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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 for Post Launch Releases)

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, andmedium 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 as well as identifying the element address assigned to different
types of elements.

1.1 Cartridge Generation Handling

The library media changer detects and stores LTO generation of each cartridge in its inventory. This provides in smart cartridge management. The media changer is aware what cartridge is supported by which tape drive. The media changer will report CHECK CONDITION status on MOVE MEDIUM and EXCHANGE MEDIUM commands that cause a medium generation conflict between a tape drive and a cartridge (i.e., a LTO4 tape into a LTO2 drive).
The media changer will report CHECK CONDITION status on MOVE MEDIUM and EXCHANGE MEDIUM commands when a drive has Encryption enabled and a cartridge generation unable to support encryption is moved to this drive.

Possible sense data on these medium generation conflicts are:

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

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1.2 Configuration changes

The media changer is equipped with a RMI and OCP interface. These interfaces allow a user to make configuration changes. When a user made a change to the media changer configuration the media changer shall inform the application client by means of a unit attention with the sense data set to MODE PARAMETERS CHANGED (06/2A/00).

1.3 Commands allowed in the presence of reservations

The details of which commands are allowed under a reservation are described in next table. The RESERVE and RELEASE commands are used to manage the reservation state of the media changer.
Next table shows all SCSI commands 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 ELEMENT STATUS (curdata=1)	Allowed
RECEIVE DIAGNOSTIC RESULTS	Conflict
RELEASE (6 & 10)	Allowed
REPORT LUNS	Allowed
REPORT SUPPORTED OPERATION CODES	Conflict
REPORT TIMESTAMP	Allowed
REQUEST SENSE	Allowed
REQUEST VOLUME ELEMENT ADDRESS	Conflict
RESERVE (6 & 10)	Conflict
SET TIMESTAMP	Conflict
SEND DIAGNOSTIC	Conflict
SEND VOLUME TAG	Conflict
TEST UNIT READY	Conflict
WRITE BUFFER	Conflict
allowed :	Commands received from SCSI initiators not holding the reservation should complete normally

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conflict :	Commands received from SCSI initiators not holding the reservation shall terminate the command with a RESERVATION CONFLICT status.

1.4 NOT READY Condition

When the media changer is unable to accept medium access commands it shall report CHECK CONDITION status on medium access commands. The sense data shall be set to the reason why the media changer is unable to perform the requested medium access command. All non-media access commands (see table below) shall be executed as specified.

The media changer is unable to process medium access commands successfully when:

Not ready reason	Sense code during not ready reason	Notes	
Initializing after POR	02/04/01		1, 3
Magazine removed	02/3B/12		
Magazine re-inserted	02/04/01		2, 3
Maintenance Library Tests	02/04/12		3
Partioning changes	02/04/01		3
Unlock multiple magazines start	02/3B/12		5
Unlock multiple magazines end	02/04/01		5

Note 1: After a power-on or device reset the media changer initializes automatically.
Note 2: When a magazine is re-inserted the media changer re-initializes automatically.
Note 3: When transitioning from not ready to ready the media changer shall return a NOT READY TO READY TRANSITION unit attention (06/28/00) before returning READY status.

Note 4: Move commands from any interface will be queued and are therefore not causing 'Not ready' status. After moving media, all affected partitions shall return a NOT READY TO READY TRANSITION unit attention (06/28/00).

Note 5: When unlock multiple magazine process start, the media changer will return (02/3B/12). At the end phase (after last to released magazine is inserted, it will change 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 access commands are processed during the not ready reason:

Processed commands during not ready reason
INQUIRY
PERSISTENT RESERVE IN
PERSISTENT RESERVE OUT
RELEASE (6)
RELEASE (10)

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REQUEST SENSE
RESERVE
RESERVE 10

1.5 Partitioning Handling

The media changer supports partitioning. The media changer may be partitioned when it has more than one tape drive. A partitioned media changer behaves identical like the un-partitioned 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 may 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 (see chapter 5) are considering a normal scenario without parallel movements.
- Mailslot magazines are potentially shared between multiple partitions. Individual slots of such a magazine are only assigned to one partition. Nevertheless mailslot magazines can only be opened completely which affects all owning partitions. If multiple partitions are setting a media removal prevention to their mailslots, the magazine can only be opened after all media removal preventions have been released.

1.6 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:

a) The return of an Execute Command service response of SERVICE DELIVERY OR TARGET FAILURE
b) An I_T nexus loss
c) A logical unit reset
d) A hard reset or
e) A power on condition

On such conditions the system aborts current SCSI command. Any mechanical operations however still need to complete. SCSI initiator can immediately start with new command execution. New command will be executed as soon as possible.
Unit attention condition with and additional sense code set to SCSI BUS RESET OCCURRED is generated.

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1.7 SCSI Mailslot Handling

When a user inserts or removes a cartridge from the mailslot the FULL bit of the element descriptor describing the mailslot shall change. This important event is reported to the application client by means of a unit attention condition (i.e., IMPORT/EXPORT ELEMENT ACCESSED). The IMPEX bit of the element descriptor is set if the cartridge in mailslot has been 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 mailslot is open (removed from the lock position), the MOVE MEDIUM command shall return CHECK CONDITION status with the sense data set to ILLEGAL REQUEST, DOOR OPEN (05/04/83).

Whenever a partition has medium removal prevented by means of the PREVENT MEDIUM REMOVAL command, opening or closing of the mailslot is prevented for all partitions using mailslots of the same mailslot magazine.

When medium removal is prevented by means of the PREVENT MEDIUM REMOVAL command, move commands to or from the import export element are not prevented.

When a user enables or disables the mailslot feature from the RMU or OCP, the assigned element addresses of all storage elements and the number of storage elements shall change. This important event is signaled to the application client by means of a unit attention condition (i.e., MODE PARAMETERS CHANGED).

If a SCSI command comes in while the mailslot is removed, the robot will service that command and then inventory the mailslot magazine if it was inserted during the SCSI command.

1.8 Supported SCSI Commands

The following table lists all Media Changer SCSI commands which need to be supported.

Command	Operation Code	Standard	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	not 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

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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
WRITE BUFFER	3Bh	SPC-3	supported

Notes:
* these commands are handled by the LUN drive
** these commands are not supported in 6U Whitebox

1.9 CDB LUN field handling

The Media Changer implementation ignores LUN fields (Byte 1, Bit 5-7) of all CDB's

1.10 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 and the volume that previously occupied the First Destination Address element is moved to the Second Destination Address element. The Second Destination Address element may or may 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							

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3				(LSB)
4	(MSB)	Source Address		
5				(LSB)
6	(MSB)	First Destination Address		
7				(LSB)
8	(MSB)	Second Destination Address		
9				(LSB)
10		Reserved	Inv1	Inv2
11	FSC	Control		
12	(MSB)			
	FAILOVER SESSION KEY			
15				(LSB)

Field descriptions:	
Medium Transport Address:	This field specifies the medium transport element used to execute the Exchange Medium command. This value can be set to either 0 or 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.
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 may or may 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 should be 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 tracked by the library, then the command is terminated with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to FAILOVER SESSION SEQUENCE ERROR.

1.11 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 provides means for an application client to get a quick response from a Read Element Status command that may follow, and is useful after a power failure, if tape medium has been changed by an operator, or if subsystem configuration has changed. The media changer shall not return GOOD status until checking of all the elements is complete. The media changer may decide that element status is accurate, and return GOOD status on this command immediately.

