

***ASACA AM-Series DVD Library
SCSI Reference Manual***

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1. GENERAL

The media library connects to the system host through a SCSI interface. This interface conforms to SCSI standards specified by ANSI X3.131-1994.

The library implementation offers a standard set of features and functions that include:

- ◆ Asynchronous and synchronous communications
- ◆ Single-ended and Differential configuration
- ◆ Implementation of SCSI-2 commands for ASACA Changer devices

This document contains specific details on the Library SCSI-2 interface implementation.

2. DEVICE MODEL

The library handles physical loading and unloading of Media cartridges into and out of a Media drive. Locations within the library are identified by an element-addressing scheme. There are four types of elements in the library: Import/Export, Medium Transport, Data Transfer, and Storage elements.

Import/Export elements are locations where the user may load or unload media to or from the library.

The Media Transport Element addresses the functions of the library that perform the media movement.

The Data Transfer Element represents the Media drive within the library.

The Storage Elements address the locations within the library system where each media unit is stored.

ASACA has added a vendor unique element called the Pass Through Element. The pass through is the mechanism used in a multi-cabinet system to move media from one chassis to another. This element is only for error recovery and has limited use. Its address is not returned on the Mode Sense Element Addressing Page. The address range is static and cannot be changed by the user. This element can only be used as a source on a move only when the library has been unable to clear this element on its own. Note that there are always two PT elements per cabinet and they are counted from left to right. This is true whether the PT on one side of the cabinet has been installed or not. For example, PT 0x32 refers to the left-side pass through in the second cabinet from the left.

Each element in the library has a unique address assigned to it and may or may not be capable of independent storage of a unit of medium.

The library assigns the default element addresses shown below.

Element Type	Symbol	Address
Default Media Transport	MT	00h
First Media Transport	MT	01h
First Import/Export	IE	80h
First Data Transfer	DT	40h
First Storage	ST	1000h

First Pass Through	PT	30h
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The host controls movement of media within the library through the use of the MOVE and EXCHANGE MEDIUM command. In issuing a MOVE MEDIUM command to the library, the host supplies a source address and a destination address. A move to and from an IE element performs physical and logical loads and unloads of a single piece of media. A move between ST and DT elements perform loads and unloads of the media into the drives.

A MOVE MEDIUM command from ST to DT will load one unit of medium from the storage location into the drive.

A MOVE MEDIUM from DT to ST will unload a cartridge from the drive slot into a storage slot. Because the position controller has no access to the data transfer element, the host must have previously issued an EJECT command to the drive. Once the cartridge has been ejected and is protruding from the drive slot, the MOVE MEDIUM command to the library will place the cartridge into the storage slot.

At any time, if status for an element cannot be determined, the EXCEPT bit will be set for that element, indicating that the library does not know the status of that element. When EXCEPT is set for an element, the library will omit source empty and destination full checking prior to a MOVE MEDIUM and EXCHANGE MEDIUM commands that uses that element.

3. SCSI LOGICAL CHARACTERISTICS

3.1 SCSI Bus Phases

The SCSI bus has eight distinct bus phases, as shown below. The SCSI bus can never be in more than one phase at any given time.

BUS FREE
ARBITRATION
SELECTION
RESELECTION
COMMAND
DATA
STATUS
MESSAGE

3.1.1 BUS FREE Phase

The BUS FREE phase is used to indicate that no SCSI device is actively using the bus and that it is available. In some cases, the library reverts to BUS FREE phase to indicate an error condition for which it has no other way to handle. This is called an unexpected disconnect.

3.1.2 ARBITRATION Phase

The ARBITRATION phase allows one SCSI device to gain control of the SCSI bus so that it can initiate or resume a process.

3.1.3 SELECTION Phase

The SELECTION phase allows the host system to select the library for the purpose of initiating some medium changer function.

The library will not respond to a selection if bad parity is detected. Also, if more than two SCSI ID bits are on the data bus, the library will not respond to selection.

As a target, the library will either respond to or ignore selection within 250 milliseconds.

3.1.4 RESELECTION Phase

RESELECTION is an optional phase that allows a target to reconnect to an initiator for the purpose of continuing some operation that was previously started by the initiator but was suspended by the target.

3.1.5 INFORMATION TRANSFER Phases

The COMMAND, DATA, STATUS and MESSAGE phases are all grouped together as the information transfer phases because they are all used to transfer data or control information via the data bus.

3.2 Asynchronous Conditions

The SCSI bus has two asynchronous conditions: the attention condition and the reset condition. These conditions cause the SCSI device to perform certain actions and can alter the phase sequence.

3.2.1 Attention Condition

The Attention condition allows a host to inform a target that the host has a message ready. The host creates the attention condition by asserting ATN at any time except during the ARBITRATION or BUS FREE phases. The target may get the message by performing a MESSAGE OUT phase.

The library will check the ATN line at selection, at any phase change and prior to release REQ for a MESSAGE IN phase. Upon detecting the attention condition, the library will immediately respond with the MESSAGE OUT phase.

3.2.2 Reset Condition

The Reset condition is used to immediately clear all SCSI devices from the bus. The BUS FREE phase always follows the reset condition.

The library will implement the soft reset alternative of SCSI-2 implying that a reset condition will internally reset the processor. If a reset is received while the positioning systems are in motion, the motion operation will not be affected.

The library will be available for selection by an initiator within 250 milliseconds following a Reset condition.

3.3 Unit Attention Conditions

The library generates UNIT ATTENTION conditions for two types of events. The UNIT ATTENTION condition will exist for each host until cleared by each host as specified in the SCSI specification.

3.3.1 POWER-ON RESET, SCSI RESET or BUS DEVICE RESET

The library will create a UNIT ATTENTION condition at power-on, in response to a SCSI reset or in response to a BUS DEVICE RESET message.

3.3.2 IMPORT/EXPORT ELEMENT ACCESSED

This condition is intended to inform the host when media within the changer may have been accessed or changed by the user. This condition also informs the host of door closure following a period during which the door was open. (Motion commands are rejected while the door is open.)

When the door is closed following an open condition, the changer will generate a UNIT ATTENTION CONDITION: IE ELEMENT ACCESSED for each host on the bus. This condition will be maintained for the host as specified by section 7.9 of the SCSI-2 specification.

