

IBM TS4300 Tape Library



SCSI Reference

Version 1 Release 0

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Contents

Feedback	v
Sending comments	v

Chapter 1. Media Changer SCSI

Command Set	1
Cartridge Generation Handling	1
Configuration changes	2
Commands that are allowed in the presence of reservations.	2
NOT READY condition.	3
Partition handling	4
SCSI abort handling	4
SCSI I/O station handling	5

Chapter 2. Supported SCSI commands . 7

CDB LUN field handling	8
EXCHANGE MEDIUM (A6h).	8
INITIALIZE ELEMENT STATUS (07h).	9
INITIALIZE ELEMENT STATUS WITH RANGE (37h)	9
INQUIRY (12h)	10
Standard inquiry data	11
Supported Vital Product Data page (00h)	13
Unit Serial Number page (80h)	14
Device Identification page (83h)	14
Vendor specific page (D0h)	16
LOG SENSE (4Dh)	16
Log Page Header format	17
Supported Pages Log page (00h)	17
Event Log page (07h)	17
Event Log structure.	18
Error event log parameter	18
Temperature Log page (0Dh)	19
Tape Alert Log page (2Eh)	20
Tape Alert flag structure	20
Statistics Counter page (30h).	20
Statistic Counter structure	21
Error Log page (34h)	22
Error Log structure.	22
Error event log parameter	23
MODE SELECT (15h)	23
Mode Select parameter list	24
Parameter List Header.	25
Control Extension page (0Ah)	25
Tape Alert page (1Ch)	26
Element Address Assignment page (1Dh)	26
Transport Geometry Parameters page (1Eh).	28
Device Capabilities page (1Fh)	28
MODE SELECT (55h)	30
MODE SENSE 6 (1Ah).	30
Mode Parameter List	31
Mode Parameter Header	31
Control Extension page (0Ah)	32
Tape Alert page (1Ch)	33
Element Address Assignment page (1Dh)	33
Transport Geometry Parameters page (1Eh).	34

Device Capabilities page (1Fh)	35
MODE SENSE 10 (5Ah)	37
Mode Parameter List	37
Mode Parameter Header	38
MOVE MEDIUM (A5h)	38
PERSISTENT RESERVE IN (5Eh)	39
PERSISTENT RESERVE IN parameter data for Read Keys.	40
PERSISTENT RESERVE IN parameter data for Read Reservation	40
PERSISTENT RESERVE IN reservation descriptor	41
PERSISTENT RESERVE OUT (5Fh)	41
PERSISTENT RESERVE OUT parameter list	42
POSITION TO ELEMENT (2Bh)	43
PREVENT / ALLOW MEDIA REMOVAL (1Eh)	44
READ BUFFER (3Ch)	45
Descriptor Mode	45
Data Mode	46
Echo Mode	46
Echo Buffer Descriptor Mode	47
READ ELEMENT STATUS (B8h)	47
Element Status Data	48
Header	48
Mixed media descriptor extension.	49
Element Descriptors	50
Medium Transport Element Status page (01h)	50
Storage Element Status page (02h).	52
Import/Export Element Status page (03h)	54
Data Transfer Element Status page (04h).	57
RELEASE (17h)	60
RELEASE 10 (57h)	60
REPORT LUNS (A0h)	61
REPORT SUPPORTED OPERATION CODES (A3h)	62
REPORT TIMESTAMP (A3h)	66
SET TIMESTAMP (A4h)	67
SEND VOLUME TAG (B6h)	68
Send Volume Tag Parameter structure	69
REQUEST SENSE (03h)	70
Possible sense keys	71
REQUEST VOLUME ELEMENT ADDRESS (B5h).	72
Request Volume Element Address header	73
RESERVE (16h)	73
RESERVE 10 (56h)	74
TEST UNIT READY (00h)	75
WRITE BUFFER (3Bh).	75
Write Data mode	76
Echo Buffer mode	76

Chapter 3. Command status byte	77
Chapter 4. Command timeouts	79
Chapter 5. Supported Tape Alert Flags	83
Chapter 6. Used Sense Keys, ASC, and ASCQ	85
Index	87

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Procedure

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Chapter 1. Media Changer SCSI Command Set

The SCSI media changer commands are based on the following specifications.

Document	T10 Version	ANSI INCITS Version
SMC-2	T10/1383-D rev 7	ANSI INCITS 382-2004
SPC-3	T10/1416-D rev 23	
SAM-2	T10/1157-D rev 24	ANSI INCITS 366-2003
SMC-3 features	TBD	TBD

A media changer logical unit receives commands to move cartridges between various types in the element address space. The element types are storage, import-export, data transfer, and medium transport. The cartridge handling robotic subsystem, addressed as a medium transport element, moves cartridges within a media changer. The media changer logical unit maintains an inventory of cartridges and the element addresses. The media changer logical unit reports this inventory when requested and also identifying the element address assigned to different types of elements.

Cartridge Generation Handling

The library media changer detects and stores LTO generation of each cartridge in its inventory.

Storing each cartridge provides in-smart cartridge management. The media changer is aware what cartridge is supported by which tape drive. The media changer reports Check Condition status on Move Medium and Exchange Medium commands that cause a medium generation conflict between a tape drive and a cartridge. For example, an LTO7 tape into an LTO5 drive. The media changer reports Check Condition status on Move Medium and Exchange Medium commands when a drive is encryption-enabled and a cartridge generation unable to support encryption is moved to this drive.

Possible sense data on these medium generation conflicts are the following.

Sense Key	ASC	ASCQ	Description
5h	30h	12h	ILLEGAL REQUEST. The destination tape drive does not support the cartridge generation at the source element address.
5h	80h	5Bh	ILLEGAL REQUEST. The destination tape drive cannot encrypt data due to (unsupported) cartridge generation at the source element address.

Configuration changes

Use the following information to make configuration changes.

The media changer is equipped with an RMI and OCP interface. Use these interfaces to make configuration changes. When you change the media changer configuration, the media changer informs the application client by using a unit attention with the sense data set to MODE PARAMETERS CHANGED (06/2A/00).

Commands that are allowed in the presence of reservations

The details of which commands that are allowed under a reservation that are described in the next table. The Reserve and Release commands are used to manage the reservation state of the media changer.

All the SCSI commands that are allowed in the presence of reservations.

Command	Media changer reserved by another initiator
Exchange Medium	Conflict
Initialize element status	Conflict
Initialize element status with range	Conflict
Inquiry	Allowed
Log select	Conflict
Log sense	Allowed
Mode select (6 & 10)	Conflict
Mode sense (6 & 10)	Allowed
Move medium	Conflict
Open/close import/export element	Conflict
Persistent reserve in	Allowed
Persistent reserve out	Conflict
Position to element	Conflict
Prevent/allow medium removal (prevent=0)	Allowed
Prevent/allow medium removal (prevent=1)	Conflict
Read buffer	Conflict
Read element status (curdata=0)	Conflict
Read elements status (curdata=1)	Allowed
Receive diagnostic results	Conflict
Release (6 & 100)	Allowed
Report luns	Allowed
Report supported operation codes	Conflict
Report timestamp	Allowed
Request sense	Allowed
Request volume element address	Conflict
Reserve(6 & 10)	Conflict

Command	Media changer reserved by another initiator
Set timestamp	Conflict
Send diagnostic	Conflict
Send volume tag	Conflict
Test unit ready	Conflict
Write buffer	Conflict
Allowed.	Commands that are received from SCSI initiators not holding the reservation complete normally.
Conflict.	Commands that are received from SCSI initiators not holding the reservation stop the command with a Reservation Conflict status.

NOT READY condition

When the media changer is unable to accept medium access commands it reports Check Condition status on medium access commands. The sense data is set to the reason why the media changer is unable to perform the requested medium access command. All non-media access commands are executed as specified.

The media changer is unable to process medium access commands successfully in the conditions listed in the table.

Not ready reason	Sense code during not ready reason	Notes
Initializing after POR	02/04/01	1, 3
Magazine removed	02/3B/12	
Magazine inserted	02/04/01	2, 3
Maintenance Library Tests	02/04/12	3
Partitioning changes	02/04/01	3
Note 1 After a power-on or device reset, the media changer initializes automatically.		
Note 2 When a magazine is inserted, the media changer reinitializes automatically.		
Note 3 When transitioning from not ready to ready, the media changer returns a Not Ready To Ready Transition unit attention (06/28/00) before returning to READY status.		
Note 4 Move commands from any interface are queued, and are therefore not causing the Not Ready status. After moving media, all affected partitions return to a Not Ready To Ready Transition unit attention (06/28/00).		
Note 5 When you unlock the multiple magazine process start, the media changer returns (02/3B/12). At the end phase (after last to be released magazine is inserted, it changes to (02/04/01) during inventory scan of all accessed magazines is running. The media changer will switch to Not Ready To Ready Transition (06/28/00) before returning to Ready status.		

The following non-media commands are processed during the Not Ready reason.

Inquiry
Persistent reserve in
Persistent reserve out

Release (6)
Release (10)
Request sense
Reserve
Reserve10

Partition handling

The media changer supports partitioning.

You can partition the media changer when it has more than one tape drive. A partitioned media changer behaves identically like the unpartitioned media changer with the following conditions.

- The number of storage slots, and data transfer elements are adjusted to match the new configuration.
- The media changer serial number in the Inquiry data changes to differentiate between the new partitions.
- Command execution-time increases. A partitioned media changer might be requested to execute more than one media access command at the same time. Since these commands are executed sequentially, the maximum execution time is multiplied by the number of enabled partitions. SCSI command timeouts are considering a normal scenario without parallel movements.
- I/O station magazines are potentially shared between multiple partitions. Individual slots of such a magazine are only assigned to one partition. Nevertheless, I/O station magazines can be only opened completely, which affects all owning partitions. If multiple partitions are setting a media removal prevention to their I/O stations, the magazine can be only opened after all media removal preventions are released.

SCSI abort handling

A task is aborted when an event or SCSI initiator device action causes termination of the task prior to its successful completion.

The following events cause a task, or several tasks, to be aborted.

- The return of an Execute command service response of Service Delivery or Target Failure.
- An I_T nexus loss.
- A logical unit reset.
- A hard reset.
- A power on condition.

On such conditions, the system aborts the current SCSI command. However, any mechanical operations still need to complete. SCSI initiator can immediately start with a new command execution. A new command is executed as soon as possible. Unit attention condition with an extra sense code set to SCSI Bus Reset Occurred is generated.

SCSI I/O station handling

When you insert or remove a cartridge from the I/O station, the Full bit of the element descriptor that describes the I/O station changes. This important event is reported to the application client by a unit attention condition, for example, Import/Export Element Accessed. The IMPEX bit of the element descriptor is set if the cartridge in the I/O station was added by a user. If it came from a storage element, the IMPEX bit is not set.

When an application client requests to move a cartridge to or from the import/export element and the I/O station is open, removed from the lock position, the Move Medium command returns Check Condition status with the sense data set to Illegal Request, Door Open (05/04/83).

Whenever medium removal prevented is on a partition by the Prevent Medium Removal command, opening or closing of the I/O station is prevented for all partitions by using I/O stations of the same I/O station magazine.

When medium removal is prevented by the Prevent Medium Removal command, move commands to or from the import export element are not prevented.

When a user enables or disables the I/O station feature from the RMU or OCP, the assigned element addresses of all storage elements and the number of storage elements changes. This important event is signaled to the application client by a unit attention condition such as Mode Parameters Changed.

If a SCSI command comes in while the I/O station is removed, the robot services that command and then inventory the I/O station magazine if it was inserted during the SCSI command.

Chapter 2. Supported SCSI commands

The following table lists all supported Media Changer SCSI commands.

Command	Operation Code	Standard	Support Status
INITIALIZE ELEMENT STATUS	07h	SMC-2	supported
EXCHANGE MEDIUM	A6h	SMC-2	supported
INITIALIZE ELEMENT STATUS WITH RANGE	37h	SMC-2	supported
INQUIRY	12h	SPC-3	supported
LOG SELECT	4Ch	SPC-3	supported
LOG SENSE	4Dh	SPC-3	supported
MODE SELECT (6)	15h	SPC-3	supported
MODE SENSE (6)	1Ah	SPC-3	supported
MODE SELECT (10)	55h	SPC-3	supported
MODE SENSE (10)	5Ah	SPC-3	supported
MOVE MEDIUM	A5h	SMC-2	supported
OPEN/CLOSE IMPORT/EXPORT ELEMENT	1Bh	SMC-3	not supported
PERSISTENT RESERVE IN	5Eh	SPC-3	supported*
PERSISTENT RESERVE OUT	5Fh	SPC-3	supported*
POSITION TO ELEMENT	2Bh	SMC-2	supported
PREVENT/ALLOW MEDIUM REMOVAL	1Eh	SPC-3	supported
READ BUFFER	3Ch	SPC-3	supported
READ ELEMENT STATUS	B8h	SMC-2	supported
RECEIVE DIAGNOSTIC RESULTS	1Ch	SPC-3	not supported
RELEASE (6)	17h	SPC-3	supported*
RELEASE (10)	57h	SPC-3	supported*
REPORT LUNS	A0H	SPC-3	supported*
REPORT SUPPORTED OPERATION CODES	A3h	SPC-3	supported
REPORT TIMESTAMP	A3h	SPC-3	supported
REQUEST SENSE	03h	SPC-3	supported
REQUEST VOLUME ELEMENT ADDRESS	B5h	SMC-2	supported
RESERVE (6)	16h	SPC-3	supported*
RESERVE (10)	56h	SPC-3	supported*
SET TIMESTAMP	A4h	SPC-3	supported
SEND DIAGNOSTIC	1Dh	SPC-3	not supported
SEND VOLUME TAG	B6h	SMC-2	supported
TEST UNIT READY	00h	SPC-3	supported

Command	Operation Code	Standard	Support Status
WRITE BUFFER	3Bh	SPC-3	supported
* Note. These commands are handled by the LUN drive.			

CDB LUN field handling

The Media Changer implementation ignores LUN fields (Byte 1, Bit 5-7) of all CDBs.

EXCHANGE MEDIUM (A6h)

The Exchange Medium command allows an application client to replace a volume at an element address with another volume.

The media changer can exchange cartridges between a mix of Storage Elements, Import/Export Elements, and Data Transfer Elements. The volume in the Source Address element is moved to the First Destination Address element. The volume that previously occupied the First Destination Address element is moved to the Second Destination Address element. The Second Destination Address element might or might not be the same as the Source Address element.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (A6h)							
1	LUN			Reserved				
2	(MSB) Medium Transport Address (LSB)							
3								
4	(MSB) Source Address (LSB)							
5								
6	(MSB) First Destination Address (LSB)							
7								
8	(MSB) Second Destination Address (LSB)							
9								
10	Reserved						Inv1	Inv2
11	FSC	Control						
12	(MSB) FAILOVER SESSION KEY (LSB)							
15								

Field Descriptions	
Medium Transport Address:	This field specifies the medium transport element that is used to execute the Exchange Medium command. This value can be set to either 0 or to the currently valid Medium Transport Element address.
Source Address:	The volume in the Source Address element is moved to the First Destination Address element address. The Source Address can be a Storage Element address, Import/Export Element address, or a Data Transfer Element address.

Field Descriptions	
First Destination Address:	The volume in the First Destination Address is moved to the Second Destination Address. The First Destination Address can be a Storage Element address, Import/Export Element address, or a Data Transfer Element address.
Second Destination Address:	The Second Destination Address element might or might not be the same as the Source Address element. The Second Destination Address can be a Storage Element address, Import/Export Element address, or a Data Transfer Element address.
Inv1/Inv2:	An Invert bit of one specifies that the medium is inverted or rotated prior to depositing the medium into the destination element. The media changer does not support medium rotation. Therefore, this field must be set to zero.
FSC:	Failover session sequence count.
Failover Session Key:	Failover session key. If the failover session key is not associated with a failover session that is tracked by the library, then the command is terminated with Check Condition status. The sense key is set to Illegal Request and the additional sense code set to Failover Session Sequence Error.

INITIALIZE ELEMENT STATUS (07h)

This command directs the medium changer to check all existing elements for tape cartridges and any status relevant to that element. This command enables an application client to get a quick response from a **Read Element Status** command that might follow. It is useful after a power failure, if tape medium was changed by an operator, or if subsystem configuration changed. The media changer does not return GOOD status until it checks that all the elements are complete. The media changer might decide that element status is accurate, and return GOOD status on the command immediately.

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

Field descriptions	
Force:	Force the check of specified element range although media changer believes that element status is accurate.

INITIALIZE ELEMENT STATUS WITH RANGE (37h)

The INITIALIZE ELEMENT STATUS WITH RANGE command causes the media changer to check the specified element range for volume status and any other relevant status. This command enables the initiator client to get a quick response from a Read Element Status command that might follow. It is useful after a power failure, if tape medium was changed by an operator, or if subsystem configuration changed. The media changer might decide that the element status is accurate, and return GOOD status on this command immediately.

Bit	7	6	5	4	3	2	1	0
0	Operation Code (37h)							
1	LUN		Force	Reserved		Fast	Range	
2	(MSB) Starting Element Address (LSB)							
3								
4	Reserved							
5	Reserved							
6	(MSB) Number of Elements (LSB)							
7								
8	Reserved							
9	Control							

Field Descriptions:

- **Range:** A Range bit of zero indicates that all element addresses are checked and that the Starting Element Address and Number of Elements fields are ignored. A Range bit of one indicates that the series of elements, beginning at the specified Starting Element Address for the specified Number of Elements are checked. If the **Number of Elements** field is zero, the range checked starts with the Starting Element Address and continues through the last element address on the unit.
- **Fast:** This bit is ignored.
- **Force:** Force the check of specified element range although media changer believes that element status is accurate.
- **Element Address:** When the Range bit is set, this field specifies the starting element address of the scan for the Initialize Elements with Range command. When the Range bit is not set, the information in this field is ignored.
- **Number of Elements:** When the Range bit is set, this field specifies the number of elements to scan during the Initialize Elements with Range command. The number of cartridges to scan must not exceed the maximum number of available storage slots, taking in account the starting **Element Address** field. When the Range bit is not set, the information in this field is ignored.