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Bit	7	6	5	4	3	2	1	0
Byte								
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.

1.12 INITIALIZE ELEMENT STATUS WITH RANGE (37h)

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

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

Field descriptions:	
Range:	A Range bit of zero indicates that all element addresses shall be 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 shall be checked. If the Number of Elements field is zero, the range checked shall start with the Starting Element Address and continue through the last element address on the unit.

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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 should 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.

1.13 INQUIRY (12h)

The INQUIRY command requests that information regarding 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 additional 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
Byte								
0	Operation Code (12h)							
1	LUN			Reserved			Obsolete	EVPD
2	Page Code							
3	(MSB) Allocation length							
4								(LSB)
5	Control							

Field descriptions:	
EVPD:	Enable Vital Product Data. An enable vital product data (EVPD) bit of one specifies that the device server shall return the optional vital product data 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
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.

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1.13.1 INQUIRY: Standard page

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 – 54	Reserved							
55	Reserved							BarC
56						Clocking	QAS	IUS
57	Reserved							
58 – 59	Version Descriptor: 005Ch (SAM-2 ANSI INCITS 366-2003)							
60 – 61	Version Descriptor: 0000h							
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 a unsupported LUN was specified the Peripheral Qualifier will return 3h which indicates that specified LUN is not supported.
Peripheral Device Type:	Indicates that this is a medium changer device. Set to 8. When a unsupported LUN was specified the Peripheral Device Type will return 1Fh which 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 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 additional bytes of INQUIRY response data available.

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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 may 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. Neither the REPORT TARGET GROUPS nor the SET TARGET GROUPS commands is supported.
3PC :	A Third-Party Copy (3PC) bit set to zero indicates that the media changer does not supports 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 (ENCSERV) 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 that this is 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 MULTIP 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, 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 an 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 is depending on the tape drive currenly hosting Media Changer functionality. Usually set to 1.
Vendor Identification:	Eight byte ASCII string. This field is set to:

0	1	2	3	4	5	6	7
S	P	E	C	T	R	A	

Product Identification:	Sixteen byte ASCII string. This field is set to:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P	Y	T	H	O	N										

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 performed on the media changer, this part of the revision level changes to reflect that update.
BarC:	When set this bit indicates that the media changer is equipped with a bar code scanner.
IUS:	Information Units Supported. Set to 0 indicating information units are not supported.
QAS:	Quick Arbitrate Supported. Set to 0 indicating QAS is not supported.
Clocking:	Indicates the level of data clocking supported. Set to 11b – if the host interface speed has not been set to limit transfers to 80MB/s. Set to 00b when the host interface speed has been set to limit transfers to 80 MB/s.
Version Descriptors:	The version descriptors report the identifier of the supported SCSI command sets.

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1.13.2 INQUIRY: 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								
0	Peripheral Qualifier (0)			Peripheral Device Type (8)				
1	Page Code (00h)							
2	Reserved							
3	Page Length (04h)							
4	00h – (this page)							
5	80h – Unit Serial Number Page							
6	83h – Device Identification Page							
7	C0h – Firmware Build Information Page							

Note: if an unsupported LUN was initially specified, the Peripheral Qualifier will return 3h and the Peripheral Device Type will return 1Fh.

1.13.3 INQUIRY: Unit serial number page (80h)

Unit Serial Number page (80h)

The Unit Serial Number VPD page contains 15 bytes of ASCII data representing a unique serial number of the media changer. Length and format of the reported string are independent from being in partitioned or non partitioned mode. The original manufactiring serial number is extended by _LL and a two digit extension for the partition number. Non-partitioned Libraries will report itself as Partition 1.

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 – 18	Serial Number (15 ACSII bytes)							

Note if an unsupported LUN was initially specified, the Peripheral Qualifier will return 3h and the Peripheral Device Type will return 1Fh.

Field descriptions:	
Serial Number :	The 15 byte ASCII Serial Number may contain ASCII numbers and ASCII characters. See next example:
	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

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	1 3 5 7 a b c X Y Z _ L L 0 1

1.13.4 INQUIRY: Device identification page (83h)

Device Identification page (83h)

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

Bit	7	6	5	4	3	2	1	0
Byte								
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 – 57	Serial Number (15 ACSII bytes)							

<u>Note:</u> if an unsupported LUN was initially specified, the Peripheral Qualifier will return 3h and the Peripheral Device Type will return 1Fh.

<u>Field descriptions:</u>	
Peripheral Qualifier:	A return value of 0 indicates that the specified LUN is supported in this device. When a unsupported LUN was specified the Peripheral Qualifier will return 3h which indicates that specified LUN is not supported.
Peripheral Device Type:	Indicates that this is a medium changer device. Set to 8. When a unsupported LUN was specified the Peripheral Device Type will return 1Fh which indicates that specified LUN is not supported.
Code Set:	This field is set to 1 indicating that the device identifier shall contain 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.

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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 eight byte Vendor ID ASCII string.
Product Identification:	This field returns the sixteen byte Product ID ASCII string.
Serial Number:	This field returns 15 byte serial number ASCII string including a Partition depending suffix like _LL01 independent if the library is partitioned or not.

1.13.5 INQUIRY: Firmware build information page (C0h)

Firmware Build Information page (C0h)

The Firmware Build Information VPD page provides information identifying the current operating firmware version.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Peripheral Qualifier (0)			Peripheral Device Type (8)				
1	Page Code (C0h)							
2	Reserved							
3	Page Length (3Ch)							
4 – 7	Reserved							
8 – 11	Media changer Firmware Checksum in ASCII							
12 – 35	Media changer Firmware Build Date in ASCII (mm-dd-yyyy)							
36 – 63	Reserved							

Note: if an unsupported LUN was initially specified, the Peripheral Qualifier will return 3h and the Peripheral Device Type will return 1Fh.

1.14 LOG SENSE (4Dh)

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

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

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8	(LSB)
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 additional 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 additional sense code of INVALID FIELD IN CDB.

PC: The Page Control field defines the type of parameter value to be returned. This field should 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 additional sense code of INVALID FIELD IN CDB. The Current Cumulative Values are the values computed since the last reset of the device (either by power-cycling, Bus Device Reset, or SCSI Reset). *Note:* only Log Sense Tape Alert page (2Eh) supports PC be 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 additional 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 should begin. This is not supported in any Log Sense page and should be set to 0.

Allocation Length: The Allocation Length field is used to inform the target how much space the initiator has 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 four bytes of the header.

Supported Pages Log Page (00h)

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When page 0 is requested, the 4-byte page header is returned followed by the pages supported in ascending order, one 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							
7	2Eh – Tape Alert page							
8	30h – Statistics Counter page							
9	34h - Error Log							

Event Log Page (07h)

In the Event Log the media changer keeps track of different system events. These events exist out of hardware errors, executed commands, and debug information. The events are stored in a FIFO mode, this 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 returned for the Event log page shall not exceed 64Kbytes. A single LOG SENSE command to the Event Log page may return all events. The Event Log page starts with a header indicating 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

Bit	7	6	5	4	3	2	1	0
Byte								
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 four bytes for this header.
Event Structure: A event structure consists out of a header and a variable number of event data bytes. This structure is defined in next table.

