This field identifies the support for the Move Medium command, where the source is a cartridge tape storage cell, and the destination is a mailslot cell. The library returns a value of 1.
<b>ST -&gt; ST</b>	This field identifies the support for the Move Medium command, where the source is a cartridge tape storage cell, and the destination is a cartridge tape storage cell. The library returns a value of 1.
<b>ST -&gt; MT</b>	This field identifies the support for the Move Medium command, where the source is a cartridge tape storage cell, and the destination is the hand. The library returns a value of 0.
<b>I/E -&gt; DT</b>	This field identifies the support for the Move Medium command, where the source is a mailslot cell, and the destination is a tape drive. The library returns a value of 1.
<b>I/E-&gt; I/E</b>	This field identifies the support for the Move Medium command, where both the source, and the destination is a mailslot cell. The library returns a value of 1.



**Device Capabilities Page Definitions:**

<b>I/E -&gt; ST</b>	This field identifies the support for the Move Medium command, where the source is a mailslot cell, and the destination is a cartridge tape storage cell. The library returns a value of 1.
<b>I/E -&gt; MT</b>	This field identifies the support for the Move Medium command, where the source is a mailslot cell, and the destination is the hand. The library returns a value of 0.
<b>DT -&gt; DT</b>	This field identifies the support for the Move Medium command, where the source, and the destination is a tape drive. The library returns a value of 1.
<b>DT -&gt; I/E</b>	This field identifies the support for the Move Medium command, where the source is a tape drive, and the destination is a mailslot cell. The library returns a value of 1.
<b>DT -&gt; ST</b>	This field identifies the support for the Move Medium command, where the source is a tape drive, and the destination is a cartridge tape storage cell. The library returns a value of 1.
<b>DT -&gt; MT</b>	This field identifies the support for the Move Medium command, where the source is a tape drive, and the destination 1 element is the hand. The library returns a value of 0.
<b>MT &lt; &gt; DT</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are the hand, and the destination 1 element is a tape drive. The library returns a value of 0.
<b>MT &lt; &gt; I/E</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are the hand, and the destination 1 element is a mailslot cell. The library returns a value of 0.
<b>MT &lt; &gt; ST</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are the hand, and the destination 1 element is a cartridge tape storage cell. The library returns a value of 0.
<b>MT &lt; &gt; MT</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are the hand, and the destination 1 element is the hand. The library returns a value of 0.
<b>ST &lt; &gt; DT</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a cartridge tape storage cell, and the destination 1 element is a tape drive. The library returns a value of 0.
<b>ST &lt; &gt; I/E</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a cartridge tape storage cell, and the destination 1 element is a mailslot cell. The library returns a value of 0.
<b>ST &lt; &gt; ST</b>	This field identifies support for the Exchange Medium command, where the source and destination 2 elements are a cartridge tape storage cell, and the destination 1 element is a cartridge tape storage cell. The library returns a value of 0.

**Device Capabilities Page Definitions:**

<b>ST &lt; &gt; MT</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a cartridge tape storage cell, and the destination 1 element is the hand. The library returns a value of 0.
<b>I/E &lt; &gt; DT</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a mailslot cell, and the destination 1 element is a tape drive. The library returns a value of 0.
<b>I/E &lt; &gt; I/E</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a mailslot cell, and the destination 1 element is a mailslot cell. The library returns a value of 0.
<b>I/E &lt; &gt; ST</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a mailslot cell, and the destination 1 element is a cartridge tape storage cell. The library returns a value of 0.
<b>I/E &lt; &gt; MT</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a mailslot cell, and the destination 1 element is the hand. The library returns a value of 0.
<b>DT &lt; &gt; DT</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a tape drive, and the destination 1 element is a tape drive. The library returns a value of 0.
<b>DT &lt; &gt; I/E</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a tape drive, and the destination 1 element is a mailslot cell. The library returns a value of 0.
<b>DT &lt; &gt; ST</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a tape drive, and the destination 1 element is a cartridge tape storage cell. The library returns a value of 0.
<b>DT &lt; &gt; MT</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a tape drive, and the destination 1 element is the hand. The library returns a value of 0.

## Mode Sense (10)

The 10-byte Mode Sense command (5Ah) enables the library to report its operating mode parameters to the initiator.

**TABLE 4-63** Mode Sense (10) Command

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

### Mode Sense (10) Command Definitions:

<b>LLBA</b>	The library returns a value of 0, indicating the LONGBLA bit shall be zero in the parameter data returned by the library.
<b>DBD</b>	Disable Block Descriptors is ignored.
<b>Page Control</b>	<p>Defines the type of parameters to be returned for the Mode Sense command, values include:</p> <hr/> <p>0h (00b) = Current Values:            The library returns the current parameter values, including:            Parameters set in the last successful Mode Select command.            Default values if saved values are unavailable or invalid.            Saved values if a MODE command has not been executed since the last power-on, interface reset, or Task Management Reset.</p> <hr/> <p>1h (01b) = Changeable Values:            The library returns the changeable parameter masks.            All requested pages are returned            Pages indicate which parameters are changeable by the initiator            All bits of changeable parameters are set to 1            All bits of parameters that are not changeable are set to 0</p>

<b>Page Control</b>	<p>2h (10b) = Default Values: The library returns the default values. Requested pages are returned with each supported parameter set to its default. Parameters not supported by the library are set to 0. Default values for the Element Address Assignment page are based on the configuration of the library.</p>
	<p>3h (11b) = Saved Values: The library returns the saved values. Requested pages are returned with supported parameters set to saved values. Parameters not supported by the library are set to 0. This option is valid only with mode pages that can be saved.</p>
<b>Page Code</b>	<p>Specifies which pages the library returns, including:</p> <ul style="list-style-type: none"> <li>02h = Protocol Specific Disconnect/Reconnect page</li> <li>18h = Protocol Specific Logical Unit page</li> <li>19h = Protocol Specific Port Control page</li> <li>1Ch = Informational Exceptions TapeAlert Control page</li> <li>1Dh = Element Address Assignment page</li> <li>1Eh = Transport Geometry page</li> <li>1Fh = Device Capabilities page</li> <li>3Fh = All pages (in the above order)</li> </ul>
<b>SubPage Code</b>	<p>The field indicates the Serial Attached SCSI Port Control Subpage, when the protocol is Serial Attached SCSI and the Page Code is set to 19h.</p> <ul style="list-style-type: none"> <li>01h = Serial Attached SCSI Phy Control and Discover Mode Subpage</li> <li>02h = Serial Attached SCSI Shared Port Control Mode Subpage</li> <li>03h = Serial Attached SCSI Enhanced Phy Control Mode Subpage</li> </ul>
<b>Allocation Length</b>	<p>Specifies the length of the parameter list the library returns. The length varies based on the Page Code and Sub-Page Code selected:</p> <ul style="list-style-type: none"> <li>8 bytes for the parameter list header (always present)</li> <li>16 additional bytes for the Fibre Channel Disconnect/Reconnect page</li> <li>16 additional bytes for the SAS Disconnect/Reconnect page</li> <li>8 additional bytes for the Fibre Channel Logical Unit Control page</li> <li>8 additional bytes for the SAS Logical Unit Control page</li> <li>8 additional bytes for the Fibre Channel Port Control page</li> <li>16 additional bytes for the SAS Port Control page</li> <li>104 additional bytes for the SAS Phy Control and Discover Mode Subpage</li> <li>16 additional bytes for the SAS Shared Port Control Mode Subpage</li> <li>48 additional bytes for the SAS Enhanced Phy Control Mode Subpage</li> <li>12 additional bytes for the Informational Exceptions TapeAlert page</li> <li>20 additional bytes for the Element Address Assignment page</li> <li>4 additional bytes for the Transport Geometry page</li> <li>20 additional bytes for the Device Capabilities page</li> </ul>

## Mode Sense (10) Data

The library returns the following mode sense data:

- A eight-byte Mode Parameter Header followed by:
- One mode page or all mode pages in the order specified in the Page Code list.
- The mode pages available are:

[“Mode Sense \(10\) Parameter Header Page” on page 126](#)

[“Fibre Channel Disconnect/reconnect Page” on page 127](#)

[“SAS Disconnect/Reconnect Page” on page 129](#)

[“Fibre Channel Logical Unit Page” on page 131](#)

[“SAS Logical Unit Page” on page 132](#)

[“Fibre Channel Port Control Page” on page 133](#)

[“SAS Port Control Page” on page 136](#)

[“SAS Phy Control and Discover Mode Subpage” on page 138](#)

[“SAS Shared Port Control Mode Subpage” on page 141](#)

[“SAS Enhanced Phy Control Subpage” on page 142](#)

[“Informational Exceptions TapeAlert Control Page” on page 145 or](#)

[“Element Address Assignment Page Definition” on page 146](#)

[“Transport Geometry Mode Page Definition” on page 148](#)

[“Device Capabilities Page Definition” on page 149](#)

- The data can be truncated to the length specified in the allocation length field.

## Mode Sense (10) Parameter Header Definition

TABLE 4-64 shows the Mode Sense Parameter Header page.

**TABLE 4-64** Mode Sense (10) Parameter Header Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	MSB of Mode Data Length							
1	LSB of Mode Data Length							
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	MSB of Block Descriptor Length							
7	LSB of Block Descriptor Length							

### Mode Sense (10) Parameter Header Page Definitions:

<b>Mode Data Length</b>	This field indicates the number of bytes of parameter information available to be transferred to the initiator, regardless of the allocation length. This field excludes the Mode Data Length byte but includes three additional Mode Parameter Header bytes and any mode pages that follow.
<b>Block Descriptor Length</b>	The library does not support block descriptors (00h).

## Fibre Channel Disconnect/Reconnect Page

TABLE 4-65 shows the format of the Mode Sense Fibre Channel Disconnect/Reconnect page.

**TABLE 4-65** Fibre Channel Disconnect/reconnect Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS	SPF	Page Code (02h)					
1	Page length (0Eh)							
2	Buffer Full Ratio							
3	Buffer Empty Ratio							
4 to 5	(MSB)	Bus Inactivity Limit						(LSB)
6 to 7	(MSB)	Disconnect Time Limit						(LSB)
8 to 9	(MSB)	Connect Time Limit						(LSB)
10 to 11	(MSB)	Maximum Burst Size						(LSB)
12	EMPD	FAA	FAB	FAC	Restricted			
13	Reserved							
14 to 15	(MSB)	First Burst Size						(LSB)

**Mode Sense: Fibre Channel Disconnect/Reconnect Page Definitions**

<b>PS</b>	The parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of 0 = the SubPage Format bit, indicating page_0 format is being used.
<b>Page Code</b>	This field is set to: 02h = identifies the page as the Disconnect/Reconnect page.
<b>Buffer Full Ratio</b>	This field indicates the device server, during read operations, how full the buffer should be prior to requesting an interconnect tenancy.
<b>Buffer Empty Ratio</b>	This field indicates the device server, during write operations, how empty the buffer should be prior to transmitting an FCP_XFER_RDY IU that requests the initiator to send data.
<b>Bus Inactivity Limit</b>	This field indicates the maximum time that the target is permitted to maintain an interconnect tenancy without data or information transfer, measured in transmission word increments. n 0000h indicates that there is no bus inactivity limit.
<b>Disconnect Time Limit</b>	This field indicates the minimum delay between interconnect tenancies measured in increments of 128 transmission words. n 0000h indicates that the disconnect time limit does not apply.
<b>Connect Time Limit</b>	The field indicates the maximum duration of a single interconnect tenancy, measured in increments of 128 transmission words. n 0000h indicates that there is no connect time limit.
<b>Maximum Burst Size</b>	This field indicates the maximum size of FCP_DATA IU that the device server shall transfer to the initiator or request from the initiator. This value is expressed in increments of 512 bytes. n 0000h indicates there is no limit on the amount of data transferred per data transfer operation.
<b>EMPD</b>	The Enable Modify Data Pointers bit indicates whether or not the target may use the random buffer access capability to reorder FCP_DATA IUs for a single SCSI command. n 0 = The target shall generate continuously increasing relative offset values for each FCP_DATA IU for a single SCSI command. n 1 = The target may transfer the FCP_DATA IUs for a single SCSI command in any order.
<b>FAA, FAB, FAC</b>	The fairness access (FA) bits, FAA, FAB, and FAC, indicate whether a target in a loop configuration shall use the access fairness algorithm. A value of 0 indicates that the target does not use fairness, while a value of 1 indicates that the target does use a fairness algorithm. n The <b>FAA bit</b> controls arbitration when the target wishes to send one or more FCP_DATA IU frames to an initiator. n The <b>FAB bit</b> controls arbitration when the initiator wishes to send one or more FCP_XFER_RDY IU frames to a target. n The <b>FAC bit</b> controls arbitration when the target wishes to send an FCP_RSP IU frame to an initiator.
<b>First Burst Size</b>	This field value is expressed in increments of 512. n 0000h indicates that there is no first burst size limit.



## SAS Disconnect/Reconnect Page

TABLE 4-66 shows the format of the Mode Sense Serial Attached SCSI Disconnect/Reconnect page.

**TABLE 4-66** SAS Disconnect/Reconnect Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS	SPF	Page Code (02h)					
1	Page Length (0Eh)							
2	Reserved (00h)							
3	Reserved (00h)							
4 to 5	(MSB)	Bus Inactivity Time Limit						(LSB)
6	Reserved (00h)							
7	Reserved (00h)							
8 to 9	(MSB)	Maximum Connect Time Limit						(LSB)
10 to 11	(MSB)	Maximum Burst Size						(LSB)
12	Reserved (00h)							
13	Reserved (00h)							
14 to 15	(MSB)	First Burst Size						(LSB)

**Mode Sense: SAS Disconnect/Reconnect Page Definitions:**

<b>PS</b>	The parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of: 0 = SubPage Format bit, indicating page_0 format is being used.
<b>Page Code</b>	This field is set to: 02h = identifies the page as the Disconnect/Reconnect page.
<b>Bus Inactivity Time Limit</b>	This field contains the maximum time in 100 $\mu$ s increments that an SSP target port is permitted to maintain a connection without transferring a frame to the SSP initiator port. n 0000h indicates that there is no bus inactivity limit.
<b>Maximum Connect Time Limit</b>	This field contains the maximum duration of a connection in 100 $\mu$ s increments. n 0000h specifies that there is no maximum connection time limit.
<b>Maximum Burst Size</b>	For read data, this field contains the maximum amount of data in 512-byte increments that is transferred during a connection by an SSP target port per I_T_L_Q nexus without transferring at least one frame for a different I_T_L_Q nexus. For write data, the value shall specify the maximum amount of data that an SSP target port requests via a single XFER_RDY frame. n 0000h in this field specifies that there is no maximum burst size.
<b>First Burst Size</b>	If the ENABLE FIRST BURST bit in the COMMAND frame is set to zero, then the FIRST BURST SIZE field is ignored.  If the ENABLE FIRST BURST bit in the COMMAND frame is set to one, then the value in the FIRST BURST SIZE field contains the maximum amount of write data in 512-byte increments that may be sent by the SSP initiator port to the SSP target port without having to receive an XFER_RDY frame from the SSP target port.

## Fibre Channel Logical Unit Page

TABLE 4-67 shows the format of the Fibre Channel Logical Unit page.

**TABLE 4-67** Fibre Channel Logical Unit Page

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

### Fibre Channel Logical Unit Page Definitions:

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of 0 for the SubPage Format bit, indicating page_0 format is being used.
<b>Protocol Identifier</b>	This field is set to 0h indicating the Fibre Channel protocol.
<b>EPDC</b>	<p>The Enable Precise Delivery Checking bit is defined as follows:</p> <ul style="list-style-type: none"> <li>0 = The target shall not use the precise delivery function and shall ignore the contents of the CRN field.</li> <li>1 = The logical unit shall use precise delivery function defined in the FCP-2 standard.</li> </ul>

## SAS Logical Unit Page

TABLE 4-68 shows the format of the Serial Attached SCSI (SAS) Logical Unit Page.

**TABLE 4-68** SAS Logical Unit Page

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

### Serial Attached SCSI Logical Unit Page Definitions:

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of 0 for the SubPage Format bit, indicating page_0 format is being used.
<b>Protocol Identifier</b>	The field is set to 6h indicating the Serial Attached SCSI (SAS) protocol.
<b>TLR</b>	0b = Transport Layer Retries are disabled.  1b = Transport Layer Retries are enabled for Transfer Ready and Data Frames for the logical unit

## Fibre Channel Port Control Page

TABLE 4-69 shows the format of the Fibre Channel Port Control page.

**TABLE 4-69** Fibre Channel Port Control Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (19h)					
1	Page Length (06h)							
2	Reserved				Protocol Identifier (0)			
3	DTFD	PLPB	DDIS	DLM	RHA	ALWI	DTIPE	DTOLI
4	Reserved							
5	Reserved							
6	Reserved					RR_TOV units		
7	Resource Recovery Time Out Value (RR_TOV)							

### Fibre Channel Port Control Page Definitions:

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>SPF</b>	SPF = The library returns a value of: 0 = SubPage Format bit, indicating page_0 format is being used.
<b>Protocol Identifier</b>	This field is set to 0h indicating the Fibre Channel protocol.
<b>DTFD</b>	Disabled Target Fabric Discovery. If the library is not attached to an arbitrated loop, it shall ignore the DTFD bit.  0 = The target attached by an arbitrated loop shall discover a fabric loop port if present on the loop and perform the public loop functions defined for targets by FC-FLA.  1 = The target attached by an arbitrated loop shall not recognize the presence of a fabric loop port on the loop.
<b>PLPB</b>	Prevent Loop Port Bypass. If the library is not attached to an arbitrated loop, it shall ignore the PLPB bit.  0 = The target allows the Loop Port Bypass (LPB) and Loop Port Enable (PBE) primitive sequences to control the port bypass circuit and participation on the loop as specified by FC-AL-2.  1 = The target attached to an FC-AL-2 loop shall ignore any Loop Port Bypass (LPB) and Loop Port Enable (LPE) primitive sequences.

<b>DDIS</b>	<p>Disable Discovery. If the library is not attached to an arbitrated loop, it shall ignore the DDIS bit.</p> <p>0 = The target shall wait to complete target discovery as defined by FC-PLDA, FC-FLA, and FC-TAPE before allowing processing of tasks to resume.</p> <p>1 = The target without a valid FLOGI attached to an arbitrated loop shall not require receipt of Address or Port Discovery (ADISC or PDISC ELSs) following loop initialization as described in FC-PLDA and FC-FLA.</p>
<b>DLM</b>	<p>Disable Loop Master. If the library is not attached to an arbitrated loop, it shall ignore the DLM bit.</p> <p>0 = The target may participate in loop master arbitration in the normal manner and, if successful, may become loop master during the loop initialization process.</p> <p>1 = The target attached to an FC-AL-2 loop shall not participate in loop master arbitration and shall not become loop master. The target shall only repeat LISM frames it receives.</p>
<b>RHA</b>	<p>Require Hard Address. If the library is not attached to an arbitrated loop, it shall ignore the RHA bit.</p> <p>0 = The target follows the normal initialization procedure, including the possibility of obtaining a soft address during the loop initialization.</p> <p>1 = The target attached to an arbitrated loop shall only attempt to obtain its hard address. If there is a conflict for the hard address selection during loop initialization or the target does not have a valid hard address available, the target shall enter the nonparticipating state.</p>
<b>ALWI</b>	<p>Allow Login Without Loop Initialization. If the library is not attached to an arbitrated loop, it shall ignore the ALWI bit.</p> <p>0 = The target shall perform the normal loop initialization procedure before entering the monitoring mode and accepting a login ELS.</p> <p>1 = The target attached to an FC-AL-2 loop shall use the hard address available in the connector or in device address jumpers, enter the monitoring state in participating mode, and accept logins without using the loop initialization procedure (see FC-AL-2).</p>
<b>DTIPE</b>	<p>Disabled Target Initiated Port Enabled. If the library is not attached to an arbitrated loop, it shall ignore the DTIPE bit.</p> <p>0 = The target shall enable itself onto the loop in according to the rules specified in FC-AL-2.</p> <p>1 = The target attached to an arbitrated loop shall wait for an initiator to send the Loop Port Enable (LPE) primitive sequence before inserting itself into a loop (see FC-AL-2)</p>

<b>DTOLI</b>	<p>Disable Target Originated Loop Initialization. If the library is not attached to an arbitrated loop, it shall ignore the <b>DTOLI</b> bit.</p> <p>0 = The target attached by an arbitrated loop shall generate LIP(F7,xx) after it enables a port into a loop.</p> <p>1 = The target attached by an arbitrated loop shall not generate a LIP following insertion into the loop.</p>
<b>RR_TOV units</b>	<p>Resource Recovery Time Out Value Units will always be:</p> <p>011b = 0.1 second units</p>
<b>RR_TOV</b>	<p>Resource Recovery Time Out Value will always be:</p> <p>F0h = 24 seconds</p>

## SAS Port Control Page

TABLE 4-70 shows the format of the Serial Attached SCSI (SAS) Port Control page.

**TABLE 4-70** SAS Port Control Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (19h)					
1	Page Length (0Eh)							
2	RSVD	Continue AWT	BAE	LED	Protocol Identifier (6h)			
3	Reserved							
4 to 5	(MSB) <div>I_T Nexus Loss Time</div> (LSB)							
6 to 7	(MSB) <div>Initiator Response Timeout</div> (LSB)							
8 to 9	(MSB) <div>Reject to Open Limit</div> (LSB)							
10 to 15	(MSB) <div>Reserved (00h)</div> (LSB)							

### Serial Attached SCSI Port Control Page Definitions:

<b>PS</b>	The parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of: 0 = SubPage Format bit, indicating page_0 format is being used.
<b>Page Code</b>	This field is set to: 19h = identifies the page as the SAS Port Control mode page.
<b>Protocol Identifier</b>	This field is set to: 06h = indicates the Serial Attached SCSI protocol.
<b>Continue AWT</b>	Continuous Arbitration Wait Time (AWT)  0 = The SAS port shall stop the AWT timer and set the AWT timer to zero when it receives an OPEN_REJECT (RETRY).  1 = The SAS port shall not stop the AWT timer and shall not set the AWT timer to zero when the SAS port receives an OPEN_REJECT (RETRY).
<b>BAE</b>	Broadcast Asynchronous Event (BAE). The device server shall:  0 = Disable origination of Broadcast (Asynchronous Event).  1 = Enable origination of Broadcast (Asynchronous Event).
<b>Ready LED Meaning</b>	The Ready LED Meaning bit specifies the READY LED signal behavior.