If both a POWER-ON RESET and an IE ELEMENT ACCESSED UNIT ATTENTION CONDITION exist at the same time, the changer will report the POWER-ON RESET condition followed by the IE ELEMENT ACCESSED condition.

3.4 Message Implementation

The message system allows communication between a host and the library for the purpose of physical path management.

3.4.1 Message Protocol

SCSI devices indicate their ability to accommodate more than the COMMAND COMPLETE message by asserting or responding to the ATN signal. The host indicates this in the SELECTION phase by asserting ATN prior to the SCSI bus condition of SEL true, and BSY false. The library indicates its ability to accommodate more messages by responding to the ATTENTION condition with the MESSAGE OUT phase after going through the SELECTION phase.

For SCSI devices that support messages other than COMMAND COMPLETE, the first message sent by the host after the SELECTION should be the IDENTIFY message. This allows the establishment of the physical path for a particular logical unit specified by the host. After the RESELECTION phase, the library's first message will be IDENTIFY. This allows the physical path to be re-established for the target's specified logical unit number. Under some exceptional conditions, a host may send the ABORT message or the BUS DEVICE RESET message instead of the IDENTIFY message, as the first message. Only one logical unit number should be identified for any one selection sequence; a second IDENTIFY message with a new logical unit number should not be issued before the SCSI bus has been released (BUS FREE phase).

The library shall support the messages listed below.

ABORT	06h
BUS DEVICE RESET	0Ch
COMMAND COMPLETE	00h
DISCONNECT	04h
IDENTIFY	80h - FFh
INITIATOR DETECTED ERROR	05h
MESSAGE PARITY ERROR	09h
MESSAGE REJECT	07h
NO OPERATION	08h
SYNCHRONOUS DATA TRANSFER REQUEST	01h (Extended)

3.4.1.1 ABORT Message (06h)

This message is sent from the host to the library to clear the present operation. If a logical unit has been identified, all pending data and status for the issuing host from the effected logical unit will be cleared, and the library will go to the BUS FREE phase. Pending data and status for other hosts will not be cleared. If a logical unit has not been identified, the library will go to the BUS FREE phase. No status or ending message will be sent for the operation.

3.4.1.2 BUS DEVICE RESET Message (0Ch)

The BUS DEVICE RESET message forces a soft reset condition on the target.

The library will respond to a BUS DEVICE RESET message by going to a BUS FREE state and creating a unit attention condition.

3.4.1.3 COMMAND COMPLETE Message (00h)

The COMMAND COMPLETE message indicates that the target has completed the current process and that status has been sent to the host.

3.4.1.4 DISCONNECT Message (04h)

The DISCONNECT message informs the host that the target desires to break the present connection but that a later reconnect will be required in order to complete the current process.

The library will implement the DISCONNECT message in such a way as to maximize bus utilization. After any command accepted, the library will attempt to disconnect from the bus.

After transmitting a DISCONNECT message successfully to the host, the library will go to the BUS FREE state. The DISCONNECT message transmission will be considered successful is ATN is inactive at the release of the ACK signal for the DISCONNECT message transfer.

The library does not support DISCONNECT messages sent from the host to the target.

3.4.1.5 IDENTIFY Message (80h+)

	7	6	5	4	3	2	1	0
0	Identify	DiscPriv	LUN -TAR	Reserved		LUNTRN		

The IDENTIFY message is sent by either an initiator or a target to establish a connection.

Only one logical unit shall be identified for any connection. If a target receives a second IDENTIFY message with a different logical unit number during a connection, it shall go to BUS FREE phase.

The Identify bit shall be set to one to specify that this is an IDENTIFY message.

A disconnect privilege (DiscPriv) bit of one specifies that the initiator has granted the target the privilege of disconnecting. The DiscPriv bit of zero specifies that the target shall not disconnect.

The library does not support target routines and LUNTAR, and LUNTRN must be set zero.

After the RESELECTION phase, the target's first message shall be IDENTIFY.

If the library receives a Logical Unit number that is not supported, in response to an INQUIRY command, the target shall return the INQUIRY data with the peripheral qualifier set to 011b. In response to any other command except REQUEST SENSE, the target shall terminate the command with CHECK CONDITION status. In response to a REQUEST SENSE command, the target shall return sense data. The sense key shall be set to ILLEGAL REQUEST and the additional sense code set to LOGICAL UNIT NOT SUPPORTED.

The library will not request a disconnect for processes unless an IDENTIFY message was received with the DiscAlw bit set.

3.4.1.6 INITIATOR DETECTED ERROR Message (05h)

The INITIATOR DETECTED ERROR message indicates that the host has detected an error that does not preclude the target from retrying the operation.

The library response to an INITIATOR DETECTED ERROR message will be to terminate the operation with a CHECK CONDITION status with the sense key set to ABORTED COMMAND and the additional sense code set to IDE RECEIVED.

3.4.1.7 MESSAGE PARITY ERROR Message (09h)

The MESSAGE PARITY ERROR message indicates that the last message byte received had a parity error.

The library will resend the message byte in error when the MESSAGE PARITY ERROR message is received.

3.4.1.8 MESSAGE REJECT Message (07h)

The MESSAGE REJECT message indicates that the last message or message byte received was inappropriate or has not been implemented.

The library response to a MESSAGE REJECT message will vary based on the circumstances for which it was sent. For example, if the library receives a MESSAGE REJECT message following the issuance of a DISCONNECT message, it will not disconnect from the bus.

3.4.1.9 NO OPERATION Message (08h)

The NO OPERATION message is sent in response to a message request when the host does not currently have any other valid message to send.

The library will continue normal operation after the receipt of a NO OPERATION message.

3.4.1.10 SYNCHRONOUS DATA TRANSFER REQUEST Message

	7	6	5	4	3	2	1	0
0	Extended message (01h)							
1	Extended message length (03h)							
2	SYNCHRONOUS DATA TRANSFER REQUEST CODE (01h)							
3	Transfer Period Factor							
4	REQ/ACK Offset							

The SYNCHRONOUS DATA TRANSFER REQUEST message is sent from the initiator to the target to request synchronous data transfer, whenever a previously-arranged data transfer agreement may have become invalid.. The agreement becomes invalid after any condition such as:

- a) after a hard reset condition;
- b) after a BUS DEVICE RESET message;
- c) after a power cycle and;
- d) after a Microcode download and Start.