INQUIRY (12h)

The INQUIRY command requests that information about parameters of the medium changer be sent to the initiator. The media changer can provide two categories of data in response to an inquiry command: Standard Inquiry Data and Vital Product Data. Standard Inquiry Data contains basic data about the Medium Changer and Vital Product Data can comprise several pages of extra data. Each Vital Product Data page requires a separate INQUIRY command from the initiator. An INQUIRY command is not affected by, nor does it clear, a Unit Attention condition.

Bit	7	6	5	4	3	2	1	0
0	Operation Code (12h)							
1	LUN		Reserved			Obsolete	EVPD	
2	Page Code							

Bit	7	6	5	4	3	2	1	0
Byte								
3	(MSB) Allocation length							(LSB)
4								
5	Control							

Field Descriptions:

- **EVPD:** Enable Vital Product Data. An enable vital product data (EVPD) bit of one specifies that the device server returns the optional vital product data that is specified by the page code field.

Note: If the EVPD bit is set to 0, the page code must be 00h.

- **Page Code:** This field contains the page number of the vital product data page to be returned for the INQUIRY command, if the EVPD bit is set to 1. The following pages are supported:
 - 00h - Supported vital product pages
 - 80h - Unit serial number page
 - 83h - Device Identification page
 - C0h - Firmware build information page
 - D0h - Vendor Specific Page
- **Allocation Length:** Specifies the number of bytes of inquiry information the media changer is allowed to return to the initiator during the command's data-in phase. Error status is not returned if the value in this field truncates the requested information.

Standard inquiry data

Bit	7	6	5	4	3	2	1	0
Byte								
0	Peripheral Qualifier (0)			Peripheral Device Type (08=Medium Changer)				
1	RMB (1)	Reserved						
2	Version (5)							
3	Obsolete	Obsolete	NormACA (0)	HiSup	Response data format (2)			
4	Additional length (45h)							
5	SCCS	ACC	TPGS		3PC	Reserved		Protect
6	BQue	EncServ	Reserved	MultiP	MChngr	Obsolete	Obsolete	Addr16
7	Obsolete	Obsolete	WBus16	Sync	Linked	Obsolete	CmdQue	Reserved
8 - 15	Vendor Identification (8 ASCII bytes)							
16 - 31	Product Identification (16 ASCII bytes)							
32 - 35	Product Revision level (4 ASCII bytes)							
36 - 37	Plant of manufacturer (2 ASCII bytes)							
38 - 49	Serial Number (12 ASCII bytes)							
50 - 54	Reserved							
55	Reserved							BarC
56					Clocking		QAS	IUS

Bit	7	6	5	4	3	2	1	0
Byte								
57	Reserved							
58 - 59	Version Descriptor: 005Ch (SAM-2 ANSI INCITS 366-2003)							
60 - 61	Version Descriptor: 0B56h							
62 - 63	Version Descriptor: 030Fh (SPC-3 T10/1416-D revision 22)							
64 - 65	Version Descriptor: 02Feh (SMC-2 ANSI INCITS 382-2004)							
66 - 73	Reserved							

Field Descriptions

- **Peripheral Qualifier** A return value of 0 indicates that the specified LUN is supported in this device. When an unsupported LUN was specified the Peripheral Qualifier returns **3h**, which indicates that specified LUN is not supported.
- **Peripheral Device Type** Indicates a medium changer device. Set to 8. When an unsupported LUN was specified, the Peripheral Device Type returns **1Fh** that indicates that specified LUN is not supported.
- **RMB** Removable Medium Bit. Set to 1.
- **Version** The media changer complies to SPC-3. Set to 5.
- **NormACA** A NORMACA bit set to zero indicates that the device server does not support a NACA bit set to one in the control byte and does not support the ACA task attribute.
- **HiSup** A hierarchical support (HISUP) bit set to zero indicates that the SCSI target device does not use the hierarchical addressing model to assign LUNs to logical units.
- **Response Data Format** This Standard Inquiry Data is in SCSI-2 format. Set to 2.
- **Additional Length** The media changer uses this field to indicate the number of extra bytes of INQUIRY response data available.
- **SCCS** The media changer does not contain an embedded storage array controller component. Set to 0.
- **ACC** The ACC bit set to zero indicates that no access controls coordinator can be addressed through this logical unit.
- **TPGS** The media changer does not support asymmetric logical unit access or supports a form of asymmetric access that is vendor-specific. The REPORT TARGET GROUPS and the SET TARGET GROUPS commands are not supported.
- **3PC** A Third-Party Copy (3PC) bit set to zero indicates that the media changer does not support third-party copy commands such as the EXTENDED COPY command.
- **Protect** A PROTECT bit set to zero indicates that the media changer does not support protection information.
- **BQue** Basic Queuing is not supported. Set to 0.
- **EncServ** An Enclosure Services (ENC SERV) bit set to zero indicates that the media changer does not contain an embedded enclosure services component.
- **MultiP** A Multi Port (MULTIP) bit set to one indicates a multi-port (two or more ports) SCSI target device and conforms to the SCSI multi-port device

requirements found in the applicable standards (SAM). A MUTLTIP bit set to zero indicates that this SCSI target device has a single port and does not implement the multi-port requirements.

- **MChanger** This medium changer is not an attached medium changer. Set to 0.
- **Addr16** When Addr16 is set to 1, the media changer does support 16-bit wide SCSI addresses. When set to 0, it indicates that the media changer does not support 16-bit wide SCSI addresses.
- **WBus16** When WBus16 is set to 1, the media changer transfers SCSI data over a 16-bit wide bus. When WBus16 is not set, data transfers are done over an 8-bit wide bus.
- **Sync** When Sync is set, data transfers are done in synchronous mode. When Sync is not set, data transfers are done in asynchronous mode.
- **Linked** Linked Commands are not supported. Set to 0.
- **CmdQue:** Support of Tagged Command Queuing depends on the tape drive currently hosting Media Changer functionality. Usually set to 1.
- **Vendor Identification** 8-byte ASCII string. This field is set to:

0	1	2	3	4	5	6	7
I	B	M					

- **Product Identification** 16-byte ASCII string. This field is set to:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
3	5	7	3	-	T	L									

- **Product Revision Level** This field contains 4 bytes of ASCII data that provides the media changer's software revision levels. When a firmware update is run on the media changer, this part of the revision level changes to reflect that update.
- **Plant of manufacturer** This field is always returns '00'.
- **Serial Number** This field returns the 12 most right ASCII bytes of the media changer serial number.
- **BarC** When set this bit indicates that the media changer is equipped with a bar code scanner.
- **IUS** Information Units Supported. Set to 0, which indicates information units are not supported.
- **QAS** Quick Arbitrate Supported. Set to 0, indicating QAS is not supported.
- **Clocking** Indicates the level of data clocking that is supported. Set to 11b if the host interface speed is not set to limit transfers to 80 MB/s. Set to 00b when the host interface speed is set to limit transfers to 80 MB/s.
- **Version Descriptors** The version descriptors report the identifier of the supported SCSI command sets.

Supported Vital Product Data page (00h)

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

Bit	7	6	5	4	3	2	1	0
Byte	Peripheral Qualifier (0)			Peripheral Device Type (8)				
0	Peripheral Qualifier (0)			Peripheral Device Type (8)				
1	Page Code (00h)							

Bit	7	6	5	4	3	2	1	0
Byte								
2	Reserved							
3	Page Length (05h)							
4	00h - (this page)							
5	80h - Unit Serial Number Page							
6	83h - Device Identification Page							
7	C0h - Firmware Build Information Page							
8	D0 - Vendor Specific Page							

Note: If an unsupported LUN was initially specified, the Peripheral Qualifier returns **3h**, and the Peripheral Device Type returns **1Fh**.

Unit Serial Number page (80h)

The Unit Serial Number VPD page contains 17 bytes of ASCII data, representing a unique serial number of the TS4300 media changer. Length and format of the reported string are independent from being in partitioned or non-partitioned mode. The most right 12-Byte of the original manufacturing serial number are extended by _LL and a two-digit extension for the partition number. Non-partitioned Libraries report itself as Partition 01.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Peripheral Qualifier (0)			Peripheral Device Type (8)				
1	Page Code (80h)							
2	Reserved							
3	Page Length (0Fh)							
4 - 20	Serial Number (17 ACSII bytes)							

Note: If an unsupported LUN was initially specified, the Peripheral Qualifier returns **3h**, and the Peripheral Device Type returns **1Fh**.

Field Descriptions:

- **Serial Number:** The 17-byte ASCII Serial Number can contain ASCII numbers and ASCII characters. See next example:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	2	3	4	5	6	a	b	c	X	Y	Z	_	L	L	0	1

Device Identification page (83h)

The Device Identification VPD page provides the means to retrieve identification descriptors from the media changer. Both Fibre Channel and SAS devices return the following Device Identification VPD page:

Byte	Bit	7	6	5	4	3	2	1	0
0		Peripheral Qualifier (0)			Peripheral Device Type (8)				
1		Page Code (83h)							
2		Reserved							
3		Page Length (37h)							
4		Reserved				Code Set (1)			
5		Reserved				Identifier Type (3)			
6		Reserved							
7		Identifier Length (08h)							
8 - 15		NAA Identifier							
16		Reserved				Code Set (2)			
17		Reserved				Identifier Type (1)			
18		Reserved							
19		Identifier Length (27h)							
20-27		Vendor Identification (8 ASCII bytes)							
28 - 43		Product Identification (16 ASCII bytes)							
44 - 60		Serial Number (17 ACSII bytes)							

Note: If an unsupported LUN was initially specified, the Peripheral Qualifier returns **3h** and the Peripheral Device Type returns **1Fh**.

Field Descriptions:

- **Peripheral Qualifier:** A return value of 0 indicates that the specified LUN is supported in this device. When an unsupported LUN was specified the Peripheral Qualifier returns **3h**, which indicates that specified LUN is not supported.
- **Peripheral Device Type:** Indicates a medium changer device. Set to 8. When an unsupported LUN was specified the Peripheral Device Type returns **1Fh**, which indicates that specified LUN is not supported.
- **Code Set:** This field is set to 1, indicating that the device identifier contains binary values.
- **Identifier Type:** The Identifier Type is set to 3, indicating that NAA identifiers are returned.
- **NAA Identifier:** This field reports the NAA identifier. This identifier is defined by the SMC WWNN of the hosting LUN master drive.
- **Code Set:** This field is set to 2 indicating that the device identifier is returned as an ASCII string.
- **Identifier Type:** The Identifier Type is set to 1 indicating that the T10 style identifier is returned.
- **Vendor Identification:** This field returns the 8-byte Vendor ID ASCII string.
- **Product Identification:** This field returns the 16-byte Product ID ASCII string.

- **Serial Number:** This field returns the 17-byte serial number ASCII string that includes a Partition depending on a suffix like _LL01 independent if the library is partitioned or not.

Vendor specific page (D0h)

The contents of this page are not specified in this document.

LOG SENSE (4Dh)

The LOG SENSE command allows an application client to retrieve statistical information that is maintained by the media changer. The statistical information is divided over several pages. A LOG SENSE command retrieves one of the statistical information pages.

Byte	Bit	7	6	5	4	3	2	1	0
0		Operation Code (4Dh)							
1		LUN			Reserved			PPC (0)	SP (0)
2		PC		Page Code					
3		Reserved							
4		Reserved							
5	(MSB)	Parameter pointer							(LSB)
6									
7	(MSB)	Allocation length							(LSB)
8									
9		Control							

Field Descriptions:

- **PPC:** If Parameter Pointer Control bit is set, the target terminates the command with Check Condition status. The sense key is set to ILLEGAL REQUEST, and an extra sense code of INVALID FIELD IN CDB.
- **SP:** Saving Log Parameters (SP) is not supported. If the SP bit is set, the command is terminated with Check Condition status with the sense key set to ILLEGAL REQUEST, and an extra sense code of INVALID FIELD IN CDB.
- **PC:** The **Page Control** field defines the type of parameter value to be returned. This field is either be set to 00b (Current Threshold Values) or 01b (Current Cumulative Values). If not, the command is terminated with Check Condition status with the sense key set to ILLEGAL REQUEST, and an extra sense code of INVALID FIELD IN CDB. The Current Cumulative Values are the values that are computed since the last reset of the device (either by power-cycling, Bus Device Reset, or SCSI Reset).

LOG SELECT with PCR set and **PC** field that is set to 3 clears both Error and Normal trace.

Note: Log Sense Tape Alert page (2Eh) supports only PC being set to Current Threshold Values.

- **Page Code:** The **Page Code** field identifies which log page is being requested by the initiator. If the page is not supported, then the command terminates with a Check Condition status with the sense key set to ILLEGAL REQUEST, and an extra sense code of INVALID FIELD IN CDB. Supported pages are

- 00h -List of Supported Pages page
- 07h -Event Log page
- 0Dh -Temperature Log page
- 2Eh -Tape Alert page
- 30h -Statistics Counter page
- 34h -Error Log page
- **Parameter Pointer:** The Parameter Pointer field allows the host to specify at which parameter within a Log Page the requested data begins. This feature is not supported in any Log Sense page and must be set to 0.
- **Allocation Length:** The **Allocation Length** field is used to inform the target how much space the initiator allocated for data. The target returns the bytes specified by allocation length.

Log Page Header format

Each Log Sense page begins with a 4-byte header.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved		Page Code					
1	Reserved							
2 - 3	Page Length							

Field Descriptions:

- **Page Code:** The Page Code echoes the page code that was specified in the CDB.
- **Page Length:** The Page Length specifies the total number of bytes contained in this log page, not including the 4 bytes of the header.

Supported Pages Log page (00h)

When page 0 is requested, the 4-byte page header is returned, followed by the pages supported in ascending order, 1 byte for each page.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved		Page Code (00h)					
1	Reserved							
2 - 3	Page Length (4)							
4	00h - Supported Log Pages page							
5	07h - Event Log page							
6	0Dh - Temperature Log page							
6	2Eh - Tape Alert page							
6	30h - Statistics Counter page							
9	34h - Error Log page							

Event Log page (07h)

In the Event Log, the media changer tracks different system events. These events exist out of hardware errors, executed commands, and debug information. The

events are stored in a FIFO mode, which means that only the n most recent events are stored. Older events are deleted. This log is stored in non-volatile memory (NVRAM) and is therefore resistant to power failures.

The data that is returned for the event log page must not exceed 64 KB. A single LOG SENSE command to the Event Log page can return all events. The Event Log page starts with a header that indicates the number of bytes of the total event history, followed by zero, or more event structures. Reading the Event Log page does not clear the event data.

Byte	Bit	7	6	5	4	3	2	1	0
0		Reserved		Page Code (07h)					
1		Reserved							
2 - 3		Page Length							
4 - xxxxh		Events Structures							

Field Descriptions:

- **Page Code:** The Page Code echoes the page code that was specified in the LOG SENSE CDB.
- **Page Length:** The Page Length specifies the total number of event bytes, not including the 4 bytes for this header.
- **Event Structure:** An event structure consists of a header and a variable number of event data bytes. This structure is defined in the next table.

Event Log structure

Byte	Bit	7	6	5	4	3	2	1	0
0		Reserved		Page Code (07h)					
1		Reserved							
2 - 3		Page Length (n-3)							
		Error event log parameters							
4		Error event log parameters [first]							
		-							
		-							
		-							
n		Error event log parameters [last]							

Error event log parameter

Byte	Bit	7	6	5	4	3	2	1	0
0		(MSB) Parameter Code (n)							
1		(LSB)							
2		DU(0)	DS(1)	TSD(0)	ETC(0)	TMC(0)	Reserved	LP(0)	

Bit	7	6	5	4	3	2	1	0
Byte								
3	Parameter Length (n-3)							
4	Error Event Data							
n								

Field Descriptions:

- **Parameter Code:** The Parameter Code is a 2-byte value that uniquely identifies the error event within the log.
- **DU:** Disable Update is set for any parameter that the host cannot reset.
- **DS:** Disable Save. The media changer has no support for SP bit. Set to 1.
- **TSD:** Target determines save method, set to 0.
- **ETC:** No threshold comparison, set to 0.
- **TMC:** No threshold is supported, set to 0.
- **LP:** The List Parameter field is set to zero for parameters that are counters and set to one for parameters that are not counters.
- **Parameter Length:** This field specifies the total length of the event structure, including the additional event data, but without the 4-byte header.
- **Error Event data:** The Event data field contains ASCII detailed information about the event. The amount of event data ranges between 0 up to a maximum 225 bytes.

Temperature Log page (0Dh)

The Temperature Log page returns the 4-byte page header followed by two Parameter Codes. Parameter Code 0000h reports the current temperature. Parameter Code 0001h reports the maximum sensor temperature at which the media changer can reliably operate.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved		Page Code (0Dh)					
1	Reserved							
2 - 3	Page Length (12)							
4 - 5	Parameter Code 0000h (Temperature)							
6	DU(0)	DS(1)	TSD(0)	ETC(0)	TMC(0)	Reserved	Reserved	LP(0)
7	Parameter Length (02h)							
8	Reserved							
9	Temperature (in degrees Celsius)							
10 - 11	Parameter Code 0001h (Max Temperature)							
12	DU(0)	DS(1)	TSD(0)	ETC(0)	TMC(0)	Reserved	Reserved	LP(0)
13	Parameter Length (02h)							
14	Reserved							
15	Max Temperature (in degrees Celsius)							

Tape Alert Log page (2Eh)

The Tape Alert Log consists of the Page Header followed by 64 Tape Alert flags. Each Tape Alert flag stands for a predetermined media changer-specific error condition. Tape Alert Flags range from 1 until 64. Every tag number has a standardized meaning. The Tape Alert log is not affected by the LOG SELECT command. The Tape Alert Log can be retrieved by using a Log Sense command with PC (Page Control) set either to 00b or 01b.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved		Page Code (2Eh)					
1	Reserved							
2	(MSB) Page Length (0140h)							
3	(LSB)							
4 - 323	64 Tape Alert Flag structures (320 bytes)							

For more information, see Chapter 5, "Supported Tape Alert Flags," on page 83.