<b>I_T Nexus Loss Time</b>	<p>This field contains the minimum time that the SSP Target Port shall retry connection requests to an SSP initiator port that are rejected with responses indicating the SSP initiator port may no longer be present before recognizing an I_T nexus loss:</p> <p>0000h = Vendor-specific amount of time.</p> <p>0001h - FFFFh = Time in milliseconds.</p> <p>FFFFh = The SSP target port shall never recognize an I_T nexus loss.</p>
<b>Initiator Response Timeout</b>	<p>This field contains the minimum time in milliseconds that the SSP target port shall wait for the receipt of a frame before aborting the command associated with that frame.</p> <ul style="list-style-type: none"> <li>• 0000h indicates that the SSP target port shall wait forever.</li> </ul>
<b>Reject to Open Limit</b>	<p>This field contains the minimum time in 10 microsecond increments that the target port shall wait to establish a connection request with an initiator port on an I_T nexus after receiving an OPEN_REJECT (RETRY), OPEN_REJECT (RESERVED CONTINUE 0), or OPEN_REJECT (RESERVED CONTINUE 1)</p> <ul style="list-style-type: none"> <li>• 0000h indicates that minimum time is vendor specific.</li> </ul>

## SAS Phy Control and Discover Mode Subpage

[TABLE 4-71](#) shows the format of the Serial Attached SCSI (SAS) Phy Control and Discover Mode Subpage.

**TABLE 4-71** SAS Phy Control and Discover Mode Subpage

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	SPF (1)	Page Code (19h)					
1	Subpage Code (01h)							
2 to 3	(MSB)	Page Length (64h)						(LSB)
4	Reserved							
5	Reserved				Protocol Identifier (6h)			
6	Generation Code							
7	Number of Phys							
SAS Phy Mode Descriptor List								
8 to 55	(MSB)	First SAS Phy Mode Descriptor						(LSB)
56 to 103	(MSB)	Second SAS Phy Mode Descriptor						(LSB)

### Serial Attached SCSI Phy Control and Discover Mode Subpage Definitions:

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of: 1 = SubPage Format bit, indicates this page uses the sub_page mode.
<b>Page Code</b>	The value 19h identifies the page as the SAS Port Control mode page.
<b>Sub-Page Code</b>	A value of 01h identifies the sub-page as the SAS Phy Control and Discover Mode Subpage.
<b>Protocol Identifier</b>	The value 06h indicates the Serial Attached SCSI (SAS) protocol.
<b>Generation Code</b>	This field is a one-byte counter that shall be incremented by one by the device server every time the values in this mode page are changed.
<b>Number of Phy</b>	This field contains the number of Phy modes in the SAS target device and indicates the number of SAS Phy mode descriptors in the SAS Phy mode descriptor list.
<b>SAS Phy Mode Descriptor Data</b>	See <a href="#">TABLE 4-72</a> for more information.

**SAS Phy Mode Descriptor Data****TABLE 4-72** SAS Phy Mode Descriptor Data

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Reserved (00h)							
1	Phy Identifier							
2	Reserved (00h)							
3	Reserved (00h)							
4	RSVD	Attached Device Type			Reserved (0)			
5	Reserved				Negotiated Physical Link Rate			
6	Reserved				Attach SSP Init Port	Attach STP Init Port	Attach SMP Init Port	RSVD
7	Reserved				Attach SSP Tgt Port	Attach STP Tgt Port	Attach SMP Tgt Port	RSVD
8 to 15	(MSB) SAS Address (LSB)							
16 to 23	(MSB) Attached SAS Address (LSB)							
24	Attached Phy Address							
25 to 31	Reserved (00h)							
32	Programmed Minimum Physical Link Rate				Hardware Minimum Physical Link Rate			
33	Programmed Maximum Physical Link Rate				Hardware Maximum Physical Link Rate			
34 to 41	Reserved (00h)							
42 to 43	(MSB) Vendor Specific (LSB)							
44 to 47	Reserved (00h)							

**Serial Attached SCSI Phy Mode Descriptor Data Definitions:**

**PS** The parameters Saveable bit is set to 0.

**Phy Identifier** A unique Phy Identifier is returned for each Phy.

<b>Attached Device Type</b>	This field indicates the device type attached to this Phy: 000b = No device attached 001b = SAS device 010b = Expander device 011b = Expander device compliant with a previous version of the SAS standard
<b>Negotiated Physical Link Rate</b>	This field indicates the logical link rate being used by the Phy: 0h = UNKNOWN. Phy is enabled. Unknown Physical Link Rate. 1h = DISABLED. Phy is disabled. 2h = PHY_RESET_PROBLEM 3h = SPINUP_HOLD 4h = PORT_SELECTOR 8h = G1. Physical Link Rate is 1.5 Gb/s 9h = G2. Physical Link Rate is 3.0 Gb/s Ah = G3. Physical Link Rate is 6.0 Gb/s
<b>Attached SSP Initiator Port</b>	This bit indicates the value of the SSP Initiator Port field received in the IDENTIFY address frame during the identification sequence.
<b>Attached STP Initiator Port</b>	This bit indicates the value of the STP Initiator Port field received in the IDENTIFY address frame during the identification sequence.
<b>Attached SMP Initiator Port</b>	This bit indicates the value of the SMP Initiator Port field received in the IDENTIFY address frame during the identification sequence.
<b>Attached SSP Target Port</b>	This bit indicates the value of the SSP Target Port field received in the IDENTIFY address frame during the identification sequence.
<b>Attached STP Target Port</b>	This bit indicates the value of the STP Target Port field received in the IDENTIFY address frame during the identification sequence.
<b>Attached SMP Target Port</b>	This bit indicates the value of the SMP Target Port field received in the IDENTIFY address frame during the identification sequence.
<b>SAS Address</b>	This field indicates the SAS Address of the LTO-5 drive that is the bridged interface for the library or partition.
<b>Attached SAS Address</b>	This field contains the value of the SAS Address field transmitted in the IDENTIFY address frame during the identification sequence.
<b>Attached Phy Address</b>	This field indicates the value of Attached Phy Address field received in the IDENTIFY address frame during the identification sequence.
<b>Programmed Minimum Physical Link Rate</b>	8h = 1.5 Gb/s 9h = 3.0 Gb/s Ah = 6.0Gb/s
<b>Hardware Minimum Physical Link Rate</b>	8h = 1.5 Gb/s 9h = 3.0 Gb/s Ah = 6.0 Gb/s
<b>Programmed Maximum Physical Link Rate</b>	8h = 1.5 Gb/s 9h = 3.0 Gb/s Ah = 6.0 Gb/s
<b>Hardware Maximum Physical Link Rate</b>	8h = 1.5 Gb/s 9h = 3.0 Gb/s Ah = 6.0 Gb/s

## SAS Shared Port Control Mode Subpage

TABLE 4-73 shows the format of the Serial Attached SCSI Shared Port Control Mode Subpage.

**TABLE 4-73** SAS Shared Port Control Subpage

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	SPF (1)	Page Code (19h)					
1	Sub-Page Code (02h)							
2 to 3	MSB				Page Length (0Ch)			LSB
4	Reserved (00h)							
5	Reserved				Protocol Identifier (6h)			
6 to 7	MSB				Power Loss Timeout			LSB
8 to 15	Reserved (00h)							

---

### Serial Attached SCSI Shared Port Control Mode Subpage Definitions:

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<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of 1 for the SubPage Format bit, indicating this page uses the sub_page mode page format.
<b>Page Code</b>	The value 19h identifies the page as the SAS Port Control mode page.
<b>Sub-Page Code</b>	The value 02h identifies the sub-page as the SAS Shared Port Control Mode Subpage.
<b>Protocol Identifier</b>	The value 06h indicates the Serial Attached SCSI protocol.
<b>Power Loss Timeout</b>	<p>This field contains the maximum time, in one millisecond increments, that a target port shall respond to connection requests with OPEN_REJECT (RETRY) after receiving NOTIFY (POWER LOSSEXPECTED).</p> <ul style="list-style-type: none"> <li>The value 0000h indicates that maximum time is vendor-specific.</li> </ul>

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## SAS Enhanced Phy Control Subpage

[TABLE 4-74](#) shows the format of the Serial Attached SCSI Enhanced Phy Control Mode Subpage.

**TABLE 4-74** SAS Enhanced Phy Control Mode Subpage

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	SPF (1)	Page Code (19h)					
1	Sub-Page Code (03h)							
2 to 3	MSB	Page Length (2Ch)						LSB
4	Reserved							
5	Reserved				Protocol Identifier (6h)			
6	Generation Code							
7	Number of Phys							
Enhanced Phy Control Mode Descriptor List								
8 to 27	MSB	First Enhanced Phy Control Mode Descriptor						LSB
28 to 47	MSB	Second Enhanced Phy Control Mode Descriptor						LSB

### SAS Enhanced Phy Control Mode Subpage Definitions:

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of 1 for the SubPage Format bit, indicating this page uses the sub_page mode page format.
<b>Page Code</b>	The value 19h identifies the page as the SAS Port Control mode page.
<b>Sub-Page Code</b>	The value 03h identifies the sub-page as the SAS Enhanced Phy Control Mode Subpage.
<b>Protocol Identifier</b>	The value 06h indicates the Serial Attached SCSI protocol.
<b>Generation Code</b>	This field is a one-byte counter that shall be incremented by one by the device server every time the values in this mode page are changed.
<b>Number of Phys</b>	This field contains the number of phys in the SAS target device and indicates the number of Enhanced Phy Control Mode Descriptors in the Enhanced Phy Control Mode descriptor list.
<b>SAS Phy Mode Descriptors</b>	See <a href="#">TABLE 4-75</a> for more information.

**Enhanced Phy Control Mode Descriptor Data****TABLE 4-75** Enhanced Phy Control Mode Descriptor Data

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Reserved (00h)							
1	Phy Identifier							
2 to 3	(MSB)	Descriptor Length (10h)						(LSB)
4 to 7	(MSB)	Programmed Phy Capabilities						(LSB)
8 to 11	(MSB)	Current Phy Capabilities						(LSB)
12 to 15	(MSB)	Attached Phy Capabilities						(LSB)
16	Reserved (00h)							
17	Reserved (00h)							
18	Reserved			Neg. SSC		Negotiated Physical Link Rate		
19	Reserved							Hdware Muxing Support

**Enhanced Phy Control Mode Descriptor Data Definitions:**

<b>Phy Identifier</b>	A unique Phy Identifier is returned for each Phy.
<b>Descriptor Length</b>	The library returns a value of 10h (16d) bytes.
<b>Programmed Phy Capabilities</b>	This field indicates the SNW-3 (Speed Negotiation Window) Phy capabilities bits that are going to be transmitted in the next link reset sequence containing SNW-3 as defined in <a href="#">TABLE 4-76</a> .
<b>Current Phy Capabilities</b>	This field indicates the outgoing SNW-3 Phy capabilities bits transmitted in the last link reset sequence as defined in <a href="#">TABLE 4-76</a> . If the last link reset sequence did not include SNW-3, then the Current Phy Capabilities field shall be set to 00000000h.
<b>Attached Phy Capabilities</b>	This field indicates the incoming SNW-3 Phy capabilities bits received in the last SNW-3 as defined in <a href="#">TABLE 4-76</a> . If the last link reset sequence did not include SNW-3, then the Attached Phy Capabilities field shall be set to 00000000h.
<b>Negotiated SSC</b>	The Negotiated SSC bit is only valid when the Negotiated Physical Link Rate is great than or equal to 8h. When valid: 0 = SSC is enabled 1 = SSC is disabled.
<b>Hardware Muxing Supported</b>	0 = The Phy does not support multiplexing. 1 = The Phy supports multiplexing.

**Phy Capabilities Data****TABLE 4-76** Phy Capabilities Data

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Start (1B)	TX SSC Type	Reserved		Requested Logical Link Rate			
Supported Settings								
1	G1 Without SSC	G1 With SSC	G2 Without SSC	G2 With SSC	G3 Without SSC	G3 With SSC	Reserved	
2	Reserved (00h)							
3	Reserved							Parity

**Phy Capabilities Data Definitions:**

<b>TX SSC Type</b>	<p>The value 0 indicates that the phy's transmitter uses down-spreading SSC when SSC is enabled (for example, the phy is a SAS phy), or that the phy does not support SSC.</p> <p>The value 1 indicates that the phy's transmitter uses center-spreading SSC when SSC is enabled (for example, the phy is an expander phy).</p>
<b>Requested Logical Link Rate</b>	This field indicates if the Phy device supports multiplexing and, if so, the logical link rate that the Phy device is requesting.
<b>G1 Without SSC</b>	<p>The Phy:</p> <p>0 = Does not support G1 – 1.5 Gbps without SSC.</p> <p>1 = Supports G1 – 1.5 Gbps without SSC.</p>
<b>G1 With SSC</b>	<p>The Phy:</p> <p>0 = Does not support – 1.5 Gbps with SSC.</p> <p>1 = Supports G1 – 1.5 Gbps with SSC.</p>
<b>G2 Without SSC</b>	<p>The Phy:</p> <p>0 = Does not support G2 – 3 Gbps without SSC.</p> <p>1 = Supports G2 – 3 Gbps without SSC.</p>
<b>G2 With SSC</b>	<p>The Phy:</p> <p>0 = Does not support G2 – 3 Gbps with SSC.</p> <p>1 = Supports G2 – 3 Gbps with SSC.</p>
<b>G3 Without SSC</b>	<p>The Phy:</p> <p>0 = Does not support G3 – 6 Gbps without SSC.</p> <p>1 = Supports G3 – 6 Gbps without SSC.</p>
<b>G3 With SSC</b>	<p>The Phy:</p> <p>0 = Does not support G3 – 6 Gbps with SSC.</p> <p>1 = Supports G3 – 6 Gbps with SSC.</p>
<b>Parity</b>	The Parity bit shall be set to one or zero such that the total number of SNW-3 Phy device capabilities bits that are set to one is even, including the Start bit and the Parity bit.



## Informational Exceptions TapeAlert Control Page

**Note** – This TapeAlert page is not fully implemented yet.

TABLE 4-77 shows the format of the Mode Sense (10) Informational Exceptions TapeAlert Control page.

**TABLE 4-77** Informational Exceptions TapeAlert Control Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (1Ch)					
1	Page Length (0Ah)							
2	Perf (0)	Rsvd (0)	EBF (0)	EWasc (0)	DExcpt (1)	Test	Rsvd (0)	LogErr (0)
3	Reserved (0h)				MRIE (3h)			
4 to 7	(MSB) <div>Interval Timer</div> (LSB)							
8 to 11	(MSB) <div>Report Count</div> (LSB)							

### Informational Exceptions TapeAlert Control Page Definitions:

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>SPF</b>	The library returns a value of 0 for the SubPage Format bit, indicating page_0 format is being used.
<b>Perf</b>	The performance bit is 0, which indicates acceptance of informational exception operations that cause delays.
<b>EBF</b>	Enable Background Functions bit will always be 0.
<b>EWasc</b>	Enable Warning bit will always be 0.
<b>DExcpt</b>	The exception bit is 1, which indicates that the library disables all information exception operations ignoring the MRIE field.  <b>Note</b> – In this mode, the software must poll the TapeAlert Log page.
<b>Test</b>	The test operations bit is 0, which requests the library not to generate any false/test informational exception conditions.
<b>LogErr</b>	The log information exception conditions bit is 0, which indicates that logging of informational exception conditions is vendor-specific.
<b>MRIE</b>	This field indicates the method the tape library uses to report informational exception conditions. The field is set to 3h but is ignored because the DExcpt bit is on.
<b>Interval Timer</b>	Bytes 4 through 7 are set to 00h, which indicates that the library will only report the informational exception condition one time.
<b>Report Count</b>	Bytes 8 through 11 are set to the current report counter value.

## Element Address Assignment Page Definition

**TABLE 4-78** defines the Element Address Assignment page of the Mode Sense (10) command.

**TABLE 4-78** Element Address Assignment Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (1)	Rsvd (0)	Page Code (1Dh)					
1	Parameter Length (12h)							
2 to 3	(MSB)	First Medium Transport Element Address						(LSB)
4 to 5	(MSB)	Number of Medium Transport Elements						(LSB)
6 to 7	(MSB)	First Storage Element Address						(LSB)
8 to 9	(MSB)	Number of Storage Elements						(LSB)
10 to 11	(MSB)	First Import/Export Element Address						(LSB)
12 to 13	(MSB)	Number Import/Export Elements						(LSB)
14 to 15	(MSB)	First Data Transfer Element Address						(LSB)
16 to 17	(MSB)	Number Data Transfer Elements						(LSB)
18 to 19	Reserved (00h)							

**Element Address Assignment Page Definitions:**

<b>PS</b>	The Parameters Saveable bit specifies that the library can save this page to non-volatile memory and returns a value of 1.
<b>Page Code</b>	Identifies the Element Address Assignment mode page and returns a value of 1Dh.
<b>Parameter Length</b>	Indicates the amount of element address data following this byte and returns a value of 12h.
<b>First Medium Transport Element Address</b>	Identifies the address of the robot and returns a value of 0h.
<b>Number of Medium Transport Elements</b>	Identifies the number of hands within the library and returns a value of 0001h.
<b>First Storage Element Address</b>	Identifies the starting address of the cartridge tape storage cells. The default starting address is 03E8h.
<b>Number of Storage Elements</b>	Identifies the number of cartridge tape storage cells within the library. The total number of cartridge tape storage cells depends on how the library is configured.
<b>First Import / Export Element Address</b>	Identifies the address of the first Import/Export element. The default starting address is 000Ah.
<b>Number of Import / Export Elements</b>	Identifies the total number of import/export cells.
<b>First Data Transfer Element Address</b>	Identifies the address of the first tape transport installed in the library. The default address is 1F4h.
<b>Number of Data Transfer Elements</b>	Identifies the number of tape drives in the library, and the library returns the configured count.

## Transport Geometry Mode Page Definition

TABLE 4-79 defines the Mode Sense Transport Geometry Mode page.

**TABLE 4-79** Transport Geometry Mode Page

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

### Transport Geometry Mode Page Definitions:

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>Page Code</b>	This field identifies the Transport Geometry mode page. The library returns a value of 1Eh.
<b>Parameter Length</b>	This field indicates the number of additional types of transport geometry descriptor data to follow the header. Each descriptor has two bytes of information. The library has one transport mechanism and returns a value of 02h.
<b>Rotate</b>	This field identifies the ability of the transport mechanism to handle two-sided media. The library does not use multiple-sided media and returns a value of 0.
<b>Member Number in Transport Element Set</b>	This field identifies the specific transport element in the system to which this descriptor is applied. The library has one transport element and returns a value of 00h.

## Device Capabilities Page Definition

TABLE 4-80 defines the Device Capabilities page of the Mode Sense (10) command.

**TABLE 4-80** Device Capabilities Page

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS (0)	Rsvd (0)	Page Code (1Fh)					
1	Parameter Length (12h)							
2	Reserved (0h)				StorDT <sup>1</sup> (1)	StorI/E <sup>2</sup> (1)	StorST <sup>3</sup> (1)	StorMT <sup>4</sup> (0)
3	Reserved (0h)							
4	Reserved (0h)				MT->DT (0)	MT->I/E (0)	MT->ST (0)	MT->MT (0)
5	Reserved (0h)				ST->DT (1)	ST->I/E (1)	ST->ST (1)	ST->MT (0)
6	Reserved (0h)				I/E->DT (1)	I/E->I/E (1)	I/E->ST (1)	I/E->MT (0)
7	Reserved (0h)				DT->DT (1)	DT->I/E (1)	DT->ST (1)	DT->MT (0)
8 to 11	Reserved (00h)							
12	Reserved (0h)				MT<>DT (0)	MT<>I/E (0)	MT<>ST (0)	MT<>MT (0)
13	Reserved (0h)				ST<>DT (0)	ST<>I/E (0)	ST<>ST (0)	ST<>MT (0)
14	Reserved (0h)				I/E<>DT (0)	I/E<>I/E (0)	I/E<>ST (0)	I/E<>MT (0)
15	Reserved (0h)				DT->DT (0)	DT<>I/E (0)	DT<>ST (0)	DT<>MT (0)
16 to 19	Reserved (00h)							
<b>Notes:</b> DT - Data Transfer Element (tape drive) I/E = Import/Export Element (mailslot) ST = Storage Element (cartridge tape storage cell) MT= Medium Transport (hand)								

**Device Capabilities Page Definitions:**

<b>PS</b>	The Parameters Saveable bit is set to 0.
<b>Page Code</b>	The Page Code field identifies the Device Capabilities mode page and always contains a value of 1Fh.
<b>Parameter Length</b>	This field indicates the amount of device capabilities data following this byte. The library returns a value of 12h (18d).
<b>StorDT</b>	This field identifies the ability of a tape drive to perform the function of element storage. The library returns a value of 1.
<b>StorI/E</b>	This field identifies the ability of a mailslot cell to perform the function of element storage. The library returns a value of 1.
<b>StorST</b>	This field identifies the ability of the cartridge tape storage cells to perform the function of element storage. The library returns a value of 1.
<b>StorMT</b>	This field identifies the ability of the hand to perform the function of element storage. The hand cannot be used as the source or destination of a move. The library returns a value of 0.
<b>MT -&gt; DT</b>	This field identifies the support for the Move Medium command, where the source is the hand, and the destination is a tape drive. The library returns a value of 0.
<b>MT -&gt; I/E</b>	This field identifies the support for the Move Medium command, where the source is the hand, and the destination is a mailslot cell. The library returns a value of 0.
<b>MT -&gt; ST</b>	This field identifies the support for the Move Medium command, where the source is the hand, and the destination is a cartridge tape storage cell. The library returns a value of 0.
<b>MT -&gt; MT</b>	This field identifies the support for the Move Medium command, where both the source and the destination is the hand. The library returns a value of 0.
<b>ST -&gt; DT</b>	This field identifies the support for the Move Medium command, where the source is a cartridge tape storage cell, and the destination is a tape drive. The library returns a value of 1.
<b>ST -&gt; I/E</b>	This field identifies the support for the Move Medium command, where the source is a cartridge tape storage cell, and the destination is a mailslot cell. The library returns a value of 1.
<b>ST -&gt; ST</b>	This field identifies the support for the Move Medium command, where the source is a cartridge tape storage cell, and the destination is a cartridge tape storage cell. The library returns a value of 1.
<b>ST -&gt; MT</b>	This field identifies the support for the Move Medium command, where the source is a cartridge tape storage cell, and the destination is the hand. The library returns a value of 0.
<b>I/E -&gt; DT</b>	This field identifies the support for the Move Medium command, where the source is a mailslot cell, and the destination is a tape drive. The library returns a value of 1.