The Transfer Period is the minimum time allowed between leading edges of successive REQ pulses and of successive ACK pulses to meet the device requirements for successful reception of data.

The REQ/ACK offset is the maximum number of REQ pulses allowed to be outstanding before the leading edge of its corresponding ACK pulses is received at the target. A REQ/ACK offset value zero shall indicates asynchronous transfer mode.

4. COMMAND IMPLEMENTATION

A command is communicated by sending a Command Descriptor Block (CDB) to the library. All Commands consist of six, ten, or twelve byte CDBs which are in group 0, 1, or 2 command groups. The CDB always has an operation code as its first byte and a control byte as its last byte.

Reserved bits, fields, bytes and code values are set aside for future standardization. Reserved bits in this document may either be reserved by the SCSI standard, or not implemented for this device. A reserved bit, field or byte should always be set to zero. If the library receives a reserved bit, field or byte that is not set to zero, the sense key will be set to ILLEGAL REQUEST, the additional sense code and qualifier will be set to INVALID FIELD IN CDB and a CHECK CONDITION status will be returned.

The operation code of the CDB has a group code field and a command code field. The three-bit group code field provides for eight groups of command codes. The group code definitions are shown below.

Group Code	CDB Length
0	six bytes
1	ten bytes
2	ten bytes
3	reserved
4	reserved
5	twelve bytes
6	vendor-specific
7	vendor-specific

The Control byte is the last byte of every CDB. The library views the control byte as a reserved byte.

5. COMMAND SUPPORT

The library will support the following commands. These include all mandatory and some optional commands for SCSI-2 Medium Changer devices.

Command Name	Description	Hex Code
CLOSEST DRIVE	Returns the closest drive to a given element that is not in use.	F2h
EXCHANGE MEDIUM	Exchanges the medium at the source address with the medium at the destination address	A6h
INITIALIZE ELEMENT STATUS	Checks all elements for medium	07h
INITIALIZE ELEMENT STATUS WITH RANGE	Checks a specified range of elements for medium	E7h
INQUIRY	Provides vendor, product, and firmware revision information	12h
MODE SELECT	Selects the current element and library configuration information	15h
MODE SENSE	Provides current element and library configuration information	1Ah
MOVE MEDIUM	Moves a medium between library elements	A5h
OPEN/CLOSE IE	Opens or closes Import/Export	FCh
PREVENT/ALLOW MEDIUM REMOVAL	Prevents or allows the manual insertion or removal of media through the mailbox or library doors	1Eh
READ ELEMENT STATUS	Determines the status of library elements	B8h
READ MAGAZINE STATUS	Determines the status of magazine	F8h
RELEASE	Releases the library system from a prior SCSI reservation	17h
REQUEST SENSE	Provides specific information as a result of a command failure or completion	03h
RESERVE	Reserves the library system for exclusive use	16h
REZERO UNIT	Resets and repositions the library system	01h
SEND DIAGNOSTIC	Initiates a self test of the library system	1Dh
TEST UNIT READY	Checks if the library system is ready	00h

5.1 CLOSEST DRIVE Command

	7	6	5	4	3	2	1	0
0	Operation Code (F2h)							
1	LUN			Reserved(0)				
2	(MSB) Element Address							
3	(LSB)							
4	Reserved (0)							
5								
6								
7								
8	Allocation Length							
9	Control (0)							

The CLOSEST DRIVE command is a vendor unique command that determines which drive should be used to load a particular piece of media. This is important in a configuration where the virtual library spans multiple cabinets so that media is only passed to the next cabinet when all local drives are full. If all drives within the chassis are full, then the cabinets closest to the media are checked for availability first.

The Element Address field specifies the location of the media that needs to be loaded. If this address is not valid, a CHECK CONDITION is generated with sense key ILLEGAL REQUEST, and additional sense code INVALID ELEMENT ADDRESS (2101).

The Allocation Length field indicates the buffer size for the return data. The data is returned as shown below.

	7	6	5	4	3	2	1	0
0	Reserved (0)							SVAL
1	(MSB) Element Address							
2	(LSB)							

The SVAL bit indicates whether and available drive was found. If the SVAL bit is 1, the element address indicates the address of the closest drive. If the SVAL bit is 0, there are currently no available drives.

5.2 EXCHANGE MEDIUM Command

	7	6	5	4	3	2	1	0
0	Operation Code (A6h)							
1	LUN			Reserved(0)				
2	Transport Element Address(0)							
3								
4	Source Address							
5								
6	First Destination Address							
7								
8	Second Destination Address							
9								
10	Reserved (0)					Inv2	Inv1	
11	Control (0)							

The EXCHANGE MEDIUM command provides a means to exchange the medium in the source element with the medium located at a destination element.

The medium in the source element is moved to the first destination element and the medium that previously occupied the first destination element is moved to the second destination element. The second destination element may or may not be the same element as the source element. In the case of a simple exchange, the source element and the destination 2 element are the same.

If the source element or the first destination element is empty, the target shall return CHECK CONDITION status, sense key ILLEGAL REQUEST, and additional sense code SOURCE ELEMENT EMPTY. If the second destination element is not equal to the source element and is found to be full, then the target shall return CHECK CONDITION status, sense key ILLEGAL REQUEST, and additional sense code DESTINATION ELEMENT FULL .

If the medium transport element required is currently occupied, the target shall return CHECK CONDITION status, sense key ILLEGAL REQUEST, and additional sense code TRANSPORT OCCUPIED.

The transport element address specifies the medium transport element that is to be used in executing this command. The default medium transport address of zero is the only medium transport element that may be specified. If the address specified is not zero, the target shall return CHECK CONDITION status, sense key ILLEGAL REQUEST, and additional sense code INVALID FIELD IN CDB. The library handles the assignment of medium transport elements.

If there is a hardware error on either of the picker mechanisms, the target shall return CHECK CONDITION status, sense key HARDWARE ERROR, and additional sense code to the type of error. The specific sense key information gives the source of the error.