Tape Alert flag structure

Bit	7	6	5	4	3	2	1	0
Byte								
0	(MSB) Parameter Code (n)							
1	(LSB)							
2	DU(0)	DS(1)	TSD(0)	ETC(0)	TMC(0)	Reserved	Reserved	LP(0)
3	Parameter Length (1)							
4	Value of Flag (Set when bit 0 = 1)							

Field Descriptions

- **Parameter Code:** The Parameter Code is a 2-byte value that uniquely identifies the parameter within the log. It ranges 1-64
- **DU:** Disable Update is set for any parameter that the Host cannot reset.
- **DS:** Disable Save. The media changer has no support for SP bit. Set to 1.
- **TSD:** Target determines save method.
- **ETC:** No threshold comparison
- **TMC:** No threshold supported.
- **LP:** The List Parameter field is set to zero for parameters that are counters and set to one for parameters that are not counters.

Statistics Counter page (30h)

This page consists of the Page Header followed by three vendor-specific counters. The information in this page is stored in NV-RAM on power shut-down. This page is not affected by the LOG SELECT command or by Firmware updates.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved		Page Code (30h)					
1	Reserved							
2	(MSB) Page Length (0048h)							
3	(LSB)							
4 - 51	4 Statistics Counter structures (32 bytes)							

Field Descriptions:

- **Page Code:** The Page Code echoes the page code that was specific in the Log Sense CDB.
- **Page Length:** The Page Length specifies the total number of bytes contained in this log page, not including the 4 bytes of the header.

Statistic Counter structure

Bit	7	6	5	4	3	2	1	0
Byte								
0	(MSB) Parameter Code (n)							
1	(LSB)							
2	DU(0)	DS(1)	TSD(0)	ETC(0)	TMC(0)		Reserved	LP(0)
3	Parameter Length (4)							
4	(MSB) Statistic Counter Value							
5								
6								
7	(LSB)							

Field Descriptions:

- **Parameter Code:** The Parameter Code is a 2-byte value that uniquely identifies the parameter within the log.
- **DU:** Disable Update is set for any parameter that the Host cannot reset.
- **DS:** Disable Save. The media changer has no support for SP bit. Set to 1.
- **TSD:** Target determines save method, set to 0.
- **ETC:** No threshold comparison, set to 0.
- **TMC:** No threshold is supported, set to 0.
- **LP:** The List Parameter field is set to zero for parameters that are counters and set to one for parameters that are not counters.

Parameter	Definition	Description	DU	LP
1	Minutes of Operation:	This 4-byte unsigned counter specifies the minutes of operation. Every minute the device is turned on this counter increments.	0	0
2	Number of Start-ups:	This 4-byte unsigned counter specifies the number of times the library is turned on.	0	0

Parameter	Definition	Description	DU	LP
3	Number of Firmware Updates:	This 4-byte unsigned counter specifies the number of times the internal flash code (ROM) is updated.	0	0
4	Number of Loader Moves:	This 4-byte unsigned counter specifies the number of times the media changer performed a successful Move operation.	0	0

Error Log page (34h)

In the Error Log the media changer keeps track of different system errors.

The events are stored in a FIFO mode. Only the *n* most recent events are stored. Older events are not displayed. This log is stored in non-volatile memory (NVRAM) and is resistant to power failures. The data returned for the Error log page does not exceed 64 Kbytes. A single LOG SENSE command to the Error Log page returns all events. The Error Log page starts with a header indicating the number of bytes of the total error history, followed by zero or more event structures. Reading the Error Log page does not clear the event data.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved		Page Code (34h)					
1	Reserved							
2 - 3	Page Length							
4 - xxxxh	Error Structures							

Field Descriptions:

- **Page Code:** The Page Code echoes the page code that was specified in the LOG SENSE CDB.
- **Page Length:** The Page Length specifies the total number of event bytes, not including the 4 bytes for this header.
- **Error Structure:** An event structure consists of a header and a variable number of event data bytes. This structure is defined in .

Error Log structure

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved		Page Code (34h)					
1	Reserved							
2-3	Page Length (n-3)							
	Event Log Parameters							
4	Error Event Log Parameter [first]							
	-							
	-							
	-							

Bit	7	6	5	4	3	2	1	0
Byte								
n	Error Event Log Parameter [last]							

Error event log parameter

Bit	7	6	5	4	3	2	1	0
Byte								
0	(MSB) Parameter Code (n)							
1								(LSB)
2	DU(0)	DS(1)	TSD(0)	ETC(0)	TMC(0)		Reserved	LP(0)
3	Parameter Length (n-3)							
4	Error Event Data							
n								

Field Descriptions:

- **Parameter Code:** The Parameter Code is a 2-byte value that uniquely identifies the error event within the log.
- **DU:** Disable Update is set for any parameter that the host cannot reset.
- **DS:** Disable Save. The media changer has no support for SP bit. Set to 1.
- **TSD:** Target determines save method, set to 0.
- **ETC:** No threshold comparison, set to 0.
- **TMC:** No threshold is supported, set to 0.
- **LP:** The List Parameter field is set to zero for parameters that are counters and set to one for parameters that are not counters.
- **Parameter Length:** This field specifies the total length of the event structure, including the additional event data, but without the 4-byte header.
- **Error Event data:** The Event data field contains ASCII detailed information about the event. The amount of event data ranges between 0 up to a maximum 225 bytes.

MODE SELECT (15h)

The MODE SELECT (6) command provides a means for an application client to specify peripheral device parameters to the media changer. Application clients must issue MODE SENSE before each MODE SELECT to determine supported pages, page lengths, changeable variables and to determine whether the page is saveable to NVRAM.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (15h)							
1	LUN			PF (1)	Reserved			SP
2	Reserved							
3	Reserved							
4	Parameter list length							

Bit	7	6	5	4	3	2	1	0
Byte								
5	Control							

Field Descriptions:

- **PF:** A PF bit of one indicates that the MODE SELECT parameters that follow the header and block descriptor complies with the SCSI-2 specification. The value must be set to 1.
- **SP:** A Save Pages (SP) bit of zero that indicates the media changer completes the specified MODE SELECT operation, and does not save any pages in nonvolatile RAM. An SP bit of one indicates that the media changer completes the specified MODE SELECT operation, and saves the current values to a nonvolatile RAM.

When a host successfully issued the MODE SELECT CDB that changed settings in one of the Mode pages, the media changer raises a Unit Attention condition to every other host who did not issue this CDB. The sense data for these hosts is set to Mode Parameters Changed (06/2A/01).

The host provides the parameters through a parameter list to the media changer. The parameter list consists of the following items.

- Parameter List Header
- Mode Select pages

Supported Mode Select Pages

Page Code	Subpage Code	Page Name	Page saveable in NVRAM	Page Description
0Ah	01h	Control Extension page	No	Provides a means to read out the capabilities of the SET TIMESTAMP and REPORT TIMESTAMP commands.
1Ch	00h	Tape Alert page	No	Provides means to select a specific way to report a Tape Alert event.
1Dh	00h	Element Address Assignment page	Yes	Provides a means to change SCSI element address assignments and respective element ranges.
1Eh	00h	Transport Geometry page	No	Provides a means to set the specifics about the Transport Element (not changeable).
1Fh	00h	Device Capabilities page	No	Provides a means to set the media changer's capabilities (not changeable).

Mode Select parameter list

The Mode Select parameter list that is shown here contains a 4-byte header, followed by an optional 8-byte block descriptor after which the Mode Select pages are specified.

Bit	7	6	5	4	3	2	1	0
Byte								
0 - 3	Parameter List Header							
4 - n	Mode Select pages							

Parameter List Header

If you send any pages with the Mode Select command to the media changer, you must first send the Parameter List Header, followed by the requested Mode Select page. The Parameter List Header has the following format:

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

If no Block Descriptor is to be sent to the media changer, specify zero as Block Descriptor Length in the Parameter Header.

After the Parameter List Header the application client can send zero, one, or more Mode Select pages to the media changer to configure any required parameter.

Control Extension page (0Ah)

By using the Control Extension page, the host can retrieve SCSI features that are provided by the media changer.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved	SPF(1)	Page Code (0Ah)					
1	Subpage code (01h)							
2	(MSB) Page Length (1Ch) (LSB)							
3								
4	Reserved				TCMOS	SCSIP(1)	IALUAE(0)	
5 - 31	Reserved							

Field Descriptions:

- **SPF:** The Sub Page Format (SPF) bit is set to one to indicate that the Control Extension page is a subpage.
- **TCMOS:** A TCMOS bit set to zero specifies that the time stamp cannot be changed by any method except those methods that are defined by this standard.
- **SCSIP:** A SCSI precedence (SCSIP) bit set to one specifies that the timestamp was changed by using a SET TIMESTAMP command takes precedence over any other methods. This value must be set to one.

- **IALUAE:** An implicit asymmetric logical unit access enabled (IALUAE) bit set to zero. The media changer does not allow implicit asymmetric logical unit access state changes.

Tape Alert page (1Ch)

The host can use this page to retrieve the tape alerts logging method.

Bit	7	6	5	4	3	2	1	0
Byte								
0	PS (0)	SPF (0)	Page Code (1Ch)					
1	Additional Page Length (0Ah)							
2	Perf (0)	Reserved			Dexcpt(1)	Test (0)	Reserved	LogErr
3	Reserved				MRIE (0)			
4 - 7	Interval Timer							
8 - 11	Report Count / Test Flag Number							

Field Descriptions

- **PS Parameters Saveable.** This field is set to zero. The media changer cannot write this page to non-volatile memory.
- **Perf:** When this bit is set to 0, the informational exception operations that can cause delays are acceptable. This bit is always set to zero.
- **Dexcpt:** When this bit is set to zero, the reporting method that is indicated by the MRIE field is used. When this bit is set to one this indicates that the media changer disables all information exception operations that ignore the MRIE field. In this mode, the initiator must be the Tape Alert log page. Currently, only MRIE mode 0 is supported, so this bit is ignored.
- **Test:** Test modes are not supported. Therefore this field is set to 0.
- **LogErr:** When this bit is set to 0, the media changer does not log any tape Alert events. When this bit is set to 1, the media changer logs Tape Alert events.
- **MRIE:** This field indicates the method that is used by the media changer to report informational exception conditions. Currently, only mode 0 is supported. This means that Tape Alert flags can be read only by polling with the LOG SENSE command to the Tape Alert page.
- **Interval Timer:** The media changer does not report Tape Alert conditions as Informational Exception conditions. Therefore, this field is set to zero.
- **Report Count / Test Flag Number:** Since test modes are not supported, this field reports Report Count only. But the media changer does not support Informational Exception conditions. Therefore, this field is set to zero.

Element Address Assignment page (1Dh)

The Element Address Assignment page is used to assign addresses to the elements of the medium changer (with the **Mode Select** command) and to report those assignments (Mode Sense). The Element Address Assignment page also defines the number of each type of element present in the subsystem configuration.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved	RSRV	Page Code (1Dh)					
1	Additional Page Length (12h)							

Bit	7	6	5	4	3	2	1	0
Byte								
2 - 3	First Medium Transport Element Address							
4 - 5	Number of Medium Transport Elements							
6 - 7	First Storage Element Address							
8 - 9	Number of Storage Elements							
10 - 11	First Import / Export Element Address							
12 - 13	Number of Import / Export Elements							
14 - 15	First Data Transfer Element Address							
16 - 17	Number of Data Transfer Elements							
18	Reserved							
19	Reserved							

Field Descriptions:

- **First Medium Transport Element Address:** By using this field, the host can specify the address of the robotic cartridge handler.
- **Number of Medium Transport Elements:** By using this field, the host can specify the number of robotic cartridge handlers within the media changer. If the Number of Medium Transport Elements is greater than the default value returned in the Mode Sense parameter data, the media changer returns a Check Condition.
- **First Storage Element Address:** By using this field, the host can specify the starting address for the cartridge storage locations.
- **Number of Storage Elements:** By using this field, the host can specify the number of cartridge storage locations. If the Number of Storage Elements is greater than the default value returned in the Mode Sense parameter data, the media changer returns a Check Condition.
- **First Import/Export Element Address:** By using this field, the host can specify the address of the import/export element.
- **Number of Import/Export Elements:** By using this field, the host can specify the maximum number of import/export elements. If the Number of Import/Export Elements is greater than the default value that is returned in the Mode Sense parameter data, the media changer returns a Check Condition.
- **First Data Transfer Element:** By using this field, the host can specify the starting address of the installed tape drives.
- **Number of Data Transfer Elements:** By using this field, the host can specify the number of tape drives installed. If the Number of Data Transfer Elements is greater than the default value returned in the Mode Sense parameter data, the media changer returns a Check Condition.

Note: The actual number of installed elements cannot be changed by the field values in the Element Address Assignment page. Specifying a value other than the specified number returns a Check Condition status with the Sense Key set to ILLEGAL REQUEST.

Transport Geometry Parameters page (1Eh)

The Transport Geometry Parameters page, in the SCSI-2 command set, determines whether each medium transport element is a member of a set of elements in a robotic subsystem. The Transport Geometry Parameters page also determines whether media rotation on the medium transport is possible. The initiator cannot change this information.

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

Field Descriptions:

- **Rotate:** Rotation of media is not an implemented feature, so the value returned for this field bit is 0.
- **Member Number in Transport Element Set:** The media changer has only one medium transport element, so the value that is returned for this field is 0.

Device Capabilities page (1Fh)

The Device Capabilities page defines the characteristics of the element types that are used by this medium changer. The initiator cannot change this information.

Byte	Bit	7	6	5	4	3	2	1	0
0	Reserved	SPF (0)	Page Code (1Fh)						
1	Additional Page Length (12h)								
2	Reserved					DT (1)	I/E (1*)	ST (1)	MT (0)
3	Reserved						ACE	VTRP (1)	S2C (1)
4	MT→RA (0)	Reserved			MT→DT (1)	MT→I/E (1)	MT→ST (1)	MT→MT (0)	
5	ST→RA (0)	Reserved			ST→DT (1)	ST→I/E (1)	ST→ST (1)	ST→MT (0)	
6	I/E→RA (0)	Reserved			I/E→DT (1*)	I/E→I/E (1*)	I/E→ST (1)*	I/E→MT (0)	
7	DT→RA (0)	Reserved			DT→DT (1**)	DT→I/E (1*)	DT→ST (1)	DT→MT (0)	
8 - 11	Reserved								
12	MT→WA (0)	Reserved			MT→DT (0)	MT→I/E (0)	MT→ST (0)	MT→MT (0)	
13	ST→WA (0)	Reserved			ST→DT (1)	ST→I/E (1*)	ST→ST (1)	ST→MT (0)	

Byte	Bit	7	6	5	4	3	2	1	0
14		I/E→WA (0)		Reserved		I/E↔DT (1*)	I/E↔I/E (1*)	I/E↔ST (1*)	I/E↔MT (0)
15		DT→WA (0)		Reserved		DT↔DT (1**)	DT↔I/E (1*)	DT↔ST (1)	DT↔MT (0)
16 - 19		Reserved							
* Only when Import/Export elements are enabled.									
** Only when number of Data Transfer elements is 2 or more.									

Field Descriptions:

- **DT:** Data Transfer. The value for this field is 1. Tape drives can store cartridges.
- **I/E:** Import/Export. The value for this field is 1. The Import/Export element can store cartridges.
- **ST:** Storage. The value reported for this field is 1. The storage elements can store cartridges.
- **MT:** Medium Transport. The value for this field is 0. The medium transport element cannot store cartridges.
- **S2C:** The **SMC-2 Capabilities** field is set to 1. This bit indicates that the Device Capabilities page supports the new VRTP, ACE, XX-RA, and XX-WA fields.
- **VTRP:** Volume Tag Reader Present. When set, this bit indicates that the media changer does have a bar code reader. The value for this field is 1.
- **ACE:** Auto Clean Enabled. When set to one, the media changer monitors the cleaning required status of the data transfer element (tape drive) and automatically cleans the data transfer element when needed. When the media changer is set to zero, it does not automatically clean the data transfer element.
- **XX→YY:** Where XX is a valid source and YY is a valid destination address. If one of these bits is set to 1, it indicates that the medium changer device supports all **Move Medium** commands for which the source is element type XX and the destination is element type YY on the condition that the element addresses are valid.
- **XX↔YY:** A one in these fields indicates that the medium can be exchanged by using the **Exchange Media** command between elements of types XX and YY on the condition that the element addresses are valid.
- **XX→RA:** These fields indicate the resources that are required to support the READ ATTRIBUTE commands for each element type XX. The media changer does not support the READ ATTRIBUTE command. Therefore, these fields are set to 0.
- **XX→WA:** These fields indicate the resources that are required to support the WRITE ATTRIBUTE commands for each element type XX. The media changer does not support the WRITE ATTRIBUTE command. Therefore, these fields are set to 0.

MODE SELECT (55h)

The MODE SELECT (10) command provides a means for an application client to specify peripheral device parameters to the media changer. Application clients issue MODE SENSE before each MODE SELECT to determine supported pages, page lengths, changeable variables and to determine whether the page is saveable to NVRAM. Refer to the Mode Select (6) description, for more information on the supported Mode Select page.

Bit	7	6	5	4	3	2	1	0	
Byte									
0	Operation Code (55h)								
1	LUN			PF (1)	Reserved			SP	
2	Reserved								
3	Reserved								
4	Reserved								
5	Reserved								
6	Reserved								
7	(MSB)			Parameter list length					
8								(LSB)	
9	Control								

Field Descriptions:

- **PF:** A PF bit of one indicates that the MODE SELECT parameters that follow the header and block descriptor complies with the SCSI-2 specification. The value must be set to 1.
- **SP:** A Save Pages (SP) bit of zero indicates that the media changer completes the specified MODE SELECT operation, and does not save any pages in non-volatile ram. An SP bit of one indicates that the media changer completes the specified MODE SELECT operation, and saves the current values to a non-volatile RAM.

MODE SENSE 6 (1Ah)

The MODE SENSE (6) command provides a means for an application client to retrieve peripheral device parameters from the media changer. It is a complementary command to the MODE SELECT (6) command.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (1Ah)							
1	LUN			Reserved	DBD	Reserved		
2	PC		Page Code					
3	Subpage Code							
4	Allocation Length							
5	Control							

Field Descriptions:

- **DBD:** The Disable Block Descriptors bit specifies whether the media changer returns block descriptors after the Parameter List Header.
- **PC:** The **Page Control** field defines the type of mode parameter values to be returned in the mode pages.