<b>I/E -&gt; I/E</b>	This field identifies the support for the Move Medium command, where both the source, and the destination is a mailslot cell. The library returns a value of 1.
<b>I/E -&gt; ST</b>	This field identifies the support for the Move Medium command, where the source is a mailslot cell, and the destination is a cartridge tape storage cell. The library returns a value of 1.
<b>I/E -&gt; MT</b>	This field identifies the support for the Move Medium command, where the source is a mailslot cell, and the destination is the hand. The library returns a value of 0.
<b>DT -&gt; DT</b>	This field identifies the support for the Move Medium command, where the source, and the destination is a tape drive. The library returns a value of 1.
<b>DT -&gt; I/E</b>	This field identifies the support for the Move Medium command, where the source is a tape drive, and the destination is a mailslot cell. The library returns a value of 1.
<b>DT -&gt; ST</b>	This field identifies the support for the Move Medium command, where the source is a tape drive, and the destination is a cartridge tape storage cell. The library returns a value of 1.
<b>DT -&gt; MT</b>	This field identifies the support for the Move Medium command, where the source is a tape drive, and the destination 1 element is the hand. The library returns a value of 0.
<b>MT &lt; &gt; DT</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are the hand, and the destination 1 element is a tape drive. The library returns a value of 0.
<b>MT &lt; &gt; I/E</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are the hand, and the destination 1 element is a mailslot cell. The library returns a value of 0.
<b>MT &lt; &gt; ST</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are the hand, and the destination 1 element is a cartridge tape storage cell. The library returns a value of 0.
<b>MT &lt; &gt; MT</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are the hand, and the destination 1 element is the hand. The library returns a value of 0.
<b>ST &lt; &gt; DT</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a cartridge tape storage cell, and the destination 1 element is a tape drive. The library returns a value of 0.
<b>ST &lt; &gt; I/E</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a cartridge tape storage cell, and the destination 1 element is a mailslot cell. The library returns a value of 0.
<b>ST &lt; &gt; ST</b>	This field identifies support for the Exchange Medium command, where the source and destination 2 elements are a cartridge tape storage cell, and the destination 1 element is a cartridge tape storage cell. The library returns a value of 0.

<b>ST &lt; &gt; MT</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a cartridge tape storage cell, and the destination 1 element is the hand. The library returns a value of 0.
<b>I/E &lt; &gt; DT</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a mailslot cell, and the destination 1 element is a tape drive. The library returns a value of 0.
<b>I/E &lt; &gt; I/E</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a mailslot cell, and the destination 1 element is a mailslot cell. The library returns a value of 0.
<b>I/E &lt; &gt; ST</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a mailslot cell, and the destination 1 element is a cartridge tape storage cell. The library returns a value of 0.
<b>I/E &lt; &gt; MT</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a mailslot cell, and the destination 1 element is the hand. The library returns a value of 0.
<b>DT &lt; &gt; DT</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a tape drive, and the destination 1 element is a tape drive. The library returns a value of 0.
<b>DT &lt; &gt; I/E</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a tape drive, and the destination 1 element is a mailslot cell. The library returns a value of 0.
<b>DT &lt; &gt; ST</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a tape drive, and the destination 1 element is a cartridge tape storage cell. The library returns a value of 0.
<b>DT &lt; &gt; MT</b>	This field identifies the support for the Exchange Medium command, where the source and destination 2 elements are a tape drive, and the destination 1 element is the hand. The library returns a value of 0.



# Move Medium

The Move Medium command (A5h) moves a cartridge tape from one specific element location to another specific element location.

The Mode Sense command provides a matrix with the valid source and destination element combinations for the Move Medium command.

When the destination element is a tape drive, the library performs the move motion, and waits until the tape drive load operation completes before returning status for the move command.

When the source element is a tape drive and the Move Option is set to 00b or 11b, the library unloads the tape from the drive and then moves the cartridge.

**TABLE 4-81** Move Medium Command

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

## Move Medium Command Definitions:

<b>Transport Element Address</b>	This field defines the robot element to use and should contain the element address 00h. A value of 00h indicates use of the default hand.  If any other value is entered it will be ignored.
<b>Source Element Address</b>	This field is the element address from which the cartridge tape is to be removed. This may be a storage cell, a mailslot cell, or a tape drive.
<b>Destination Element Address</b>	This field is the element address where the cartridge tape is to be placed.  This may be a storage cell, a mailslot cell, or a tape drive.
<b>Invert</b>	The library does not support this function and requires a value of 0.

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<b>Move Option</b>	<p>These two bits define optional operations associated with the Move Medium command.</p> <p>00 = The library performs a normal move medium operation. If the source element is a data transfer element and there is a cartridge in the data transfer element, the library unloads the cartridge in the data transfer element and then performs the move operation.</p> <p>10 = The library performs a mount operation with write protect enabled. That is, the user can read the data on the cartridge but cannot write to the cartridge. This option is valid only when the destination element address is a data transfer element. If the destination data transfer element (tape drive) does not support this feature or fails to acknowledge the write-protected mount option, the mount fails. In either case, the library returns the Hardware Error sense key (04) with an ASC of 40 and an ASCQ of 02 (Drive Error).</p> <p>11 = The data transfer element specified in the source element field performs a rewind, followed by a unload operation and then the move medium operation. This option is valid only when the source element address is a data transfer element.</p>
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## Persistent Reserve In

The Persistent Reserve In (5Eh) and Persistent Reserve Out (5Fh) commands resolve contention among multiple initiators and multiple-port targets within the system.

The Persistent Reserve In command is used by initiators to obtain information about active registrations or an active reservation.

**TABLE 4-82** Persistent Reserve In Command

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

### Persistent Reserve In Command Descriptions:

<b>Service Action</b>	<p>This field defines the type of request that is being made to the initiator.</p> <p>Valid values are 00h, 01h, 02h, and 03h.</p> <p>00h = Returns Read Keys Data (see <a href="#">TABLE 4-83</a>)</p> <p>01h = Returns Read Reservations Data (see <a href="#">TABLE 4-84</a>)</p> <p>02h = Returns Report Capabilities Data (see <a href="#">TABLE 4-86</a>)</p> <p>03h = Returns Full Status Data (see <a href="#">TABLE 4-88</a>)</p> <p>Values 04h through 1Fh are reserved.</p>
<b>Allocation Length</b>	<p>This field indicates how much space has been 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.</p>

## Read Keys Data

The Read Keys service action requests that the library returns a list of all the current Reservation keys it has registered.

TABLE 4-83 shows the format of the parameter data returned in response to a Persistent Reserve In command with the Read Keys service action.

**TABLE 4-83** Read Keys Data

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

### Read Keys Data Definitions:

<b>PRGeneration</b>	<p>This value is a 32-bit counter that is incremented every time a Persistent Reserve Out command requests a Register, Register &amp; Ignore, a Clear, a Preempt, or a Preempt and Abort operation.</p> <p>It allows the application client to determine if another application client has changed the configuration.</p> <p>This counter is set to zero after a Power-On-Reset.</p>
<b>Additional Length</b>	This field indicates the number of bytes in the reservation key list.
<b>Reservation Key List</b>	These fields contain all the eight-byte reservation keys that have been registered with the library through a Persistent Reserve Out command.

## Read Reservations Data

The Read Reservations service action requests that the library return a description of all current Reservation keys it has registered.

See [TABLE 4-84](#) for the format of the parameter data returned in response to a Persistent Reserve In command with the Read Reservations service action.

**TABLE 4-84** Read Reservations Data

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

### Read Reservations Data Definitions:

<b>PRGeneration</b>	<p>This value is a 32-bit counter that is incremented every time a Persistent Reserve Out command requests a Register, Register &amp; Ignore, a Clear, a Preempt, or a Preempt and Abort operation.</p> <p>It allows the application client to determine if another application client has changed the configuration.</p> <p>This counter is set to zero after a Power-On-Reset.</p>
<b>Additional Length</b>	<p>This field indicates the number of bytes in the list of reservation descriptors:  0 = No Reservation held  16 = Active Reservation Data</p>
<b>Reservation Descriptors</b>	<p>Each persistent reservation for a logical unit has one reservation descriptor that has the format shown in <a href="#">TABLE 4-85</a>.</p>

**TABLE 4-85** Reservation Descriptors Format

Byte	Bit							
	7	6	5	4	3	2	1	0
0 to 7	(MSB) Reservation Key (LSB)							
8 to 11	(MSB) Obsolete (LSB)							
12	Reserved (00h)							
13	Scope				Type			
14 to 15	Obsolete (00h)							

**Reservation Descriptors Format Definitions:**

<b>Reservation Key</b>	This value indicates the reservation key for the descriptor data that follows.
<b>Scope</b>	<p>The value in the Scope field indicates whether a persistent reservation applies to an entire logical unit or to an element. The only valid value is 0h.</p> <p>0h = The persistent reservation applies to the logical unit</p>
<b>Type</b>	<p>This value specifies the characteristics of the persistent reservation.</p> <p>Valid values are 3h, 6h, and 8h.</p> <p>3h = Exclusive Access: This value indicates that the initiator holding the persistent reservation has exclusive access. Some commands (such as Move Medium) are only allowed for the persistent reservation holder.</p> <p>6h = Exclusive Access, Registrants Only: This value indicates that any currently registered initiator has exclusive access. Some commands (such as Move Medium) are only allowed for registered I_T nexuses.</p> <p>8h = Exclusive Access, Registrants Only: This value indicates that any currently registered initiator has exclusive access. Some commands (such as Move Medium) are only allowed for registered I_T nexuses.</p>

## Report Capabilities Data

The format for the parameter data provided in response to a Persistent Reserve In command with the Report Capabilities service action is shown in [TABLE 4-86](#).

**TABLE 4-86** Report Capabilities Data

Byte	Bit							
	7	6	5	4	3	2	1	0
0 to 1	(MSB)  Length (0008h)   							

### Report Capabilities Data Definitions:

<b>Length</b>	This field indicates the length in bytes of the parameter data.
<b>CRH</b>	The Compatibility Reservation Handling bit is set to a value of 1 indicating the library supports the exceptions to the SPC-2 RESERVE and RELEASE commands as described in SPC-3.
<b>SIP_C</b>	The library will return a value of 1 for the Specify Initiator Ports Capable bit, indicating the SPEC_I_PT bit in the PERSISTENT RESERVE OUT command parameter data is supported.
<b>ATP_C</b>	All Target Ports Capable bit  0 = The library does not support the ALL_TG_PT bit in the PERSISTENT RESERVE OUT command parameter data. 1 = The library supports the ALL_TG_PT bit in the PERSISTENT RESERVE OUT command parameter data.
<b>PTPL_C</b>	Persist Through Power Loss Capable bit  0 = The library does not support the persist through power loss capability for persistent reservations and the APTPL bit in the in PERSISTENT RESERVE OUT command parameter data 1 = The library supports the persist through power loss capability for persistent reservations and the APTPL bit in the in PERSISTENT RESERVE OUT command parameter data

<b>TMV</b>	Type Mask Valid bit  0 = The PERSISTENT RESERVATION TYPE MASK field shall be ignored 1 = The PERSISTENT RESERVATION TYPE MASK field contains a bit map indicating which persistent reservation types are supported by the library.
<b>PTPL_A</b>	Persist Through Power Loss Activated bit  0 = The persist through power loss capability is not activated. 1 = The persist through power loss capability is activated.

The Persistent Reservation Type Mask field contains a bit map that indicates the persistent reservation types that are supported by the library.

**TABLE 4-87** Read Reservations Parameter Data

Byte	Bit							
	7	6	5	4	3	2	1	0
4	WR_EX_AR (0)	EX_AC_RO (1)	WR_EX_RO (0)	Rsvd	EX_AC (1)	Rsvd	WR_EX (0)	Rsvd
5	Reserved							EX_AC_AR (0)

**Read Reservations Parameter Data Definitions:**

<b>WR_EX_AR</b>	The library returns a value of 0, indicating the Write Exclusive-All Registrants persistent reservation type is not supported.
<b>EX_AC_RO</b>	The library returns a value of 1, indicating the Exclusive Access-Registrants Only persistent reservation type is supported.
<b>WR_EX_RO</b>	The library returns a value of 0, indicating the Write Exclusive-Registrants Only persistent reservation type is not supported.
<b>EX_AC</b>	The library returns a value of 1, indicating the Exclusive Access- persistent reservation type is supported.
<b>WR_EX</b>	The library returns a value of 0, indicating the Write Exclusive persistent reservation type is not supported.
<b>EX_AC_AR</b>	The library returns a value of 0, indicating the Exclusive Access-All Registrants persistent reservation type is not supported.



## Read Full Status Data

The Read Full Status service action requests that the library return a list of all the current Reservation keys it has registered along with information about each initiator.

[TABLE 4-88](#) shows the format of the parameter data returned in response to a Persistent Reserve In command with the Read Full Status service action.

**TABLE 4-88** Read Full Status Data

Byte	Bit							
	7	6	5	4	3	2	1	0
0 to 3	(MSB)  PRGeneration   <							

### Read Full Status Data Definitions:

<b>PRGeneration</b>	<p>This value is a 32-bit counter that is incremented every time a Persistent Reserve Out command requests a Register, Register &amp; Ignore, a Clear, a Preempt, or a Preempt and Abort operation.</p> <p>It allows the application client to determine if another application client has changed the configuration.</p> <p>This counter is set to zero after a Power-On-Reset.</p>
<b>Additional Length</b>	This field indicates the number of bytes in the list of full status descriptors
<b>Full Status Descriptor</b>	See <a href="#">TABLE 4-89</a> for more information.

**TABLE 4-89** Read Full Status Descriptor Data

Byte	Bit							
	7	6	5	4	3	2	1	0
0 to 7	(MSB) Reservation Key (LSB)							
8 to 11	(MSB) Reserved (LSB)							
12	Reserved						ALL_TG_PT	R_HOLD_ER
13	Scope				Type			
14 to 17	(MSB) Reserved (LSB)							
18 to 19	(MSB) Relative Target Port Identifier (LSB)							
20 to 23	(MSB) Additional Descriptor Length (18h) (LSB)							
24 to 47	(MSB) Transport ID Data (LSB)							

**Read Full Status Descriptor Data Definitions:**

Reservation Key	This value indicates the reservation key for the descriptor data that follows.
ALL_TG_PT	<p>A value of 0 in the All Target Port Groups bit indicates this full status descriptor represents a single I_T nexus.</p> <p>A value of 1 in the All Target Port Groups bit indicates that:</p> <ul style="list-style-type: none"> <li>• This full status descriptor represents all the I_T nexuses that are associated with both: <ul style="list-style-type: none"> <li>• The initiator port specified by the Transport ID Data; and</li> <li>• Every target port in the SCSI target device;</li> </ul> </li> <li>• All the I_T nexuses are registered with the same reservation key; and</li> <li>• All the I_T nexuses are either reservation holders or not reservation holders as indicated by the R HOLDER bit.</li> </ul>

**Read Full Status Descriptor Data Definitions:**

R_Holder	The Reservation Holder Bit is defined as follows:  0 = All I_T nexuses described by this full status descriptor are registered but are not persistent reservation holders. 1 = All I_T nexuses described by this full status descriptor are registered and are persistent reservation holders.
Type	When the Reservation Holder Bit is 1, this field indicates the type of Persistent Reservation:  3h = Exclusive Access 6h = Exclusive Access - Registrants Only 8h = Exclusive Access - All Registrants
Relative Target Port Identifier	1 = Target Port 1 2 = Target Port 2
Transport ID Data	This field identifies the initiator port that is part of the I_T nexus or I_T nexuses described by this full status descriptor.  <ul style="list-style-type: none"> <li>TABLE 4-90 shows the Transport ID returned for a Fibre Channel Host.</li> <li>TABLE 4-91 shows the transport ID data returned for a SAS Host.</li> </ul>

**TABLE 4-90** Fibre Channel Transport ID Data

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Format Code (00b)		Reserved		Protocol Identifier (0h)			
1 to 7	Reserved							
8 to 15	N_Port_Name							
16 to 23	Reserved							

**Fibre Channel Transport ID Data Definitions:**

Protocol Identifier	This field is set to 0h indicating the Fibre Channel protocol
N_PORT_NAME	This field specifies the N_Port_Name that is returned by the initiator in the PLOGI extended link service frame.

**TABLE 4-91** SAS Transport ID Data

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Format Code (00b)		Reserved		Protocol Identifier (6h)			
1 - 3	Reserved							
4 - 11	SAS Address							
12 - 23	Reserved							

**SAS Transport ID Data Definitions:**

Protocol Identifier	This field is set to 6h indicating the Serial Attached SCSI protocol
SAS Address	This field specifies the SAS Address of the Initiator Port.

## Persistent Reserve Out

The Persistent Reserve Out (5Fh) command reserves a target for the exclusive or shared use of an initiator.

**TABLE 4-92** Persistent Reserve Out Command

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

**Persistent Reserve Out Command Definitions:**

<b>Service Action</b>	<p>This value indicates the action that will result from the Persistent Reservation Command:</p> <p>00h = Register: Register or Unregister a reservation key with the library without generating a reservation.</p> <p>01h = Reserve: Create a persistent reservation of the scope and type specified in Byte 2.</p> <p>02h = Release: Remove an active persistent reservation.</p> <p>03h = Clear: Clear all persistent reservations for all initiators and reset all reservation keys to 0, if the requesting initiator is registered.</p>
<b>Service Action (Continued)</b>	<p>04h = Preempt: Remove all reservations and registrations for the initiators associated with the service action reservation key in the parameter list.</p> <p>05h = Preempt and Abort: Perform a Preempt action and, additionally, clear the task set for all initiators associated with the service action reservation key. Also, clear any mailslot locks and contingent allegiance in effect for these initiators.</p> <p>06h = Register and Ignore Existing Key: Register a reservation key with the library</p> <p>07h = Register and Move: Register a reservation key for another I_T nexus with the device server and move a persistent reservation to that I_T nexus.</p>
<b>Scope</b>	<p>The value in the Scope field indicates whether a persistent reservation applies to an entire logical unit or to an element. The only valid value is 0h.</p> <p>0h = The persistent reservation applies to the logical unit</p>
<b>Type</b>	<p>This value specifies the characteristics of the persistent reservation. Valid values are 3h, 6h and 8h.</p> <p>3h = Exclusive Access: Some commands (for example, Move Medium) are only allowed for the persistent reservation holder. There is only 1 persistent reservation holder.</p> <p>6h = Exclusive Access, Registrants Only: Some commands (for example, Move Medium) are only allowed for registered I_T nexuses. There is only 1 persistent reservation holder.</p> <p>8h = Exclusive Access, All Registrants: Some commands (for example, Move Medium) are only allowed for registered I_T nexuses. Each registered I_T nexus is a persistent reservation holder.</p>
<b>Parameter List Length</b>	<p>The parameter data for the Persistent Reserve Out command includes all fields, even when a field is not required for the specified service action.</p>

The parameter list for the Persistent Reserve Out command has this format:

**TABLE 4-93** Persistent Reserve Out Parameter List

Byte	Bit							
	7	6	5	4	3	2	1	0
0 to 7	(MSB) Reservation Key (LSB)							
8 to 15	(MSB) Service Action Reservation Key (LSB)							
16 to 19	(MSB) Obsolete (LSB)							
20	Reserved (0h)				SPEC-I-PT	ALL-TGT-PT (0)	Rsvd (0)	APTPL
21	Reserved (00h)							
22 to 23	Obsolete (00h)							

**Persistent Reserve Out Parameter List Definitions:**

<b>Reservation Key</b>	This field contains an eight-byte value that identifies the initiator.
<b>Service Action Reservation Key</b>	This field contains information needed for five service actions: Register, Register and Ignore Existing Key, Preempt, Preempt and Abort, and Register and Move.
<b>SPEC_I_PT</b>	<p>The Specify Initiator Ports bit is only applicable to the Register and Register and Ignore Service Actions:</p> <p>0 = The library shall apply the registration only to the I_T nexus that sent the Persistent Reservation Out command.</p> <p>1 = The additional parameter data shall include a list of Transport IDs and the library shall also apply the registration to the I_T nexus for each initiator port specified by a TransportID.</p>
<b>ALL-TG-PT</b>	The All Target Ports bit is not supported and must be set to 0.
<b>APTPL</b>	<p>The Activate Persist Through Power Loss bit is only valid for the Register, Register and Ignore, and Register and Move service actions and is defined as follows:</p> <p>0 = The library shall not preserve any persistent reservation and all registrations if power is lost and later returned.</p> <p>1 = The library preserves any persistent reservation and all registrations if power is lost and later returned.</p>

[TABLE 4-94](#) summarizes which fields are set by the application client and interpreted by the library for each service action and scope value.