Event Log structure

Bit	7	6	5	4	3	2	1	0
Byte								

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0	Reserved	Page Code (07h)
1	Reserved	
2 – 3	Page Length (n-3)	
	Error event log parameters	
4	Error event log parameter[first]	
	. . .	
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 erro 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 shall determine save method, set to 0
ETC: No threshold comparison, set to 0
TMC: No threshold 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 maximum 255 bytes

Temperature Log Page (0Dh)

This page returns the 4-byte page header followed by two Parameter Codes. Parameter Code 0000h reports the current temperature and Parameter Code 0001h reports the maximum sensor temperature at which the media changer is capable of operating reliable.

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

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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)

This page consists of the Page Header followed by 64 Tape Alert flags. Each Tape Alert flag stands for a pre-determined media changer specific error condition. Tape Alert Flags range from 1 until 64. Every lag number has a standardized meaning. This page will not be affected by the LOG SELECT command. This page can be retrieved by means of 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)							

The Tape Alert flags supported by the media changer are shown in a chapter below

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 from 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 shall determine save method

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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 three vendor specific counters. The information in this page is stored in NV-RAM on power shut-down. This page will not be affected by the LOG SELECT command nor 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 four 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)							
5	Statistic Counter Value							
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 shall determine save method, set to 0
ETC :	No threshold comparison, set to 0
TMC :	No threshold 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

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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 will increment.	0	0
2	Number of Power-ups:	This 4 byte unsigned counter specifies the number of times the media changer is turned on.	0	0
3	Number of Firmware Updates:	This 4 byte unsigned counter specifies the number of times the internal flash code (ROM) has been 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, this means that only the *n* most recent events are stored. Older events are not displayed. This log is stored in non volatile memory (NVRAM) and is therefore resistant to power failures.
The data returned for the Error log page shall not exceed 64Kbytes. A single LOG SENSE command to the Error Log page may return 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 four bytes for this header.
Error Structure: A event structure consists out of a header and a variable number of event data bytes. This structure is defined in next table.

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)							
	Error event log parameters							
4	Error event log parameter[first]							

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	. . .
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	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 erro 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 shall determine save method, set to 0
ETC: No threshold comparison, set to 0
TMC: No threshold 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 maximum 255 bytes

1.15 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 should issue MODE SENSE prior to each MODE SELECT to determine supported pages, page lengths, changeable variables and to determine is the page is savable 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							
5	Control							

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Field descriptions:

PF: A PF bit of one indicates that the MODE SELECT parameters following the header and block descriptor(s) complies with the SCSI-2 specification. The value must be set to 1

SP: A Save Pages (SP) bit of zero indicates the media changer shall perform the specified MODE SELECT operation, and shall not save any pages in non-volatile ram. An SP bit of one indicates that the media changer shall perform the specified MODE SELECT operation, and shall save the current values to a non-volatile RAM.

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

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

- Parameter List Header
- Mode Select page(s)

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 changers capabilities. (not changeable)

Mode Select Parameter List

The Mode Select parameter list shown below, 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 page(s)							

Parameter List Header

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

Bit	7	6	5	4	3	2	1	0
Byte								

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0	Reserved
1	Reserved
2	Reserved
3	Block Descriptor Length (0)

If no Block Descriptor is wished to be send 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 means of this page the host can control SCSI features 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)						
3								(LSB)
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 this is a subpage.
TCMOS:	A TCMOS bit set to zero specifies that the timestamp shall not be changed by any method except those defined by this standard.
SCSIP:	A SCSI precedence (SCSIP) bit set to one specifies that the timestamp changed using a SET TIMESTAMP command shall take precedence over any other methods. This value must be set to one.
IALUAE:	The implicit asymmetric logical unit access enabled (IALUAE) bit must be set to zero. The media changer does not allow implicit asymmetric logical unit access state changes.

Tape Alert Page (1Ch)

By means of this page the Host can specify the method of reporting Tape Alert events. Currently only the polling method is supported.

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

Field descriptions:	

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Perf:	When this bit is set to 0, this indicates that informational exception operations that can cause delays are acceptable. When this bit is set to 1, informational exception operations that cause delays are disabled.
Dexcpt:	When this bit is set to zero the reporting method indicated by the MRIE field is used. When this bit is set to one this indicates that the media changer shall disable all information exception operations, ignoring the MRIE field (In this mode the initiator must the poll the Tape Alert log page). Currently only MRIE mode 0 is supported, so this bit is ignored.
Test:	Test modes are not supported, this field must be set to zero.
LogErr:	When this bit is set to 0, the media changer shall not log any Tape Alert events. When this bit is set to 1, the media changer shall log Tape Alert events.
MRIE:	With this field the initiator can specify the method used by the media changer to report informational exception conditions (Tape Alert events). Currently only mode 0 is supported. This means that Tape Alert flags can only be read 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 must be 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 report Tape Alert events as Informational Exception conditions, therefore this field must be set to zero.

Element Address Assignment page (1Dh)

The Element Address Assignment Page is used to assign new addresses to the elements of the medium changer (via the Mode Select command) and to report those assignments (Mode Sense). When requested the media changer can store new element addresses in NVRAM. When stored in NVRAM these addresses will automatically become the default addresses after every power up. The format of the element address assignment page is shown in the next table. Note this page will only be stored in non volatile memory when the Host sets the SP bit in the CDB.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved	RSRV	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							
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 means of this field the host can specify the address of the robotic cartridge handler.

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Number Medium Transport Elements: By means of this field the host can specify the number of robotic cartridge handler 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 shall return a Check Condition.

First Storage Element Address: By means of this field the host can specify the starting address for the cartridge storage locations.

Number of Storage Elements: By means of 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 shall return a Check Condition.

First Import/Export Element Address: By means of this field the host can specify the address of the import/export element.

Number of Import/Export Elements: By means of 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 returned in the Mode Sense parameter data, the media changer shall return a Check Condition.

First Data Transfer Element: By means of this field the host can specify the starting address of the installed tape drives.

Number of Data Transfer Elements: By means of 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 shall return a Check Condition.

Note that 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 is provided in the SCSI-2 command set to determine whether each medium transport element is a member of a set of elements in a robotic subsystem, and if the medium transport is capable of media rotation. The initiator cannot change this information.

Bit	7	6	5	4	3	2	1	0
Byte								
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: This field indicates the specific transport element in the system to apply this descriptor to. The media changer has only one transport element , so the value returned for this field is 0.

Device Capabilities page (1Fh)

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

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved	SPF (0)	Page Code (1Fh)					
1	Additional Page Length (12h)							
2	Reserved				DT (1)	I/E (1*)	ST (1)	MT (0)

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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)
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					

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: SMC-2 Capabilities field is set to 1. This bit indicates that this page supports the new VRTP, ACE, XX-RA, and XX-WA fields.

VTRP: Volume Tag Reader Present. 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 shall monitor the cleaning required status of the data transfer element (tape drive) and automatically clean the data transfer element when needed. When set to zero the media changer 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 means of 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 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 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.

***** Only when Import/Export elements are enabled.

****** Only when number of Data Transfer elements is 2 or more.

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1.16 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 should issue MODE SENSE prior to each MODE SELECT to determine supported pages, page lengths, changeable variables and to determine is the page is savable to NVRAM. For documentation on the supported Mode Select pages refer to the Mode Select (6) description.

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 following the header and block descriptor(s) complies with the SCSI-2 specification. The value must be set to 1

SP: A Save Pages (SP) bit of zero indicates the media changer shall perform the specified MODE SELECT operation, and shall not save any pages in non-volatile ram. An SP bit of one indicates that the media changer shall perform the specified MODE SELECT operation, and shall save the current values to a non-volatile RAM.