00b	Report Current Values (equal to default values if no pages previously saved).
01b	Report changeable values.
10b	Report Default Values
11b	Report Saved Values (equal to default values if no pages previously saved).

- **Page Code:** The page code defines which pages are returned. See next table. An Initiator can request one or all mode sense pages. Each response includes a 4 bytes for the Parameter List Header, followed by the specified number of bytes for each page.

Page Code	Subpage Code	Number bytes	Page Name	Page Description
0Ah	01h	32	Control Extension Page	Provides a means to read out the capabilities of the SET TIMESTAMP and REPORT TIMESTAMP commands.
1Ch	00h	12	Tape Alert Page	Allows the host to see what mechanism is used to report Tape Alert events.
1Dh	00h	20	Element Address Assignment Page	Provides a means to read the SCSI element address assignments and respective element ranges.
1Eh	00h	4	Transport Geometry Page	Provides a means to read the specifics about the Medium Transport Element.
1Fh	00h	20	Device Capabilities Page	Provides a means to read the media changer's capabilities.
3Fh	00h	70	All pages	Returns all Mode Sense pages in incrementing order.
3Fh	FFh	102	All pages, including subpages	Returns all Mode Sense pages, including subpages in incrementing order.

Mode Parameter List

The returned data on a Model Sense (10) command begins with an 8-byte Mode Parameter Header. The header is followed by one or all Mode Sense pages as requested by the Page Code and Subpage Code fields.

Bit	7	6	5	4	3	2	1	0
Byte								
0 - 3	Mode Parameter Header							
4 - n	Mode Sense Pages							

Mode Parameter Header

The returned data on a Mode Sense (6) command begins with a 4-byte Mode Parameter Header. This header has the following structure.

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

Field Descriptions:

- **Mode Data Length:** This field displays the number of bytes of parameter information the media changer returns as a result of this command, which excludes the Mode Data Length, but includes the three additional Parameter List Header bytes. If a block descriptor was requested, this count is also added to the Mode Data Length.
- **Block Descriptor Length:** If the DBD is cleared in the CDB, the media changer might return an 8-byte Block Descriptor. When a Block Descriptor is returned, the Block Descriptor Length reports 8. When the DBD bit is set, the media changer does not return Block Descriptors and the Block Descriptor Length is 0. All fields in Block Descriptor are considered reserved and are therefore set to 0.

Control Extension page (0Ah)

By using the Control Extension page, the host can retrieve SCSI features that are provided by the media changer.

Bit	7	6	5	4	3	2	1	0
Byte								
0	PS(0)	SPF(1)	Page Code (0Ah)					
1	Subpage code (01h)							
2	(MSB) Page Length (1Ch) (LSB)							
3								
4	Reserved				TCMOS	SCSIP(1)	IALUAE(0)	
5 - 31	Reserved							

Field Descriptions:

- **PS:** Parameters Savable. This field is set to zero. The media changer cannot write this page to non-volatile memory.
- **SPF:** The Sub Page Format (SPF) bit is set to one to indicate that the Control Extension page is a subpage.
- **TCMOS:** A TCMOS bit set to zero specifies that the time stamp cannot be changed by any method except those methods that are defined by this standard.
- **SCSIP:** A SCSI precedence (SCSIP) bit set to one specifies that the timestamp was changed by using a SET TIMESTAMP command takes precedence over any other methods. This value must be set to one.
- **IALUAE:** An implicit asymmetric logical unit access enabled (IALUAE) bit set to zero. The media changer does not allow implicit asymmetric logical unit access state changes.

Tape Alert page (1Ch)

The host can use this page to retrieve the tape alerts logging method.

Bit	7	6	5	4	3	2	1	0
Byte								
0	PS (0)	SPF (0)	Page Code (1Ch)					
1	Additional Page Length (0Ah)							
2	Perf (0)	Reserved			Dexcpt(1)	Test (0)	Reserved	LogErr
3	Reserved				MRIE (0)			
4 - 7	Interval Timer							
8 - 11	Report Count / Test Flag Number							

Field Descriptions

- **PS** Parameters Saveable. This field is set to zero. The media changer cannot write this page to non-volatile memory.
- **Perf**: When this bit is set to 0, the informational exception operations that can cause delays are acceptable. This bit is always set to zero.
- **Dexcpt**: When this bit is set to zero, the reporting method that is indicated by the MRIE field is used. When this bit is set to one this indicates that the media changer disables all information exception operations that ignore the MRIE field. In this mode, the initiator must be the Tape Alert log page. Currently, only MRIE mode 0 is supported, so this bit is ignored.
- **Test**: Test modes are not supported. Therefore this field is set to 0.
- **LogErr**: When this bit is set to 0, the media changer does not log any tape Alert events. When this bit is set to 1, the media changer logs Tape Alert events.
- **MRIE**: This field indicates the method that is used by the media changer to report informational exception conditions. Currently, only mode 0 is supported. This means that Tape Alert flags can be read only by polling with the LOG SENSE command to the Tape Alert page.
- **Interval Timer**: The media changer does not report Tape Alert conditions as Informational Exception conditions. Therefore, this field is set to zero.
- **Report Count / Test Flag Number**: Since test modes are not supported, this field reports Report Count only. But the media changer does not support Informational Exception conditions. Therefore, this field is set to zero.

Element Address Assignment page (1Dh)

The Element Address Assignment page is used to assign addresses to the elements of the medium changer (with the **Mode Select** command) and to report those assignments (Mode Sense). The Element Address Assignment page also defines the number of each type of element present in the subsystem configuration.

Bit	7	6	5	4	3	2	1	0
Byte								
0	PS(1)	SPF(0)	Page Code (1Dh)					
1	Additional Page Length (12h)							
2 - 3	First Medium Transport Element Address							
4 - 5	Number of Medium Transport Elements							
6 - 7	First Storage Element Address							

Bit	7	6	5	4	3	2	1	0
Byte								
8 - 9	Number of Storage Elements							
10 - 11	First Import / Export Element Address							
12 - 13	Number of Import / Export Elements							
14 - 15	First Data Transfer Element Address							
16 - 17	Number of Data Transfer Elements							
18	Reserved							
19	Reserved							

Field Descriptions:

- **PS:** Parameter Saveable. This field is set to 1. The media changer can save this page to non-volatile memory.
- **First Medium Transport Element Address:** By using this field, the host can specify the address of the robotic cartridge handler.
- **Number of Medium Transport Elements:** By using this field, the host can specify the number of robotic cartridge handlers within the media changer. If the Number of Medium Transport Elements is greater than the default value returned in the Mode Sense parameter data, the media changer returns a Check Condition.
- **First Storage Element Address:** By using this field, the host can specify the starting address for the cartridge storage locations.
- **Number of Storage Elements:** By using this field, the host can specify the number of cartridge storage locations. If the Number of Storage Elements is greater than the default value returned in the Mode Sense parameter data, the media changer returns a Check Condition.
- **First Import/Export Element Address:** By using this field, the host can specify the address of the import/export element.
- **Number of Import/Export Elements:** By using this field, the host can specify the maximum number of import/export elements. If the Number of Import/Export Elements is greater than the default value that is returned in the Mode Sense parameter data, the media changer returns a Check Condition.
- **First Data Transfer Element:** By using this field, the host can specify the starting address of the installed tape drives.
- **Number of Data Transfer Elements:** By using this field, the host can specify the number of tape drives installed. If the Number of Data Transfer Elements is greater than the default value returned in the Mode Sense parameter data, the media changer returns a Check Condition.

Transport Geometry Parameters page (1Eh)

The Transport Geometry Parameters page, in the SCSI-2 command set, determines whether each medium transport element is a member of a set of elements in a robotic subsystem. The Transport Geometry Parameters page also determines whether media rotation on the medium transport is possible. The initiator cannot change this information.

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

Field Descriptions:

- **PS:** Parameter Saveable. This field is set to 0. The media changer cannot save this page to non-volatile memory.
- **Rotate:** Rotation of media is not an implemented feature, so the value returned for this field bit is 0.
- **Member Number in Transport Element Set:** The media changer has only one medium transport element, so the value that is returned for this field is 0.

Device Capabilities page (1Fh)

The Device Capabilities page defines the characteristics of the element types that are used by this medium changer. The initiator cannot change this information.

Byte	Bit	7	6	5	4	3	2	1	0	
0		PS(0)	SPF (0)	Page Code (1Fh)						
1		Additional Page Length (12h)								
2		Reserved				DT (1)	I/E (1*)	ST (1)	MT (0)	
3		Reserved					ACE	VTRP	S2C	
								(1)	(1)	
4		MT→RA (0)	Reserved		MT→DT (1)	MT→I/E (1)	MT→ST (1)	MT→MT (0)		
5		ST→RA (0)	Reserved		ST→DT (1)	ST→I/E (1)	ST→ST (1)	ST→MT (0)		
6		I/E→RA (0)	Reserved		I/E→DT (1*)	I/E→I/E (1*)	I/E→ST (1*)	I/E→MT (0)		
7		DT→RA (0)	Reserved		DT→DT (1**)	DT→I/E (1*)	DT→ST (1)	DT→MT (0)		
8 - 11		Reserved								
12		MT→WA (0)	Reserved		MT→DT (0)	MT→I/E (0)	MT→ST (0)	MT→MT (0)		
13		ST→WA (0)	Reserved		ST→DT (1)	ST→I/E (1*)	ST→ST (1)	ST→MT (0)		
14		I/E→WA (0)	Reserved		I/E→DT (1*)	I/E→I/E (1*)	I/E→ST (1*)	I/E→MT (0)		
15		DT→WA (0)	Reserved		DT→DT (1**)	DT→I/E (1*)	DT→ST (1)	DT→MT (0)		

Bit	7	6	5	4	3	2	1	0
Byte								
16 - 19	Reserved							
* Only when Import/Export elements are enabled.								
** Only when number of Data Transfer elements is 2 or more.								

Field Descriptions:

- **PS:** Parameters Saveable. This field is set to zero. The media changer cannot write this page to non-volatile memory.
- **DT:** Data Transfer. The value for this field is 1. Tape drives can store cartridges.
- **I/E:** Import/Export. The value for this field is 1. The Import/Export element can store cartridges.
- **ST:** Storage. The value reported for this field is 1. The storage elements can store cartridges.
- **MT:** Medium Transport. The value for this field is 0. The medium transport element cannot store cartridges.
- **S2C:** The **SMC-2 Capabilities** field is set to 1. This bit indicates that the Device Capabilities page supports the new VRTP, ACE, XX-RA, and XX-WA fields.
- **VTRP:** Volume Tag Reader Present. When set, this bit indicates that the media changer does have a bar code reader. The value for this field is 1.
- **ACE:** Auto Clean Enabled. When set to one, the media changer monitors the cleaning required status of the data transfer element (tape drive) and automatically cleans the data transfer element when needed. When the media changer is set to zero, it does not automatically clean the data transfer element.
- **XX→YY:** Where XX is a valid source and YY is a valid destination address. If one of these bits is set to 1, it indicates that the medium changer device supports all **Move Medium** commands for which the source is element type XX and the destination is element type YY on the condition that the element addresses are valid.
- **XX↔YY:** A one in these fields indicates that the medium can be exchanged by using the **Exchange Media** command between elements of types XX and YY on the condition that the element addresses are valid.
- **XX→RA:** These fields indicate the resources that are required to support the READ ATTRIBUTE commands for each element type XX. The media changer does not support the READ ATTRIBUTE command. Therefore, these fields are set to 0.
- **XX→WA:** These fields indicate the resources that are required to support the WRITE ATTRIBUTE commands for each element type XX. The media changer does not support the WRITE ATTRIBUTE command. Therefore, these fields are set to 0.

MODE SENSE 10 (5Ah)

The MODE SENSE (10) command provides a means for an application client to retrieve peripheral device parameters from the media changer. It is a complementary command to the MODE SELECT command.

Byte	Bit	7	6	5	4	3	2	1	0
0	Operation Code (5Ah)								
1	LUN			Reserved	DBD	Reserved			
2	PC		Page Code						
3	Subpage Code								
4	Reserved								
5	Reserved								
6	Reserved								
7	(MSB)	Allocation length							
8	(LSB)								
9	Control								

Field Descriptions:

- **DBD:** The Disable Block Descriptors bit specifies whether the media changer returns block descriptors after the Parameter List Header.
- **PC:** The **Page Control** field defines the type of mode parameter values to be returned in the mode pages.

00b	Report Current Values (equal to default values if no pages previously saved).
01b	Report changeable values.
10b	Report Default Values
11b	Report Saved Values (equal to default values if no pages previously saved).

- **Page Code:** The page code defines which pages are returned. See next table. An Initiator can request one or all mode sense pages. Each response includes a 4 bytes for the Parameter List Header, followed by the specified number of bytes for each page.

Mode Parameter List

The returned data on a Model Sense (10) command begins with an 8-byte Mode Parameter Header. The header is followed by one or all Mode Sense pages as requested by the Page Code and Subpage Code fields.

Byte	Bit	7	6	5	4	3	2	1	0
0 - 3	Mode Parameter Header								
4 - n	Mode Sense Pages								

Mode Parameter Header

The returned data on a Mode Sense (10) command begins with an 8-byte Mode Parameter Header. This header has the following structure.

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

Field Descriptions:

- **Mode Data Length:** Displays the number of bytes of parameter information the media changer returns as a result of this command. The total amount excludes the Mode Data Length, but includes the six extra Mode Parameter Header bytes. If a block descriptor was requested, this count is also added to the Mode Data Length.
- **Block Descriptor Length:** When the DBD bit is set to zero, the media changer can return an 8-byte Block Descriptor. When a Block Descriptor is returned, the Block Descriptor Length reports 8. When the DBD bit is set, the media changer does not return Block Descriptors and the Block Descriptor Length reports 0. All fields in the Block Descriptor are considered to be reserved and are therefore set to 0.

MOVE MEDIUM (A5h)

The **Move Medium** command allows an application client to move tape cartridges from one element address to another specific element address. The media changer can transfer cartridges between Storage Elements, Import/Export Elements, and Data Transfer Elements.

Byte	Bit	7	6	5	4	3	2	1	0
0		Operation Code (A5h)							
1		LUN			Reserved				
2	(MSB)	Medium Transport Address							
3								(LSB)	
4	(MSB)	Source Address							
5								(LSB)	
6	(MSB)	Destination Address							
7								(LSB)	
8		Reserved							
9		Reserved							

Bit	7	6	5	4	3	2	1	0
Byte								
10	Reserved							Invert
11	FSC		Control					
12	(MSB)							
	FAILOVER SESSION KEY							
15								(LSB)

Field Descriptions:

- **Medium Transport Address:** This field specifies the medium transport element that is used to run the **Move Medium** command. This value can be set to either 0 or the currently valid **Medium Transport Element** address.
- **Source Address:** Element address from which the tape cartridge is moved. It can be a Storage Element address, Import/Export Element address, or a Data Transfer Element address.
- **Destination Address:** Element address to which the tape cartridge is moved. It can be a Storage Element address, Import/Export Element address, or a Data Transfer Element address.
- **Invert:** An Invert bit of one specifies that the medium must be inverted or rotated before the medium is deposited into the destination element. The media changer does not support medium rotation. Therefore, this field must be set to zero.
- **FSC:** Failover session sequence count.
- **Failover Session Key:** If the failover session key is not associated with a failover session that is tracked by the library, then the command is terminated with CHECK CONDITION status. The sense key set to ILLEGAL REQUEST. The additional sense code is set to FAILOVER SESSION SEQUENCE ERROR.

PERSISTENT RESERVE IN (5Eh)

The PERSISTENT RESERVE IN command is used to obtain information about persistent reservation keys that are active within a media changer. This command is used with the PERSISTENT RESERVE OUT command.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (5Eh)							
1	LUN			Service Action				
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	(MSB)		Allocation Length					
8								(LSB)
9	Control							

Field Descriptions:

- **Service Action:** The following service actions are supported:

Code	Name	Description
00h	Read Keys	Reads all registered Reservation Keys
01h	Read Reservation	Reads the current persistent reservations
02h - 1Fh	Reserved	Reserved

- **Allocation Length:** With the **Allocation Length** field, the application client specifies how much space is allocated for the returned parameter list.

PERSISTENT RESERVE IN parameter data for Read Keys

The format for the parameter data that is provided in response to a PERSISTENT RESERVE IN command with the Read Keys service action is shown here.

Bit	7	6	5	4	3	2	1	0	
Byte									
0	(MSB) Generation								
3								(LSB)	
4	(MSB) Additional length ($n - 7$)								
7								(LSB)	
	Reservation Key List								
8	(MSB) First reservation key								
15								(LSB)	
	...								
$n - 7$	(MSB) Last reservation key								
n								(LSB)	

Field Descriptions:

- **Generation:** See SPC-3 r23.
- **Additional Length:** See SPC-3 r23.
- **Reservation Key List:** See SPC-3 r23.

PERSISTENT RESERVE IN parameter data for Read Reservation

The format for the parameter data that is provided in response to a PERSISTENT RESERVE IN command with the Read Reservation service action is shown here.

Bit	7	6	5	4	3	2	1	0	
Byte									
0	(MSB) Generation								
3								(LSB)	
4	(MSB) Additional length ($n - 7$)								
7								(LSB)	
8	(MSB) Reservation Descriptors								
n								(LSB) (See next table)	

Field Descriptions:

- **Generation:** See SPC-3 r23.
- **Additional Length:** See SPC-3 r23.
- **Reservation Descriptors:** See SPC-3 r23.

PERSISTENT RESERVE IN reservation descriptor

The format for the reservation descriptor is shown here. A reservation descriptor for the persistent reservation, if any, is present in the logical unit. Also, a reservation descriptor for each element, if any, has a persistent reservation.

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

Field Descriptions:

- **Reservation Key:** See SPC-3 r23.
- **Scope-Specific Address:** See SPC-3 r23.
- **Scope:** See SPC-3 r23.
- **Type:** See SPC-3 r23.

PERSISTENT RESERVE OUT (5Fh)

The PERSISTENT RESERVE OUT command is used to request service actions that reserve the whole media changer or certain elements for the exclusive or shared use of a particular initiator. The command uses other service actions to manage and remove such reservations. The command is used with the PERSISTENT RESERVE IN command and is not used with the RESERVE and RELEASE commands.