**TABLE 4-94** Persistent Reserve Out Service Actions and Valid Parameters

Service Action	Allowed Scope	Type	Reservation Key	Service Action Reservation Key	APTPL	ALL_TG_PT	SPEC_I_PT
REGISTER	ignored	ignored	valid	valid	valid	valid	valid
REGISTER AND IGNORE EXISTING KEYS	ignored	ignored	ignored	valid	valid	valid	valid
RESERVE	LU_SCOPE	valid	valid	ignored	ignored	ignored	ignored
RELEASE	LU_SCOPE	valid	valid	ignored	ignored	ignored	ignored
CLEAR	ignored	ignored	valid	ignored	ignored	ignored	ignored
PRE-EMPT	LU_SCOPE	valid	valid	valid	ignored	ignored	ignored
PRE-EMPT & ABORT	LU_SCOPE	valid	valid	valid	ignored	ignored	ignored
Register & Move	LU_SCOPE	valid	valid	valid	valid	valid	ignored

**TABLE 4-95** Service Action Reservation Key Information

If the service action is...	Then the information in the field is...
Register	the new reservation key to be registered
Register and Ignore Existing Key	the new reservation key to be registered
Preempt	the reservation key of the persistent reservation being pre-empted
Preempt and Abort	the reservation key of the persistent reservation being pre-empted
Register and Move	the reservation key to be registered on the specified I_T nexus.
See list of service action values <a href="#">on page 166</a> .	



## Position to Element

The Position to Element command (2Bh) is supported only for compatibility with existing applications. It causes the hand to be positioned to the specified destination element address.

**TABLE 4-96** Position to Element Command

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

### Position to Element Command Definitions:

<b>Transport Element Address</b>	This field defines the hand element to use and should contain the element address of the hand or 00h (0d). A value of 00h (0d) indicates use of the default hand.
<b>Destination Element Address</b>	This field defines the address of the element where the hand is to be positioned.
<b>Invert</b>	The library does not support this function and requires a value of 0.

## Prevent/Allow Medium Removal

The Prevent/Allow Medium Removal command (1Eh) requests that the library enable or disable operator access to the mailslot and magazine(s).

- If allowed, the mailslot and magazine(s) are unlocked. The mailslot may be opened and the magazine(s) may be unlatched from the user interface.
- If prevented, the mailslot and magazine(s) are locked. The mailslot cannot be opened and the magazine(s) cannot be unlatched from the user interface.

This command is independent of device reservations if the Prevent bit is 0.

The library keeps Prevent/Allow data on a per-initiator basis.

- If any initiator has set a prevent state, the library prevents anyone from opening the mailslot or unlatching the magazine(s).

During power-on and following a reset, all initiators are set to an allow state, which enables user interface access to the mailslot and magazine(s).

**TABLE 4-97** Prevent/Allow Medium Removal Command

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

### Prevent/Allow Medium Removal Command Definitions:

#### Prevent Bit

The Prevent bit values are:

0 = Allow access to the mailslot and magazine(s).

1 = Prevent access to the mailslot and magazine(s).

## Read Element Status

The Read Element Status command (B8h) requests that the library return the status of the elements in the library.

**TABLE 4-98** Read Element Status Command

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

### Read Element Status Command Definitions:

<b>VolTag</b>	<p>This bit indicates whether volume tag (VolTag) information is to be reported in response to this command:</p> <p>0 = Volume Tag information is not reported</p> <p>1 = Volume Tag information is reported.</p>
<b>Element Type Code</b>	<p>This field specifies the particular element types selected for reporting:</p> <p>0h = All Element Types reported</p> <p>1h = Medium Transport Element (hand)</p> <p>2h = Storage Element (cartridge tape storage cells)</p> <p>3h = Import/Export Element (mailslot)</p> <p>4h = Data Transfer Element (tape drive)</p> <p>For an Element Type Code of 0h, the element types are reported in ascending element address order, beginning with the first element greater than or equal to the Starting Element Address.</p>

<b>Starting Element Address</b>	<p>This field specifies the minimum element address to report. Only elements with an element address greater than or equal to the Starting Element Address are reported.</p> <p>Element descriptor blocks are not generated for undefined element addresses.</p> <p>The Starting Element Address is set to a valid address for the library but does not have to be an address of the type requested in the Element Type Code.</p>
<b>Number of Elements</b>	<p>This field represents the maximum number of element descriptors to be transferred. This is an actual number of element descriptors to be transferred, not an element address range.</p>
<b>CurData</b>	<p>The current data bit specifies that the library shall return element status data without causing device motion.</p> <p>0 = Library operations are normal, and library mechanics may become active if needed to gather element static data.</p> <p>1 = The library is responding with data only; no mechanical operations are active</p> <p>The CurData bit is effectively ignored by the library. The library will perform or not perform mechanical operations to obtain proper information at it's discretion independently of the setting of this bit.</p>
<b>DvcID</b>	<p>The device identification bit indicates whether the return data will contain device identification information.</p> <p>0 = The library will not return device identification information.</p> <p>1 = The library will return device identification information only for data transfer elements.</p>
<b>Allocation Length</b>	<p>This field specifies the length in bytes of the space allocated by the initiator for the transfer of element descriptors. Only complete element descriptors are transferred. Element descriptors are transferred until one of the following conditions is met:</p> <p>All available element descriptors of the type specified in the Element Type Code have been transferred.</p> <p>The number of element descriptors specified in the Number of Elements field have been transferred.</p> <p>There is less allocation length space available than required for the next complete element descriptor or header to be transferred.</p>

## Read Element Status Data

The library returns data for a Read Element Status command with this structure:

- An eight-byte Element Status Data header, followed by
  - One to four element pages, one page per element type.

A page consists of:

- An eight-byte Element Status Page header, followed by
  - One or more Element Descriptors. The format of the descriptor is based on the element type reported in this page. Each element type receives a separate Element Descriptor format.

Data can be truncated based on the length specified in the allocation field.

## Element Status Data Header Definition

The library sends this header once for each Read Element Status command.

**TABLE 4-99** Element Status Data Header Definition

Byte	Bit							
	7	6	5	4	3	2	1	0
0 to 1	(MSB) First Element Address Reported (LSB)							
2 to 3	(MSB) Number of Elements Available (LSB)							
4	Reserved (00h)							
5 to 7	(MSB) Byte Count of Report Available (all pages, n-7) (LSB)							
8 to n	Element Status pages							

### Element Status Data Header Definitions:

<b>First Element Address Reported</b>	This field indicates the lowest element address found of the type specified in the Element Type Codes and greater than or equal to the Starting Element Address.
<b>Number of Elements Available</b>	This field indicates the number of elements found of the type specified in the Element Type Codes and greater than or equal to the Starting Element Address. This number is adjusted to be less than or equal to the count specified in the Number of Elements field in the Read Element Status command.
<b>Byte Count of Report Available</b>	This field indicates the number of bytes of element status data available for all elements meeting the requirements of the Read Element Status command. This count does not include the Element Status Data header bytes. This value is not adjusted to match the allocation length from the command.

## Element Status Page Header Definition

The library sends this header once for each type of element descriptors.

**TABLE 4-100** Element Status Page Header

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Reserved				Element Type Code			
1	PVolTag	AVolTag (0)	Reserved (0)					
2 to 3	(MSB)  Element Descriptor Length   <							

### Element Status Page Header Definitions:

<b>Element Type Code</b>	<p>This field indicates the specific element type being reported by this element descriptor page.</p> <p>The types are:</p> <p>01h = Medium Transport Element (hand)  02h = Storage Element (cartridge tape storage cells)  03h = Import/Export Element (mailslot cells)  04h = Data Transfer Element (tape drive)</p>
<b>PVolTag</b>	<p>This bit indicates if primary volume tag (PVolTag) information has been requested and is present. The possible values indicate:</p> <p>0 = Volume Tag information has not been requested. The data is omitted from the element descriptors.</p> <p>1 = Volume Tag information has been requested to be reported and is present.</p>
<b>AVolTag</b>	<p>The library does not support alternative volume tags (AVolTag) and returns a value of 0.</p>
<b>Element Descriptor Length</b>	<p>This field indicates the total number of bytes contained in a single element descriptor.</p>

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<b>Byte Count of Descriptor Data Available</b>	<p>This field indicates the total number of bytes of element descriptor data available for the elements of this element type that meet the requirements of the Read Element Status command. This count does not include the Element Status Page header bytes.</p> <p>This value is not adjusted to match the allocation length.</p>
<b>Element Descriptors</b>	<p>The following sections contain the field definitions for the four types of library elements, which are:</p> <p>Medium Transport Element (the hand)</p> <p>Storage Element (cartridge tape storage cells)</p> <p>Import/Export Element (mailslot cells)</p> <p>Data Transfer Element (tape drives)</p> <p>Each element descriptor includes the element address and status flags. Each element descriptor might also contain sense key information as well as other information, depending on the element type.</p> <p>The element descriptors for the four types of elements are similar, with the exception of a few fields. Note: The differences in Bytes 02, 06, and 07 for the four element descriptors.</p> <p>The library does not support alternate volume tags. This information is not included in any of the element descriptors.</p>

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## Medium Transport Element Descriptor Definition

Medium transport elements are robotic components capable of physically moving cartridges. The Medium Transport Element Descriptor defines the robot characteristics.

**TABLE 4-101** Medium Transport Element Descriptor

Byte	Bit							
	7	6	5	4	3	2	1	0
0 to 1	(MSB) Element Address (LSB)							
2	Reserved (00h)					Except	Rsvd (0)	Full
3	Reserved (00h)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Reserved (00h)							
7	Reserved (00h)							
8	Reserved (00h)							
9	SValid	Invert (0)	Reserved (00h)		ED	Medium Type		
10 to 11	(MSB) Source Storage Element Address (LSB)							
12 to 47	Primary Volume Tag Information Field omitted if PVolTag=0							
48	Reserved (0h)				Code Set (0)			
49	Reserved (0h)				Identifier Type (0)			
50	Reserved (00h)							
51	Identifier Length (0)							
52	Media Domain Field moved up if Primary Volume Tag Information is omitted.							
53	Media Type Field moved up if Primary Volume Tag Information is omitted.							
54 to 55	Reserved (00h) Field moved up if Primary Volume Tag Information is omitted.							



**Medium Transport Element Descriptor Definitions:**

<b>Element Address</b>	This field contains the element address of the robot.
<b>Except</b>	<p>This bit indicates the current operational state of the robot:</p> <p>0 = The hand is operational.</p> <p>1 = The hand 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.</p>
<b>Full</b>	<p>This bit indicates if the hand contains a cartridge tape:</p> <p>0 = The hand does not contain a cartridge tape.</p> <p>1 = The hand contains a cartridge tape.</p> <p>An initiator would see a cartridge in the hand during a Read Element Status only in the case of an anomaly.</p>
<b>Additional Sense Code</b>	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.
<b>Additional Sense Code Qualifier</b>	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.
<b>SValid</b>	<p>This bit indicates if the Source Element Address and Invert fields are valid:</p> <p>0 = The Source Element Address and Invert fields are not valid.</p> <p>1 = The Source Element Address and Invert fields are valid.</p>
<b>Invert</b>	The library does not support multi-sided media and returns a value of 0.
<b>ED</b>	<p>0 = The element is enabled (for example a magazine or drive has been installed or has been logically enabled)</p> <p>1 = The element is disabled</p>
<b>Medium Type</b>	<p>This field provides the type of medium currently present in the element as determined by the medium changer.</p> <p>The library returns the following values:</p> <p>0h = Unspecified - the medium changer cannot determine the medium type.</p> <p>1h = Data Medium</p> <p>2h = Cleaning Medium</p>
<b>Source Storage Element Address</b>	This field is valid only if the SValid field is 1. This field contains the address of the last element from which the data cartridge was moved.

<b>Primary Volume Tag Information</b>	<p>When the PVolTag bit is set to 1, the library returns volume tag information. When PVolTag is set to 0, this field is omitted, and the reserved fields below it are moved up.</p> <p>The library volume tag information includes six bytes of left-justified ASCII data that represents volume/serial number data from the cartridge tape.</p> <p>The field is padded to 32 bytes with 26 ASCII spaces. If the label on the cartridge tape is not readable, these 32 bytes will be set to 0.</p> <p>The last four bytes of the Volume Tag Information typically consist of two reserved bytes and two volume sequence bytes. The library does not support sequence numbers. These four bytes are set to 0.</p>
<b>Code Set</b>	<p>This field specifies the code set used for the identifier field and is set to 0 (not supported) for the Medium Transport Element Descriptor:</p> <p>0h = Reserved</p>
<b>Identifier Type</b>	<p>The Identifier Type field indicates the format and assignment authority for the identifier and is set to 0 (not supported) for the Medium Transport Element Descriptor: 0h = Vendor Specific</p>
<b>Identifier Length</b>	<p>This field indicates the length of the Identifier field and is set to 0 (not supported) for the Medium Transport Element Descriptor. Note: That the combined length of the identifier field and the Identifier Pad is 32 bytes.</p>
<b>Media Domain</b>	<p>The Media Domain field along with the Media Type field provides a hierarchy of information that indicates the type of media in the element:</p> <p>43h = The element contains an LTO (or future) cleaning form factor cartridge (43h is 'C').</p> <p>4Ch = The element contains an LTO form factor cartridge (4Ch is 'L').</p> <p>FFh = The media domain cannot be determined.</p> <p>This field is not valid if the Full bit is not set.</p>

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<b>Media Type</b>	<p>The Media Type field along with the Media Domain field provides a hierarchy of information that indicates the type of media in the element.</p> <p>If the Media Domain field is 43h (43h is 'C'), the value reported for the Media Type field identifies in ASCII the type of LTO cleaning cartridge:</p> <ul style="list-style-type: none"> <li>1 = The element contains an HP Generation 1 LTO cleaning cartridge.</li> <li>2 = The element contains an IBM Generation 1 LTO cleaning cartridge.</li> <li>3 = The element contains a Quantum Generation 1 LTO cleaning cartridge.</li> <li>U = The element contains a Universal LTO cleaning cartridge.</li> <li>FFh = The media type cannot be determined.</li> </ul> <p>This field is not valid if the Full bit is not set.</p> <p>If the Media Domain field is 4Ch (4Ch is 'L'), the value reported for the Media Type field identifies in ASCII the type of LTO cartridge:</p> <ul style="list-style-type: none"> <li>1 = The element contains a 100 GB Generation 1 LTO cartridge.</li> <li>2 = The element contains a 200 GB Generation 2 LTO cartridge.</li> <li>3 = The element contains a 400 GB Generation 3 LTO cartridge.</li> <li>4 = The element contains an 800 GB Generation 4 LTO cartridge.</li> <li>5 = The element contains a 1500 GB Generation 5 LTO cartridge.</li> <li>T = The element contains a 400 GB Generation 3 LTO WORM cartridge.</li> <li>U = The element contains an 800 GB Generation 4 LTO WORM cartridge.</li> <li>V = The element contains a 1500 GB Generation 5 LTO WORM cartridge.</li> <li>FFh = The media type cannot be determined</li> </ul> <p>This field is not valid if the Full bit is not set.</p>
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## Storage Element Descriptor Definition

Storage elements are the main cartridge tape storage cells of the library. The Storage Element Descriptor describes a storage cell.

**TABLE 4-102** Storage Element Descriptor

Byte	Bit							
	7	6	5	4	3	2	1	0
0 to 1	(MSB) Element Address (LSB)							
2	Reserved (00h)				Access (1)	Except	Rsvd (0)	Full
3	Reserved (00h)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Reserved (00h)							
7	Reserved (00h)							
8	Reserved (00h)							
9	SValid	Invert (0)	Reserved (00h)		ED	Medium Type		
10 to 11	(MSB) Source Storage Element Address (LSB)							
12 to 47	Primary Volume Tag Information (Field omitted if PVolTag=0)							
48	Reserved (0h)				Code Set (0)			
49	Reserved (0h)				Identifier Type (0)			
50	Reserved (00h)							
51	Identifier Length (0)							
52	Media Domain (Field moved up if Primary Volume Tag Information omitted.)							
53	Media Type (Field moved up if Primary Volume Tag Information omitted.)							
54 to 55	Reserved (00h, 00h) (Field moved up if Primary Volume Tag Information omitted.)							

**Storage Element Descriptor Definitions:**

<b>Element Address</b>	This field contains the element address of the storage element reported.
<b>Access</b>	This bit indicates access is allowed to the storage element by the hand. The library returns a value of 1.
<b>Except</b>	This bit indicates the operational state of the storage element: 0 = The storage element is in a normal state. 1 = The storage element is in an abnormal state, and the Additional Sense Code and the Additional Sense Code Qualifier fields contain information regarding the abnormal state. Other fields in the descriptor might be invalid, and should be ignored.
<b>Full</b>	This field indicates if the storage element contains a cartridge tape: 0 = The storage element does not contain a cartridge tape. 1 = The storage element does contain a cartridge tape.
<b>Additional Sense Code</b>	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.
<b>Additional Sense Code Qualifier</b>	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.
<b>SValid</b>	This bit indicates if the Source Element Address and Invert fields are valid: 0 = The Source Element Address and Invert fields are not valid. 1 = The Source Element Address and Invert fields are valid.
<b>Invert</b>	The library does not support multi-sided media and returns a value of 0.
<b>ED</b>	0 = The element is enabled (for example a magazine or drive has been installed or has been logically enabled) 1 = The element is disabled.
<b>Medium Type</b>	This field provides the type of medium currently present in the element as determined by the medium changer. The library returns the following values: 0h = Unspecified - the medium changer cannot determine the medium type. 1h = Data Medium 2h = Cleaning Medium
<b>Source Storage Element Address</b>	This field is valid only if the SValid bit is 1. It contains the address of the last element from which the data cartridge was moved.
<b>Primary Volume Tag Information</b>	When the PVolTag bit is set to 1, the library returns Volume Tag Information. When PVolTag is set to 0, this field is omitted, and the reserved fields below it are moved up. The library Volume Tag Information includes six bytes of left-justified ASCII data, which represents volume/serial number data from the cartridge tape. The field is padded to 32 bytes with 26 ASCII spaces. If the label on the cartridge tape is not readable, these 32 bytes are set to 0. The last four bytes of the Volume Tag Information typically consist of two reserved bytes and 2 volume sequence bytes. The library does not support sequence numbers. These four bytes are set to 0.

<b>Code Set</b>	This field specifies the code set used for the identifier field and is set to 0 (not supported) for the Storage Element Descriptor: 0h = Reserved.
<b>Identifier Type</b>	The Identifier Type field indicates the format and assignment authority for the identifier and is set to 0 (not supported) for the Storage Element Descriptor:  0h = Vendor Specific
<b>Identifier Length</b>	This field indicates the length of the Identifier field and is set to 0 (not supported) for the Storage Element Descriptor. Note that the combined length of the identifier field and the Identifier Pad is 32 bytes.
<b>Media Domain</b>	The Media Domain field along with the Media Type field provides a hierarchy of information that indicates the type of media in the element:  43h = The element contains an LTO (or future) cleaning form factor cartridge (43h is 'C').  4Ch = The element contains an LTO form factor cartridge (4Ch is 'L').  FFh = The media domain cannot be determined.  This field is not valid if the Full bit is not set.
<b>Media Type</b>	The Media Type field along with the Media Domain field provides a hierarchy of information that indicates the type of media in the element.  If the Media Domain field is 43h (43h is 'C'), the value reported for the Media Type field identifies in ASCII the type of LTO cleaning cartridge:  1 = The element contains an HP Generation 1 LTO cleaning cartridge. 2 = The element contains an IBM Generation 1 LTO cleaning cartridge. 3 = The element contains a Quantum Generation 1 LTO cleaning cartridge. U = The element contains a Universal LTO cleaning cartridge. FFh = The media type cannot be determined.  If the Media Domain field is 4Ch (4Ch is 'L'), the value reported for the Media Type field identifies in ASCII the type of LTO cartridge:  1 = The element contains a 100 GB Generation 1 LTO cartridge. 2 = The element contains a 200 GB Generation 2 LTO cartridge. 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 1500 GB Generation 5 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 1500 GB Generation 5 LTO WORM cartridge. FFh = The media type cannot be determined.  This field is not valid if the Full bit is not set.

## Import/Export Element Descriptor Definitions

Import/Export elements are the mailslot of the library. The Import/Export Element Descriptor describes a mailslot cell.

**TABLE 4-103** Import/Export Element Descriptor

Byte	Bit							
	7	6	5	4	3	2	1	0
0 to 1	(MSB) Element Address (LSB)							
2	OIR	CMC	InEnab (1)	ExEnab (1)	Access	Except	ImpExp	Full
3	Reserved (00h)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Reserved (00h)							
7	Reserved (00h)							
8	Reserved (00h)							
9	SValid	Invert (0)	Reserved (00h)		ED	Medium Type		
10 to 11	(MSB) Source Storage Element Address (LSB)							
12 to 47	Primary Volume Tag Information (Field omitted if PVolTag=0)							
48	Reserved (0h)				Code Set (0)			
49	Reserved (0h)				Identifier Type (0)			
50	Reserved (00h)							
51	Identifier Length (00h)							
52	Media Domain (Field moved up if Primary Volume Tag Information omitted.)							
53	Media Type (Field moved up if Primary Volume Tag Information omitted.)							
54 to 55	Reserved (00h, 00h) (Field moved up if Primary Volume Tag Information omitted.)							