The source address, the first destination address, and the second destination address may represent a storage or a data transfer element. If the address specified has not been assigned

to a specific, allowable element of the medium changer, the target shall return CHECK CONDITION status, sense key ILLEGAL REQUEST, an additional sense code to INVALID ELEMENT ADDRESS.

The device capability MODE SENSE page provides a matrix with the supported source element to first destination element combinations for EXCHANGE MEDIUM commands with source element the same as second destination elements.

An Inv1 bit of one specifies that the medium shall be inverted prior to depositing the medium into the first destination element.

An Inv2 bit of one specifies that the medium shall be inverted prior to depositing the medium into the second destination element.

5.3 INITIALIZE ELEMENT STATUS Command

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

The INITIALIZE ELEMENT STATUS command performs checks the status of the available elements. This command will initiate an inventory of all of the storage elements to determine medium presence.

This command will update all information contained in the element database maintained internally to the library system. Medium in the IE elements will be identified with sensors. The library system may attempt to pick the tray to determine the presence of medium in the DT elements, if the appropriate option is set in the MODE SELECT command.

If both pickers are full, the inventory will be rejected by returning CHECK CONDITION status, sense key ILLEGAL REQUEST, and additional sense code TRANSPORT OCCUPID.

Depending upon the capacity of the library system, this command may take up to 60 minutes to complete. The library system will disconnect from the host system until the completion of the Initialize element status command.

5.4 INITIALIZE ELEMENT STATUS WITH RANGE Command

	7	6	5	4	3	2	1	0
0	Operation Code (E7h)							
1	LUN			Reserved(0)				Range
2	(MSB) Starting Element Address							
3	(LSB)							
4	Reserved (0)							
5	Reserved (0)							
6	(MSB) Number of Elements							
7	(LSB)							
8	Reserved (0)							
9	Control (0)							

The INITIALIZE ELEMENT STATUS WITH RANGE command performs checks the status of the specified range of elements in the library. This command will initiate an inventory of the specified range of the storage elements to determine medium presence.

This command will update information contained in the element database maintained internally to the library system. Medium in the IE elements will be identified with sensors. The library system may attempt to pick the tray to determine the presence of medium in the DT elements, if the appropriate option is set in the MODE SELECT command.

If both pickers are full, the inventory will be rejected and return CHECK CONDITION status, sense key ILLEGAL REQUEST, and additional sense code TRANSPORT OCCUPIED.

The library system will disconnect from the host system until the completion of the Initialize element status with range command.

The Range field of one specifies that the specific range of elements will be initialized. A value of zero specifies that all elements in the library will be initialized, ignoring the Starting Element Address and Number of Elements fields.

The Starting Element Address field specifies the first element address to be initialized. The Number of Elements field specifies the number of elements to be initialized. These fields are only valid if the Range field is set to one.

5.5 INQUIRY Command

	7	6	5	4	3	2	1	0
0	Operation Code (12h)							
1	LUN			Reserved(0)				EVPD
2	Page Code (0)							
3	Reserved (0)							
4	Allocation Length							
5	Control (0)							

The INQUIRY command requests that information regarding parameters of the library be sent to the initiator.

The LUN requested may be in the range of 0-7. If the library system consists of only one logical unit (unit 0), then the library will respond to a non-zero LUN with a peripheral Device Type of 1fh with a 011b qualifier.

The enable vital product data (EVPD) is not supported and must be set to zero. The library will support the standard INQUIRY data only. If the EVP bit is set to one, the library will return CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and an additional sense code of INVALID FIELD IN CDB.

The page code field specifies which page of vital product data information the target should return. If the page code field is not zero, the library will return CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and an additional sense code of INVALID FIELD IN CDB.

The INQUIRY command will return CHECK CONDITION status only when the library cannot return the requested data.

If an INQUIRY command is received from an initiator with a pending unit attention condition, the library will perform the INQUIRY command and will not clear the unit attention condition.

5.5.1 Standard Inquiry Data

	7	6	5	4	3	2	1	0
0	Periph Qualifier			Peripheral Dev Type				
1	RMB (1)	Device-type Modifier(0)						
2	ISO Version(0)		ECMA Version (0)		ANSI-Approved Version (2)			
3	Reserved (0)			Response Data Format (2)				
4	Additional Length (n-4) (1F)							
5	Reserved (0)							
6	Reserved (0)							
7	Reserved (0)			SYNC	Reserved (0)			SFTR
8 15	Vendor ID (ASACA)							
16 31	Product ID							
32 35	Product Revision Level							

The peripheral qualifier field and the peripheral device-type field will be set as follows:

- ◆ For LUN=0, the peripheral qualifier field will be set to 000b and the peripheral device-type byte will be set to 08H, indicating a medium changer device.
- ◆ For LUN=1 through 7, the peripheral qualifier field will be set to 000b if supported and attached with a peripheral device-type byte of 08h. It is set to 001b if capable of supporting more LUN's but none are currently attached. A value of 011b is used if this LUN is not available and the peripheral device-type byte will be set to 7Fh to indicate that the Logical Unit Number is not supported.

The library will indicate that the medium is removable by setting the removable medium bit (RMB) to a one.

The device-type modifier field will be set to zero.

The ISO Version and ECMA Version fields will be set to zero. The ANSI Version field will be set to 02H indicating compliance with SCSI-2.

The Response Data Format field will be set to 02H indicating a INQUIRY data format compatible with SCSI-2.

The additional length field will contain a value of 1FH, indicating that there are a total of 36 bytes of INQUIRY data. If the allocation length of the CDB is too small to transfer all of the parameters, the additional length field will not be adjusted to reflect the truncation.

SYNC - This field returns a one which indicates synchronous data transfer is supported.

SFTR - This field returns a one indicating the unit does not support the Hard Reset alternative.

The vendor ID field contains an eight-byte, left-justified, space-padded “ASACA”.

The product ID field contains a sixteen-byte, left-justified, space-padded field of one of the following: AM750DVD.

The product revision level field will contain the revision code for the library SCSI firmware installed in the device (XX.Y - where XX represents the primary revision and Y represents the minor revision level).