Initiators that complete PERSISTENT RESERVE OUT service actions are identified by a reservation key that is provided by the application client. An application client uses the PERSISTENT RESERVE IN command to obtain the reservation key for the initiator that holds a persistent reservation. The application client can then use the PERSISTENT RESERVE OUT command to preempt that reservation.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (5Fh)							
1	LUN				Service Action			
2	Scope				Type			

Bit	7	6	5	4	3	2	1	0
Byte								
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	(MSB) Parameter List Length							
8	(LSB)							
9	Control							

Field Descriptions:

- **Service Action:** The following service actions are supported.

Code	Name	Description
00h	Register	Register a reservation key with the device server.
01h	Reserve	Creates a persistent reservation that has a specified Scope and Type.
02h	Release	Releases the selected reservation for the requesting initiator
03h	Clear	Clears all reservation keys and all persistent reservations.
04h	Preempt	Preempts persistent reservations from another initiator
05h	Preempt and Abort.	Preempts persistent reservations from another initiator and aborts all tasks for all initiators that are registered with the specified registration key.
06h	Register and ignore existing Key.	Register a reservation key with the device server.
07h - 1Fh	Reserved	Reserved

- **Type:** See SPC-3 r23.
- **Scope:** The value in the **Scope** field specifies whether a persistent reservation applies to an entire logical unit or to an element.

Code	Description
0h	Persistent reservation applies to the full logical unit.
1h	Obsolete
2h	Persistent reservation applies to the specified element.
3h - Fh	Reserved

- **Parameter List Length:** The Parameter List Length is set to the length of the Persistent Reserve Out Parameter List structure.

PERSISTENT RESERVE OUT parameter list

The format for the reservation descriptor is shown here. A reservation descriptor for the persistent reservation, if any, is present in the logical unit. A reservation descriptor for each element, if any, has a persistent reservation.

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

Field Descriptions:

- **Reservation Key:** The **Reservation Key** field contains a value that is provided by the application client to the device server to identify the initiator that is the source of the PERSISTENT RESERVE OUT command.
- **Service Action Reservation Key:** For the **Register**, and **Register and Ignore Existing Key** service action, the Service Action Reservation Key contains the new registration key to be registered. For the **Preempt**, and **Preempt and Abort** service actions, the **Service Action Reservation Key** field contains the reservation key of the persistent reservations that are being preempted. The **Service Action Reservation Key** field is ignored for all other service actions.
- **Scope-Specific Address:** If the Scope is an Element Scope reservation, the **Scope-Specific Address** field contains the element address (0 completes the most significant 2 bytes).
- **APTPL:** The Activate Persist Through power Loss (APTPL) bit is valid only for the **Register**, or **Register and Ignore Existing Key** service action. In all other cases, the APTPL bit is ignored.

POSITION TO ELEMENT (2Bh)

The POSITION TO ELEMENT command allows an application client to position the Medium Transport Element to a specific element address. The destination address can be set to any Storage Element, Import/Export Element, or Data Transfer Element address.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (2Bh)							
1	LUN			Reserved				
2	(MSB) Medium Transport Address (LSB)							
3								
4	(MSB) Destination Address (LSB)							
5								
6	Reserved							
7	Reserved							

Bit	7	6	5	4	3	2	1	0
Byte								
8	Reserved							Invert
9	Control							

Field Descriptions:

- **Medium Transport Address:** This field contains either 0 or the currently valid element address of the Medium Transport Element.
- **Destination Address:** This field contains the destination element address for the **Position to Element** command. This destination address can be a Storage Element, Import/Export Element, or a Data Transfer Element address.
- **Invert:** The media changer does not support medium rotation. This value must be set to 0.

PREVENT / ALLOW MEDIA REMOVAL (1Eh)

The PREVENT / ALLOW MEDIA REMOVAL command enables or disables removing cartridges from the media changer. The command also enables or disables opening the I/O station. When the media changer is partitioned, the command controls the cartridges that are related to the partition in which the command is received. And when I/O stations are shared by different partitions, the command controls opening of the I/O station for all partitions. A prevent condition does not affect an UNLOAD command that is issued to the tape drive. Also, a prevent condition does not inhibit a front panel LOAD of a cartridge when the tape drive is empty. A prevent condition is cleared when all initiators issue the **Prevent Allow Medium Removal** command with the **Prevent** field set to 0 (allow cartridge removal). The prevent condition is also cleared after a power-on and after a SCSI Bus reset.

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

Field Descriptions:

- **Prevent:** When this bit is set, unlocking of the magazine and I/O station is disabled. When the Prevent bit is cleared, unlocking of the magazine and I/O station are enabled.

READ BUFFER (3Ch)

The READ BUFFER command is used with Write Buffer. It allows the application client to test the media changer's data buffer and the SCSI bus integrity. It is also used to read out Vendor Specific settings and debug logs.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (3Ch)							
1	LUN			Reserved	Mode			
2	Buffer ID							
3	(MSB) Buffer offset (LSB)							
4								
5								
6	(MSB) Allocation Length (LSB)							
7								
8								
9	Control							

Field Descriptions:

- **Mode:** The **Mode** field is used to select the mode of operation. The media changer supports the following values within the field.

0010b	Data
0011b	Descriptor
1010b	Echo buffer
1011b	Echo Descriptor

If any non-supported value is set, the media changer terminates the command with a Check Condition status and an Illegal Request sense key set.

- **Buffer ID:** For all modes, only buffer ID zero is supported.
- **Buffer Offset:** The **Buffer Offset** field is not supported and must be set to zero. If the **Buffer Offset** field specifies an unsupported value, the media changer returns Check Condition status. The sense key is set to ILLEGAL REQUEST and the sense data to INVALID FIELD IN CDB.
- **Allocation Length:** The Allocation Length specifies the maximum number of bytes that the initiator allocated for returned data. The media changer can report only up to 65536 bytes of data.

Descriptor Mode

In this mode, the media changer returns the Buffer Capacity of the specified Buffer ID in Data Mode. If a not supported Buffer ID is specified, the media changer returns zero as Buffer Capacity. The next table specifies the Buffer Descriptor, which is returned on a READ BUFFER command in Descriptor Mode.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Offset Boundary (0)							

Bit	7	6	5	4	3	2	1	0
Byte								
1	(MSB)							
...	Buffer Capacity							
3	(LSB)							

Field Descriptions:

- **Offset Boundary:** The **Offset Boundary** field defines the byte alignment for the buffer. The media changer supports only byte alignment, so this value is zero.
- **Buffer Capacity:** The **Buffer Capacity** field returns the size of the specified Buffer ID buffer in bytes. This size is the maximum size that includes the length byte. The Read Buffer command in Data Mode supports Buffer ID zero. Buffer ID zero can store up to 256 bytes. The returned Buffer Capacity for Buffer ID zero is 000100h. The Buffer Capacity for all other Buffer ID values is set to 000000h.

Data Mode

In this mode, the media changer returns the information that is stored in the specified Buffer ID. This mode is used to test SCSI bus data integrity with the WRITE BUFFER command. The Data Mode returns up to 256 bytes from the specified Buffer ID to the host. The value in the Buffer Offset field cannot exceed the length of the specified Buffer ID. Only Buffer ID 00h is supported. Potential Buffer overruns are detected and the command is rejected. By using a READ BUFFER command in Data Mode, the host can retrieve the information that is sent by a WRITE BUFFER command in Data Mode. The returned number of bytes is defined by the value that is stored in the Allocation Length field of the READ BUFFER CDB.

Bit	7	6	5	4	3	2	1	0
Byte								
0 - n	(data defined by previous Data Mode WRITE BUFFER command)							

Echo Mode

In this mode, the media changer returns the same number of bytes of data as received in the prior Echo Mode WRITE BUFFER command from the same host. If a prior Echo Mode WRITE BUFFER command did not complete successfully, the Echo Mode READ BUFFER command returns Check Condition status. The sense key is set to ILLEGAL REQUEST and the sense data is set to COMMAND SEQUENCE ERROR. If the data in the Echo Buffer was overwritten by another host the media changer returns Check Condition status. The sense key is set to ILLEGAL REQUEST and the sense data is set to ECHO BUFFER OVERWRITTEN. The maximum length of the Echo Mode buffer is 256 bytes.

Bit	7	6	5	4	3	2	1	0
Byte								
0 - n	(data that is defined by previous Echo Mode WRITE BUFFER command)							

Echo Buffer Descriptor Mode

In this mode, the media changer returns the descriptor information for the Echo Buffer. The **Buffer Offset** field is reserved in this mode. The **Buffer ID** field is ignored in this mode. The next table specifies the Buffer Descriptor, which is returned on a READ BUFFER command in Echo Buffer Descriptor Mode.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved							EBOS
1	Reserved							
2	Reserved			(MSB)				
3	Buffer Capacity							(LSB)

Field Descriptions:

- **EBOS:** The Echo Buffer Overwritten Support bit is set. The media changer returns ECHO_BUFFER_OVERWRITEN sense data when the buffer is overwritten by another initiator.
- **Buffer Capacity:** The **Buffer Capacity** field returns the maximum size of the Echo Buffer in bytes. The Echo Buffer can store up to 256 bytes.

READ ELEMENT STATUS (B8h)

The READ ELEMENT STATUS command allows the application client to obtain the status of the media changer's internal elements.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (B8h)							
1	LUN			VolTag	Element Type Code			
2	(MSB) Starting Element Address							(LSB)
3								
4	(MSB) Number of Elements							(LSB)
5								
6	Reserved				Mixed	CurData	DVCID	
7	(MSB) Allocation Length							
8								
9								
10	Reserved							
11	Control							

Field Descriptions:

- **VolTag:** If the VolTag bit is set, the media changer returns volume tag information in the element descriptors. If the VolTag bit is not set, the media changer does not return volume tag information.
- **Element Type Code:** This field specifies the element type or types that are selected to report in response to this command. A value of 0 indicates that status for all element types is to be reported.

0h	Report all element types.
1h	Report Medium Transport Elements (Cartridge pickers)
2h	Report Storage Elements (Cartridge Slots)
3h	Report Import / Export Elements (I/O Stations)
4h	Report Data Transfer Elements (Tape drives)
5h - Fh	Reserved

- **Starting Element Address:** This field indicates the starting element address. Elements greater or equal than the starting address are returned.
- **Number of Elements:** This field specifies the maximum number of element descriptors to return. If the allocation length is not sufficient to transfer all of the element information, the target transfers all the information that can be transferred. It is not an error condition.
- **Mixed:** If the Mixed bit is set, the media changer returns mixed media identifiers for every element descriptor. If the Mixed bit is not set, the media changer does not return mixed media identifiers.
- **CurData:** If the CurData bit is set, the media changer returns current element status data in any case even if it is incomplete, since inventory scan is ongoing. If the CurData bit is zero, the media changer always returns valid element status data, but it responds with check condition if the library is busy..
- **DVCID:** If the DVCID bit is set, the media changer returns device identifiers for the Data Transfer element. A DVCID bit of zero specifies that the device does not return device identifiers.
- **Allocation Length:** This field specifies the number of bytes that the initiator that is allocated for returned data. The **Read Element Status** command can be issued with an Allocation Length that is specified as 8 bytes (the length of the status page header). The length of the status page header determines the Allocation Length that is required to transfer all of the element status data that becomes available as a result of the command. The media changer reports only up to 65536 bytes of data.

Element Status Data

Description of data that is returned by the **Read Element Status** command.

The **Element Status Data** consists of an 8-byte Header followed by one or more status pages (for each element type). The status pages are made up of an 8-byte subheader and one or more element descriptors (one for each element address).

Header

The data that is returned on a **Read Element Status** command always starts with the Header. This Header reports the first element address, the number of elements, and the byte count of the report.

Bit	7	6	5	4	3	2	1	0
Byte								
0 - 1	First Element Address Reported							
2 - 3	Number of Elements Available							
4	Reserved							
5 - 7	Byte Count of Report Available							

Field Descriptions:

- **First Element Address Reported:** This field indicates the element address of the element with the smallest element address found to meet the **Read Element Status** command's request.
- **Number of Elements Available:** This field displays the number of elements found. The status for these elements is returned if the Allocation Length specified in the Read Element Status command's CDB was sufficient.
- **Byte Count of Report Available:** This field indicates the number of available element status bytes that meet the CDB requirements. This value does not adjust to match the **Allocation Length** field of the CDB and does not include the 8-byte element status header.

Mixed media descriptor extension

When the Mixed bit in the Read Element Status command is set, the media changer returns an extension to every element descriptor. The format of this extension is displayed in the next table.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Media Domain							
1	Media type							
2	Media Domain of Data Transfer Device							
3	Media Type of Data Transfer Device							
4	Compatible Media Length							
5	RO	Compatible Media Type 1						
6	RO	Compatible Media Type 2						
7	RO	Compatible Media Type 3						
8	RO	Compatible Media Type 4						
9	RO	Compatible Media Type 5						
10	RO	Compatible Media Type 6						
11	RO	Compatible Media Type 7						

The Media Domain field represents the native element storage type when the element is empty, and when the element is full it represents the form factor of the loaded media. See the next table for a list of possible Domain numbers.

Domain number	Form Factor
4Ch	LTO
43h	LTO - cleaning
44h	LTO - diagnostics
7Fh	Unknown

The Media Type field represents the particular type of media within the media domain. The decoded meaning depends on the Media Domain field. The next table describes the possible cartridge types for the LTO Media Domains.

LTO Type number	Cartridge
'A', 41h	LTO Gen 1, variable length type A
'B', 42h	LTO Gen 1, variable length type B
'C', 43h	LTO Gen 1, variable length type C
'1', 31h	LTO Gen 1 Ultrium 100 GB
'2', 32h	LTO Gen 2 Ultrium 200 GB
'3', 33h	LTO Gen 3 Ultrium 400 GB
'T', 54h	LTO Gen 3, WORM
'4', 34h	LTO Gen 4 Ultrium 800 GB
'5', 35h	LTO Gen 5 Ultrium 1.5 TB
'6', 36h	LTO Gen 6 Ultrium 2.5 TB
'7', 37h	LTO Gen 7 Ultrium 6.4 TB
7Fh	Unknown

Element Descriptors

The element descriptors include the element address and status flags for the elements. The descriptors might also contain sense code information and other information, which depends on the element type. The following four subsections describe each of the possible element descriptors.

Medium Transport Element Status page (01h)

The Medium Transport Element is the device that physically moves the tapes around in the media changer. The media changer has one Medium Transport element. This element can be addressed explicitly with the Medium Transport Element address or implicitly as address 0.

Byte	Bit	7	6	5	4	3	2	1	0
Subheader									
0	Element Type Code (1h = Medium Transport)								
1	PVolTag	AVolTag	Reserved						
2 - 3	Transport Element Descriptor Length								
4	Reserved								
5 - 7	Byte Count of Descriptor Data Available								
Element Descriptor									
8 - 9	Medium Transport Element Address								
10	Reserved					Except	Reserved	Full	
11	Reserved								
12	Additional Sense Code								
13	Additional Sense Code Qualifier								
14 - 16	Reserved								
17	SValid	Invert	Reserved		ED	Medium Type			
18 - 19	Source Storage Element Address								
20 - 55	Primary Volume Tag Information								

Bit	7	6	5	4	3	2	1	0
Byte								
	(Field is omitted if PvolTag = 0)							
56 - 59	Reserved (Field is moved up if Primary Volume Tag Information field is omitted).							
60 - 71	Mixed Media descriptor (Field is omitted if Mixed = 0).							

Field Descriptions:

- **PVolTag:** Primary Volume Tag. When set, this flag indicates valid information in the **Primary Volume Tag Information** field. This flag is set when the **VolTag** field was set in the CDB.
- **AVolTag:** Alternate Volume Tag. Always set to 0.
- **Transport Element Descriptor Length:** This field indicates the number of bytes for each element descriptor of the transport element type.
- **Byte Count of Descriptor Data Available:** This field indicates the total number of bytes of element descriptor data available for all transport elements that meet the request in the CDB. The value is not adjusted to match the allocation length available.
- **Medium Transport Element Address:** This field provides the address of the Medium Transport Element of this changer device whose status is reported by this element descriptor block.
- **Except:** Exception. An exception bit of 0 indicates that the medium transport element is in a normal state. If this bit is 1, information on the abnormal state is available in the **Additional Sense Code** and **Additional Sense Code Qualifier** fields.

Note: Exceptions to the transport element are set if there are robotic-related critical move errors. They are cleared after successful execution of move commands (for example, move medium, exchange medium, initialize element status, or position to element) since they are forcing reinitialization of the robotics.

- **Full:** A full bit value of one indicates that the medium transport element of the changer device contains a tape cartridge. A value of 0 indicates that the medium transport element is empty.
- **Additional Sense Code:** This field provides specific information about an abnormal medium transport state (valid only if the Except bit is 1).
- **Additional Sense Code Qualifier:** This field provides more detail about an abnormal medium transport state (valid only if the Except bit is 1).
- **SValid:** Source Valid. When set to 1, indicates that the **Source Storage Element Address** field and the Invert bit information fields are valid. When 0, indicates that the values in these fields are not valid.
- **Invert:** The media changer uses single-sided media and does not support inverting of the media. The value reported for this field is 0.
- **ED:** An ED bit of one indicates that the element is disabled. An ED bit value of zero indicates that the element is enabled.
- **Medium Type:** The **Medium Type** field provides the type of medium currently present in the Media Transfer Element. The next table describes the values for the Medium Types.

0h	Unspecified
1h	Data Medium
2h	Cleaning Medium
3h	Diagnostics Medium
4h	WORM Medium
5h - 7h	Reserved

- **Source Storage Element Address:** This field provides the address of the last storage element from which the tape cartridge was moved (valid only if the SValid bit is 1).
- **Primary Volume Tag Information:** When VolTag in the CDB was set, the media changer returns a 36-byte PVolTag Identifier. This identifier contains the bar code label of the cartridge in the Medium Transport Element.

The next table contains a list of the ASC and ASCQ values that appear in the **Additional Sense Code** and **Additional Sense Code Qualifier** fields of the Medium Transport Element descriptor if the element is in an abnormal state. The **Except** field of an element descriptor indicates whether an element is in an abnormal state.