1.17 MODE SENSE (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 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:

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DBD:	The Disable Block Descriptors bit specifies if the media changer may return block descriptor 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 should be returned. See next table. A Initiator can request one or all mode sense pages. Each response includes a four 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 changers 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 Mode Sense (10) command begins with an four byte Mode Parameter Header 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 Page(s)							

Mode Parameter Header

The returned data on a Mode Sense (6) command begins with a four 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							

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3	Block Descriptor Length

Field descriptions:

Mode Data Length: This field indicates the number of bytes of parameter information the media changer is returning as a result of this command, excluding the Mode Data Length but including 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 bit is cleared in the CDB the media changer may return an eight byte Block Descriptor. When a Block Descriptor is returned the Block Descriptor Length will report 8. When the DBD bit is set the media changer will not return Block Descriptors and therefore the Block Descriptor Length will report 0. All fields in block descriptor are considered to be reserved and are therefore set to 0.

Control Extension page (0Ah)

By means of this page the host can retrieve SCSI features 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)							
3								(LSB)
4	Reserved					TCMOS(0)	SCSIP(1)	IALUAE(0)
5	Reserved				Initial Priority			
6 – 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 this is a subpage.
TCMOS:	A TCMOS bit set to zero specifies that the timestamp shall not be changed by any method except those defined by this standard.
SCSIP:	A SCSI precedence (SCSIP) bit set to one specifies that the timestamp changed using a SET TIMESTAMP command shall take precedence over any other methods.
IALUAE:	The implicit asymmetric logical unit access enabled (IALUAE) bit is set to zero. The media changer does not allow implicit asymmetric logical unit access state changes.

Tape Alert page (1Ch)

By means of this page the host can 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							

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Field descriptions:

PS: Parameters Savable. 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, this indicates that 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 indicated by the MRIE field is used. When this bit is set to one this indicates that the media changer shall disable all information exception operations, ignoring 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 shall not log any Tape Alert events. When this bit is set to 1, the media changer shall log Tape Alert events.

MRIE: This field indicates the method used by the media changer to report informational exception conditions. Currently only mode 0 is supported. This means that Tape Alert flags can only be read 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 (via the Mode Select command) and to report those assignments (Mode Sense). This 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							
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:	This field indicates the address of the robotic cartridge handler (other than the default Medium Transport Element address of zero).
Number Medium Transport Elements:	This field indicates the number of robotic cartridge handler within the media changer. The media changer has one robotic cartridge handler, set to 0001h.
First Storage Element Address:	This field indicates the starting address for the cartridge storage locations.

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Number of Storage Elements:	This field indicates the total number of cartridge storage locations contained within the medium changer.
First Import/Export Element Address:	This field indicates the starting address of the first import/export element.
Number of Import/Export Elements:	This field indicates the total number of import/export elements contained within the medium changer.
First Data Transfer Element:	This field indicates the starting address of the installed tape drives.
Number of Data Transfer Elements:	This field indicates the number of tape drives contained within the medium changer.

Transport Geometry Parameters page (1Eh)

The Transport Geometry Parameters Page is provided in the SCSI-2 command set to determine whether each medium transport element is a member of a set of elements in a robotic subsystem, and if the medium transport element is capable of media rotation.

Bit	7	6	5	4	3	2	1	0
Byte								
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:	This field indicates the specific medium transport element in the system to apply this descriptor to. The media changer has only one medium transport element , so the value returned for this field is 0.

Device Capabilities page (1Fh)

The Device Capabilities Page defines the characteristics of the element types used by this medium changer. The initiator may use this information to determine which functions are permitted for the Move Medium, Exchange Medium, Read Attribute, and Write Attribute commands.

Bit	7	6	5	4	3	2	1	0
Byte								
0	PS (0)	SPF (0)	Page Code (1Fh)					
1	Additional Page Length (12h)							
2	Reserved				DT (1)	I/E	ST (1)	MT (0)
3	Reserved					ACE	VTRP	S2C
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	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)

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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)
16 – 19	Reserved					

Field descriptions:

PS: Parameters Savable. 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 when Import/Export elements are enabled.

ST: Storage. The value reported for this field is 1. Storage elements can store cartridges.

MT: Medium Transport. The value for this field is 0. The Medium Transport element cannot store cartridges.

S2C: SMC-2 Capabilities field is set to 1. This bit indicates that this page supports the new VRTP, ACE, XX-RA, and XX-WA fields.

VTRP: Volume Tag Reader Present. This bit is set to 1 when the media changer has a bar code reader. This bit is set to zero when the media changer does not have a bar code reader.

ACE: Auto Clean Enabled shall be set to one if the media changer is managing the data transfer element cleaning process. The ACE bit shall be set to zero if the media changer is not managing the cleaning process.

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 means of the Exchange Medium command between elements of types XX and YY on the condition that the element addresses are valid.

XX→RA: These fields indicate the resources 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 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.

***** Only when Import/Export elements are enabled

****** Only when number of Data Transfer elements is 2 or more.

1.18 MODE SENSE (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 to the MODE SELECT command. For documentation on the supported Mode Pages refer to the Mode Sense (6) command.

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Bit	7	6	5	4	3	2	1	0
Byte								
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 if the media changer may return block descriptor 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 should be returned. See next table. A Initiator can request one or all mode sense pages. Each response includes a four bytes for the Parameter List Header, followed by the specified number of bytes for each page:

Mode Parameter List

The returned data on a Mode Sense (10) command begins with an eight byte Mode Parameter Header 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 – 7	Mode Parameter Header							
8 – n	Mode Sense Page(s)							

Mode Parameter Header

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

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

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4	Reserved							
5	Reserved							
6	(MSB)	Block Descriptor Length						
7								(LSB)

Field descriptions:

Mode Data Length: This field indicates the number of bytes of parameter information the media changer is returning as a result of this command, excluding the Mode Data Length but including the six additional 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 may return an eight byte Block Descriptor. When a Block Descriptor is returned the Block Descriptor Length will report 8. When the DBD bit is set the media changer will not return Block Descriptors and the Block Descriptor Length will report 0. All fields in block descriptor are considered to be reserved and are therefore set to 0.

1.19 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 is capable to transfer cartridges between Storage Elements, Import/Export Elements, and Data Transfer Elements.

Bit	7	6	5	4	3	2	1	0
Byte								
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							
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 used to execute 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 being moved. This can be a Storage Element address, Import/Export Element address or a Data Transfer Element address.

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Destination Address:	Element address to which the tape cartridge is being moved. This 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 should be 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 tracked by the library, then the command shall be terminated with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to FAILOVER SESSION SEQUENCE ERROR.

1.20 PERSISTENT RESERVE IN (5Eh)

The PERSISTENT RESERVE IN command allows an application client to obtain information about persistent reservation keys that are active within an media changer. This command is used in conjunction 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: By means of the Allocation Length field the application client specifies the how much space has been allocated for the returned parameter list.

PERSISTENT RESERVE IN Parameter Data for Read Keys

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

Bit	7	6	5	4	3	2	1	0
Byte								
0	(MSB) Generation							
3								(LSB)

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File name:
Form No.: R&D internal document template

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 provided in response to a PERSISTENT RESERVE IN command with the Read Reservation service action is shown below:

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				(see next table)				(LSB)

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 below. There shall be a reservation descriptor for the persistent reservation, if any, present in the logical unit and a reservation descriptor for each element, if any, having a persistent reservation.