5.6 MODE SELECT Command

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

The MODE SELECT command provides a means for the initiator to specify medium, logical unit or peripheral device parameters to the library system. These parameters are used to configure the library system upon power-up, SCSI bus reset, or BUS DEVICE reset message. The initiator may specify the parameters in a parameter list that can include the following:

- 4 bytes for the Parameter List Header (required)
- 20 bytes for the Element Address Assignment page
- 7 bytes for the SCSI Configuration page

Initiators should issue MODE SENSE prior to each MODE SELECT to determine supported pages, page lengths, and other parameters. The MODE SENSE command should utilize the PC field set to 1h and the Page Code field set to 3Fh to determine which pages of mode parameters are supported, which parameters within the pages are changeable, and the supported length of each page. It is not an error if a page containing no changeable fields is part of the parameter list as long as none of the actual parameters within that page have been changed.

When a MODE SELECT command is issued to the library system, the parameters are not changed until the library system has verified that the new values are valid. If a value is not valid, the library system returns the appropriate error and does not change the MODE SELECT parameters.

If an initiator sends a MODE SELECT command that changes any parameters that apply to other initiators, the target generates a unit attention condition for all initiators except the one

that issued the MODE SELECT command. The media changer will then set the additional sense code to MODE PARAMETERS CHANGED.

A page format (PF) bit must be set to one indicating that the MODE SELECT parameters following the header and block descriptor(s) are structured as pages of related parameters and are as specified in the SCSI-2 standard.

The Save Parameters (SP) bit set to one specifies that all savable pages shall be written to non-volatile memory after successfully changing the current parameters. If the SP bit is set to zero, only the current parameter values are changed.

The parameter list length field specifies the length in bytes of the mode parameter list that shall be transferred from the initiator to the target during the DATA OUT phase. A parameter list length of zero indicates that no data shall be transferred. This condition is not considered an error. Any non zero parameter list length sends that specific amount of data.

The target terminates the command with CHECK CONDITION status if the parameter list length results in the truncation of any mode parameter header, mode parameter block descriptor(s), or mode page. The sense key is set to ILLEGAL REQUEST, and the additional sense code is set to PARAMETER LIST LENGTH ERROR.

The target terminates the MODE SELECT command with CHECK CONDITION status, set the sense key to ILLEGAL REQUEST, set the additional sense code to INVALID FIELD IN PARAMETER LIST, and does not change any mode parameters for the following conditions:

- If the initiator sets any field that is reported as not changeable by the target to a value other than its current value.
- If the initiator sets any field in the mode parameter header or block descriptor(s) to an unsupported value.
- If an initiator sends a mode page with a page length not equal to the page length returned by the MODE SENSE command for that page.
- If the initiator sends an unsupported value for a mode parameter and rounding is not implemented for that mode parameter.
- If the initiator sets any reserved field in the mode parameter list to a non-zero value.

If the initiator sends a value for a mode parameter that is outside the range supported by the target and rounding is implemented for that mode parameter, the command is terminated with a CHECK CONDITION status, ILLEGAL REQUEST sense key, and additional sense code of INVALID FIELD IN PARAMETER LIST.

Block descriptors are not supported, and parameter data list sent with a block descriptor will terminate with CHECK CONDITION status, the sense key is set to ILLEGAL REQUEST, and additional sense code to INVALID FIELD IN PARAMETER LIST, and does not change any mode parameters.

The supported pages for MODE SELECT command are as follows.

Page Code	Description
1Dh	Element Address Assignment Page
20h	SCSI Configuration Page

5.6.1 Mode Select Data

Mode Select data sent to the library from the host must conform to the following format. Note that the actual page data begins at byte 4 of the Mode Select data, after the parameter list header, which consists of 4 bytes of zero.

Byte	Item
0	Parameter List Header Reserved (0)
3	
4	Page(s)
n	

5.6.2 Element Address Assignment Page

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

The element address assignment page is used to assign the addresses for each of the elements of the medium changer. This page also defines the number of each type of element present.

The medium transport element address field identifies the first medium transport element contained in the library system.

The number of medium transport elements field defines the total number of medium transport elements contained in the library system. Please refer to the table below for the value of this field.

The first storage element address field identifies the first medium storage element defined in the library system.

The number of storage elements field defines the total number of medium storage elements contained in the library. Please refer to the table below for the valid values of this field.

The first import/export element address field identifies the first medium portal that is accessible by the medium transport devices and by an operator from outside the medium changer, either via an external port or via a defined location within the library.

The number of import/export elements field contains the total number of import/export elements contained in the medium changer and accessible to the medium transport elements. Please refer to the table below for the valid values of this field.

The first data transfer element address field identifies the first data transfer element contained in the medium changer.

The number of data transfer elements field defines the total number of data transfer elements contained in the medium changer and accessible to the medium transport elements. Please refer to the following table for device configuration and the table on the Device Model, section 2, for the default element addressing.

Element Address Assignment Page Field	Element	AM750DVD Configurations				
Number of medium transport elements	MT	2	2	2	2	2
Number of storage elements	ST	600 (258h)	650 (28Ah)	700 (2BCh)	750 (2EEh)	800 (2EEh)
Number of import/export elements	IE	1	1	1	1	1
Number of data transfer elements	DT	12 (Ch)	9	6	3	0

The number of MT, ST, IE elements is not changeable via Mode Select for any model. These are fixed in the library configuration information, which is setup during installation.

5.6.3 SCSI Configuration Page

The Library system supports a Vendor Unique SCSI Configuration Page with the following format:

	7	6	5	4	3	2	1	0
0	0	0	Page Code (20h)					
1	Page Length (05h)							
2	Reserved (0)			Parity	SCSI ID			
3	Minit (1)	DCE (1)	ImpEj (0)	HIES (1)	SIES (0)	RemDT (1)	Dinit (0)	Pinit (0)
4	Reserved (0)							BCChk (0)
5	Default Transport Address							
6	(0)							

The Parity bit determines whether SCSI bus parity checking is enabled or disabled. A zero indicates that bus parity checking is disabled (Default). A one indicates that bus parity checking is enabled.

The SCSI ID bits indicate which SCSI ID the library system will operate at after the next SCSI reset or power cycle. The default SCSI ID can be set from hardware. See the installation section of the User's Manual for the correct procedure.

The Minit (Magazine Initialize) bit enables and disables automatic IES on door close and power-up when a new magazine is detected. The IES command will be issued only for the new magazine unless the Dinit and Pinit bits are set. Minit is enabled by default.