ASC	ASCQ	Description	Action
30h	03h	Cleaning cartridge	The element contains a cleaning cartridge.
3Bh	12h	Magazine removed	Insert magazine.

Storage Element Status page (02h)

The Storage Element is the device that physically stores a cartridge in the media changer. The number of available Storage Elements depends on the media changer model. A Storage Element contains a cartridge when the Full bit is set.

Byte	Bit	7	6	5	4	3	2	1	0
Subheader									
0	Element Type Code (2h = Storage Element)								
1	PVolTag	AVolTag	Reserved						
2 - 3	Storage Element Descriptor Length								
4	Reserved								
5 - 7	Byte Count of Descriptor Data Available								
Element Descriptor									
8 - 9	Storage Element Address								
10	Reserved				Access	Except	Reserved	Full	
11	Reserved								
12	Additional Sense Code								
13	Additional Sense Code Qualifier								
14 - 16	Reserved								
17	SValid	Invert	Reserved		ED	Medium Type			

Byte	Bit	7	6	5	4	3	2	1	0
18 - 19	Source Storage Element Address								
20 - 55	Primary Volume Tag Information								
	(Field is omitted if PVolTag = 0).								
56 - 59	Reserved								
	(Field moved up if Primary Volume Tag Information field is omitted).								
60 - 71	Mixed Media descriptor								
	(Field is omitted if Mixed = 0).								

Field Descriptions:

- **PVolTag:** Primary Volume Tag. When set, this flag indicates valid information in the **Primary Volume Tag Information** field. This flag is set when the **VolTag** field is set in the CDB.
- **AVolTag:** Alternate Volume Tag. Always set to 0.
- **Storage Element Descriptor Length:** Indicates the number of bytes for each element descriptor of the storage element type.
- **Byte Count of Descriptor Data Available:** Indicates the total number of bytes of element descriptor data available for all storage elements that meet the request in the CDB. The value is not adjusted to match the allocation length available.
- **Storage Element Address:** This field provides the address of the Storage Element of this changer device whose status is reported by this element descriptor block.
- **Access:** When set to 1, this field indicates that access to the storage element by a medium transport element is allowed. If 0, indicates access to the storage element by a medium transport element is denied.
- **Except:** Exception. An exception bit of 0 indicates that the element is in a normal state. If this bit is 1, information on the abnormal state is available in the **Additional Sense Code** and **Additional Sense Code Qualifier** fields.

Note: There are currently no exceptions reported to storage elements.

- **Full:** A full bit value of 1 indicates that the storage element address contains a unit of media. A value of 0 indicates that the storage element address is empty.
- **Additional Sense Code:** This field provides specific information about an abnormal storage element state.
- **Additional Sense Code Qualifier:** This field provides more detail about an abnormal storage element state.
- **SValid:** Source Valid. When set to 1, indicates that the **Source Storage Element Address** field and the Invert bit information fields are valid. When set to 0, indicates that the values in these fields are not valid.
- **Invert:** The media changer uses single-sided media and does not support inverting of the media. The value reported for this field is 0.
- **ED:** An ED bit of 1 indicates that the element is disabled (a magazine is not installed or is logical-disabled). An ED bit value of 0 indicates that the element is enabled.

- **Medium Type:** The **Medium Type** field provides the type of medium currently present in the Storage Element. The next table describes the values for the Medium Types.

0h	Unspecified
1h	Data Medium
2h	Cleaning Medium
3h	Diagnostics Medium
4h	WORM Medium
5h - 7h	Reserved

- **Source Storage Element Address:** This field provides the address of the last storage element from which the tape cartridge was moved (valid only if the SValid bit is 1).
- **Primary Volume Tag Information:** When VolTag in the CDB is set, the **Primary Volume Tag Information** field provides identifying the unit of media in this element. When VolTag in the CDB is not set, this field is omitted.

The next table contains a list of the ASC and ASCQ values that appear in the **Additional Sense Code** and **Additional Sense Code Qualifier** fields of an element descriptor if the element is in an abnormal state. The **Except** field of an element descriptor indicates whether an element is in an abnormal state.

ASC	ASCQ	Description	Action
30h	03h	Cleaning cartridge	The element contains a cleaning cartridge.
3Bh	12h	Magazine removed	Insert magazine.
83h	00h	Element not yet scanned	The media changer did not scan this element up to now.

Import/Export Element Status page (03h)

Import/Export elements are locations of volumes that are inserted into or withdrawn from the media changer. A volume in one of these elements is accessible by the Medium Transport Element and by an operator.

Bit	7	6	5	4	3	2	1	0
Byte								
Subheader								
0	Element Type Code (3h = Import / Export Element)							
1	PVolTag	AVolTag	Reserved					
2 - 3	Import / Export Element Descriptor Length							
4	Reserved							
5 - 7	Byte Count of Descriptor Data Available							
Element Descriptor								
8 - 9	Import / Export Element Address							
10	OIR	CMC	InEnab	ExEnab	Access	Except	ImpExp	Full
11	Reserved							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							

Byte	Bit	7	6	5	4	3	2	1	0
14 - 16		Reserved							
17		SValid	Invert	Reserved		ED	Medium Type		
18 - 19		Source Storage Element Address							
20 - 55		Primary Volume Tag Information							
		(Field is omitted if PVolTag = 0).							
56 - 59		Reserved							
		(Field moved up if Primary Volume Tag Information field is omitted).							
60 - 71		Mixed Media descriptor							
		(Field is omitted if Mixed = 0).							

Field Descriptions:

- **PVolTag:** Primary Volume Tag. When set, this flag indicates valid information in the **Primary Volume Tag Information** field. This flag is set when the **VolTag** field was set in the CDB.
- **AVolTag:** Alternate Volume Tag. Always set to 0.
- **Import/Export Element Descriptor Length:** This field indicates the number of bytes for each element descriptor of the Import/Export element type.
- **Byte Count of Descriptor:** This field indicates the total number of bytes of element descriptor data available for all.
- **Date Available:** Import/Export elements that meet the request in the CDB. The value is not adjusted to match the allocation length available.
- **Import/Export Element Address:** This field provides the address of the import/export element of this changer device whose status is reported by this element descriptor block.
- **Full:** A full bit value of 1 indicates that the import/export element address contains a unit of media. A value of 0 indicates that the import/export element address is empty.
- **ImpExp:** An import/export bit of 1 indicates the unit of media in the import/export element was placed there by an operator. A bit of zero indicates the unit of media in the import/export element was placed there by the medium transport element.
- **Except:** Exception. An exception bit of 0 indicates that the element is in a normal state. If this bit is 1, information on the abnormal state is available in the **Additional Sense Code** and **Additional Sense Code Qualifier** fields.

Note: There are currently no exceptions reported to import/export elements.

- **Access:** When Access is set to 1, this field indicates that access to the import/export element by a medium transport element is allowed. If 0, indicates access to the import/export element by a medium transport element is denied.
- **ExEnab:** An Export Enable bit of one indicates that the import/export element supports movement of media into of the scope of the media changer device.

- **InEnab:** An Import Enable bit of 1 indicates that the import/export element supports movement of media out of the scope of the media changer device. An InEnab bit of 0 indicates that this element does not support export actions.
- **CMC:** Connected Media Changer bit of 1 indicates that exports are to a connected media changer. A CMC bit of 0 indicates that exports are to the operator and imports are from the operator.
- **OIR:** Operator Intervention Required bit of 1 indicates that operator intervention is required to make the import/export element accessible. The OIR bit is set to 0 if no operator intervention is required, or if the Access bit is set to 1.
- **Additional Sense Code:** This field provides specific information about an abnormal import/export element state.
- **Additional Sense Code Qualifier:** This field provides more detail about an abnormal import/export element state.
- **SValid:** Source Valid. When set to 1, indicates that the **Source Storage Element Address** field and the Invert bit information fields are valid. When set to 0, indicates that the values in these fields are not valid.
- **Invert:** The media changer uses single-sided media and does not support inverting of the media. The value reported for this field is 0.
- **ED:** An ED bit of 1 indicates that the element is disabled (for example, a magazine is not installed or is logical-disabled). An ED bit value of 0 indicates that the element is enabled.
- **Medium Type:** The **Medium Type** field provides the type of medium currently present in the Storage Element. The next table describes the values for the Medium Types.

0h	Unspecified
1h	Data Medium
2h	Cleaning Medium
3h	Diagnostics Medium
4h	WORM Medium
5h - 7h	Reserved

- **Source Storage Element Address:** This field provides the address of the last storage element from which the tape cartridge was moved (valid only if the SValid bit is 1).
- **Primary Volume Tag Information:** When VolTag in the CDB is set, the **Primary Volume Tag Information** field provides identifying the unit of media in this element. When VolTag in the CDB is not set, this field is omitted.

The next table contains a list of the ASC and ASCQ values that appear in the **Additional Sense Code** and **Additional Sense Code Qualifier** fields of an element descriptor if the element is in an abnormal state. The **Except** field of an element descriptor indicates whether an element is in an abnormal state.

ASC	ASCQ	Description	Action
30h	03h	Cleaning cartridge	The element contains a cleaning cartridge.
3Bh	12h	Magazine removed	Insert magazine.
83h	00h	Element not scanned	The media changer did not scan this element up to now.

Data Transfer Element Status page (04h)

The Data Transfer Element is the device that stores user data on the cartridges in the media changer (tape drive). A Data Transfer Element contains a cartridge when the Full bit is set.

Bit	7	6	5	4	3	2	1	0
Byte								
Subheader								
0	Element Type Code (4h = Data Transfer Element)							
1	PVolTag	AVolTag	Reserved					
2 - 3	Data Transfer Element Descriptor Length							
4	Reserved							
5 - 7	Byte Count of Descriptor Data Available							
Element Descriptor								
8 - 9	Data Transfer Element Address							
10	Reserved				Access	Except	Reserved	Full
11	Reserved							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Obsolete	Reserved	IDValid	Obsolete	Reserved	Obsolete		
15	SCSI Bus Address							
16	Reserved							
17	SValid	Invert	Reserved		ED	Medium Type		
18 - 19	Source Storage Element Address							
20 - 55	Primary Volume Tag Information (Field is omitted if PVolTag = 0).							
56	Reserved				Code Set			
57	Reserved				Identifier Type			
58	Reserved							
59	Identifier Length							
60 - 93	(MSB) Identifier (Omitted if DVCID = 0 in CDB) (LSB)							
94 - 105	Mixed Media descriptor (Field is omitted if Mixed = 0).							

Field Descriptions:

- **PVolTag:** Primary Volume Tag. When set, this flag indicates valid information in the **Primary Volume Tag Information** field. This flag is set when the **VolTag** field was set in the CDB.

- **AVolTag:** Alternate Volume Tag. The media changer does not support dual-sided media. Therefore, the Alternate Volume Tag label is always set to zero even when the VolTag bit is set in the CDB.
- **Data Transfer Element Descriptor Length:** This field indicates the number of bytes for each element descriptor of the Data Transfer element type.
- **Byte Count of Descriptor Data Available:** This field indicates the total number of bytes of element descriptor data available for all Data Transfer elements that meet the request in the CDB. The value is not adjusted to match the allocation length available.
- **Data Transfer Element Address:** This field provides the address of the data transfer element of this changer device whose status is reported by this element descriptor block.
- **Access:** When set to 1, indicates that access to the data transfer element by a medium transport element is allowed. If 0 access to the data transfer element by a medium transport element is denied. A value of 1 in this bit might not be sufficient to ensure a successful operation. Access is set to 0 if the drive is not fully configured or configuration failed (see below). The access bit of a data transfer element is also set to 0 if the tape is threaded or if media removal prevention of the drive is set by an application client.
- **Except:** An Except bit of 0 indicates that the data transfer element is in a normal state; When set to 1, it indicates an abnormal state. Information about an abnormal state is available in the additional sense code and more sense code qualifier bytes.

Note: An appropriate exception is reported to the data transfer element if the related tape drive couldn't be correctly configured for any reason. More detailed description about the error can be found in the ticket logon RMI.

- **Full:** A Full bit value of 1 indicates that the data transfer element of the changer device contains a tape cartridge. A value of 0 indicates that the data transfer element is empty.
- **Additional Sense Code:** This field provides specific information about the abnormal data transfer element state.
- **Additional Sense Code Qualifier:** This field provides more detail about an abnormal data transfer element state.
- **IDValid:** If the IDValid bit is set to one, the **SCSI Bus Address** field reports the SCSI address of the Data Transfer Element.
- **SCSI Bus Address:** This field returns the SCSI Bus Address of the Data Transfer Element.
- **SValid:** Source Valid. When set to 1, indicates that the **Source Storage Element Address** field and the Invert bit fields are valid. When set to 0, indicates that the values in these fields are not valid.
- **Invert:** The media changer uses single-sided media and does not support inverting of the media. The value reported for this field is 0.
- **ED:** An ED bit of 1 indicates that the element is disabled (for example, the tape drive is not installed or is logical-disabled). An ED bit value of 0 indicates that the element is enabled.
- **Medium Type:** The **Medium Type** field provides the type of medium currently present in the data transfer element. The next table describes the values for the Medium Types.

0h	Unspecified
1h	Data Medium

2h	Cleaning Medium
3h	Diagnostics Medium
4h	WORM Medium
5h - 7h	Reserved

- **Source Storage Element Address:** This field provides the address of the last storage element from which the tape cartridge was moved (valid only if the SValid bit is 1).
- **Primary Volume Tag Information:** When VolTag in CDB was set, the media changer returns a 36-byte PVolTag Identifier. This identifier contains the bar code label of the cartridge that is mounted in the tape drive.

0	1	2	3	4	5	6	7
n	n	n	n	n	n	t	t

The first 6 characters are any combination of uppercase A-Z or 0-9 (for example, ABC123) to identify the cartridge volume. The last 2 characters are determined by the cartridge media type (L for LTO and 1 for tape cartridge generation or drive manufacturer unique identifier).

- **Code Set:** If the DVCID bit is set in the CDB, the **Code Set** field is set to 2h, which indicates that ASCII values are returned. If the DVCID bit in the CDB is set to 0, the code set is set to 0h.
- **Identifier Type:** If the DVCID bit is set in the CDB, the Identifier Type is set to 1h. If the type is set to 1h, it indicates that the identifier field contains an 8-byte vendor identifier followed by vendor-unique identifier information. If the DVCID bit in the CDB is set to 0, the **Identifier Type** field is set to 0h.
- **Identifier Length:** If the DVCID bit is set in the CDB, the media changer returns a 34-byte structure with information about the tape drive. In this structure the tape drive Vendor ID, Product ID, and the tape drive serial number are reported. The **Identifier Length** field contains the length in bytes of the **Identifier** field. When the DVCID bit is not set in the CDB, the **Identifier Length** field is set to 00h.
- **Identifier:** If the DVCID bit is set in the CDB, the **Identifier** field provides the Vendor ID, Product ID, and tape drive serial number. If the DVCID bit in the CDB is set to 0, the **Identifier** field is omitted. The Identifier structure is described in the next table.

Byte	Description
0..7	Vendor identifier (8 ASCII bytes)
8..23	Product Identifier (16 ASCII bytes)
24..33	Tape Drive serial number (10 ASCII bytes)

The next table contains a list of the ASC and ASCQ values that appear in the **Additional Sense Code** and **Additional Sense Code Qualifier** fields of an element descriptor if the element is in an abnormal state. The **Except** field of an element descriptor indicates whether an element is in an abnormal state.

ASC	ASCQ	Description	Action
30h	03h	Cleaning cartridge	The element contains a cleaning cartridge.

ASC	ASCQ	Description	Action
82h	FCh	Drive communication problem	The drive configuration failed. The data transfer element might be offline.
83h	00h	Element not scanned	The media changer did not scan this element up to now.

RELEASE (17h)

The RELEASE command allows an application client to release a previously reserved media changer.

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

RELEASE 10 (57h)

The RELEASE 10 command allows an application client to release a previously reserved media changer. The media changer supports Third-Party reservation. Third-Party release allows an application client to release a logical unit that was previously reserved by using Third-Party reservation.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (57h)							
1	LUN			3rdPty	Reserved		LongID	Reserved
2	Obsolete							
3	Third-Party Device ID							
4	Reserved							
5	Reserved							
6	Reserved							
7	(MSB) Parameter List Length (LSB)							
8								
9	Control							

Field Descriptions:

- **LongID:** Device IDs that are greater than 255 are not supported. Therefore, setting of LongID results in a Check Condition status. The Sense Key is set to ILLEGAL REQUEST and the sense data to INVALID FIELD IN CDB.

- **3rdPty:** If the third party (3rdPty) bit is zero, a third-party release is not requested. If the 3rdPty bit is zero, the LongID and **Parameter List Length** field are ignored. If the 3rdPty bit is 1, the media changer releases the reservation. But, it is released only if the initiator ID and Third-Party Device ID are identical when compared to the RESERVE command that established the reservation.
- **Third-Party Device ID:** This field provides the Device ID for the third party when 3rdPty bit is set.

REPORT LUNS (A0h)

The REPORT LUNS command requests the media changer logical unit inventory is sent to the application client. The returned logical unit inventory includes all the logical units within the media changer.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (A0h)							
1	LUN				Reserved			
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	(MSB)							
7	Allocation Length							
8								
9	(LSB)							
10	Reserved							
11	Control							

Field Descriptions:

- **Allocation length:** This field specifies the maximum length of parameter list data the host can receive.

If the allocation length is less than 16 bytes, the media changer returns Check Condition status. The sense key is set to ILLEGAL REQUEST. The sense data is set to INVALID FIELD IN CDB. The next table describes the returned logical unit inventory data.