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

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15	(LSB)

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

1.21 PERSISTENT RESERVE OUT (5Fh)

The PERSISTENT RESERVE OUT command allows an application client 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 shall be used in conjunction with the PERSISTENT RESERVE IN command and shall not be used with the RESERVE and RELEASE commands.
Initiators performing PERSISTENT RESERVE OUT service actions are identified by a reservation key provided by the application client. An application client may use the PERSISTENT RESERVE IN command to obtain the reservation key for the initiator holding a persistent reservation and may 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		
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 having a specified Scope Type.
02h	Release	Releases the selected reservation for the requesting initia
03h	Clear	Clears all reservation keys and all persistent reservations
04h	Preempt	Preempts persistent reservations from another initiator

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	05h	Preempt and Abort	Preempts persistent reservations from another initiator and aborts all tasks for all initiators 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:

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 shall be set to the length of the Persistent Reserve Out Paramter List structure.

PERSISTENT RESERVE OUT Parameter List

The format for the reservation descriptor is shown below. There shall be a reservation descriptor for the persistent reservation, if any, present in the logical unit and a reservation descriptor for each element, if any, having a persistent reservation.

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

Field descriptions:

Reservation Key: The Reservation Key field contains a value 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 an 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 shall contain the element address (zero filled in the most significant two bytes).

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APTPL: The Activate Persist Through power Loss (APTPL) bit shall be valid only for the Register, or the Register and Ignore Existing Key service action. In all other cases the APTPL bit shall be ignored.

1.22 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 may 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							
3								(LSB)
4	(MSB) Destination Address							
5								(LSB)
6	Reserved							
7	Reserved							
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 an Data Transfer Element address.
Invert:	The media changer does not support medium rotation. This value must be set to 0.

1.23 PREVENT / ALLOW MEDIA REMOVAL (1Eh)

The PREVENT / ALLOW MEDIA REMOVAL command allows an application client to enable or disable the ability to remove magazines from the media changer and enables or disables the ability to open the mailslot. When the media changer is partitioned, the PREVENT / ALLOW MEDIA REMOVAL command controls the magazines related to the partition in which the PREVENT / ALLOW MEDIUM REMOVAL command is received. And when mailslots are shared by different partitions, the PREVENT / ALLOW MEDIA REMOVAL command controls opening of the mailslot for all partitions.
A prevent condition inhibits the media changer to open magazines and the Import/Export element. A prevent condition shall not affect the media changer to move cartridges to or from the Import / Export element. A prevent condition shall not affect an UNLOAD command issued to the tape drive. Also a prevent condition shall 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.

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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 mailslot is disabled. When the Prevent bit is cleared unlocking of the magazine and mailslot is enabled.

1.24 READ BUFFER (3Ch)

The READ BUFFER command is used in conjunction with the WRITE BUFFER command. It allows the application client to test the media changer's data buffer and the SCSI bus integrity. It may also be 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)							
4	Buffer offset							
5								(LSB)
6	(MSB)							
7	Allocation Length							
8								(LSB)
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 shall return Check Condition status.

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	The sense key will be 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 has allocated for returned data. The media changer can only report 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 will return zero as Buffer Capacity. 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)							
1	(MSB)							
…	Buffer Capacity							
3								(LSB)

Field descriptions:

Offset Boundary: The Offset Boundary field defines the byte alignment for the buffer. The media changer only supports byte alignment, so this value will be zero.

Buffer Capacity: The Buffer Capacity field returns the size of the specified Buffer ID buffer in bytes. Note that this is the maximum size including 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 stored in the specified Buffer ID. This mode is used to test SCSI bus data integrity in conjunction 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 may not 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 means of a READ BUFFER command in Data Mode the host can retrieve the information send by a WRITE BUFFER command in Data Mode. The returned number of bytes is defined by the value 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 shall return Check Condition status. The sense key shall be set to ILLEGAL REQUEST and the sense data shall be set to COMMAND SEQUENCE ERROR. If the data in the Echo Buffer has been overwritten by another

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host the media changer shall return Check Condition status. The sense key shall be set to ILLEGAL REQUEST and the sense data shall be 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 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. 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 shall return 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.

1.25 READ ELEMENT STATUS (B8h)

The READ ELEMENT STATUS command allows the application client to obtain the status of the media changer 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						
3								(LSB)
4	(MSB)	Number of Elements						
5								(LSB)
6	Reserved					Mixed	CurData	DVCID
7	(MSB)							
8	Allocation Length							
9								(LSB)
10	Reserved							
11	Control							

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Field descriptions:	
VolTag:	If the VolTag bit is set the media changer shall return volume tag information in the element descriptors. If the VolTag bit is not set the media changer shall not return volume tag information.
Element Type Code:	This field specifies the element type(s) 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 (Mail Slots) 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 completely transferred; this is not an error condition.
Mixed:	If the Mixed bit is set the media changer shall return an mixed media identifiers for every element descriptor. If the Mixed bit is not set the media changer shall not return mixed media identifiers.
CurData:	If the CurData bit is set the media changer shall return current element status data in any case even if it may be incomplete since inventory scan is ongoing. If the CurData bit is zero, the media changer will always return valid element status data, but it may respond with check condition if the library is busy.
DVCID:	If the DVCID bit is set the media changer will return device identifiers for the Data Transfer element. A DVCID bit of zero specifies that the device shall not return device identifiers.
Allocation Length:	This field specifies the number of bytes that the initiator has allocated for returned data. Note that the Read Element Status command can be issued with an Allocation Length specified as 8 bytes (the length of the status page header) to determine the Allocation Length required to transfer all of the element status data that become available as a result of the command. Te media chnager can only report up to 65536 bytes of data.

Element Status Data

Data returned by the Read Element Status command is described below. 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 sub-header and one or more element descriptors (one for each element address).

Header

The data 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							

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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 indicates 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 shall return an extension to every element descriptor. The format of this extension is shown in 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 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

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‘C’, 43h	LTO Gen 1, variable length type C
‘1’, 31h	LTO Gen 1 Ultrium 100GB
‘2’, 32h	LTO Gen 2 Ultrium 200GB
‘3’, 33h	LTO Gen 3 Ultrium 400GB
‘T’, 54h	LTO Gen 3, WORM
‘4’, 34h	LTO Gen 4 Ultrium 800GB
‘U’, 55h	LTO Gen 4, WORM
‘5’, 35h	LTO Gen 5 Ultrium 1.5TB
‘V’, 56h	LTO Gen 5, WORM
‘6’, 36h	LTO Gen 6 Ultrium 2.5TB
‘W’, 57h	LTO Gen 6, WORM
'7', 37h	LTO Gen 7 Ultrium 6.4TB
‘X’, 58h	LTO Gen 7, WORM
'8', 38h	LTO Gen 8 Ultrium 12TB
‘Y’, 59h	LTO Gen 8, WORM
‘R’, 52h	LTO Gen 8 Type M 9TB
7Fh	Unknown

Element Descriptors

The element descriptors include the element address and status flags for the elements and may also contain sense code information and/or other information depending 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.