**Import/Export Element Descriptor Definitions:**

<b>Element Address</b>	This field contains the element address of the import/export element reported.
<b>OIR</b>	Operator Intervention Required bit 0 = No operator intervention required to make the mailslot accessible. 1 = Operator intervention required to make the mailslot accessible.
<b>CMC</b>	This bit is set to zero to indicate the import/export element is a mailslot.  A CMC bit of zero indicates that exports are to the operator's domain and imports are from the operator's domain.  Media shall not leave the domain of the media changer when prevented by the PREVENT ALLOW MEDIA REMOVAL command (see SPC).
<b>InEnab</b>	This bit indicates the import/export element supports the movement of cartridge tapes into the library.  The library returns a value of 1.
<b>ExEnab</b>	This bit indicates that the import/export element supports the movement of cartridge tapes out of the library.  The library returns a value of 1.
<b>Access</b>	This bit indicates whether access is allowed to the mailslot element by the hand.  0 = The mailslot is open and cannot be accessed by the hand or the magazine at the requested Element Address has been removed. Thus the Full and Primary Volume Tag information cannot be determined and should be ignored. More information about this condition is available through the Additional Sense Code and Additional Sense Code Qualifier fields.  1 = The mailslot is closed and accessible.
<b>Except</b>	This bit indicates the operational state of the import/export element:  0 = The import/export element is in the normal state. 1 = The import/export element is in an abnormal state, and the Additional Sense Code and the Additional Sense Code Qualifier fields contain information regarding the abnormal state. Other fields in this descriptor might be invalid, and should be ignored.
<b>ImpExp</b>	This bit indicates how the cartridge tape was placed in the element:  0 = The cartridge tape in the import/export element was placed there by the library hand as part of an export operation.  1 = The cartridge tape in the import/export element was placed there by an operator as part of an import operation.
<b>Full</b>	This bit indicates if the import/export element contains a cartridge tape:  0 = The import/export element does not contain a cartridge tape. 1 = The import/export element does contain a cartridge tape.
<b>Additional Sense Code</b>	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.
<b>Additional Sense Code Qualifier</b>	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.
<b>SValid</b>	This bit indicates if the Source Element Address and Invert fields are valid:  0 = The Source Element Address and Invert fields are not valid. 1 = The Source Element Address and Invert fields are valid.



<b>Invert</b>	The library does not support multi-sided media. The information reported is 0.
<b>ED</b>	0 = The element is enabled (for example a magazine or drive has been installed or has been logically enabled) 1 = The element is disabled
<b>Medium Type</b>	This field provides the type of medium currently present in the element as determined by the medium changer.  The library returns the following values:  0h = Unspecified - the medium changer cannot determine the medium type. 1h = Data Medium 2h = Cleaning Medium
<b>Source Storage Element Address</b>	This field is valid only if the SValid bit is 1. It contains the address of the last element from which the data cartridge was moved.
<b>Primary Volume Tag Information</b>	When the PVolTag bit is set to 1, the library returns Volume Tag Information. When PVolTag is set to 0, this field is omitted, and the reserved fields below it are moved up.  The library Volume Tag Information includes 6 bytes of left-justified ASCII data which represents volume/serial number data read from the cartridge tape. The field is padded to 32 bytes with 26 ASCII spaces. If the label on the cartridge tape is not readable, these 32 bytes will be set to 0.  The last four bytes of the Volume Tag Information consist of two reserved bytes and two-volume sequence bytes. The library does not support sequence numbers. These four bytes are set to 0.
<b>Code Set</b>	This field specifies the code set used for the identifier field and is set to 0 (not supported) for the Import/Export Element Descriptor  0h = Reserved
<b>Identifier Type</b>	The Identifier Type field indicates the format and assignment authority for the identifier and is set to 0 (not supported) for the Import/Export Element Descriptor:  0h = Vendor Specific
<b>Identifier Length</b>	This field indicates the length of the Identifier field and is set to 0 (not supported) for the Import/Export Element Descriptor.  <b>Note:</b> That the combined length of the identifier field and the Identifier Pad is 32 bytes.
<b>Media Domain</b>	The Media Domain field along with the Media Type field provides a hierarchy of information that indicates the type of media in the element:  43h = The element contains an LTO (or future) cleaning form factor cartridge (43h is 'C').  4Ch = The element contains an LTO form factor cartridge (4Ch is 'L').  FFh = The media domain cannot be determined.  This field is not valid if the Full bit is not set.

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**Media Type**

The Media Type field along with the Media Domain field provides a hierarchy of information that indicates the type of media in the element.

If the Media Domain field is 43h (43h is 'C'), the value reported for the Media Type field identifies in ASCII the type of LTO cleaning cartridge:

1 = The element contains a HP Generation 1 LTO cleaning cartridge.  
2 = The element contains an IBM Generation 1 LTO cleaning cartridge.  
3 = The element contains a Quantum Generation 1 LTO cleaning cartridge.  
U = The element contains a Universal LTO cleaning cartridge.  
FFh = The media type cannot be determined.  
This field is not valid if the Full bit is not set.

If the Media Domain field is 4Ch (4Ch is 'L'), the value reported for the Media Type field identifies in ASCII the type of LTO cartridge:

1 = The element contains a 100 GB Generation 1 LTO cartridge.  
2 = The element contains a 200 GB Generation 2 LTO cartridge.  
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 1500 GB Generation 5 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 1500 GB Generation 5 LTO WORM cartridge.  
FFh = The media type cannot be determined.  
This field is not valid if the Full bit is not set.

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## Data Transfer Element Descriptor Definitions

Data transfer elements are the tape drives in the library. The Data Transfer Element Descriptor Definitions page describes a tape drive. The following table shows the data returned when the **DvcID bit in the command is set to 0**.

**TABLE 4-104** Data Transfer Element Descriptor When DvcID = 0

Byte	Bit							
	7	6	5	4	3	2	1	0
0 to 1	(MSB) Element Address (LSB)							
2	Reserved (0h)				Access	Except	Rsvd (0)	Full
3	Reserved (00h)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Reserved (00h)							
7	Reserved (00h)							
8	Reserved (00h)							
9	SValid	Invert (0)	Reserved (00h)		ED	Medium Type		
10 to 11	(MSB) Source Storage Element Address (LSB)							
12 to 47	Primary Volume Tag Information (Field omitted if PVolTag = 0)							
48	Reserved (0h)				Code Set (0)			
49	Reserved (0h)				Identifier Type (0)			
50	Reserved (00h)							
51	Identifier Length (0)							
52	Media Domain (Field moved up if Primary Volume Tag information omitted.)							
53	Media Type (Field moved up if Primary Volume Tag information omitted.)							
54	Transport Domain (Field moved up if Primary Volume Tag information omitted.)							
55	Transport Type (Field moved up if Primary Volume Tag information omitted.)							
56 to 87	(MSB) Transport Serial Number (LSB)							

**Data Transfer Element Descriptor When DvcID = 0 Definitions:**

<b>Element Address</b>	This bit contains the element address of the data transfer element reported.
<b>Access</b>	<p>This bit indicates access is allowed to the data transfer element by the hand:</p> <p>0 = Access is not allowed to the tape drive element by the hand. This will be the case when a cartridge tape is loaded and in use by the tape drive. The tape is set to ejected before it becomes accessible.</p> <p>1 = The tape drive is accessible.</p>
<b>Except</b>	<p>This bit indicates the operational state of the data transfer element:</p> <p>0 = The data transfer element is in the normal state.</p> <p>1 = The data transfer element is in an abnormal state, and the Additional Sense Code and the Additional Sense Code Qualifier fields contain information regarding the abnormal state. Other fields in this descriptor might be invalid, and should be ignored.</p>
<b>Full</b>	<p>This bit indicates if the data transfer element contains a cartridge tape:</p> <p>0 = The data transfer element does not contain a cartridge tape.</p> <p>1 = The data transfer element does contain a cartridge tape.</p>
<b>Additional Sense Code</b>	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.
<b>Additional Sense Code Qualifier</b>	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.
<b>SValid</b>	<p>This bit indicates if the Source Element Address and Invert fields are valid:</p> <p>0 = The Source Element Address and Invert fields are not valid.</p> <p>1 = The Source Element Address and Invert fields are valid.</p>
<b>Invert</b>	The library does not support multi-sided media and returns a value of 0.
<b>ED</b>	<p>0 = The element is enabled (for example a magazine or drive has been installed or has been logically enabled)</p> <p>1 = The element is disabled</p>
<b>Medium Type</b>	<p>This field provides the type of medium currently present in the element as determined by the medium changer.</p> <p>The library returns the following values:</p> <p>0h = Unspecified - the medium changer cannot determine the medium type.</p> <p>1h = Data Medium</p> <p>2h = Cleaning Medium</p>
<b>Source Storage Element Address</b>	This field is valid only if the SValid bit is 1. It contains the address of the last element from which the data cartridge was moved.

<b>Primary Volume Tag Information</b>	<p>When the PVolTag bit is set to 1, the library returns Volume Tag Information. When PVolTag is set to 0, this field is omitted, and the reserved fields below it are moved up.</p> <p>The library Volume Tag Information includes 6 bytes of left-justified ASCII data which represents volume/serial number data read from the cartridge tape. The field is padded to 32 bytes with 26 ASCII spaces.</p> <p>If the label on the cartridge tape is not readable, these 32 bytes will be set to 0.</p> <p>The last four bytes of the Volume Tag Information have two reserved bytes and two volume sequence bytes. The library does not support sequence numbers. These four bytes are set to 0.</p>
<b>Code Set</b>	<p>This field specifies the code set used for the identifier field and is set to 0 (not supported) for the Data Transfer Element Descriptor (DvcID = 0): 0h = Reserved</p>
<b>Identifier Type</b>	<p>The Identifier Type field indicates the format and assignment authority for the identifier and is set to 0 (not supported) for the Data Transfer Element Descriptor (DvcID = 0): 0h = Vendor Specific</p>
<b>Identifier Length</b>	<p>This field indicates the length of the Identifier field and is set to 0 (not supported) for the Data Transfer Element Descriptor (DvcID = 0)</p> <p><b>Note:</b> That the combined length of the identifier field and the Identifier Pad is 32 bytes.</p>
<b>Media Domain</b>	<p>The Media Domain field along with the Media Type field provides a hierarchy of information that indicates the type of media in the element:</p> <p>43h = The element contains an LTO (or future) cleaning form factor cartridge (43h is 'C'). 4Ch = The element contains an LTO form factor cartridge (4Ch is 'L'). FFh = The media domain cannot be determined. This field is not valid if the Full bit is not set.</p>
<b>Media Type</b>	<p>The Media Type field along with the Media Domain field provides a hierarchy of information that indicates the type of media in the element.</p> <p>If the Media Domain field is 43h (43h is 'C'), the value reported for the Media Type field identifies in ASCII the type of LTO cleaning cartridge:</p> <p>1 = The element contains a HP Generation 1 LTO cleaning cartridge. 2 = The element contains an IBM Generation 1 LTO cleaning cartridge. 3 = The element contains a Quantum Generation 1 LTO cleaning cartridge. U = The element contains a Universal LTO cleaning cartridge. FFh = The media type cannot be determined. This field is not valid if the Full bit is not set.</p>

<b>Media Type (cont.)</b>	<p>If the Media Domain field is 4Ch (4Ch is 'L'), the value reported for the Media Type field identifies in ASCII the type of LTO cartridge:</p> <p>1 = The element contains a 100 GB Generation 1 LTO cartridge.  2 = The element contains a 200 GB Generation 2 LTO cartridge.  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 1500 GB Generation 5 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 1500 GB Generation 5 LTO WORM cartridge.  FFh = The media type cannot be determined.</p> <p>This field is not valid if the Full bit is not set.</p>
<b>Transport Domain</b>	<p>The Transport Domain field with the Transport Type field provide a hierarchy of information that indicates the type of data transfer element installed:</p> <p>4Ch = The transport supports LTO form factor cartridges (4Ch is 'L').  FFh = The transport domain cannot be determined.</p>
<b>Transport Type</b>	<p>If the Transport Domain field is 4Ch (4Ch is 'L'), the value in the Transport Type field indicates that the drive installed is:</p> <p>33h = An HP Generation 2 LTO drive.  34h = An IBM Generation 2 LTO drive.  35h = A Quantum Generation 2 LTO drive.  36h = An HP Generation 3 LTO drive.  37h = An IBM Generation 3 LTO drive.  38h = A Quantum Generation 3 LTO drive.  39h = An HP Generation 4 LTO drive.  3Ah = An IBM Generation 4 LTO drive.  3Bh = An HP Generation 5 LTO drive.  3Ch = An IBM Generation 5 LTO drive.  FFh = The type cannot be determined.</p>
<b>Transport Serial Number</b>	<p>Thirty-two ASCII characters represent the unique transport serial number.</p> <p>For tape drives with less than 32 bytes of ASCII serial number data, the value is left-justified and the unused LSB bytes contain ASCII blanks.</p> <p>If the serial number is not available from a tape drive that should support an ASCII serial number, ASCII blanks are returned.</p> <p>Left justification in this 32-byte field provides space for serial numbers of varying lengths.</p>

## Data Transfer Element Descriptor Definitions

Data transfer elements are the tape drives in the library. The Data Transfer Element Descriptor Definitions page describes a tape drive. The following table shows the data returned when the **DvcID bit in the command is set to 1**.

**TABLE 4-105** Data Transfer Element Descriptor When DvcID = 1

Byte	Bit							
	7	6	5	4	3	2	1	0
0 to 1	(MSB) Element Address (LSB)							
2	Reserved (0)				Access	Except	Rsvd (0)	Full
3	Reserved (00h)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Reserved (00h)							
7	Reserved (00h)							
8	Reserved (00h)							
9	SValid	Invert (0)	Reserved (00h)		ED	Medium Type		
10 to 11	(MSB) Source Storage Element Address (LSB)							
12 to 47	Primary Volume Tag Information (Field omitted if PVolTag = 0)							
48	Reserved (0h)				Code Set (2)			
49	Reserved (0h)				Identifier Type (0)			
50	Reserved (00h)							
51	Identifier Length (x)							
52 to 52+x-1 (x bytes)	Identifier							
32-x bytes	Identifier Pad							
84	Media Domain							
85	Media Type							
86	Transport Domain							
87	Transport Type							

**Data Transfer Element Descriptor (DvcID = 1) Definitions:**

<b>Element Address</b>	This bit contains the element address of the data transfer element reported.
<b>Access</b>	<p>This bit indicates access is allowed to the data transfer element by the hand:</p> <p>0 = Access is not allowed to the tape drive element by the hand. This will be the case when a cartridge tape is loaded and in use by the tape drive. The tape must be ejected before it becomes accessible.</p> <p>1 = The tape drive is accessible.</p>
<b>Except</b>	<p>This bit indicates the operational state of the data transfer element:</p> <p>0 = The data transfer element is in the normal state.</p> <p>1 = The data transfer element is in an abnormal state, and the Additional Sense Code and the Additional Sense Code Qualifier fields contain information regarding the abnormal state. Other fields in this descriptor might be invalid, and should be ignored</p>
<b>Full</b>	<p>This bit indicates if the data transfer element contains a cartridge tape:</p> <p>0 = The data transfer element does not contain a cartridge tape.</p> <p>1 = The data transfer element does contain a cartridge tape.</p>
<b>Additional Sense Code</b>	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.
<b>Additional Sense Code Qualifier</b>	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.
<b>SValid</b>	<p>This bit indicates if the Source Element Address and Invert fields are valid:</p> <p>0 = The Source Element Address and Invert fields are not valid.</p> <p>1 = The Source Element Address and Invert fields are valid.</p>
<b>Invert</b>	The library does not support multi-sided media and returns a value of 0.
<b>ED</b>	<p>0 = The element is enabled (for example a magazine or drive has been installed or has been logically enabled).</p> <p>1 = The element is disabled.</p>
<b>Medium Type</b>	<p>This field provides the type of medium currently present in the element as determined by the medium changer.</p> <p>The library returns the following values:</p> <p>0h = Unspecified - the medium changer cannot determine the medium type.</p> <p>1h = Data Medium</p> <p>2h = Cleaning Medium</p>
<b>Source Storage Element Address</b>	This field is valid only if the SValid bit is 1. It contains the address of the last element from which the data cartridge was moved.
<b>Primary Volume Tag Information</b>	<p>When the PVolTag bit is set to 1, the library returns Volume Tag Information. When PVolTag is set to 0, this field is omitted, and the reserved fields below it are moved up.</p> <p>The library Volume Tag Information includes 6 bytes of left-justified ASCII data which represents volume/serial number data read from the cartridge tape. The field is padded to 32 bytes with 26 ASCII spaces.</p> <p>If the label on the cartridge tape is not readable, these 32 bytes will be set to 0.</p> <p>The last four bytes of the Volume Tag Information have two reserved bytes and two volume sequence bytes. The library does not support sequence numbers. These four bytes are set to 0.</p>



<b>Code Set</b>	<p>This field specifies the code set used for the identifier field:</p> <p>2h = The identifier contains ASCII graphic codes (code values 20h through 7Eh).</p>
<b>Identifier Type</b>	<p>The Identifier Type field indicates the format and assignment authority for the identifier:</p> <p>0h = No assignment authority was used, and consequently there is no guarantee that the identifier is globally unique. In other words, the identifier is vendor specific.</p>
<b>Identifier Length</b>	<p>This field indicates the length of the Identifier field. Note: That the combined length of the Identifier field and the Identifier Pad is 32 bytes.</p>
<b>Identifier</b>	<p>This field contains the device identification of the type indicated in the Identifier Type field and in the format specified in the Code Set field.</p>
<b>Identifier Pad</b>	<p>This field contains binary zeros if the identifier is binary. This field contains ASCII blanks if the identifier is ASCII. The number of zeros or blanks depends on the length of the Identifier field. Note that the combined length of the Identifier field and the Identifier Pad is 32 bytes.</p>
<b>Media Domain</b>	<p>The Media Domain field along with the Media Type field provides a hierarchy of information that indicates the type of media in the element:</p> <p>43h = The element contains an LTO (or future) cleaning form factor cartridge (43h is 'C').</p> <p>4Ch = The element contains an LTO form factor cartridge (4Ch is 'L').</p> <p>FFh = The media domain cannot be determined.</p> <p>This field is not valid if the Full bit is not set.</p>
<b>Media Type</b>	<p>The Media Type field, along with the Media Domain field, provides a hierarchy of information that indicates the type of media in the element.</p> <p>If the Media Domain field is 43h (43h is 'C'), the value reported for the Media Type field identifies in ASCII the type of LTO cleaning cartridge:</p> <p>1 = The element contains an HP Generation 1 LTO cleaning cartridge.</p> <p>2 = The element contains an IBM Generation 1 LTO cleaning cartridge.</p> <p>3 = The element contains a Quantum Generation 1 LTO cleaning cartridge.</p> <p>U = The element contains a Universal LTO cleaning cartridge.</p> <p>FFh = The media type cannot be determined.</p> <p>This field is not valid if the Full bit is not set.</p>
<b>Media Type (cont.)</b>	<p>If the Media Domain field is 4Ch (4Ch is 'L'), the value reported for the Media Type field identifies in ASCII the type of LTO cartridge:</p> <p>1 = The element contains a 100 GB Generation 1 LTO cartridge.</p> <p>2 = The element contains a 200 GB Generation 2 LTO cartridge.</p> <p>3 = The element contains a 400 GB Generation 3 LTO cartridge.</p> <p>4 = The element contains an 800 GB Generation 4 LTO cartridge.</p> <p>5 = The element contains a 1500 GB Generation 5 LTO cartridge.</p> <p>T = The element contains a 400 GB Generation 3 LTO WORM cartridge.</p> <p>U = The element contains an 800 GB Generation 4 LTO WORM cartridge.</p> <p>V = The element contains a 1500 GB Generation 5 LTO WORM cartridge.</p> <p>FFh = The media type cannot be determined.</p> <p>This field is not valid if the Full bit is not set.</p>
<b>Transport Domain</b>	<p>The Transport Domain field with the Transport Type field provide a hierarchy of information that indicates the type of data transfer element installed:</p> <p>4Ch = The transport supports LTO form factor cartridges (4Ch is 'L').</p> <p>FFh = The transport domain cannot be determined.</p>

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<b>Transport Type</b>	<p>If the Transport Domain field is 4Ch (4Ch is 'L'), the value in the Transport Type field indicates that the drive installed is:</p> <p>33h = An HP Generation 2 LTO drive. 34h = An IBM Generation 2 LTO drive. 35h = A Quantum Generation 2 LTO drive. 36h = An HP Generation 3 LTO drive. 37h = An IBM Generation 3 LTO drive. 38h = A Quantum Generation 3 LTO drive. 39h = An HP Generation 4 LTO drive. 3Ah = An IBM Generation 4 LTO drive. 3Bh = An HP Generation 5 LTO drive. 3Ch = An IBM Generation 5 LTO drive. FFh = The type cannot be determined.</p>
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## Release (6)

The 6-byte Release command (17h) enables the initiator to release a unit reservations of the library as set using a previous Reserve command.

Performing a unit release of a library that has no active reservations is not considered an error. Only the initiator that performed the reservation can release the reservation. If another initiator attempts to release a unit reservation, the library returns good status, but does not release the reservation.

**TABLE 4-106** Release Command (6)

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

## Release (10)

The 10-byte Release command (57h) enables the initiator to release unit reservations of the library as set using a previous Reserve command and optionally to perform a release for a third party initiator.

Performing a unit release of a library that has no active reservations is not considered an error. Only the initiator that performed the reservation or the third party for which the reservation was made can release the reservation. If another initiator attempts to release a unit reservation, the library returns good status, but does not release the reservation.