Bit	7	6	5	4	3	2	1	0
Byte								
0	(MSB)	LUN List Length (0008h)						
3	(LSB)							
4	(MSB)	Reserved						
7	(LSB)							
8	Address method (0h)				Bus Identifier (00h)			
9	Single level LUN (00h)							
10	(MSB)	Null Second Level						

Bit	7	6	5	4	3	2	1	0
Byte								
11								(LSB)
12	(MSB)		Null Third Level					
13								(LSB)
14	(MSB)		Null Fourth Level					
15								(LSB)

REPORT SUPPORTED OPERATION CODES (A3h)

The REPORT SUPPORTED OPERATION CODES command requests information on commands that the addressed logical unit supports. An application client requests a list of all operation codes and service actions that are supported by the media changer.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (A3)							
1	LUN			Service Action (0Ch)				
2	RCTD	Reserved				Reporting Options		
3	Requested Operation Code							
4	(MSB)		Requested Service Action					
5								(LSB)
6	(MSB)		Allocation Length					
7								
8								
9								(LSB)
10	Reserved							
11	Control							

Field Descriptions:

- **RCTD:** A return command timeouts descriptor (RCTD) bit set to 1, specifies that the command timeouts descriptor is included in each command descriptor returned, or in the one command parameter data that is returned. A RCTD bit set to 0, specifies that the command timeouts descriptor is not returned.
- **Reporting Options:** The **Reporting Options** field specifies the information to be returned in to the parameter data.

Reporting Option	Description
000b	A list of all operation codes and service actions that are supported by the logical unit are returned in the all_commands parameter data format. The Requested Operation Code CDB field and Requested Service Action CDB field is ignored.

Reporting Option	Description
001b	The command support data for the operation code that is specified in the Requested Operation Code field is returned in the one_command parameter data format. The Requested Service Action CDB field is ignored. If the Requested Operation Code field specifies an operation code that has service actions, the command is terminated with CHECK CONDITION status. Also, the sense key is set to ILLEGAL REQUEST, and the additional sense code is set to INVALID FIELD IN CDB.
010b	The command support data for the operation code and service action that is specified in the Requested Operation Code CDB field and Requested Service Action CDB field is returned in the one_command parameter data format. If the Requested Operation Code CDB field specifies an operation code that does not have service actions, the command is terminated with CHECK CONDITION status. Also, the sense key is set to ILLEGAL REQUEST, and the additional sense code is set to INVALID FIELD IN CDB. The media changer can report only up to 65536 bytes of data.
011b	Reserved

- **Requested Operation Code:** The **Requested Operation Code** field specifies the operation code of the command to be returned in the one_command parameter data format.
- **Requested Service Action:** The **Requested Service Action** field specifies the service action of the command to be returned in the one_command parameter data format.
- **Allocation Length:** The **Allocation length** field specifies the length in bytes of the SET TIMESTAMP parameters that is transferred from the application client to the device server. A parameter list length of 0 indicates that no data is transferred, and that no change is made to the timestamp.

The REPORT SUPPORTED OPERATION CODES all_commands parameter data format begins with a 4-byte header that contains the length in bytes of the parameter data, followed by a list of supported commands. Each command descriptor contains information about a single supported command CDB (one operation code and service action combination, or one non-service-action operation code). The list of command descriptors contains all commands that are supported by the logical unit.

The All Commands parameter data format is shown in next table.

Bit	7	6	5	4	3	2	1	0
Byte								
0 - 3	Command data length (n-3)							
4 - n	Command Descriptors							

Each Command Descriptor contains information about a single supported command CDB. The Command Descriptor format is shown in next table.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code							
1	Reserved							
2	(MSB)	Service Action						
3								(LSB)

Bit	7	6	5	4	3	2	1	0
Byte								
4	Reserved							
5	Reserved					CTDP	SERVACTV	
6	(MSB)	CDB Length						
7	(LSB)							
8	Command timeouts descriptor (if CTDP = 1)							
...								
19								

Field Descriptions

- **CTDP:** A command timeouts descriptor present (CTDP) bit set to 1 indicates that the command timeouts descriptor is included in this command descriptor. A CTDP bit set to zero indicates that the command timeouts descriptor is not included in this command descriptor.
- **SERVACTV:** A service action valid (SERVACTV) bit set to 0 indicates that the operation code that is indicated by the OPERATION CODE does not have service actions and the SERVICE ACTION field contents are reserved. A SERVACTV bit set to 1 indicates that the operation code that is indicated by the OPERATION CODE field has service actions and the contents of the SERVICE ACTION field are valid.

The REPORT SUPPORTED OPERATION CODES one_command parameter data format contains information about the CDB. It also includes a usage map for bits in the CDB for the command that is specified by the **Reporting Options**, **Requested Operation Code**, and **Requested Service Action** fields in the REPORT SUPPORTED OPERATION CODES CDB.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved							
1	CTDP	Reserved				Support		
2	(MSB)	CDB Size (n-3)						
3	(LSB)							
4	(MSB)	CDB Usage Data						
n	(LSB)							
n+1	Command timeouts descriptor (if CTDP = 1)							
...								
n+12								

Field Descriptions

- **Support:** The **Reporting Options** field specifies the information to be returned in the parameter data.

Support	Description
000b	Data about the requested SCSI command is not currently available. All data after byte 1 is not valid. A subsequent request for command support data is successful.

Support	Description
001b	The device server does not support the requested command. All data after byte 1 is undefined.
010b	Reserved
011b	The device server supports the requested command in conformance with a SCSI standard.
100h	Reserved
101h	The device server supports the requested command in a vendor-specific manner.
110h	Reserved

CDB Usage Data:

The first byte is the Operation Code of the requested command. When the Op Code has a Service Action that is associated with it, it is located in the second byte, in the correct location. All further bytes up to the original CDB length contain a usage map. Each bit that is supported as a parameter field is set to one. Any field that is either reserved or ignored is set to 0.

Command timeouts descriptor format:

Bit	7	6	5	4	3	2	1	0
Byte								
0	(MSB)	Descriptor Length (000Ah)						
1								(LSB)
2	Reserved							
3	Command Specific							
4	(MSB)	Nominal command processing timeout						
...								
7								
8	(MSB)	Recommended command timeout						
...								
11								

Field Descriptions

- **Command Specific:** The COMMAND SPECIFIC field contains timeout information that is specific to one or more commands. If no command-specific timeout information is defined by this or the applicable command standard, the COMMAND SPECIFIC field is reserved.
- **Nominal Command processing timeout:** A non-zero value in NOMINAL COMMAND PROCESSING TIMEOUT field specifies the minimum amount of time in seconds the application client waits prior to querying for the progress of the command that is identified by the parameter data that contains this command timeouts descriptor. A value of zero in NOMINAL COMMAND PROCESSING TIMEOUT field indicates that no timeout is indicated.
- **Recommended Command timeout:** A non-zero value in the RECOMMENDED COMMAND TIMEOUT field specifies the recommended time in seconds the application client waits before timing out the command that is identified by the parameter data that contains this command timeouts descriptor. A value of zero in the RECOMMENDED COMMAND TIMEOUT field indicates that no time is indicated.

The device server sets the suggested command timeout to a value greater than or equal to the nominal command processing timeout.

REPORT TIMESTAMP (A3h)

The REPORT TIMESTAMP command requests that the media changer returns the value of the logical unit's timestamp.

Bit	7	6	5	4	3	2	1	0
0	Operation Code (A3)							
1	LUN			Service Action (0Fh)				
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	(MSB) Allocation Length (LSB)							
7								
8								
9								
10	Reserved							
11	Control							

Field Descriptions:

- **Allocation Length:** The **Allocation Length** field specifies the maximum number of bytes the initiator can allocate for returned data.

The Timestamp is not affected by an I_T nexus loss or a logical unit reset. Also, the Timestamp persists during a hard reset event.

The REPORT TIMESTAMP parameter data format is shown in next table.

Bit	7	6	5	4	3	2	1	0
0 - 1	Timestamp parameter data length (0Ah)							
2	Reserved				Timestamp Origin			
3	Reserved							
4 - 9	Timestamp							
10 - 11	Reserved							

Field Descriptions:

- **Timestamp parameter data length:** The **Timestamp parameter data length** field indicates the number of bytes of parameter data that follows.
- **Timestamp Origin:** The **Timestamp Origin** field indicates the origin of the timestamp.

Code	Description
000b	Timestamp is initialized to zero at power-on or as the result of a hard reset.
001b	Reserved
010b	Timestamp is initialized by the SET TIMESTAMP command.
011b	Timestamp is initialized by methods outside the scope of the standard.

- **Timestamp:** The **Timestamp** field contains the current value of the timestamp. The **Timestamp** field returns the number of milliseconds that elapsed since midnight, 1 January 1970 UTC.

SET TIMESTAMP (A4h)

The SET TIMESTAMP command requests the device server to initialize the timestamp in the media changer.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (A4)							
1	LUN			Service Action (0Fh)				
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	(MSB) Allocation Length (LSB)							
7								
8								
9								
10	Reserved							
11	Control							

Field Descriptions:

- **Parameter List Length:** The **Parameter List Length** field specifies the length in bytes of the SET TIMESTAMP parameters that are transferred from the application client to the device server. If the requested list length is terminated with CHECK CONDITION status with the same sense key set to ILLEGAL REQUEST, and the additional sense code set to PARAMETER LENGTH ERROR. The SET TIMESTAMP parameter data format is shown in next table.

Bit	7	6	5	4	3	2	1	0
Byte								
0 - 3	Reserved							
4 - 9	Timestamp							
10 - 11	Reserved							

Field Descriptions:

- **Timestamp:** The **Timestamp** field contains the requested value of the new timestamp. The **Time Stamp** field is the number of milliseconds that elapsed since midnight, 1 January 1970 UTC. If the high-order byte in the **Time Stamp** field is greater than F0h, the command is terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST. Also, the additional sense code is set to INVALID FIELD IN PARAMETER LIST.

SEND VOLUME TAG (B6h)

By using the SEND VOLUME TAG command, an application client can transfer a volume tag template to be used for a search of existing volume tag information. The command can also be used to establish new volume tag information for one volume in a media changer element address. The function of the command is conveyed by the **Send Action Code** field value. The REQUEST VOLUME ELEMENT ADDRESS command can be used to transfer the results of a translate search operation.

Byte	Bit	7	6	5	4	3	2	1	0
0		Operation Code (B6h)							
1		LUN			Reserved	Element Type Code			
2	(MSB)	Element Address							
3									
4		Reserved							
5		Reserved			Send Action Code				
6 - 7		Reserved							
8	(MSB)	Parameter List Length							
9									
10		Reserved							
11		Control							

Field Descriptions:

- **Element Type Code:** The **Element Type Code** field specifies an element type specification as defined in the **Read Element Status** command. If the **Send Action Code** field indicates a Translate operation, this field indicates the element types to be searched. If the value is zero, all element types are candidates for a translate operation. If the **Send Action Code** does not indicate a Translate, this field is treated as reserved.
- **Element Address:** The **Element Address** field gives the media changer element address whose interpretation depends on the **Send Action Code** field. When the **Send Action Code** field is a Translate, the **Element Address** field gives the starting element to be examined for the search operation. When the **Send Action Code** field is Assert, Replace, or Undefined, the **Element Address** field gives the specific **Element Address** where the volume tag information for a volume is to be modified.
- **Send Action Code:** The **Send Action Code** field gives the function to be run by this command as specified in the next table:

Code	Description
0h	Translate - search all defined volume tags.

Code	Description
1h	Translate - search only primary volume tags.
4h	Translate - search all defined tags, ignore sequence numbers.
5h	Translate - search primary tags, ignore sequence numbers.
8h	*Assert - as the primary volume tag, if tag now undefined
Ah	*Replace - the primary volume tag - current tag ignored
Ch	Undefine - the primary volume tag - current tag ignored.
*Assigned volume tag information is cleared on unit reset.	

- **Parameter List Length:** The **Parameter List Length** field is zero when the **Send Action Code** is an Undefine function. The **Parameter List Length** is set to the length of the **Send Volume Tag Parameter** structure.

Send Volume Tag Parameter structure

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

Field Descriptions:

- **Volume Identification Template:** The **Volume Identification Template** field specifies a search template for Translate functions and the value of the new volume identification information for other **Send Volume Tag** command functions. As a search template, this field can contain the wildcard characters ? and *. The ? matches any single character. The * matches any string of characters. When it appears in a template, the remainder of the template at higher offsets in the field is not used. For Assert, Replace, or Undefined functions, the wildcard characters cannot be used.
- **Minimum Volume Sequence Number:** The **Minimum Volume Sequence Number** field specifies the new sequence number for the Assert and Replace functions. For a Translate, this field specifies the least value in the volume sequence number field of the volume tag information that meets the search specification.
- **Maximum Volume Sequence Number:** The **Maximum Volume Sequence Number** field specifies the maximum number value in the volume sequence number field of the volume tag information that meets the search specification. This field is ignored for Assert, Replace, and Undefine functions.

REQUEST SENSE (03h)

The REQUEST SENSE command allows an application client to retrieve the sense data of the media changer.

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

Field Descriptions:

- **Allocation length:** This field specifies the maximum sense data length the host wants to receive.

The sense data is valid for a CHECK CONDITION status that is returned on the previous command. The sense data bytes are preserved by the media changer until retrieved by the REQUEST SENSE command from the same initiator.

If the media changer receives a REQUEST SENSE command, it returns up to 18 bytes of Sense Data with the appropriate values in the Sense Key, Additional Sense Code, and Additional Sense Code Qualifier.

Byte	Bit	7	6	5	4	3	2	1	0
0	Valid (0)	Response code (70h)							
1	Segment number								
2	Filemark	EOM	ILI	Reserved	Sense Key				
3 - 6	Information								
7	Additional sense length (0Ah)								
8 - 11	Reserved								
12	Additional sense code								
13	Additional sense code qualifier								
14	Reserved								
15	SKSV	C/D	Reserved		BPV	Bit Pointer			
16	Field Pointer								
17									

Field Descriptions:

- **Valid:** A Valid bit of one indicates that the **Information** field contains valid information as defined in the SCSI specification. This bit is set to 0.
- **Response Code:** A value of 70h indicates a current error. The report is associated with the most recently received command. Response code value 71h (deferred errors) not implemented. No other values are returned.

- **Segment Number:** This byte contains the number of the current segment descriptor if the Request Sense command is the response to a Copy, Compare, or Copy and Verify command. It is always zero.
- **Filemark:** This bit is only used in sequential access devices. It is always set to zero.
- **EOM:** The End Of Medium bit is for sequential-access and printer devices. This bit is always set to zero.
- **ILI:** An Incorrect Length Indicator indicates that the requested block length did not match the logical of the data on the medium. This bit is always set to zero.
- **Sense Key, ASC, ASCQ:** Sense Key, Additional Sense Code, and Additional Sense Code Qualifier provide a hierarchy of information. The sense key provides generic categories in which error and exception conditions can be reported. Additional sense codes provide further detail that describes the sense code. Additional sense code qualifiers add further detail to the additional sense code. These bytes show detailed information about the error and exception conditions.
- **Information:** The contents of the information field is device-type or command specific. These bytes are always zero.
- **Additional Sense Length:** This field specifies the number of additional sense bytes to follow. If the allocation length of the command descriptor block is too small to transfer all of the additional sense bytes, the additional sense is not adjusted to reflect the truncation.
- **SKSV:** When the Sense-Key Specific Valid bit is set to zero, the data in the **Sense Key Specific** field (bytes 15, 16, and 17) do not contain valid data. When the SKSV bit is set to one, bytes 15, 16, and 17 contain more information about the error condition.
- **C/D:** A command data (C/D) bit of one indicates that the illegal parameter is in the CDB. A C/D bit of zero indicates that the illegal condition is in the data parameters that are sent by the host.
- **BPV:** A bit pointer valid (BPV) bit of zero indicates that the value in the **Bit Pointer** field is not valid. A BPV bit of one indicates that the **Bit Pointer** field specifies which bit of the byte specified in the **Field Pointer** field is in error.
- **Field Pointer:** The **Field Pointer** field indicates which byte of the CDB or parameter data was in error. Bytes are numbered starting from zero, as shown in the tables that describe the commands and parameters.

Possible sense keys

Sense Key	Name	Description
0h	NO SENSE	Indicates that there is no specific sense key information to be reported.
1h	RECOVERED ERROR	Indicates that the last command that is completed successfully with some recovery action that is completed by the device server.
2h	NOT READY	Indicates that the logical unit that is addressed cannot be accessed. Operator intervention might be required to correct this condition.
4h	HARDWARE ERROR	Indicates that the device server detected an unrecoverable hardware failure (for example, controller failure, device failure, parity error) while the command is completing or during a self-test.

Sense Key	Name	Description
5h	ILLEGAL REQUEST	Indicates that there was an illegal parameter in the command descriptor block or in the additional parameters that are supplied as data for some commands.
6h	UNIT ATTENTION	Indicates that the removable medium is changed or the target is reset.
Bh	ABORTED COMMAND	Indicates that the device server aborted the command.

Note: A list of possible sense keys, with supported sense codes (ASC) and more sense code qualifiers (ASCQ) is available in Chapter 6, “Used Sense Keys, ASC, and ASCQ,” on page 85.

REQUEST VOLUME ELEMENT ADDRESS (B5h)

The REQUEST VOLUME ELEMENT ADDRESS command allows an application client to retrieve the results of the last successful SEND VOLUME TAG command with the Send Action Code field set to a Translate search value. Multiple REQUEST VOLUME ELEMENT ADDRESS commands can be used to retrieve the results of a single SEND VOLUME TAG command.

Byte	Bit	7	6	5	4	3	2	1	0
0		Operation Code (B5h)							
1		LUN			VolTag	Obsolete			
2	(MSB)	Element Address							
3									
4	(MSB)	Number Elements to Report							
5									
6		Reserved							
7	(MSB)	Allocation Length							
8									
9									
10		Reserved							
11		Control							

For each **Send Volume Tag** command, the media changer reports in response to a **Request Volume Element Address** command zero or more elements that match a volume tag template in element address order. When information for a specific element address is reported, only higher element addresses are reported by subsequent **Request Volume Element Address** commands.

Field Descriptions:

- **VolTag:** A VolTag bit of one indicates that the media changer reports volume tag information. A value of zero indicates that the volume tag information is not reported.

- **Element Address:** The **Element Address** field specifies a media changer element address whose interpretation depends on the **Send Action Code** field of the last successful **Send Volume Tag** command. When the **Send Action Code** field was a Translate, the **Element Address** field gives the minimum element address to be reported by this command. When the **Send Action Code** field is Assert, Replace, or Undefine, the **Element Address** field gives the particular element whose volume tag information was modified.
- **Number of Elements to Report:** The **Number of Elements to Report** field specifies the maximum number of elements to report that match the last **Send Volume Tag** command translate template.
- **Allocation Length:** If the Allocation Length is not sufficient to transfer all the element descriptors, the media changer returns only those descriptors whose complete contents fit within the allocation length.