Bit	7	6	5	4	3	2	1	0
Byte								
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 (field omitted if PvolTag = 0)							
56 – 59	Reserved							

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	(field moved up if Primary Volume Tag Information field is omitted)
60 – 71	Mixed Media descriptor (field 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 will be 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 the medium transport element is in a normal state. If this bit is 1, information on the abnormal state may be available in the Additional Sense Code and Additional Sense Code Qualifier fields. Note: Exceptions to the transport element are set in case of robotic related critical move errors. They are cleared after successful execution of move commands (e.g. move medium, exchange medium, initialize element status or position to element) since they are forcing re-initialization of the robotics. Changes of exception bit status or related sense codes will cause an unit attention, 28h 00h.	
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 the medium transport element is empty.	
Additional Sense Code:	This field may provide specific information about an abnormal medium transport state (valid only if the Except bit is 1).	
Additional Sense Code Qualifier:	This field may provide 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 singe 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 the element is disabled. An ED bit value of zero indicates the element is enabled	
Medium Type:	The Medium Type field provides the type of medium currently present in the Media Transfer Element. 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	

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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 will return a 36 byte PvolTag Identifier. This identifier will contain the bar code label of the cartridge in the Medium Transport Element.	

Next table contains a list of the ASC and ASCQ values that will 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 if an element is in an abnormal state.

ASC	ASCQ	Description	Action
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.

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

Field descriptions:		

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PvolTag:	Primary Volume Tag. When set this flag indicates valid information in the Primary Volume Tag Information field. This flag will be set when the VolTag field was set in the CDB.	
AvolTag:	Alternate Volume Tag. Always set to 0.	
Storage Element Descriptor Length:	This field indicates the number of bytes for each element descriptor of the storage element type.	
Byte Count of Descriptor Data Available:	This field 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 the element is in a normal state. If this bit is 1, information on the abnormal state may be available in the Additional Sense Code and Additional Sense Code Qualifier fields. 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 the storage element address is empty.	
Additional Sense Code:	This field may provide specific information about an abnormal storage element state.	
Additional Sense Code Qualifier:	This field may provide 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 singe 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 the element is disabled (e.g. a magazine is not installed or has been logical disabled). An ED bit value of zero indicates the element is enabled	
Medium Type:	The Medium Type field provides the type of medium currently present in the Storage Element. 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 will be omitted.	

Next table contains a list of the ASC and ASCQ values that will appear in the Additional Sense Code

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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 if an element is in an abnormal state.

ASC	ASCQ	Description	Action
3Bh	12h	Magazine removed	Insert magazine.

Import/Export Element Status Page (03h)

Import/Export elements are locations of volumes that are being 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							
14 – 16	Reserved							
17	Svalid	Invert	Reserved		ED	Medium Type		
18 – 19	Source Storage Element Address							
20 – 55	Primary Volume Tag Information (field omitted if PvolTag = 0)							
56 – 59	Reserved (field moved up if Primary Volume Tag Information field is omitted)							
60 – 71	Mixed Media descriptor (field 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 will be 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 Data Available:	This field indicates the total number of bytes of element descriptor data available for all 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.	

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Full:	A full bit value of 1 indicates that the import/export element address contains a unit of media. A value of 0 indicates the import/export element address is empty.	
ImpExp:	An import export bit of one indicates the unit of media in the import/export element was placed there by an operator. An 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 the element is in a normal state. If this bit is 1, information on the abnormal state may be available in the Additional Sense Code and Additional Sense Code Qualifier fields. Note: There are currently no exceptions reported to import-export elements.	
Access:	When 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. An InEnab bit of zero indicates that this element does not support import actions.	
InEnab:	An Import Enable bit of one indicates that the import/export element supports movement of media out of the scope of the media changer device. An InEnab bit of zero indicates that this element does not support export actions.	
CMC:	Connected Media Changer bit of one indicates that exports are to a connected media changer. A CMC bit of zero indicates that exports are to the operator and imports are from the operator.	
OIR:	Operator Intervention Required bit of one indicates operator intervention is required to make the import/export element accessible. The OIR bit shall be set to zero if no operator intervention is required or if the Access bit is set to one.	
Additional Sense Code:	This field may provide specific information about an abnormal import/export element state.	
Additional Sense Code Qualifier:	This field may provide 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 singe 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 the element is disabled (e.g. a magazine is not installed or has been logical disabled). An ED bit value of zero indicates the element is enabled	
Medium Type:	The Medium Type field provides the type of medium currently present in the Storage Element. 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).	

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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 will be omitted.	

Next table contains a list of the ASC and ASCQ values that will 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 if an element is in an abnormal state.

ASC	ASCQ	Description	Action
3Bh	12h	Magazine removed	Insert magazine.

Data Transfer Element Status Page (04h)

The Data Transfer Element is the device that stores user data on the cartridges in the media changer (aka 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 omitted if PvolTag = 0)							
56	Reserved				Code Set			
57	Reserved				Identifier Type			
58	Reserved							
59	Identifier Length							
	(MSB)							
60 – 93	Identifier (Omitted if DVCID = 0 in CDB)							
								(LSB)
94 – 105	Mixed Media descriptor (field omitted if Mixed = 0)							

Field descriptions:		

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PvolTag:	Primary Volume Tag. When set this flag indicates valid information in the Primary Volume Tag Information field. This flag will be 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 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. Note that a value of 1 in this bit may not be sufficient to ensure a successful operation. Access is set to 0 if the drive has not been finally configured or configuration has failed (see below).	
Except:	An Except bit of 0 indicates the data transfer element is in a normal state; When set to 1 indicates an abnormal state (information about an abnormal state may be available in the additional sense code and additional sense code qualifier bytes). Note: An appropriate exception will be reported to the data transfer element if the related tape drive couldn't be correctly configured by any reason. More detailed description about the error cause can be found in the ticket log on 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 the data transfer element is empty.	
Additional Sense Code:	This field may provide specific information about the abnormal data transfer element state.	
Additional Sense Code Qualifier:	This field may provide more detail about an abnormal data transfer element state.	
IDValid:	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 0, indicates that the values in these fields are not valid.	
Invert:	The media changer uses singe 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 the element is disabled (e.g. the tape drive is not installed or has been logical disabled). An ED bit value of zero indicates the element is enabled.	
Medium Type:	The Medium Type field provides the type of medium currently present in the data transfer element. Next table describes the values for the Medium Types : 0h Unspecified	

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	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 will return a 36 byte PvolTag Identifier. This identifier will contain the bar code label of the cartridge mounted in the tape drive. 0 1 2 3 4 5 6 7 n n n n n n t t The first six (6) characters are any combination of upper case A-Z or 0-9 (e.g. ABC123) to identify the cartridge volume. The last two (2) characters are determined by the cartridge media type (i.e. “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, indicating 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. This indicates that the identifier field contains a fourteen byte vendor specific identifier. 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 will return a 14 byte structure with information about the tape drive. In this structure a header of four bytes (hard coded) and ten bytes with 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 header and the 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 below: **Byte** — **Description** 0..3 — Header 0x02, 0x00, 0x00, 0x0A 4..13 — Tape Drive serial number (10 ASCII bytes)	

1.26 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							

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3	Reserved
4	Reserved
5	Control

1.27 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 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							
8								(LSB)
9	Control							

Field descriptions:

LongID: Device IDs greater than 255 are not supported, therefore setting of LongID will result in a Check Condition status. The Sense Key will be 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 release is not requested. If the 3rdPty bit is zero then the LongID and Parameter List Length field shall be ignored. If the 3rdPty bit is one then the media changer shall release the reservation, but 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.

1.28 REPORT LUNS (A0h)

The REPORT LUNS command requests the media changer logical unit inventory be 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							

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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 hosts is capable to receive.