The DCE (Door Close Exceptions) bit indicates whether or not to set the Except bit in the element database for all elements on door close. A one enables exceptions on door close.

The ImpEj (Implied Eject) bit determines whether the library should issue an eject media command to a DT element prior to a Move or Exchange operation. By default, ImpEj is disabled and eject operations must be handled by the host.

The HIES (Hard IES) and SIES (Soft IES) determine how to perform an element inventory. When HIES is enabled, a pick check is used to determine the status of the elements. When SIES is enabled, the library attempts to determine media presence by a barcode read operation. Barcodes readers are currently not supported on the DVD libraries and HIES must be set to 1. BCChk enables barcode checks on Move or Exchange operations. This option is currently not supported on DVD libraries and should always be set to zero.

RemDT (Remember DTs) bit determines whether DT elements should be inventoried when an IES is issued. If RemDT is enabled, current DT status will not be checked. If disabled, the library will attempt to pick all DT elements. The library will issue a command to eject the drive if ImpEj is enabled.

The Dinit bit enables or disables an automatic INITIALIZE ELEMENT STATUS after a door is opened. The following values define its operation:

- 0- Disable automatic INITIALIZE ELEMENT STATUS (Default)
- 1- Enable automatic INITIALIZE ELEMENT STATUS

The Pinit bit enables or disables an automatic INITIALIZE ELEMENT STATUS after a power up. The following values define its operation:

- 0- Disable automatic INITIALIZE ELEMENT STATUS (Default)
- 1- Enable automatic INITIALIZE ELEMENT STATUS

The Default Transport Address defines the MT element address to be used when a CDB specifies the default MT (0). This value is ignored in the DVD libraries along with all references to transport address in a CDB. The MT element is always selected internally in order to both normalize wear on each specific element and to optimize movement of the picker.

5.7 MODE SENSE Command

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

The library does not support the disable block descriptor (DBD) field and for compatibility with host drivers this field is ignored.

The page control (PC) field defines the type of parameters that are to be returned for the MODE SENSE command. The following values are valid for the PC field:

- 0- Current values: Indicates that the library system returns the current parameter values.
- 1- Changeable values: Indicates that the library system returns the changeable parameter mask. The requested pages are returned and indicate which parameters the initiator can change. All bits of changeable parameters are set to 1. All bits of parameters that are not changeable by the initiator are set to 0.
- 2- Default values: Indicates that the library system returns the factory default values.
- 3- Saved values: Indicates that the library system returns the values saved in non-volatile memory. If no parameters have been saved for the requested page(s) the default parameters will be returned.

The MODE SENSE command provides a means for the library to report parameters to a host via page codes as shown below:

Page Code	Description
1Dh	Element Address Assignment Page
1Eh	Transport Geometry Parameters Page
1Fh	Device Capabilities Page
20h	SCSI Configuration Page
3Fh	All Supported Pages

An initiator may request any one or all of the supported pages of a target. If an initiator attempts a MODE SENSE command with a page code value that is not implemented by the target, the target shall return CHECK CONDITION status and shall set the sense key to ILLEGAL REQUEST and the additional sense code to INVALID FIELD IN CDB.

A page code field of 3Fh indicates that all pages implemented by the target shall be returned to the initiator.

5.7.1 Mode Sense Data

Mode Sense data returned from the library to the host conforms to the following format. The first four bytes constitute the page header followed by the mode sense data for the specified page. Note that the actual page data begins at byte 4 of the mode sense data. If the mode sense CDB indicates that all page codes shall be transferred, the pages will be returned in ascending page code order, and the mode data length will indicate the number of bytes for all pages.

Mode Sense Data Header:

Byte	Item
0	Mode Data Length
1	Reserved (0)
2	Reserved (0)
3	Reserved (0)

The Mode Data Length is the total length of the mode data not including the Mode Data Length byte.

The number of bytes provided for each page code is as follows:

Number of Return Bytes	Page Number	Description
24	1Dh	Element Address Assignment
10	1Eh	Transport Geometry Parameters
24	1Fh	Device Capabilities
11	20h	SCSI Configuration
57	3Fh	All Pages

5.7.2 Element Address Assignment Page

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

The element address assignment page is used to report the addresses assigned to the elements of the medium changer. This page also defines the number of each type of element present in the current configuration.

A PS bit of one indicates that the library system is capable of saving the page in a non-volatile vendor-specific location. The library supports the saving of this parameter page, the PS bit value will always be one.

The medium transport element address field identifies the first medium transport element contained in the library system. This default address in the library can be found in the Default Address Table on page 3.

The number of medium transport elements field (denoted as WW above) defines the total number of medium transport elements configured in the library system. Please refer to the table on the clause 5.5.2. This value is not changeable.

The first storage element address field identifies the first medium storage element defined in the library system. The default address in the library can be found in the Default Address Table on page 3.

The number of storage elements field (denoted as XX above) defines the total number of medium storage elements configured in the library. Please refer to the table on the clause 5.5.2. This value is not changeable.

The first import/export element address field identifies the first medium portal that is accessible by the medium transport devices and by an operator from outside the medium changer, either via an external port or via a defined location within the library. The default address in the library can be found in the Default Address Table on page 3.

The number of import/export elements field (denoted as YY above) contains the total number of import/export elements configured in the medium changer and accessible to the medium transport elements. Please refer to the table on the clause 5.5.2. This value is not changeable.

The first data transfer element address field identifies the first data transfer element contained in the medium changer. The default address in the library can be found in the Default address table on page 3.

The number of data transfer elements field (denoted as ZZ above) defines the total number of data transfer elements configured in the medium changer and accessible to the medium transport elements. Please refer to the table on the clause 5.5.2. This value is not changeable.

5.7.3 Transport Geometry Page

The Library system supports the transport geometry page with the following format:

	7	6	5	4	3	2	1	0	
0	PS	Rsvd (0)	Page Code (1Eh)						
1	Page Length								
2	Reserved (0)						Rotate		
3	Member Number in Transport Element Set (00h)								
4	Reserved (0)						Rotate		
5	Member Number in Transport Element Set (01h)								

The page savable (PS) bit for the Transport Geometry Page is 0, because the library system does not support saving this page to nonvolatile memory.