**TABLE 4-107** Release (10) Command

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (57h)							
1	Ignored			3rdpty	Reserved (0h)		LongID	Obsolete (0)
2	Reserved (00h)							
3	Third Party Device Id							
4-6	Reserved (00h)							
7 to 8	(MSB)  Parameter List Length  (LSB)							
9	Control Byte							

### Release (10) Command Definitions:

<b>3rdpty</b>	This field indicates whether the reservation is on behalf of a third party or not. 0 = The reservation is on behalf of the calling requester. 1 = The reservation is on behalf of a specified Third party Device Id.
<b>LongID</b>	This field is ignored. LongIDs are not supported.
<b>Third Party Device ID</b>	The ID of the third Party device.
<b>Parameter List Length</b>	This field is ignored (LongIDs are not supported).

# Report LUNS

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

**TABLE 4-108** Report LUNs Command

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

## Report LUNs Command Definitions:

<b>Select Report</b>	<p>This field specifies the type of logical unit addresses that shall be reported.</p> <ul style="list-style-type: none"> <li>00h = LUN addresses reported shall be limited to the following addressing: <ul style="list-style-type: none"> <li>LUN addressing method.</li> <li>Peripheral device addressing method.</li> <li>Flat space addressing method.</li> </ul> </li> <li>02h = All LUNS accessible to the initiator for this port are accessible.</li> </ul>
<b>Allocation Length</b>	<p>This field specifies the number of bytes that the initiator has allocated for data to be returned from the Report LUNs command.</p> <p>The Allocation must be at least 16 bytes.</p> <p>If it is less, a check condition is returned with the sense key set to illegal request and the additional sense data set to invalid field in the command descriptor block (CDB).</p>

## Report LUNs Data Definition

The library returns the following data for the Report LUNs command.

**TABLE 4-109** Report LUNs Data

Byte	Bit							
	7	6	5	4	3	2	1	0
0 to 3	(MSB) LUN list length (LSB)							
4 to 7	Reserved (00h)							
8 to 15	(MSB) First LUN Descriptor (LSB)							
n -7 to n	(MSB) Last LUN Descriptor (n) (LSB)							

### Report LUNs Data Definitions:

<b>LUN list length</b>	<p>The library returns the length in bytes of the LUN list that is available for transfer. It is equal to 8 times the number of available logical units for the initiator.</p> <p>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.</p>
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**TABLE 4-110** LUN Descriptor

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Address Method		Bus ID (0h)					
1	Single Level LUN Address							
2 to 3	Second Level LUN Address (00h)							
4 to 5	Third Level LUN Address (00h)							
6 to 7	Fourth Level LUN Address (00h)							

### LUN Descriptor Data Definitions:

<b>Address Method</b>	This is set to 0h indicating single level LUN addressing is used.
<b>Bus ID</b>	This is set to 0h indicating a logical unit at the current level.
<b>Single Level LUN Address</b>	This is the value of the LUN
<b>Second, Third, and Fourth Level LUN Address</b>	Set to 00h for single level addressing

# Report Target Port Groups

The Report Target Port Groups command (A3h) requests that the library return the Target Port Group data for all ports.

**TABLE 4-111** Report Target Port Groups Command

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

## Report Target Port Group Command Definitions:

<b>Service Action</b>	0Ah
<b>Allocation Length</b>	Specifies the length of the parameter list the library returns. The maximum length is 20h (32d) bytes. The library transfers the number of bytes specified by the Allocation Length or the available Report Target Port Groups data, whichever is less.

## Report Target Port Group Data Definitions

The library returns the following data for the Report Target Port Groups command.

**TABLE 4-112** Report Target Port Groups Data

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

### Report Target Port Group Data Definitions:

**Returned Data Length** Indicates the length in bytes of the Target Port Descriptor data available to the initiator.

## Target Port Group Descriptor Data

**TABLE 4-113** Target Port Group Descriptor Data

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PREF	Reserved (00h)			Asymmetric Access State			
1	T_Sup	Reserved (00h)			U_Sup	S_Sup	AN_Sup	AO_Sup
2 to 3	(MSB)	Target Port Group (LSB)						
4	Reserved (00h)							
5	Status Code (02h)							
6	Reserved (00h)							
7	Target Port Group Count							
Target Port Descriptors								
8 to 11	(MSB)	First Target Port Descriptor (LSB)						
n-3 to n	(MSB)	Second Target Port Descriptor (omitted for tape drive with 1 SCSI Port) (LSB)						



**Target Port Group Descriptor Data Definitions:**

<b>PREF</b>	<p>This bit indicates if the target port group is a preferred target port group.</p> <p>0b indicates the target port group is not a preferred target port group.</p> <p>1b indicates that the target port group is a preferred target port group.</p> <p><b>Note</b> – All ports in the Active/Optimized group are preferred</p>
<b>Asymmetric Access State</b>	<p>This field contains the target port group's current asymmetric access state.</p> <p>The library supports the following Asymmetric Access States:</p> <p>0h = Active/Optimized. This state indicates that the ports in the group are fully operational.</p> <p>3h = Unavailable. This state indicates that the ports in the group are not available.</p>
<b>T_Sup</b>	The library returns a Transitioning Support bit of 0, indicating the Transitioning asymmetric access state is not supported.
<b>U_Sup</b>	<p>0 = The Unavailable asymmetric access state is not supported.</p> <p>1 = The Unavailable asymmetric access state is supported.</p>
<b>S_Sup</b>	The library returns a Standby Support bit of 0, indicating the Standby asymmetric access state is not supported.
<b>AN_Sup</b>	The library returns an active/non-optimized support bit of 0, indicating the Active/non-optimized asymmetric access state is not supported.
<b>AO_Sup</b>	<p>0 = The Active/Optimized asymmetric access state is not supported.</p> <p>1 = The Active/Optimized asymmetric access state is supported.</p>
<b>Target Port Group</b>	<p>The target port group field contains an identification of the group.</p> <p>00h = Target Port Group 0</p> <p>01h = Target Port Group 1</p>
<b>Status Code</b>	The library returns a status code value of 2, indicating the target port group asymmetric access state is altered by implicit asymmetrical logical unit access behavior.
<b>Target Port Group Count</b>	The target port count field indicates 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. The target port group count can range from a value of 1 to 2.

## Target Port Descriptor Data

**TABLE 4-114** Target Port Descriptor Data

Byte	Bit							
	7	6	5	4	3	2	1	0
0 to 1	Reserved (00h)							
2 to 3	Relative Target Port Identifier							

**Target Port Descriptor Data Definitions:**

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<b>Relative Target Port Identifier</b>	0000h = No Target Port
	0001h = Relative Target Port 1
	0002h = Relative Target Port 2

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# Request Sense

The Request Sense command (03h) requests the library transfer sense data to the initiator.

**TABLE 4-115** Request Sense Command

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

## Request Sense Command Definitions:

<b>Desc</b>	The Desc bit indicates which sense data format shall be returned. The library returns a value of 0, indicating fixed format sense data is returned.
<b>Allocation Length</b>	This field specifies the number of bytes that the initiator has allocated for returned sense data. The library provides a maximum of 14h (20d) bytes of sense data.

## Sense Data

Sense data is available when:

- The previous command to the specified I\_T\_L nexus terminated with Check Condition status. Multiple errors might occur during the processing of a single SCSI command. The sense key reflects the first error that occurred.
- The Request Sense command was issued to an unsupported LUN. In this case, the library does not return a check condition and returns sense data:
  - Sense Key set to Illegal Request (05h).
  - ASC set to Logical Unit Not Supported (25h).
  - ASCQ set to 00h.

If no sense data is available for the specified I\_T\_L nexus, the library returns sense data:

- Sense Key set to No Sense (0h)
- ASC set to No Additional Sense Information (00h)
- ASCQ set to 00h

The library returns Check Condition status for a Request Sense command only to report errors specific to the command itself.

For example: A non-zero reserved bit is detected in the CDB.

If a recovered error occurs during the execution of a Request Sense command, the library returns the sense data with Good status. If the library returns a Check Condition status for a Request Sense command, the sense data might be invalid.

For example: A non-zero reserved bit is detected in the CDB.

If a recovered error occurs during the execution of a Request Sense command, the library returns the sense data with Good status. If the library returns a Check Condition status for a Request Sense command, the sense data might be invalid.

## Request Sense Data Definitions

TABLE 4-116 shows the Request Sense Data Definitions.

**TABLE 4-116** Request Sense Data

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Valid (0)	Error Code (70h)						
1	Segment Number (00h)							
2	Reserved (0h)				Sense Key			
3 to 6	(MSB)	Information (00h)						(LSB)
7	Additional Sense Length (n-7)							
8 to 11	(MSB)	Command Specific Information (00h)						(LSB)
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 (0h)		
16 to 17	(MSB)	Field Pointer						(LSB)
18	Reserved (00h)							
19	Reserved (00h)							

### Request Sense Data Definitions:

<b>Valid</b>	This bit indicates if the Information field contains valid data. The library does not return data in the Information field. The value is 0.
<b>Error Code</b>	This bit indicates if the error is current or deferred. The library returns only current errors. The value is 70h.
<b>Segment Number</b>	The library does not support segment numbers and returns a value of 00h.
<b>Sense Key</b>	The Sense Key (SK) field, with the Additional Sense Code and Additional Sense Code Qualifier fields, describes the error.
<b>Information</b>	The library does not support this field and returns a value of 00h.
<b>Additional Sense Length</b>	This field indicates the Additional Sense Length provided by the library excluding this byte. The typical value is 0Ch (12d).
<b>Command Specific Information</b>	The library does not support this field and returns a value of 00h.

<b>Additional Sense Code</b>	The Additional Sense Code (ASC) field, with the Sense Key and Additional Sense Code Qualifier fields, describes the error.
<b>Additional Sense Code Qualifier</b>	The Additional Sense Code Qualifier (ASCQ) field, with the Sense Key and Additional Sense Code fields, describes the error.
<b>Field Replaceable Unit Code</b>	The library does not support this field and returns a value of 00h.
<b>SKSV (Sense Key Specific Valid)</b>	When the Sense Key Specific Valid bit is set to 1, the fields C/D, BPV, and Field pointers are valid. Otherwise, ignore these fields.
<b>C/D (Command/Data)</b>	<p>Command/Data indicates whether the Check Condition status resulted from an illegal parameter in either the command descriptor block (Command) or the parameter list (Data)</p> <p>0 = Illegal parameter in the parameter list.</p> <p>1 = Illegal parameter in the command descriptor block.</p>
<b>BPV (Bit Pointer Valid)</b>	<p>0 = Indicates that the value in the bit pointer field is not valid.</p> <p>1 = Indicates that the bit pointer field specifies which bit of the byte designated by the Field Pointer field is in error.</p>
<b>Bit Pointer</b>	When the Bit Pointer Valid field is set to 1, this value indicates which bit of the byte designated by the Field Pointer field is in error.
<b>Field Pointer</b>	<p>This field contains the number of the byte where the error occurred.</p> <p>Byte numbers start at 00.</p> <p>When a multiple-byte field is in error, the Field Pointer contains the value of the most significant byte of the field, which is the byte with the lowest byte number.</p> <p>For example, if a field consists of bytes 02, 03, and 04, the most significant byte is 02.</p>

## Sense Key

The Sense Key field provides basic information about an error.

[TABLE 4-117](#) lists the Sense Keys with an explanation for each code. The Sense Key field, with the Additional Sense Code and Additional Sense Code Qualifier fields, provides a description about the error.

See [“Additional Sense Codes and Qualifiers” on page 207](#) for more information.

**TABLE 4-117** Sense Key Code Descriptions

Code	Error	Description
0h	No Sense	Indicates there is no specific sense key information to be reported. A sense key of 0 indicates a successful command.
2h	Not Ready	Indicates the addressed logical unit is not ready for library motion commands (library is not initialized, device is not ready).
3h	Medium Error	Indicates that the command terminated with a non-recovered error condition that may have been caused by a flaw in the medium or an error in the recorded data.
4h	Hardware Error	Indicates the device detected an unrecoverable hardware failure while performing the command or during a self-test.
5h	Illegal Request	Indicates an illegal parameter in the command descriptor block or in the parameter list data.
6h	Unit Attention	Indicates a power-on or reset has occurred to the device, or a not ready-to-ready transition has occurred, or an I/O element has been accessed. Also, this may indicate mode parameters have changed, or the microcode has been changed.
Bh	Aborted Command	Indicates the device aborted the command. The initiator might be able to recover by trying the command again.

## Additional Sense Codes and Qualifiers

Bytes 12 and 13 of the sense data contain the Additional Sense Code (ASC) and Additional Sense Code Qualifier (ASCQ) fields. These codes provide additional device-specific information about the error or exception.

Each code contains a unique combination of the sense key, additional sense code, and additional sense code qualifier. The following pages describe the error codes for the library grouped by type of sense key.

## No Sense Key

The library returns a No Sense Key (00h) when sense is requested, but no error has occurred. The ASC and ASCQ values are zero.

## Not Ready Sense Key Codes

If a command is sent when the library is not ready, it generates a Not Ready error code. The following codes describe the conditions of the library that can generate Not Ready codes.

**TABLE 4-118** Not Ready Sense Keys

Description	Sense Key	ASC	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, Logical Unit Not Ready, Operation in Progress	2h	04h	07h
Not Ready, Logical Unit Offline	2h	04h	12h
Not Ready, Maintenance Mode	2h	04h	81h
Not Ready, Mailslot Open	2h	3Ah	02h
Not Ready, Cleaning Cartridge Installed	2h	30h	03h

### 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 in a number of situations, including power-on, after a magazine is removed and inserted, and as part of a recovery during certain failures.

### Not Ready, Manual Intervention Required

This sense data indicates that the library is in an inoperable state. The operator should check the user interface to determine what action is required.

### Not Ready, Logical Unit Not Ready, Operation in Progress

This sense data indicates that the library is busy processing another command.

### Not Ready, Logical Unit Offline

This sense data indicates that the library is offline and cannot process the command.

### Not Ready, Maintenance Mode

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



## Not Ready, Mailslot Open

The library detected that the mailslot is open and a SCSI command was issued to access the mailslot.

## Not Ready, Cleaning Cartridge Installed

The library is performing an Auto Clean function on the data transfer element (tape drive) requested.

**Note** – While the cleaning cartridge remains in the drive, the library processes host commands normally. If a host requests a data mount to the drive being cleaned, then the library rejects the command and sends the Not Ready sense key (02), with ASC 30h and ASCQ 03 (Cleaning Cartridge Installed).

The host receives the data mount error for the duration of the cleaning time. Cleaning times vary, depending on the type of drive, the cleaning cartridge, robotic times, and potential retry operations. The tape is good for 20 uses. Each time you use it takes longer than the last time because the operation goes farther on the tape cartridge. The longest cycle, cleaning cycle (20), takes approximately 5 minutes and 15 seconds.

## Medium Errors Sense Key Codes

The library generates this error when a SCSI Move command is terminated with a non-recovered error condition that may have been caused by a flaw in the medium or an error in the recorded data.

**TABLE 4-119** Medium Error Sense Keys

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

## Medium Error, Cleaning Cartridge Expired

The library returns this error when a SCSI Move to a drive is requested, and the source cartridge is an expired cleaning cartridge.

## Hardware Error Sense Key

The library generates a Hardware Error sense key if a hardware or firmware error is detected during command execution. The following pages describe the conditions that generate hardware errors.

**TABLE 4-120** Hardware Error Sense Keys

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

### **Hardware Error, General**

The library generates a general hardware error when it detects an internal electronics error during a command. This includes the electronics, vision system, and robotics of the library.

### **Hardware Error, Tape Drive**

The library generates a tape-drive error when an operation to the drive fails. The problem could be the tape drive or the interface between the library and tape drive.

### **Hardware Error, Mailslot**

The library generates a hardware error when the mailslot fails.

### **Hardware Error, Embedded Software**

The library generates a hardware error when an unexpected condition is detected by the embedded software that controls the SCSI interface. This error is used for arbitrary limitations of the embedded software.

### **Hardware Error, Media Load/Eject Failed**

The library generates a hardware error when a load or eject fails to complete.

## Illegal Request Sense Key

Any illegal parameters in a command descriptor block (CDB) or parameter list for a particular command generate an Illegal Request sense key (see [TABLE 4-121](#)).

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, which is in error.

If available, the SKSV bit in the sense data is set to 1.

See [“Request Sense” on page 203](#) for more information.

**TABLE 4-121** Illegal Request Sense Keys

Description	Sense Key	ASC	ASCQ
Invalid Field in Command information Unit	5h	0Eh	03h
Parameter Length Error	5h	1Ah	00h
Invalid Command	5h	20h	00h
Invalid Element	5h	21h	01h
Invalid Field in CDB	5h	24h	00h
Logical Unit Not Supported	5h	25h	00h
Invalid Field in Parameters	5h	26h	00h
Invalid Release of Persistent Reservation	5h	26h	04h
Incompatible Medium	5h	30h	00h
Saving Parameters Not Supported	5h	39h	00h
Medium Not Present, Drive Not Unloaded	5h	3Ah	00h
Medium Magazine Removed	5h	3Bh	12h
Destination Element Full	5h	3Bh	0Dh
Source Element Empty	5h	3Bh	0Eh
Magazine Removed	5h	3Bh	12h
Insufficient Resources	5h	55h	03h

## Unit Attention Sense Key

The library generates a Unit Attention sense key for *all* initiators if the library needs to inform the host of an asynchronous event. The following pages describe library conditions that generate Unit Attention errors.

**TABLE 4-122** Unit Attention Sense Keys

Description	Sense Key	ASC	ASCQ
Power-On Occurred	6h	29h	01h
SCSI Bus or Target Reset	6h	29h	02h
LUN Reset	6h	29h	03h
Device Internal Reset	6h	29h	04h
Not Ready-to-Ready Transition	6h	28h	00h
Mailslot Element Accessed	6h	28h	01h
Mode Parameters Changed	6h	2Ah	01h
Reservations Preempted	6h	2Ah	03h
Reservations Released	6h	2Ah	04h
Registrations Preempted	6h	2Ah	05h

### Power On

The library generates this type of Unit Attention when the library is powered-on, IPLed from the operator panel, or reset over the interface. A Unit Attention is generated for all initiators.

### SCSI Bus or Target Reset

The library generates this type of Unit Attention to all initiators after the library is clear of all I/O processes following the SCSI Bus or Target reset.

### LUN Reset

The library generates this type of Unit Attention to all initiators after the library is clear of all I/O processes following the LUN reset.

### Device Internal Reset

The library generates this type of Unit Attention to all initiators after the library is clear of all I/O processes following an internal device reset.

### Not Ready to Ready Transition

The library generates this type of Unit Attention when the library transitions to a ready state from a not ready state. This transition can occur following any conditions that cause a not ready state. A Unit Attention is generated for all initiators.

**Mailslot Element Accessed**

The library generates this type of Unit Attention when the operator opens and closes the mailslot. Issue a Read Element Status command to obtain an updated inventory. A Unit Attention is generated for all initiators.

**Note** – After running Send Diagnostic page code 80 or 81, this Unit Attention sense key will be returned at completion, which indicates that the inventory has changed.

**Mode Parameters Changed**

The library generates this type of Unit Attention when a different initiator performs a Mode Select operation. Issuing a Mode Sense command can retrieve the current parameters. This Unit Attention is issued for all initiators except the one that performed the Mode Select.

**Persistent Reservations/Registrations Preempted or Released**

The library generates these types of Unit Attention sense keys when one initiator has its persistent reservations or registrations cleared by another initiator.

## Aborted Command Sense Key

The library generates an Aborted Command error code when a SCSI command is aborted because of a SCSI protocol error. The initiator might not register a Check Condition status related to these errors because of the nature of the aborted commands, but the sense data is available. The following pages describe the conditions of the library that generates Aborted Commands.

**TABLE 4-123** Aborted Command Sense Keys

Description	Sense Key	ASC	ASCQ
Logical Unit Communication Failure	0Bh	08h	00h
Mechanical Positioning Error	0Bh	15h	01h
Command Phase Error	0Bh	4Ah	00h
Data Phase Error	0Bh	4Bh	00h
Command Overlap	0Bh	4Eh	00h

### Logical Unit Communication Failure

The drive returns this status when there is a logical unit communication failure that prevents the library from processing the command.

### Mechanical Positioning Error

The library detected an error while trying to position and the operation could not be completed.

### Command Phase Error

The library detected a command phase error and the operation could not be completed.

### Data Phase Error

The library detected a data phase error and the operation could not be completed.

### Command Overlap

The library detected another command from an initiator while one was already in process.

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# Request Volume Element Address

The Request Volume Element Address command (B5h) requests that the library return the results of a previous Send Volume Tag command.

**TABLE 4-124** Request Volume Element Address Command

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (B5h)							
1	Ignored			VolTag	Reserved (0h)			
2 to 3	(MSB) Starting Element Address (LSB)							
4 to 5	(MSB) Number of Elements (LSB)							
6	Reserved (00h)							
7 to 9	(MSB) Allocation Length (LSB)							
10	Reserved (00h)							
11	Control Byte (00h)							

## Request Volume Element Address Command Descriptions:

<b>VolTag (Volume Tag)</b>	<p>This bit indicates whether volume tag (VolTag) information is to be reported in response to this command:</p> <p>0 = Volume Tag information is not reported.</p> <p>1 = Volume Tag information is reported.</p>
<b>Starting Element Address</b>	<p>Specifies the minimum element address to report.</p> <p>Only elements with an address greater than or equal to the Starting Element Address are reported.</p> <p>The Starting Element Address must be a valid address for the library but does not have to be an address of the type requested in the Element Type Code.</p>
<b>Number of Elements</b>	Represents the maximum number of element descriptors to be transferred.