If the allocation length is less than 16 bytes the media changer shall return Check Condition status. The sense key shall be set to ILLEGAL REQUEST and the sense data shall be set to INVALID FIELD IN CDB.
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						
11								(LSB)
12	(MSB)	Null Third Level						
13								(LSB)
14	(MSB)	Null Fourth Level						
15								(LSB)

1.29 REPORT SUPPORTED OPERATION CODES (A3h)

The REPORT SUPPORTED OPERATION CODES command requests information on commands the addressed logical unit supports. An application client may request a list of all operation codes and service actions 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)

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6	(MSB)
7	Allocation Length
8	
9	(LSB)
10	Reserved
11	Control

Field descriptions:	
RCTD:	A return command timeouts descriptor (RCTD) bit set to one specifies that the command timeouts descriptor shall be included in each command descriptor that is returned or in the one_command parameter data that is returned. A RCTD bit set to zero specifies that the command timeouts descriptor shall not be returned.
Reporting Options :	The Reporting Options field specifies the information to be returned in the parameter data.

Reporting Option	Description
000b	A list of all operation codes and service actions supported by the logical unit shall be returned in the all_commands parameter data format. The Requested Operation Code Cdb field and Requested Service Action Cdb field shall be ignored.
001b	The command support data for the operation code specified in the Requested Operation Code field shall be returned in the one_command parameter data format. The Requested Service Action Cdb field shall be ignored. If the Requested Operation Code field specifies an operation code that has service actions, then the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.
010b	The command support data for the operation code and service action specified in the Requested Operation Code Cdb field and Requested Service Action Cdb field shall be 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, then the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB. The media changer can only report 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 shall be transferred from the application client to the device server. A parameter list length of zero indicates that no data shall be transferred, and that no change shall be made to the timestamp.

The REPORT SUPPORTED OPERATION CODES all_commands parameter data format begins with a four-byte header that contains the length in bytes of the parameter data followed by a list of

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supported commands. Each command descriptor contains information about a single supported command CDB (i.e., one operation code and service action combination, or one non-service-action operation code). The list of command descriptors shall contain all commands 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)
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 one indicates that the command timeouts descriptor in 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 zero indicates the operation code indicated by the OPERATION CODE does not have service actions and the SERVICE ACTION field contents are reserved. A SERVACTV bit set to one indicates the operation code 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 and a usage map for bits in the CDB for the command 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

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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 may be successful.
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. If the Op Code has a Service Action associated, it
will be located in the second byte, in the correct location. All further bytes up to the original CDB length contain a
usage map. Each bit which is supported as a parameter field is set to one, any field which is either reserved or
ignored will be set to zero.

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							

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4	(MSB)
...	Nominal command processing timeout
7	(LSB)
8	(MSB)
...	Recommended command timeout
11	(LSB)

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 the applicable command standard the COMMAND SPECIFIC field is reserved.
Nominal command processing timeout:	A non-zero value in NOMINAL COMMAND PROCESSING TIMEOUT field indicates the minimum amount of time in seconds the application client should wait prior to querying for the progress of the command 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 aplication client should wait prior to timing out the command 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 should set the recommended command timeout to a value greater than or equal to the nominal command processing timeout.

1.30 REPORT TIMESTAMP (A3h)

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

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

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Field descriptions:	
Allocation Length:	The Allocation Length specifies the maximum number of bytes that the initiator has allocated for returned data.

The Timestamp shall not be affected by an I_T nexus loss or a logical unit reset. It is also persisting during
hard reset.

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

Bit	7	6	5	4	3	2	1	0
Byte								
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 follow.
Timestamp Origin:	The Timestamp origin field indicates the origin of the timestamp. **Code** / **Description** 000b: Timestamp initialized to zero at power-on or as the result of a hard reset 001b: Reserved 010b: Timestamp initialized by the SET TIMESTAMP command 011b: Timestamp initialized by methods outside the scope of this standard
Timestamp:	The Timestamp field contains the current value of the timestamp. The Timestamp field returns the number of milliseconds that have elapsed since midnight, 1st January 1970 UTC

1.31 SET TIMESTAMP (A4h)

The SET TIMESTAMP command requests the device server to initialize the timestamp of 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							

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5	Reserved
6	(MSB)
7	Allocation Length
8	
9	(LSB)
10	Reserved
11	Control

Field descriptions:	
Parameter List Length:	The PARAMETER LIST LENGTH field specifies the length in bytes of the SET TIMESTAMP parameterd that shall be transferred from the application client to the device server. If the requested list length is not matching the length of the SET TIMESTAMP parameter data, the command shall be terminated with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to PARAMETER LENGTH ERROR.

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

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

Field descriptions:	
Timestamp:	The Timestamp field shall contain the requested value of the new timestamp. The Timestamp field shall be the number of milliseconds that have elapsed since midnight, 1st January 1970 UTC. If the high order byte in the TIMESTAMP field is greater than F0h, the command shall be terminated with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

1.32 SEND VOLUME TAG (B6h)

By means of 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 or establish new volume tag information for a volume residing 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 may be used to transfer the results of a translate search operation.

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Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (B6h)							
1	LUN			Reserved	Element Type Code			
2	(MSB)	Element Address						
3								(LSB)
4	Reserved							
5	Reserved				Send Action Code			
6 - 7	Reserved							
8	(MSB)	Parameter List Length						
9								(LSB)
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 shall be 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 performed by this command as specified in next table:

Code	Description
0h	Translate – search all defined volume tags
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

Parameter List Length: The Parameter List Length field shall be zero when the Send Action Code is an undefine function. The Parameter List Length shall be 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						

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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 may contain the wildcard characters '?' and '*'. The '?' shall match any single character. The '*' shall match 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 may not 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 undefined functions.

*Assigned volume tag information is cleared on unit reset and after SCSI initiated inventory scan (initialize element status, initialize element status with range.

1.33 REQUEST SENSE (03h)

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

Bit	7	6	5	4	3	2	1	0
Byte								
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 hosts wants to receive.

The sense data is valid for a check condition status 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.

Bit	7	6	5	4	3	2	1	0
Byte								

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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	(MSB) Field Pointer					
17	(LSB)					

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 may be reported. Additional sense code provide further detail describing 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 additional information regarding 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 send 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 describing the commands and parameters.

Possible Sense Keys

Sense Key	Name	Description

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0h	NO SENSE	Indicates that there is no specific sense key information to be reported.
1h	RECOVERED ERROR	Indicates that the last command completed successfully with some recovery action performed by the device server.
2h	NOT READY	Indicates that the logical unit addressed cannot be accessed. Operator intervention may be required to correct this condition.
4h.	HARDWARE ERROR	Indicates that the device server detected a non-recoverable hardware failure (for example, controller failure, device failure, parity error, etc.) while performing the command or during a self test.
5h	ILLEGAL REQUEST	Indicates that there was an illegal parameter in the command descriptor block or in the additional parameters supplied as data for some commands
6h	UNIT ATTENTION	Indicates that the removable medium may have been changed or the target has been 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 additional sense code qualifiers (ASCQ) is available in chapter 8.

1.34 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 may be used to retrieve the results of a single SEND VOLUME TAG command.

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

For each Send Volume Tag command, the media changer shall report in response to a Request Volume Element Address command zero or more elements that match a volume tag template in element address order. Once information for a given element address has been reported, only higher element addresses shall be reported by subsequent Request Volume Element Address commands.