Request Volume Element Address header

Bit	7	6	5	4	3	2	1	0	
Byte									
0	(MSB) First Element Address Reported								
1								(LSB)	
2	(MSB) Number of Elements Reported								
3								(LSB)	
4	Reserved			Send Action Code					
5	(MSB) Byte Count of Report Available								
6									
7								(LSB)	

Field Descriptions:

- **First Element Address Reported:** This field indicates the element address of the element with the smallest element address found to meet the **Send Volume Tag** command's request.
- **Number of Elements Reported:** This field specifies the number of elements found. The status for these elements is returned if the **Allocation Length** specified in the **Request Volume Element Address** command was sufficient.
- **Send Action Code:** The Send Action Code in the **Request Volume Element Address** header returns the Send Action code of the last successful **Send Volume Tag** command.
- **Byte Count of Report Available:** This field indicates the number of available element status bytes that meet the CDB requirements. This value does not adjust to match the **Allocation Length** field of the CDB and does not include the 8-byte **Request Volume Element Address** header.

RESERVE (16h)

The RESERVE command allows the initiator to reserve the media changer. After the media changer is reserved, only the INQUIRY, LOG SENSE, RELEASE, REQUEST SENSE, REPORT LUNS, READ ELEMENT STATUS with CurData set and ALLOW MEDIUM REMOVAL commands are accepted from other initiators. All other commands result in a Reservation Conflict status.

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

RESERVE 10 (56h)

The RESERVE and RELEASE commands provide the mechanism for contention resolution in multiple initiator systems. The third-party reservation allows logical units to be reserved for another specified SCSI device. When an initiator reserves the media changer, only INQUIRY, LOG SENSE, RELEASE, REQUEST SENSE, REPORT LUNS, READ ELEMENT STATUS with CurData set, and ALLOW MEDIUM REMOVAL commands are accepted from other initiators. All other commands result in a Reservation Conflict status.

Byte	Bit	7	6	5	4	3	2	1	0
0	Operation Code (56h)								
1	LUN			3rdPty	Reserved		LongID	Reserved	
2	Obsolete								
3	Third-Party Device ID								
4	Reserved								
5	Reserved								
6	Reserved								
7	(MSB)	Parameter List Length							(LSB)
8									
9	Control								

Field Descriptions:

- **LongID:** Device IDs that are greater than 255, are not supported, therefore setting of LongID results in a Check Condition status. The Sense Key is set to ILLEGAL REQUEST and the sense data to INVALID FIELD IN CDB.
- **3rdPty:** If the third party (3rdPty) bit is zero, then a third-party reservation is not requested. If the 3rdPty bit is one, then the LongID and **Parameter List Length** field are ignored. If the 3rdPty bit is one, then the media changer is reserved by the initiator ID specified in the **Third-Party Device ID** field. The reservation is preserved until it is superseded by another valid RESERVE command from the initiator that made the reservation or until it is released by the same initiator, by a SCSI RESET message, by a Hard Reset condition, or by a power-on cycle. The media changer ignores any attempt to release the reservation that is made by any other initiator.
- **Third-Party Device ID:** This field provides the Device ID for the third party when 3rdPty bit is set.

TEST UNIT READY (00h)

TEST UNIT READY checks if the media changer is ready for commands that involve cartridge movement. If the media changer completed initialization and the magazines are inserted, the command returns Good Status. Otherwise, Check Condition is reported.

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

WRITE BUFFER (3Bh)

WRITE BUFFER is used with Read Buffer as a diagnostic function for testing the device data buffer, DMA engine, SCSI bus interface hardware, and SCSI bus integrity.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (3Bh)							
1	LUN			Reserved	Mode			
2	Buffer ID							
3	(MSB) Buffer offset (LSB)							
4								
5								
6	(MSB) Parameter list length (LSB)							
7								
8								
9	Control							

Field Descriptions:

- **Mode:** The **Mode** field is used to select the mode of operation. The media changer supports the following values within this field.

0010b	Data
1010b	Echo buffer

If any non-supported value is set, the media changer terminates the command with a Check Condition status. The sense key is set to ILLEGAL REQUEST and the sense data to INVALID FIELD IN CDB.

- **Buffer ID:** Buffer ID must be set to zero.
- **Buffer Offset:** The Buffer Offset must be set to zero.

Write Data mode

With this mode, SCSI bus integrity can be tested with the READ BUFFER command.

The host can, with this mode, send up to 256 bytes to the media changer. This data can be retrieved with the READ BUFFER command. The Buffer Offset specifies the offset within the buffer. Potential buffer overruns are detected and result into a Check Condition. Also, the sense key is set to ILLEGAL REQUEST, and the additional sense data to INVALID FIELD IN CDB.

Echo Buffer mode

In this mode, the host can send data to the echo buffer. The data in the echo buffer is preserved until the library is reset, power-cycled, or overwritten by another host. The Buffer ID and Buffer Offset fields are ignored in this mode. The capacity of the echo buffer can be determined by the **Buffer Capacity** field in the READ BUFFER echo buffer descriptor. The maximum length of the Echo Mode buffer is 256 bytes. When the parameter list length exceeds the total listed length, the media changer returns Check Condition status. The sense key is set to ILLEGAL REQUEST and the sense data is set to INVALID FIELD IN CDB.

Bit	7	6	5	4	3	2	1	0
Byte								
0 - n	(Echo Mode WRITE BUFFER data)							

Chapter 3. Command status byte

The media changer enters the status phase once for each received command. The supported status bytes are displayed in the next table.

Status	Value	Description
Good	00h	This status indicates that the media changer successfully completed the command.
Check condition	02h	An error condition occurred during command processing. The REQUEST SENSE command responds with detailed error information.
Busy	08h	The target is busy. This status is returned when the device is unable to accept a command from an otherwise acceptable initiator. The initiator reissues the command later.
Reservation conflict	18h	This status is returned by the media changer when a SCSI initiator attempts to access the media changer after it is reserved by another initiator with the RESERVE command.

Chapter 4. Command timeouts

This table lists the media changer commands with the recommended nominal and maximum timeout values. The nominal timeout values specify the minimum time that is required to operate the command.

Note: If the media changer is working in a multi-host environment, the timeout values must be adjusted for the worst case timeout value from a pending motion command from another host.

Note: If the media changer is partitioned, the timeout values must be adjusted for the worst case timeout value due to a pending motion command in another partition.

Op Code	SCSI Command	Command Timeout	Notes
A6h	EXCHANGE MEDIUM (between slot and slot)	36 minutes	
	EXCHANGE MEDIUM (implicit between drive and slot)	75 minutes	3
	(the media changer initiates a cartridge unload from the drive. The EXCHANGE MEDIUM command timeout is adjusted to account for maximum unload time).		
	EXCHANGE MEDIUM (explicit between drive and slot)	38 minutes	
	(the host issued an UNLOAD command to the tape drive prior to issuing the EXCHANGE MEDIUM command).		
07h	INITIALIZE ELEMENT STATUS	60 minutes	1.6
37h	INITIALIZE ELEMENT STATUS WITH RANGE with FAST bit set (ignore bar code labels).	60 minutes	2.6
	INITIALIZE ELEMENT STATUS WITH RANGE with FAST bit cleared (scan bar code labels).	60 minutes	2.6
12h	INQUIRY	10 seconds	
4Dh	LOG SENSE	30 seconds	
15h	MODE SELECT 6	30 seconds	
55h	MODE SELECT 10	30 seconds	
1Ah	MODE SENSE 6	30 seconds	
5Ah	MODE SENSE 10	30 seconds	

Op Code	SCSI Command	Command Timeout	Notes
A5h	MOVE MEDIUM (slot to slot)	12 minutes	
	MOVE MEDIUM (slot to drive).	25 minutes	
	MOVE MEDIUM (implicit drive to slot) (the media changer initiates cartridge unload from the drive. The MODE MEDIUM command timeout is adjusted to account for maximum unload time).	25 minutes	3
	MOVE MEDIUM (explicit drive to slot) (the host issued an UNLOAD command to the tape drive before the MOVE MEDIUM command is issued).	13 minutes	
5Eh	PERSISTENT RESERVE IN	30 seconds	
5Fh	PESISTENT RESERVE OUT	30 seconds	
2Bh	POSITION TO ELEMENT	10 minutes	
1Eh	PREVENT/ALLOW MEDIUM REMOVAL	30 seconds	
3Ch	READ BUFFER	30 seconds	4
B8h	READ ELEMENT STATUS (CURDATA set)	30 seconds	
B8h	READ ELEMENT STATUS (CURDATA cleared).	30 seconds	
1Ch	RECEIVE DIAGNOSTIC RESULTS	30 seconds	
17h	RELEASE 6	30 seconds	
57h	RELEASE 10	30 seconds	
02h	REQUEST SENSE	10 seconds	
16h	RESERVE 6	60 seconds	
56h	RESERVE 10	30 seconds	
A0h	REPORT LUNS	10 seconds	
A3h	REPORT TIMESTAMP	30 seconds	
A3h	REPORT SUPPORTED OPERATION CODES	30 seconds	
B5h	REQUEST VOLUME ELEMENT ADDRESS	30 seconds	
B6h	SEND VOLUME TAG	30 seconds	
A4h	SET TIMESTAMP	30 seconds	
00h	TEST UNIT READY	10 seconds	
3Bh	WRITE BUFFER	180 minutes	5

Notes:

1. The Initialize Element Status timeout assumes a fully populated unit.
2. The Initialize Element Status With Range timeout assumes a fully populated unit.
3. The Move Medium command assumes a move from one storage element to the data transfer element or vice versa. If the cartridge is not unloaded by a host command to the tape drive, before the Move Medium command is received, the media changer issues an Unload command to the tape drive. Therefore, the timeout value must be adjusted from the maximum time a data transfer element takes to rewind and unload the cartridge.

4. The Read Buffer timeout is based on a 16 K-data-chunk request. Adjust the timeout value if larger data chunks are requested.
5. The Write Buffer timeout is based on a 16 K-data-chunk request. Adjust the timeout value if larger data chunks are sent.
6. Maximum timeout is required if support for unlabeled media that is enabled and mechanical touching is needed for verification of media presence.

Chapter 5. Supported Tape Alert Flags

Listing of the Tape Alert flags that are supported by the media changer.

Parameter Code	Flag name	Type	Description
01d	Library Hardware A	C	The media changer mechanism is having difficulty in communicating with the drive: <ul style="list-style-type: none"> • Turn the library OFF then ON • Restart the operation. If the problem persists, contact IBM technical support.
02d	Library Hardware B	W	A problem with the media changer mechanism. If the problem persists, contact IBM technical support.
04d	Library Hardware D	C	The library has a hardware fault that is not mechanically related or requires a power cycle to recover: <ul style="list-style-type: none"> • Turn the media changer OFF then ON • Restart the operation. • If the problem persists, contact IBM technical support.
05d	Library	W	The library mechanism might have a hardware fault.
	Diagnostics Required		Run extended diagnostics to verify and diagnose the problem. Check the library user's manual for device-specific instructions on running extended diagnostic tests.
13d	Library Pick Retry	W	A potential problem with the drive ejecting cartridges or with the library picking cartridges from a slot. <ul style="list-style-type: none"> • No action needs to be taken. • If the problem persists, contact IBM technical support.
14d	Library Pick Retry	W	There is a potential problem with the library mechanism placing a cartridge into a slot. <ul style="list-style-type: none"> • No action must be taken currently. • If the problem persists, contact IBM technical support.
15d	Library Load Retry	W	A potential problem with the drive or the library mechanism that is loading cartridges, or an incompatible cartridge. This flag is cleared when the next move command is received.
16d	Library Door	C	The library failed because the door is open. <ol style="list-style-type: none"> 1. Clear any obstructions from the library door. 2. Close the library door. 3. If the problem persists, call the library supplier help line.
17d	Library I/O Station	C	A mechanical problem with the library media import/export I/O station.
19d	Library Security	W	Library security is compromised. The door was opened, then closed during operation.

Parameter Code	Flag name	Type	Description
20d	Library Security Mode	I	The library security code is changed. The library is either in secure mode, or the library exited secure mode. This flag is for information purposes only. No action is required.
21d	Library Offline	I	The library is manually turned offline and is unavailable for use.
22d	Library drive Offline	I	A drive inside the library is taken offline. This flag is for information purposes only. No action is required.
24d	Library Inventory	C	The library detected an inconsistency in its inventory. <ul style="list-style-type: none"> • Redo the library inventory to correct inconsistency. • Restart the operation.
28d	Power Supply	W	A redundant power supply failed inside the library. Check the library user's manual for instructions on replacing the failed power supply.
33d	Library Capacity Exceeded	C	The total number of volumes exceeds the available number of storage elements. Remove a cartridge from the inventory to recover.
<ul style="list-style-type: none"> • I = Informational suggestion to user. • W = Warning. Remedial action is advised. Performance of data might be at risk. • C = Critical. Immediate remedial action is required. 			

Chapter 6. Used Sense Keys, ASC, and ASCQ

Sense Key	ASC	ASCQ	Description
Not Ready (02h)	04h	00h	Not ready, cause not reportable.
	04h	01h	Not ready, in progress, almost ready, for example, scanning magazines.
	04h	03h	Not ready, manual intervention required
	04h	12h	Not ready, offline
	3Bh	12h	Not ready, magazine removed
Media Error (03h)	30h	00h	Media error
	30h	07h	Cleaning failure
Hardware Error (04h)	80h	D7h	Internal software error
	80h	D8h	Database access error
	81h	B0h	Internal system communication failed
	81h	B2h	Robotic controller communication failed
	81h	B3h	Mechanical positioning error
	81h	B4h	Cartridge did not transport completely.
	82h	FCh	Drive configuration failed. Data transfer element might be offline.

Sense Key	ASC	ASCQ	Description
Illegal Request (05h)	04h	83h	Door open
	1Ah	00h	Parameter length error
	20h	00h	Invalid command operation code
	21h	01h	Invalid element address
	24h	00h	Invalid field CDB
	25h	00h	Invalid LUN
	26h	00h	Invalid field in parameter list
	26h	01h	Parameter list error: parameter not supported
	26h	02h	Parameter value invalid
	2Ch	00h	Saving parameters is not supported.
	30h	12h	Incompatible Media loaded to drive.
	39h	00h	Saving parameters is not supported.
	3Bh	0Dh	Medium destination element full
	3Bh	0Eh	Medium source element empty
	3Bh	11h	Magazine not accessible
	3Bh	18h	Element disabled
	3Bh	1Ah	Data transfer element removed
	39h	00h	Saving parameters is not supported.
	44h	81h	Source element not ready
	44h	82h	Destination element not ready
	53h	02h	Library media removal prevented state set.
	53h	03h	Drive media removal prevented state set.
	82h	93h	Failure session sequence error
	82h	94h	Failover command sequence error
	82h	95h	Duplicate failover session key
	82h	96h	Invalid failover key
82h	97h	Failover session that is released.	
Unit Attention (06h)	28h	00h	Not ready to change, medium changed.
	28h	01h	Import/export element that is accessed.
	29h	02h	SCSI Bus reset occurred
Aborted command (0Bh)	3Fh	0Fh	ECHO buffer overwritten
	4Eh	00h	Overlapped command attempt

Index

Numerics

00h (TEST UNIT READY) 75
03h (REQUEST SENSE) 70
07h (INITIALIZE ELEMENT STATUS) 9
12h (INQUIRY) 10
15h (MODE SELECT 6) 23
16h (RESERVE) 74
17h (RELEASE) 60
1Ah (MODE SENSE 6) 30
1Eh (PREVENT / ALLOW MEDIA
REMOVAL) 44
2Bh (POSITION TO ELEMENT) 43
37h (INITIALIZE ELEMENT STATUS
WITH RANGE) 10
3Bh (WRITE BUFFER) 75
3Ch (READ BUFFER) 45
4Dh (LOG SENSE) 16
55h (MODE SELECT 10) 30
56h (RESERVE 10) 74
57h (RELEASE 10) 60
5Ah (MODE SENSE 10) 37
5Eh (PERSISTENT RESERVE IN) 39
5Fh (PERSISTENT RESERVE OUT) 41

A

A0h (REPORT LUNS) 61
A3h (REPORT SUPPORTED OPERATION
CODES) 62
A3h (REPORT TIMESTAMP) 66
A4h (SET TIMESTAMP) 67
A5h (MOVE MEDIUM) 38
ASC 85
ASCQ 85

B

B5h (REQUEST VOLUME ELEMENT
ADDRESS) 72
B6h (SEND VOLUME TAG) 68
B8h (READ ELEMENT STATUS) 47

C

Command status byte 77
Command timeouts 79
comments, sending v

D

D0h (VENDOR INQUIRY) 16

F

feedback, sending v

I

INITIALIZE ELEMENT STATUS (07h) 9
INITIALIZE ELEMENT STATUS WITH
RANGE (37h) 10
INQUIRY (12h) 10

L

LOG SENSE (4Dh) 16

M

MODE SELECT 10 (55h) 30
MODE SELECT 6 (15h) 23
MODE SENSE 10 (5Ah) 37
MODE SENSE 6 (1Ah) 30
MOVE MEDIUM (A5h) 38

P

PERSISTENT RESERVE IN (5Eh) 39
PERSISTENT RESERVE OUT (5Fh) 41
POSITION TO ELEMENT (2Bh) 43
PREVENT / ALLOW MEDIA REMOVAL
(1Eh) 44

R

READ BUFFER (3CH) 45
READ ELEMENT STATUS (B8h) 47
RELEASE (17h) 60
RELEASE 10 (57H) 60
REPORT LUNS (A0H) 61
REPORT SUPPORTED OPERATION
CODES (A3h) 62
REPORT TIMESTAMP (A3h) 66
REQUEST SENSE (03h) 70
REQUEST VOLUME ELEMENT
ADDRESS (B5h) 72
RESERVE 10 (56H) 74
RESERVE(16h) 74

S

SCSI 7
SEND VOLUME TAG (B6h) 68
Sense keys 85
SET TIMESTAMP (A4h) 67
supported commands 7

T

TEST UNIT READY (00h) 75

V

VENDOR INQUIRY (D0h) 16

W

WRITE BUFFER (3Bh) 75



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