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<b>Allocation Length</b>	<p>Specifies the length in bytes of the space allocated by the initiator for the transfer of element descriptors. Only complete element descriptors are transferred. Element descriptors are transferred until one of the following conditions is met:</p> <p>All available element descriptors of the type specified in the Element Type Code have been transferred.</p> <p>The number of element descriptors specified in the Number of Elements field has been transferred.</p> <p>There is less allocation length space available than required for the next complete element descriptor or header to be transferred.</p>
<b>Request Volume Element Address Data</b>	<p>The library returns data for a Request Volume Element Address command in:</p> <p>An eight-byte Volume Element Address header, followed by</p> <p>One to four element pages, one page per element type. A page consists of:</p> <p>An eight-byte Element Status Page header, followed by</p> <p>One or more Element Descriptors.</p> <p>The format of the descriptor is based on the element type reported in this page. There is a separate Element Descriptor format for each element type.</p> <p>The data can be truncated based on the length specified in the allocation length field.</p>

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## Volume Element Address Header Definition

The Volume Element Address Header is sent once for each command.

**TABLE 4-125** Volume Element Address Header

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

### Volume Element Address Header Definitions:

<b>First Element Address Reported</b>	This field indicates the lowest element address found of the type specified in the Element Type Codes and greater than/equal to the starting address.
<b>Number of Elements Available</b>	<p>This field indicates the number of elements found of the type specified in the Element Type Codes and greater than or equal to the Starting Element Address.</p> <p>This number is adjusted to be less than or equal to the count specified in the Number of Elements field.</p>
<b>Send Action Code</b>	This field contains the value of the send action code field from the previous Send Volume Tag command. The value is 5h.
<b>Byte Count of Report Available</b>	<p>This field indicates the number of bytes of element status data available for all elements that meet the requirements of the Request Volume Element Address command.</p> <p>This count does not include the Element Status Data header bytes.</p> <p>This value is not adjusted to match the allocation length from the command.</p>
<b>Element Status Pages</b>	<p>The element pages returned by a Request Volume Element Address command are the same format as returned by the Read Element Status command.</p> <p>See <a href="#">“Read Element Status” on page 171</a> for more information.</p>

## Reserve (6)

The 6-byte Reserve command (16h) allows the initiator to perform unit reservations. Unit reservations are reservations of the library as a whole.

**TABLE 4-126** Reserve Command

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

### Other Commands and Reservations

Unit reservations are released or canceled by:

- A “Release” command from the same initiator
- A Task Management reset:
  - Target Reset
  - LUN Reset
- An interface reset
- A power-on reset of the library

If the library is reserved as a unit, the library processes only the following commands from another initiator:

- Prevent/Allow Medium Removal with Prevent bits set to 0
- Inquiry
- Log Sense
- Release (the reservation is not released)
- Request Sense
- Report LUNs
- Report Target Port Groups

All other commands result in a Reservation Conflict status (18h).

## Reserve (10)

The 10-byte Reserve command (56h) allows the initiator to perform unit reservations. Unit reservations are reservations of the library as a whole.

Another capability of the Reserve (10) command as opposed to the Reserve (6) command is the ability to do third party reservations. The third party reservation allows the reservation of a logical unit within a logical unit on behalf of another SCSI device.

**Note:** New host applications should not use 3rd party reservations. These are legacy SPC-2 commands. Persistent Reservations should instead be implemented.

**TABLE 4-127** Reserve (10) Command

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (56h)							
1	Ignored			3rd Pty	Reserved		LongID	Obsolete (0)
2	Obsolete (00h)							
3	Third Party Device Id							
4-6	Reserved							
7 to 8	(MSB) <div>Parameter List Length</div> (LSB)							
9	Control Byte							

### Reserve (10) Command Descriptions:

<b>3rd Pty</b>	This field indicates whether the reservation is on behalf of a third party or not: 0 = The reservation is on behalf of the calling requester. 1 = The reservation is on behalf of a specified Third party Device Id.
<b>LongID</b>	This field is ignored. LongIDs are not supported.
<b>Third Party Device Id</b>	The ID of the third-party device.
<b>Parameter List Length</b>	This field is ignored (LongIDs are not supported).

## Other Commands and Reservations

Unit reservations are released or canceled by:

- A Release command from the initiator that owns the reservation (original initiator or the third party)
- A Task Management reset:
  - Target Reset
  - LUN Reset
- An interface reset
- A power-on reset of the library

If the library is reserved as a unit, the library processes only the following commands from another initiator:

- Prevent/Allow Medium Removal with Prevent bits set to 0
- Inquiry
- Log Sense
- Release (the reservation is not released)
- Request Sense
- Report LUNs
- Report Target Port Groups

All other commands result in a Reservation Conflict status (18h).

## Send Diagnostic

The Send Diagnostic command (1Dh) requests the library to perform a self-diagnostic test. The library accepts this command for compatibility, but does not perform any action.

**TABLE 4-128** Send Diagnostic Command

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (1Dh)							
1	Ignored			PF	Rsvd (0)	SelfTest (1)	DevOfI (0)	UnitOfI (0)
2	Reserved (00h)							
3 to 4	(MSB) Parameter List Length							(LSB)
5	Control Byte (00h)							

### Send Diagnostic Command Descriptions:

<b>PF</b>	The library supports the page format (PF) specified by SCSI-3. The value of PF should be 1. However, the library accepts a 0 for self test.
<b>SelfTest</b>	The library returns a value of 1, indicating a request to the library to complete the library's default test.
<b>DevOfI</b>	This feature is not supported by the library; the value is set to 0.
<b>UnitOfI</b>	This feature is not supported by the library; the value is set to 0.
<b>Parameter List Length</b>	For the self-test option, a value of 0h is required.

## Send Volume Tag

The Send Volume Tag command (B6h) is a request for the library to transfer a volume tag template. The template corresponds to a VOLSER label template and is used by the library to search for desired elements. A subsequent Request Volume Element Address command is used to transfer the results of this search.

**TABLE 4-129** Send Volume Tag Command

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

### Send Volume Tag Command Descriptions:

<b>Element Type Code</b>	<p>This field specifies the element types selected for reporting by this command:</p> <p>0h = All Element Types reported  1h = Medium Transport Element (hand)  2h = Storage Element (cartridge tape storage cells)  3h = Import/Export Element (mailslot)  4h = Data Transfer Element (tape drive)</p> <p>For an Element Type Code of 0h, the element types are reported in ascending element address order, beginning with the first element greater than or equal to Starting Element Address.</p>
<b>Starting Element Address</b>	<p>This field specifies the element address at which to start the search. Only elements with an element address greater than or equal to the Starting Element Address are reported.</p> <p>The Starting Element Address must be a valid address for the library, but does not have to be an address of the type requested in the Element Type Code.</p>
<b>Send Action Code</b>	<p>This field specifies the function to be performed. The library only supports the translate and search primary volume tag function. The value is 5h.</p>

<b>Parameter List Length</b>	<p>This field indicates the length in bytes of the Parameter List that follows the command:</p> <p>00h = No data is transferred.</p> <p>28h = A Volume Identification Template is transferred.</p> <p>A value of 0 is not considered an error.</p>
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## Send Volume Tag Parameter List

The Send Volume Tag command requires a parameter list that defines the volume template to search for.

**TABLE 4-130** Send Volume Tag Parameter List

Byte	Bit							
	7	6	5	4	3	2	1	0
0 to 31	(MSB)	Volume Identification Template						(LSB)
32	Reserved (00h)							
33	Reserved (00h)							
34 to 35	(MSB)	Minimum Volume Sequence Number						(LSB)
36	Reserved (00h)							
37	Reserved (00h)							
38 to 39	(MSB)	Maximum Volume Sequence Number						(LSB)

- Volume Identification Template**  
 This ASCII field specifies a volume identification search template. A maximum of 6 ASCII characters may be used. The first 00 hex terminates the volume identification search template. The remaining characters are set to 0.
- Characters allowed are the same as those used on the cartridge VOLSER labels and include characters 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**  
 Sequence numbers are not supported on the library; ignore this field.
- Maximum Volume Sequence Number**  
 Sequence numbers are not supported on the library; ignore this field.

## Test Unit Ready

The Test Unit Ready command (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 status if the library is ready to accept additional commands. This command also returns a Check Condition if the library is not ready or if there are pending Unit Attentions.

**TABLE 4-131** Test Unit Ready Command

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



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## Locations

This appendix describes the SL150 Modular Library System walls (sides), tape slots (also named cells in prior interface manuals), and location scheme.

### Library Walls

There are two types of walls in the library:

1. Left side wall, which consists of a 15-cartridge slot magazine array
2. Right side wall, which consists of 15-cartridge slot array magazine and 4-cartridge slot Mailslot magazine array

[FIGURE A-1](#) and [FIGURE A-2](#) show valid storage slot, mailslot, and drive locations.

Tapes (cartridges) placed in slots lay flat, hub down, and parallel to the floor. To prevent slippage, tapes are held within their slots by molded-in internal retainer clips.

### Tape Slot Locations

Tape locations in previous libraries were listed by a LIBRARY Physical addressing scheme involving "Panel, Row, and Column" indices. SL150 uses the USER Physical addressing scheme which may change per the component being referenced.

Component	SCSI Element Address	USER Physical addressing
Slot (Data)	Yes	<module>, <side>, <row>, <column>
Slot (Reserved)	No	<module>, <side>, <row>, <column>
Drives	Yes	<module>, <top/bottom>
Mailslot	Yes	<slot number>
Power Supply	No	<module>, <top/bottom>
Hand (Robot)	Yes	n/a

FIGURE A-1 through FIGURE A-2 illustrate where these terms apply; TABLE A-1 shows the starting element address and the maximum number of each element type when the SL150 library is installed with 10 modules.

## Slot Maps

FIGURE A-1 and FIGURE A-2 show valid storage slot, mailslot, and drive locations.

TABLE A-1 shows the starting element address and the maximum number of each element type when the SL150 library is installed with 10 modules.

**Note** – The mailslots allow an operator to insert or remove cartridges during library operations. The mailslots are also referred to as Import/Export elements or cartridge access ports (CAPs).

## Default Element Mapping

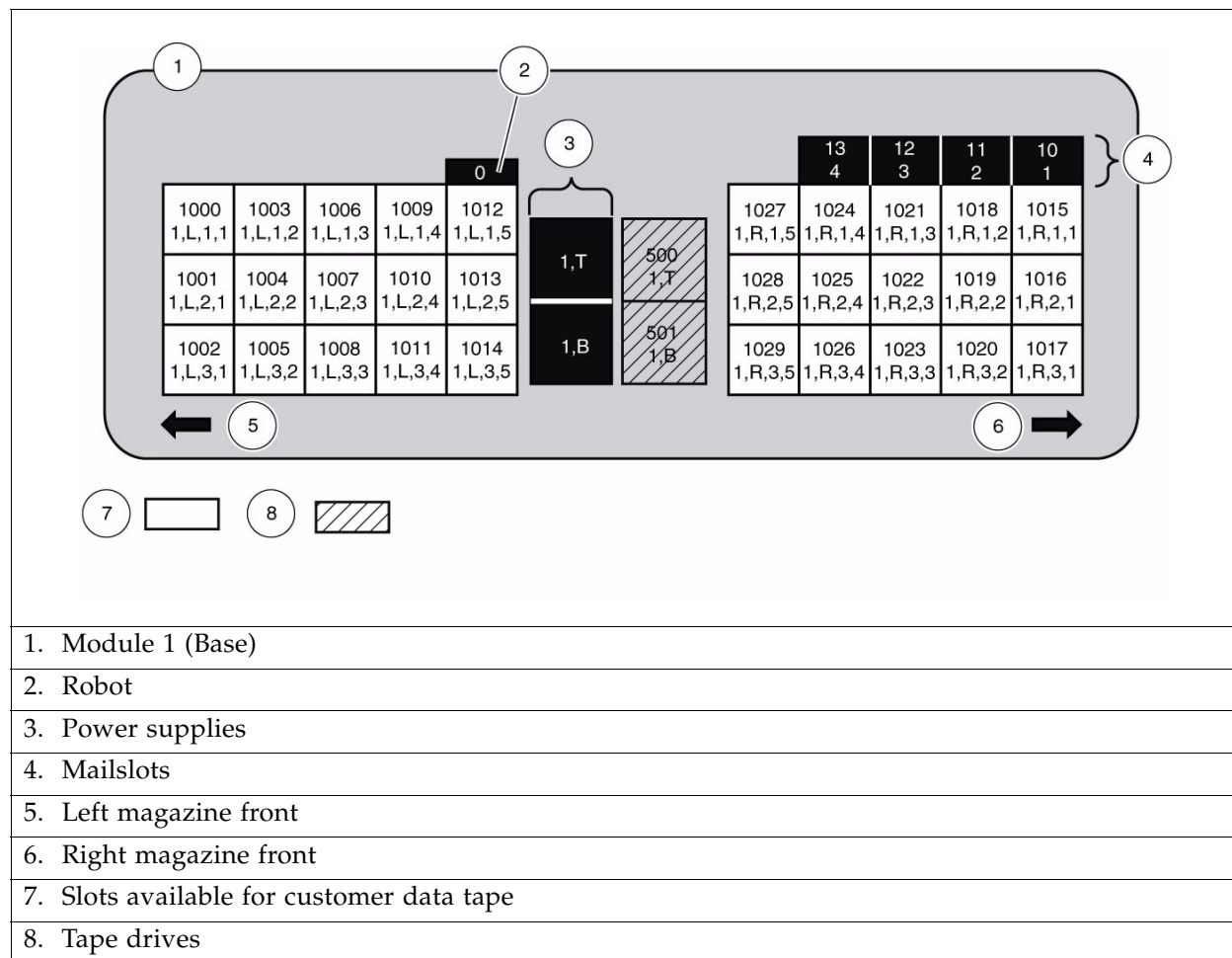
The following table shows the default first element and maximum number of elements in the SL150 library:

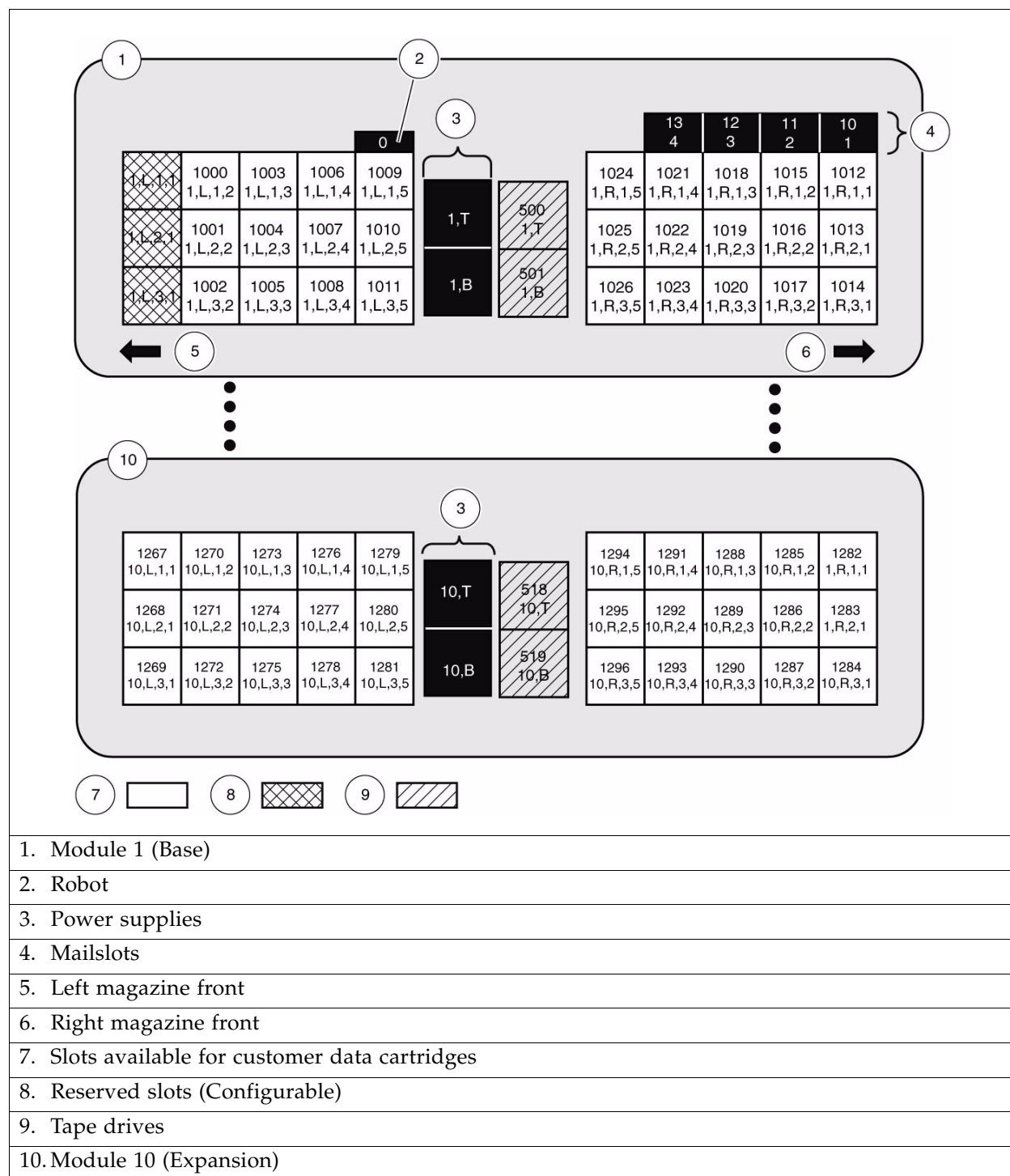
**TABLE A-1** Default Starting Element Address and Maximum Number of Elements

Element Type	First Default Element Address	Maximum Number of Elements for an SL150 Library with 10 Modules
Hand	0	1
Mailslot	10	4
Drives	500	20
Storage Slots	1000	300

**TABLE A-2** Numbering Key

Element Type	Numbering Key
Hand	Host Address: <SCSI Element Address>
Mailslot	Host Address: <SCSI Element Address> User Physical: <slot number>
Drives	Host Address: <SCSI Element Address> User Physical: <module>,<Top   Bottom>
Storage Slots	Host Address: <SCSI Element Address> User Physical: <module>,<side>,<row>,<column>
Reserved Slots	User Physical: <module>,<side>,<row>,<column>
Power Supply	User Physical: <module>,<Top   Bottom>

**FIGURE A-1** Base Module Slots of Non-Partitioned SL150 Library

**FIGURE A-2** Base Module and Drive Expansion Module Slots (After Configuring Reserved Slots)

**TABLE A-3** Storage Slot, Mailslot, and Drive Counts for Different Configurations

	Module 1	Expansion Module	Total Slots	Mailslots	Maximum Drives
Module 1	30		30	4	2
Module 1 + 1 drive expansion module	30	30	60	4	4
Module 1 + 2 drive expansion modules	30	60	90	4	6
Module 1 + 3 drive expansion modules	30	90	120	4	8
Module 1 + 4 drive expansion modules	30	120	150	4	10
Module 1 + 5 drive expansion modules	30	150	180	4	12
Module 1 + 6 drive expansion modules	30	180	210	4	14
Module 1 + 7 drive expansion modules	30	210	240	4	16
Module 1 + 8 drive expansion modules	30	240	270	4	18
Module 1 + 9 drive expansion modules	30	270	300	4	20
<b>Note</b> – 1. Expansion modules have 30 slots and 2 drives each (no mailslots) 2. When the mailslots are used for storage slots, add the mailslots count number in that column to the number in the total slots column.					

## Diagnostic and Cleaning Cartridge Locations

A total of up to 3 slots are allowed to be configured within the front left (Column 1) of the base module. The reserved slots may contain diagnostic and cleaning cartridges. The customer may not elect to configure any reserved slots, in which case these are used as normal storage slots.

The user may configure up to 3 of these reserved slots in the base module magazine beginning from row 1, column 1 and proceeding to row 3 of Column 1.

Reserved slots in a partitioned library must be configured prior to enabling partitioning.



---

## Partitioning Overview

The SL150 library can be partitioned into two distinct sections.

Briefly stated, this means that instead of one library—with all its cartridge slots, tape drives, and mailslots—being a single entity, the library and these components can now be divided into two sections or partitions. Each partition can be accessed by one host or multiple hosts.

### Partitioning—General

Partitioning has terms associated with it that you and your customer must understand to effectively use the feature. In certain cases, these terms redefine some concepts that are familiar with users of the traditional, non-partitioned library configuration.

A “partition” is defined as the process of dividing portions of a library into discrete sections. The partitioning feature offers great flexibility for users.

Enabling the library to be partitioned requires some important considerations:

- Each partition designates tape drives solely to its partition, the other partition cannot use these tape drives.
- Partition users must anticipate how much storage area is needed for their resident tape volumes and the amount of free slots required. Once storage needs are defined for the partitions within the library, sufficient modules need to be present within the library to accommodate this need.

The SCSI element numbering within partitioned libraries is continuous for each partition.

## Partitioning—Feature

The SL150 library supports two partitions.

**Important:** You must enable the partitioning feature through the administrator role within the Settings Screen under the Partitions tab. Online help within the library explains the partitioning configuration presented when partitions are enabled. Only the admin can enable or disable the partitioning feature.

The customer has the choice of a non-partitioned library or a library with two partitions. When a partitioned library is desired, the library uses the following simple method for dividing the resources in two partitions:

- Storage Slots
  - Partition 1 owns all storage slots on the left side of the library.
  - Partition 2 owns all storage slots on the right side of the library.
- Tape Drives
  - Partition 1 owns the top tape drive in Module 1 and the top tape drive in each additional expansion module.
  - Partition 2 owns the bottom tape drive in Module 1 and the bottom drive in additional expansion module.
- Mailslot Elements
  - The mailslot elements are shared by both partitions.

Using [FIGURE B-1](#) as an example, partition one owns the left side of the base and the base expansion modules, SCSI element numbering begins at the first available slot in Module 1 and continues through the expansion module slots. The first drive in the top module will begin the element numbering for partition 1 and continue to each top drive slot in all expansion modules that are installed.