The additional page length byte is set to 04h, and the Rotate bit is set to one.

5.7.4 Device Capabilities Page

	7	6	5	4	3	2	1	0
0	PS (0)	Rsvd (0)	Page Code (1Fh)					
1	Page Length (12h)							
2	Reserved (0)				StorDT (1)	StorI/E (1)	Stor/ST (1)	StorMT (0)
3	Reserved (0)							
4	Reserved (0)				MT->DT (1)	MT->I/E (1)	MT->ST (1)	MT->MT (0)
5	Reserved (0)				ST->DT (1)	ST->I/E (1)	ST->ST (1)	ST->MT (0)
6	Reserved (0)				I/E->DT (1)	I/E->I/E (1)	I/E->ST (1)	I/E->MT (0)
7	Reserved (0)				DT->DT (1)	DT->I/E (1)	DT->ST (1)	DT->MT (0)
8 -- 11	Reserved (0)							
12	Reserved (0)				MT<>DT (0)	MT<>I/E (0)	MT<>ST (0)	MT<>MT (0)
13	Reserved (0)				ST<>DT (1)	ST<>I/E (1)	ST<>ST (1)	ST<>MT (0)
14	Reserved (0)				I/E<>DT (1)	I/E<>I/E (1)*	I/E<>ST (1)	I/E<>MT (0)
15	Reserved (0)				DT<>DT (1)	DT<>I/E (1)	DT<>ST (1)	DT<>MT (0)
16 -- 19	Reserved (0)							

The device capability page defines characteristics of the element types on this medium changer. The initiator to determine which functions are permitted by the MOVE MEDIUM command may use this information.

A PS bit of one indicates that the target is capable of saving the page in a non-volatile, vendor-specific location. Because the library does not support changing of this page, the PS bit value will always be zero.

In the field names on this page, the following element type abbreviations are used:

- MT is a medium transport element
- ST is a storage element
- I/E is an import/export element (If configured for the device)
- DT is a data transfer element

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

A StorXX bit value of one indicates that the defined elements of type XX may provide independent storage for a media volume. A value of zero indicates that elements of type XX provide virtual sources or destinations and that some other type of element provides the location of the media volume. The value of StorST is one by the definition of that element type.

An XX->YY bit value of one indicates that the medium changer device supports MOVE MEDIUM commands where the source is element type XX and the destination is element type YY. An XX->YY value of zero indicates that these MOVE MEDIUM commands will be rejected with ILLEGAL REQUEST.

An XX->YY bit value of B in the table above, indicates that this capability is dependent upon the library type. This value will be set to one if the library is configured for an import/export area.

An XX<>YY bit value of one indicates that the medium changer device supports EXCHANGE MEDIUM commands where the source is element type XX, destination 1 is type YY, and destination 2 is the same element type as the source element. These bits indicate the support for the possible values of simple exchange operations. An XX<>YY bit value of zero indicates that these EXCHANGE MEDIUM commands will be rejected with ILLEGAL REQUEST. An XX<>YY bit value of C indicates that this capability is available only on library systems that support the EXCHANGE MEDIUM command with more than one media picking element.

5.7.5. SCSI Configuration Page

The Library system supports a Vendor Unique SCSI Configuration Page with the following format:

	7	6	5	4	3	2	1	0
0	0	0	Page Code (20h)					
1	Page Length (05h)							
2	Reserved (0)			Parity	SCSI ID			
3	Minit (1)	DCE (1)	ImpEj (0)	HIES (1)	SIES (0)	RemDT (1)	Dinit (0)	Pinit (0)
4	Reserved (0)							BCChk (0)
5	Default Transport Address							
6	(0)							

The page savable (PS) bit is set to 1 indicating that this page may be saved using the MODE SELECT command. See Section 5.5.3 for an explanation of all parameters on this page.

5.8 MOVE MEDIUM Command

	7	6	5	4	3	2	1	0
0	Operation Code (A5h)							
1	LUN			Reserved (0)				
2	Transport Element Address							
3								
4	Source Address							
5								
6	Destination Address							
7								
8	Reserved(0)							
9	Reserved(0)							
10	Reserved(0)							Inv
11	Control (0)							

The MOVE MEDIUM command requests that the library move a unit of medium from a source element to a destination element.

The transport element address field specifies the medium transport element that is to be used in executing this command. The default medium transport element of zero should always be used. If a invalid address is specified, the library will set the sense key to ILLEGAL REQUEST, set the additional sense code to INVALID ELEMENT ADDRESS and return CHECK CONDITION status.

The source address and the destination address may represent a storage element, an import/export element, a data transfer element or a medium transport element. If the address specified has not been assigned to a specific element of the medium changer, the library will set the sense key to ILLEGAL REQUEST, set the additional sense code to INVALID ELEMENT ADDRESS and return CHECK CONDITION status.

If this command is received and the source element is empty or the destination address is full, the library will set the sense key to ILLEGAL REQUEST, set the additional sense code to either SOURCE ELEMENT EMPTY or DESTINATION ELEMENT FULL and return CHECK CONDITION status.

An invert bit (Inv) of one specifies that the medium should be inverted or rotated prior to depositing the medium into the destination element.

5.9 OPEN/CLOSE IE Command

	7	6	5	4	3	2	1	0
0	Operation Code (FCh)							
1	LUN			Reserved(0)				
2	IE Element Address							
3								
4	Reserved(0)							
7								
8	Reserved(0)							Open
9	Control (0)							

The Open/Close IE command requests the library to either open or close the import/export for single disk insertion or removal.

The element address field is the address of IE element being requested.

The Open bit of one indicates that the import/export should be opened.

The Open bit of zero indicates that the import/export should be closed.

5.10 PREVENT/ALLOW MEDIUM REMOVAL Command

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

The PREVENT/ALLOW MEDIUM REMOVAL command requests that the library enables or disables the removal of the media in the logical unit.

The PRV field indicates whether a PREVENT or ALLOW operation is being issued. A value of one in the PRV field indicates that the library should prevent media removal while a value of zero indicates that media removal should be allowed. While media removal is prevented, the library inhibits mechanisms to open the mailbox.

Prevent of medium removal is terminated upon receipt of Allow media removal command from all initiators which set a previous Prevent media removal condition, or by a power-up, SCSI bus reset, or BUS DEVICE reset message.