Field descriptions:

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VolTag: A VolTag bit of one indicates that the media changer shall report volume tag information. A value of zero indicates that the volume tag information shall not be 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 of those 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 shall only return 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)							
6				Byte Count of Report Available				
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 indicates 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.

1.35 RESERVE (16h)

The RESERVE command allows an initiator to reserve the media changer. After reserving the media changer, 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.

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

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2	Obsolete
3	Obsolete
4	
5	Control

1.36 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 a 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.

Bit	7	6	5	4	3	2	1	0
Byte								
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							
8								(LSB)
9	Control							

Field descriptions:

LongID: Device IDs greater than 255 are not supported, therefore setting of LongID will result in a Check Condition status. The Sense Key will be 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 zero then the LongID and Parameter List Length field shall be 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, or by a Hard Reset condition, or by a power-on cycle. The media changer shall ignore any attempt to release the reservation made by any other initiator.

Third-Party Device ID: This field provides the Device ID for the third party when 3rdPty bit is set.

1.37 TEST UNIT READY (00h)

The TEST UNIT READY command allows an application client to determine if the media changer is ready for commands involving cartridge movement. If the media changer has completed initialization

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and the magazines are inserted, the command returns GOOD status. Otherwise, CHECK CONDITION status is returned.

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							

1.38 WRITE BUFFER (3Bh)

The WRITE BUFFER command is used in conjunction with the READ BUFFER command 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)							
4	Buffer offset							
5								(LSB)
6	(MSB)							
7	Parameter list length							
8								(LSB)
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 will be set to ILLEGAL REQUEST and the sense data to INVALID FIELD IN CDB.
Buffer ID :	Buffer ID must be set to zero.
Buffer Offset :	Buffer Offset must be set to zero.

Write Data Mode

With this mode, SCSI bus integrity can be tested in conjunction with the READ BUFFER command. The host can by means of this mode send up to 256 bytes to the media changer. This data can be

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retrieved by means of the READ BUFFER command. The Buffer Offset specifies the offset within the buffer. Potential buffer overruns are detected and will result into a Check Condition the sense key will be 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 media changer 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 may 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 length of this page, the media changer shall return Check Condition status. The sense key shall be set to ILLEGAL REQUEST and the sense data set to INVALID FIELD IN CDB.

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

1.39 Command Status Byte

The media changer enters the status phase once for each received command. The supported status bytes are shown in 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 should reissue the command at later time.
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

1.40 Command Timeouts

The table below lists the media changer commands with the recommended nominal and maximum time-out values. The nominal timeout values specify the minimum time required to operate the command.

Note: If the media changer is working in a multi host environment, the time-out values should be adjusted for the worst case time-out value from a pending motion command from another host.
Note: If the media changer is partitioned, the time-out values should be adjusted for the worst case time-out value due to a pending motion command in another partition.

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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 the unload of the cartridge from the drive. The EXCHANGE MEDIUM command timeout has been adjusted to account for maximum unload time)		
	EXCHANGE MEDIUM (explicit between drive and slot)	38 minutes	
	(the host has 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	
A5h	MOVE MEDIUM (slot to slot)	12 minutes	
	MOVE MEDIUM (slot to drive)	25 minutes	
	MOVE MEDIUM (implicit drive to slot)	25 minutes	3
	(the media changer initiates the unload of the cartridge from the drive. The MODE MEDIUM command timeout has been adjusted to account for maximum unload time)		
	MOVE MEDIUM (explicit drive to slot)	13 minutes	
	(the host has issued an UNLOAD command to the tape drive prior to issuing the MOVE MEDIUM command)		
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 (with CURDATA set)	30 seconds	
B8h	READ ELEMENT STATUS (with 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	

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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 time-out assumes a fully populated unit.
2. The Initialize Element Status With Range time-out 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 has not been unloaded by a host command to the tape drive, prior to receiving the Move Medium command, the media changer will issue an Unload command to the tape drive. Therefore the time-out value needs to be adjusted for the maximum time a data transfer element takes to rewind and unload the cartridge.
4. The Read Buffer time-out is based on a 16K-data-chunck request. Adjust the time-out value if larger data chunks are requested.
5. The Write Buffer time-out is based on a 16K-data-chunck request. Adjust the time-out value if larger data chunks are send.
6. Maximum time-out is required if support for unlabeled media enabled and mechanical touching needed for verification of media presence.

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1.41 Supported Tape Alert Flags

The following Tape Alert Flags are supported in the media changer:

Parameter Code	Flag name	Type	Description
01d	Library Hardware A	C	The library mechanism is having difficulty communicating with the drive: - Turn the media changer OFF then ON - Restart the operation - If problem persists, contact Technical Support
02d	Library Hardware B	W	There is a problem with the library mechanism. If the problem persists, contact 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: - Turn the media changer OFF then ON - Restart the operation - If the problem persists, contact Technical Support.
05d	Library Diagnostics Required	W	The library mechanism may have a hardware fault. Run extended diagnostics to verify and diagnose the problem. Check the library users manual for device specific instructions on running extended diagnostic tests.
13d	Library Pick Retry	W	There is a potential problem with the drive ejecting cartridges or with the library picking cartridges from a slot. - No action needs to be taken at this time. - If the problem persists, contact Technical Support.
14d	Library Place Retry	W	There is a potential problem with the library mechanism placing a cartridge into a slot. - No action needs to be taken at this time. - If the problem persists, contact Technical Support.
15d	Library Load Retry	W	There is a potential problem with the drive or the library mechanism loading cartridges, or an incompatible cartridge. This flag is cleared when the next move command is received.
16d	Library Door	C	The library has failed because the door is open: 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 Mailslot	C	There is a mechanical problem with the library media import/export mailslot.
19d	Library Security	W	Library security has been compromised. The door was opened then closed during operation.
20d	Library Security Mode	I	The library security mode has been changed. The library has either been put into secure mode, or the library has exited the secure mode. This is for information purposes only. No action is required.
21d	Library Offline	I	The library has been manually turned offline and is unavailable for use.
22d	Library Drive Offline	I	A drive inside the library has been taken offline. This is for information purposes only. No action is required.
24d	Library Inventory	C	The library has detected an inconsistency in its inventory. - Redo the library inventory to correct inconsistency - Restart the operation

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27d	Cooling FAN Failure	W	A library cooling fan has failed. This flag is cleared when all fans are working again.
28d	Power Supply	W	A redundant power supply has failed inside the library. Check the library users 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.
I =	Informational suggestion to user.		
W =	Warning. Remedial action is advised. Performance of data may be at risk.		
C =	Critical. Immediate remedial action is required.		

1.42 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 becoming ready, scanning magazines, etc.
	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 may be offline
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	Command sequence error
	30h	12h	Incompatible Media loaded to Drive
	39h	00h	Saving parameters not supported
	3Bh	0Eh	Medium source element empty
	3Bh	0Dh	Medium destination element full
	3Bh	11h	Magazine not accessible
	3Bh	18h	Element disabled
	3Bh	1Ah	Data transfer element removed

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	39h	00h	Saving parameters 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	Failover session sequence error
	82h	94h	Failover command sequence error
	82h	95h	Duplicate failover session key
	82h	96h	Invalid failover key
	82h	97h	Failover session released
Unit attention (06h)	28h	00h	Not ready yo ready change, medium may have changed
	28h	01h	Import/export element accessed
	29h	02h	SCSI Bus reset occured
Aborted command (0Bh)	3Fh	0Fh	ECHO buffer overwritten
	4Eh	00h	Overlapped command attempt

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