The library will discover the current number of modules at each boot up. If you shut down the library and then boot up, the partitions will redefine to the current number of modules.

After ENABLING partitioning, the library sets the bridged drive for each partition:

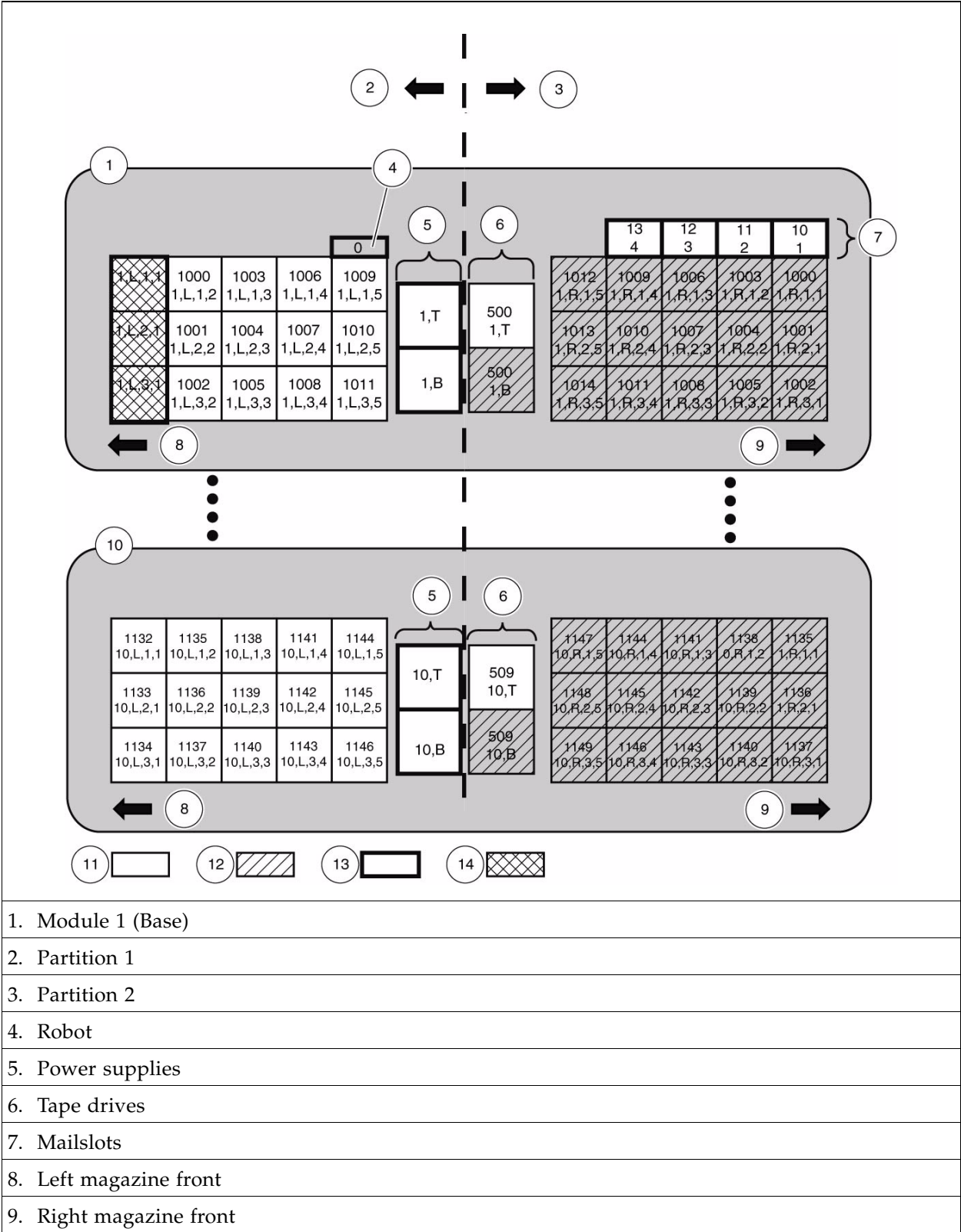
- The bridged drive for partition 1 is the top drive in Module 1. Partition 1 owns all tape drives in the top slot of each module.
- The bridged drive for partition 2 is the bottom drive in Module 1. Partition 2 owns all tape drives in the bottom slot of each module.

## Partitioning—Access Control

All hosts that issues commands to a bridged HP LTO-5 drive may also send commands to the library partition. Commands are processed by the partition in which the bridged drive resides. The host sends commands to the drive on LUN 0 and to the library on LUN 1.



FIGURE B-1 Partitioned SL150 Modular Tape Library



**FIGURE B-1** Partitioned SL150 Modular Tape Library

10. Module 10 (Expansion)
11. Partition 1 resource
12. Partition 2 resource
13. Shared resource
14. Reserved slots (configurable, shared resource)

## Partitioning—Shared Mailslot Behavior

When the library is partitioned, the mailslots are shared between the two partitions. When a partition needs access to the mailslots, the operator must use the ASSIGN action in the user interface to assign the partition to the mailslots before initiating an import or export operation. Refer to the SL150 Users Guide for help.

A Partition-Mailslot assignment gives a partition exclusive ownership of the shared mailslot. This ensures that cartridges are always entered into the correct partition and prevents the other partition from taking ownership of a shared mailslot that is already in use.

If the mailslot is not assigned to the partition, a SCSI host connected to the partition will receive a status indication from the library that the mailslot is open. When a SCSI host receives status that the mailslot is open, the application will let the operator close the mailslot or ASSIGN the mailslot to the partition. The following SCSI commands will return mailslot open status when the mailslot is not assigned to the partition or when the mailslot is actually open:

- A SCSI MOVE command to or from a mailslot element. The command will end in Check Condition Status. The sense data will indicate Not Ready, Mailslot Open (Sense Key = 2h, ASC = 3Ah, ASCQ = 02h).
- A SCSI READ ELEMENT STATUS command that includes the mailslot elements. The command will end in GOOD status. The Import/Export Element Descriptor data for the mailslot element will return an exception condition indicating that the mailslot is open; the Except Bit will be set to 1, the ASC field will be set to 3Ah, and the ASCQ field will be set to 02h.

TABLE B-1 shows how the SCSI Move and SCSI Read Element Status commands are affected by the shared mailslot assignment.

**TABLE B-1** SCSI Commands Affected by the Shared Mailslot Assignment

<b>Mailslot Assignment</b>	<b>Commands from Partition 1</b>	<b>Commands from Partition 2</b>
Unassigned	<p>Commands will be processed as though the mailslot door is open. The following commands will report exception status:</p> <ul style="list-style-type: none"> <li>• Read Element Status command that includes the mailslot element(s)</li> <li>• Move command with source or destination set to a mailslot</li> </ul>	<p>Commands will be processed as though the mailslot door is open. The following commands will report exception status:</p> <ul style="list-style-type: none"> <li>• Read Element Status command that includes the mailslot element(s)</li> <li>• Move command with source or destination set to a mailslot</li> </ul>
Assigned to Partition 1	<p>Commands will be processed normally. The SCSI Read Element Status and SCSI Move commands will only report that the Mailslot is open if it is physically opened and the request includes the mailslot.</p>	<p>Commands will be processed as though the mailslot door is open. The following commands will report exception status:</p> <ul style="list-style-type: none"> <li>• Read Element Status command that includes the mailslot element(s)</li> <li>• Move command with source or destination set to a mailslot</li> </ul>
Assigned to Partition 2	<p>Commands will be processed as though the mailslot door is open. The following commands will report exception status:</p> <ul style="list-style-type: none"> <li>• Read Element Status command that includes the mailslot element(s)</li> <li>• Move command with source or destination set to a mailslot</li> </ul>	<p>Commands will be processed normally. The SCSI Read Element Status and SCSI Move commands will only report that the Mailslot is open if it is physically opened and the request includes the mailslot.</p>

**Note** – The operator *must* use the UNASSIGN action in the user interface to remove the partition ownership of the mailslots when the import or export operation is complete.

The operator can open the mailslot only if it is unlocked. The locked or unlocked state of the mailslot depends on the mailslot assignment and the SCSI Prevent/Allow Medium Removal state. The library keeps separate Prevent/Allow Medium Removal data for each partition. Refer to the SCSI Prevent/Allow Medium Removal Command for more details.

TABLE B-2 shows the conditions under which the shared mailslot is either locked or unlocked. A value of "ignored" indicates that the Prevent/Allow Media Removal state for the associated partition does not matter.

**TABLE B-2** Shared Mailslot Door Locked/Unlocked Conditions

<b>Mailslot Assignment</b>	<b>Partition 1 Prevent/Allow Media Removal State</b>	<b>Partition 2 Prevent/Allow Media Removal State</b>	<b>Mailslot Locked State</b>
Unassigned	ignored	ignored	Locked
Assigned to Partition 1	Allowed	ignored	Unlocked
Assigned to Partition 1	Prevented	ignored	Locked
Assigned to Partition 2	ignored	Allowed	Unlocked
Assigned to Partition 2	ignored	Prevented	Locked

## Partitioning—Removing the Feature

To disable the partitioning feature, simply disable partitioning on the SETTINGS screen under the Partition tab and it will revert to a non-partitioned library configuration. Only the admin can enable or disable the partitioning feature.

After the partitions are removed, the top drive in Module 1 is configured to be the bridged drive for the non-partitioned library.

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# Glossary

This glossary defines terms and abbreviations in this publication.

Some of the definitions are taken from other glossaries. The letters in the parentheses that follow some definitions indicate the source of the definition:

**(A)** *The American National Standard Dictionary for Information Systems*, ANSI X3.172-1990, copyright 1990 by the American National Standards Institute (ANSI).

**(E)** The ANSI/Electronic Industries Association (EIA) Standard-440-A, *Fiber Optic Terminology*.

**(I)** *The Information Technology Vocabulary*, developed by Subcommittee 1, Joint Technical Committee 1, of the International Organization for Standardization and International Electro-technical Commission (ISO/IEC/JTC1/SC1).

**(IBM)** *The IBM Dictionary of Computing*, copyright 1994 by IBM.

**(T)** Draft international standards committee drafts, and working papers being developed by the ISO/IEC/JTC1/SC1.

## A

### **arm**

The robotic assembly that is lowered between the columns of tapes. The arm hangs on four wires from the Z mechanism. The arm includes the hand, the rails the hand rides on, the track motor that moves the hand along the rails, and the KLT card.

### **alphanumeric**

A character or group of characters that identifies a register, a particular part of storage, or some other data source or destination. (A).

## B

### **base chassis**

The sheet metal and plastic chassis that makes up the framework for module 1 (see [Module 1](#)).

### **BM**

See [Module 1](#).

## C

### **cartridge**

A storage device that consists of magnetic tape on a supply reel in a protective housing. The spine of the cartridge usually contains a label listing the volume identification number. Also called tape, tape cartridge, tape volume, or cassette.

### **cartridge access port (CAP)**

See [mailslot](#).

### **cleaning cartridge**

A tape cartridge that contains special material to clean the tape path in a transport or drive. LTO Ultrium cleaning cartridge labels have a CLN prefix and a CU media identifier.

### **configuration**

The manner in which the hardware and software of an information processing system is organized and interconnected. (T)

## D

### **data cartridge**

A term used to distinguish a cartridge onto which a tape drive may write data.

### **diagnostics**

Pertaining to the detection and isolation of errors in programs and faults in equipment.

### **drive**

A drive controls the movement of the tape and records or reads the data on the tape as desired by the customer (see [tape drive](#)).

### **drive slot**

The space where the drive module resides.

### **drive cleaning**

The device feature that uses a cleaning cartridge to clean a tape drive.

### **drive module**

See [tape drive](#).

## E

### **encryption**

The process of changing data into a form that cannot be read until it is deciphered, protecting the data from unauthorized access and use.

### **Ethernet**

A local-area, packet-switched network technology. Originally designed for coaxial cable, it now also runs over shielded, twisted-pair cable. Ethernet is a 10 or 100 Megabytes-per-second LAN.

### **expansion cable**

A cable used to connect expansion modules to Module 1. Each end of the cable has a USB A style connector.

**expansion chassis**

The sheet metal and plastic chassis that makes up the framework for modules 2 - 10 (see [Module X \(2, 3, ..., 10\)](#)).

**export**

The action in which the device places a cartridge into the mailslot so that the operator can remove the cartridge. Also called eject.

## F

**FC**

See [fibre channel](#).

**FCP**

See [front control panel](#).

**fiber optics**

The branch of optical technology concerned with the transmission of radiant power through fibers made of transparent materials such as glass, fused silica, and plastic. (E)

**fiber-optic cable**

A cable made of ultra-thin glass or silica fibers which can transmit data using pulses of laser light. Fiber-optic cables have several advantages over copper cables: they have much less signal loss; they allow information to be transmitted at higher speeds and over longer distances; they are not affected by external electrical noise; and they are better for transmissions which require security.

**fibre channel**

The National Committee for Information Technology Standards standard that defines an ultrahigh-speed, content-independent, multilevel data transmission interface that supports multiple protocols simultaneously. Fibre Channel supports connectivity to millions of devices over copper and/or fiber-optic physical media and provides the best characteristics of both networks and channels over diverse topologies.

**front control panel**

An assembly mounted on the front of Module 1. It includes the touch screen operator panel, various LEDs and switches, and associated electronics.

## G

**get**

An activity in which a robot obtains a cartridge from a slot or drive.

**gripper**

The portion of the hand assembly that grasps and holds a cartridge.

**GUI**

Graphical user interface. Software that allows the user to control the device through visual screens.

# H

## **hand**

The robotic mechanism that grabs cartridges and moves them between slots and the drive. It is a component of the arm. The hand has a reach mechanism that gets cartridges from slots or drives and puts them into slots or drives. The hand also has a wrist mechanism that rotates the hand to allow it to reach cartridges on either side or the drives at the back of the library.

## **hardware**

All or part of the physical components of an information processing system, such as computers or peripheral devices. (T) (A)

## **HBA**

See [host bus adapter \(HBA\)](#).

## **host computer**

In a computer network, a computer that usually performs network control functions and provides end users with services such as computation and database access. (T)

## **host bus adapter (HBA)**

A circuit installed in a multi-platform host or device that interfaces between the device and the bus.

## **host interface**

An interface between a network and host computer. (T)

# I

## **import**

The process of bringing a cartridge into the library from the mailslot. Also called enter.

## **indicator**

A device that provides a visual or other indication of the existence of a defined state. (T)

## **initialization**

The operations required for setting a device to a starting state, before the use of a data medium, or before implementation of a process. (T)

## **interface**

Hardware, software, or both, that links systems, programs, or devices. (IBM)

## **inventory**

The process of reading and storing in memory the bar code identification and location of all cartridges in a library.

# K

## **KLE**

See [module controller](#).



## L

### **LC connector**

A standard connector for 2-Gbps or 4-Gbps Fibre Channel data transfer. This type of connector is used on fiber-optic cables.

### **LED**

Light emitting diode. An electronic device that lights up when electricity is passed through it.

### **left magazine**

A plastic assembly containing 15 Tape Slots that can be inserted into the left side (as viewed from the front) of Modules 1-10. Right Magazines and Left Magazines are not interchangeable.

### **library**

A robotic system that stores, moves, mounts, and dismounts data cartridges that are used in data read or write operations.

### **load**

The process of moving a cartridge from a slot to the tape drive.

### **LMAG**

See [left magazine](#).

### **LTO**

An acronym for Linear Tape-Open technology. An “open format” technology, which means that users will have multiple sources of products and media.

### **LUN**

Logical Unit Number. An address for a component of a SCSI device. In this device, the host computer sends the SCSI commands to for the *library* to LUN 1 of the master *tape drive* and sends SCSI commands for the tape drive itself to LUN 0.

## M

### **magazine**

A removable array containing 15 cartridge slots that can be inserted into a base or expansion module.

### **magnetic tape**

A tape with a magnetizable layer on which data can be stored. (T)

### **magnetic tape drive**

A mechanism for controlling the movement of magnetic tape, commonly used to move magnetic tape past a read head or write head, or to allow automatic rewinding. (I) (A)

### **mailslot**

A plastic and metal assembly located in the upper right corner of the Base Chassis used to enter tapes into the library and to remove tapes from the library. The mailslots are also referred to as Import/Export elements. Before SL150, this was commonly referred to as a CAP (Cartridge Access Port), mostly internally.

**midplane**

A card mounted in the Base Chassis and Expansion Chassis. The card is identical whether used in a Base Chassis or an Expansion Chassis. This card is behind the tape slots and in front of the tape drives. Other cards connect to it either by direct connection or via a cable. Called the "Base Module Midplane" or "Expansion Module Midplane" when referring to this card in a specific module.

**Module 1**

The smallest workable library. Mounted in the top rack position above any Expansion Modules (Modules 2-10). Consists of the Base Chassis with the Midplane, Robot, Front Control Panel, Mailslot, one or two Power Supplies, up to two Tape Drives, Left Magazine, and Right Magazine.

**Module X (2, 3, ..., 10)**

A module that can be added to the bottom of an existing library to increase its capacity for drives and cartridges. Consists of the Expansion Chassis, Expansion Controller, up to two Power Supplies, up to two Tape Drives, a Left Magazine and a Right Magazine.

**module controller**

A card inserted into the back of Modules 2-10 that controls the operation of the module. Connected to the Robot by an Expansion Cable.

**multimode fiber**

An optical fiber designed to carry multiple signals, distinguished by frequency or phase, at the same time.

## N

**net mask**

A 32-bit, or 4-byte number, in dotted decimal format (typically written as four numbers separated by periods, such as 255.255.0.0 or 255.255.255.0) that is applied to an IP address to identify the network and node address of a host or router interface. (*Synonymous* with subnet mask.)

**network**

An arrangement of nodes and branches that connects data processing devices to one another through software and hardware links to facilitate information interchange.

## O

**offline**

Neither controlled by, nor communicating with, a computer. (IBM)

**online**

Pertaining to the operation of a functional unit when under the direct control of the computer. (T)

**operator panel**

A component of the front control panel consisting of a seven inch WVGA color touch screen.

**OPP**

See [operator panel](#).

## P

### **port**

A specific communications end point within a host. A port is identified by a port number. (IBM) (2) In Fibre Channel, an access point in a device where a link attaches.

### **put**

An activity in which a robot places a cartridge into a slot or drive.

### **power supply**

An AC to DC power supply. Mounts into a Power Supply Slot on the rear of a module (Modules 1-10). Referred to as a "Top Power Supply" or "Bottom Power Supply" when referring to a power supply installed in a specific module.

### **Power Supply Filler**

A metal frame that slides into a Power Supply Slot when a Power Supply will not be used in that slot. Mechanically fills the otherwise empty slot. Does not have any electrical connections.

## R

### **release**

A distribution of a new product or new function and fixes for an existing product. (IBM)

### **right magazine**

A plastic assembly containing 15 Tape Slots that can be inserted into the right side (as viewed from the front) of Modules 1-10. Right Magazines and Left Magazines are not interchangeable.

### **RMAG**

See [right magazine](#).

### **robot**

An assembly that incorporates the bulk of Module 1 electronics and the robotic components. This assembly is a combination of mechanical components, electronics, and a sheet metal housing. It is located at the top of the Module 1 and incorporates the arm, Z mechanism, a CPU board, plus the KLC and KLZ cards.

## S

### **SAS**

Serial Attached SCSI. A computer bus technology and serial communication protocol for direct attached storage devices, including disk drives and high-performance tape drives.

### **SCSI**

Small Computer System Interface. A standard interface and command set for transferring data between mass storage and other devices. The host computer uses SCSI commands to operate the device. Depending on the model, physical connection between the host computer and the tape drive will use a parallel SCSI, SAS, or Fibre Channel interface.

**slot**

An empty location into which something else may be placed. Most commonly used when referring to the locations in the magazine or mailslot where tape cartridges are placed. Power supplies and drives are also placed in slots.

**switch**

In Fibre Channel technology, a device that connects Fibre Channel devices together in a fabric.

## T

**tape cartridge**

A container holding magnetic tape that can be processed without separating the tape from the container. The device uses data and cleaning cartridges. These cartridges are not interchangeable. *See* cartridge.

**tape drive**

An electro-mechanical device that moves magnetic tape and includes mechanisms for writing and reading data to and from the tape. The drive is mounted into a proprietary tray (sometimes called a sled).

**Tape Drive Filler**

A metal frame that slides into a Tape Drive Slot when a Tape Drive will not be used in that Slot. Mechanically fills the otherwise empty slot. It does not have any electrical connections.

**Terabyte**

A unit of storage, abbreviated T or TB, equal to 1,024 Gigabytes.

## U

**U**

A measure of chassis height. 1U in rack measurement is 44.45 millimeters (1.75 inches).

**USB**

Universal Serial Bus. A serial bus standard used to interface devices.

## W

**World Wide Identifier**

A unique identifier in a Fibre Channel or SAS storage network, also called a World Wide Name (WWN). The first three bytes are derived from an IEEE Organizationally Unique Identifier (OUI), which defines the manufacturer or vendor. The remaining five bytes are assigned by the vendor.

**WORM**

An acronym for Write Once Read Many times, a class of recording systems that allow recording and adding data, but not altering recorded data.

**wrist**

A component of the hand assembly that rotates the hand horizontally.

## X

### **XCB**

See [expansion cable](#).

### **XPM**

See [Module X \(2, 3, ..., 10\)](#).

## Z

### **Z mechanism**

The robotic assembly mounted at the back of the robot that raises and lowers the arm. The Z mechanism includes a motor, gears, the bullwheel, and the wires and pulleys that hold the arm. As the motor turns, the bullwheel rotates and extends or retracts the wires to lower or raise the arm.

### **ZMech**

See [Z mechanism](#).



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