5.11 READ ELEMENT STATUS Command

	7	6	5	4	3	2	1	0
0	Operation Code (B8h)							
1	LUN			Vol- Tag	Element Type Code			
2	Starting Element Address							
3								
4	Number of Elements							
5								
6	Reserved (0)							
7	Allocation Length							
9								
10	Reserved (0)							
11	Control (0)							

The READ ELEMENT STATUS command requests the library to report the status of its internal elements to the initiator. This command returns the data created as a result of the INITIALIZE ELEMENT STATUS command and as modified by media movement.

The VolTag field indicates whether or not volume tag (bar code label information) is to be reported in response to this command. Volume tags are currently not supported and this field must be zero.

The Element Type Code field specifies the particular element type(s) selected for reporting by this command. A value of zero specifies that status for all element types should be reported. The element type codes are defined below:

Code	Description
0h	All element types
1h	Medium Transport Element
2h	Storage Element
3h	Import Export Element
4h	Data Transfer Element

The starting element address specifies the minimum element address to report. Only elements with an element type code permitted by the element type code specification and an element address greater than or equal to the starting element address will be reported.

The number of elements specifies the maximum number of element descriptors to be created by the library for this command. The value specified by this field is not the range of element addresses to be considered for reporting but rather the number of defined elements to report. If the allocation length is not sufficient to transfer all of the element descriptors, the library

will transfer all those descriptors that can be completely transferred and this will not be considered an error.

The data returned by the READ ELEMENT STATUS command will consist of an eight-byte Element Status Data header followed by one to four element status pages. Each status page consists of an eight-byte Element Status Page header followed by one or more Element Descriptors.

5.11.1 Element Status Data Header

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

The first element address reported field indicates the element address of the element with the smallest element address found to meet the command request.

The number of elements field indicates the number of elements meeting the request in the command. The status for these elements is returned if sufficient allocation length was specified.

The byte count of report available indicates the number of bytes of element status page data available for all elements meeting the request in the command. This value is not adjusted to match the allocation length.

5.11.2 Element Status Data Structure

The following figure provides an illustration of the element status data structure.

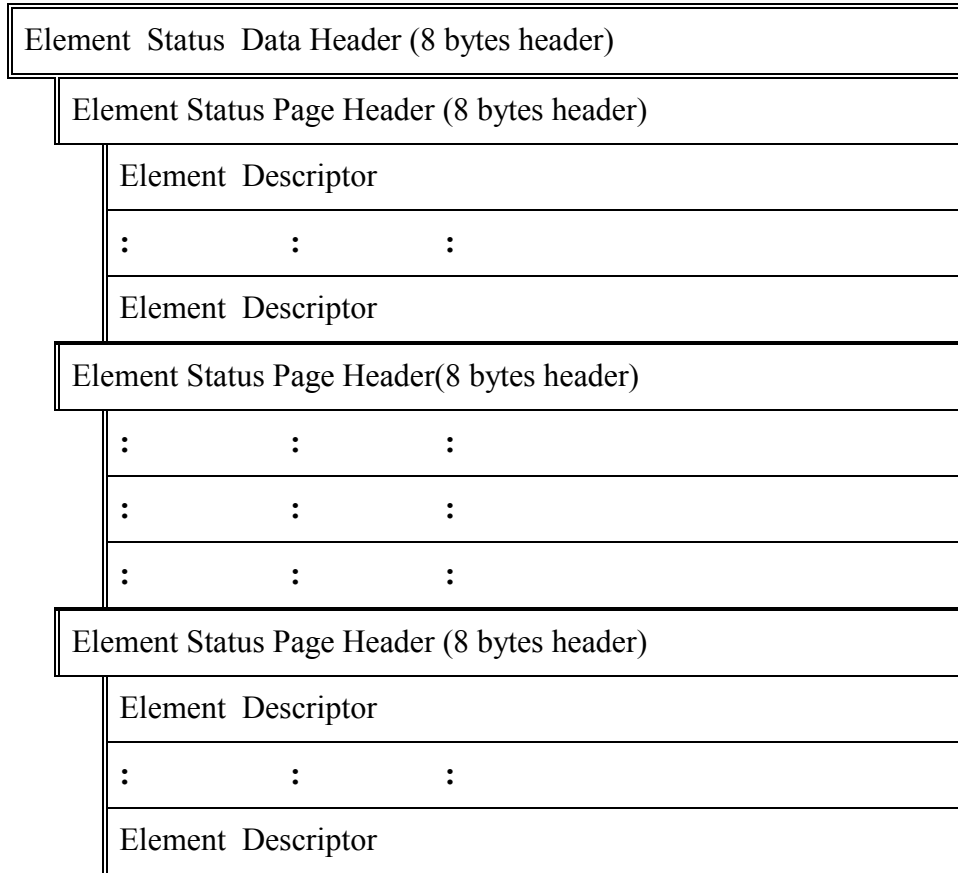


Figure: Illustration of the Element Status Data Structure

5.11.3 Element Status Page Header

	7	6	5	4	3	2	1	0
0	Element Type Code							
1	PVol -Tag	AVol -Tag	Reserved (0)					
2	Element Descriptor Length							
3								
4	Reserved (0)							
5	Byte Count of Descriptor Data Available							
6								
7								

The element status page header includes the element type code, the length of each descriptor block and the number of bytes of element descriptor information, which follow the header for this element type.

The element type code indicates the element type reported by this page.

The PVolTag field is not supported and will always be set to 0. Setting this value to one will return invalid field in the CDB.

The AVolTag field is not supported and will always be set to 0. Setting this value to one will return invalid field in the CDB.

The element descriptor length field indicates the number of bytes in each element descriptor.

The byte count of descriptor data available field indicates the number of bytes of element descriptor data available for elements of this element type meeting the request in the command. This value is not adjusted to match the allocation length.

Each element descriptor includes the element address, status flags and may contain sense code information as well as other information depending on the element type.

5.11.4 Medium Transport Element Descriptor Format

	7	6	5	4	3	2	1	0
0 1	Element Address							
2	In Pallet	Out Pallet	Reserved (0)		Up	Except	Rsvd (0)	Full
3	Reserved (0)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6 8	Reserved (0)							
9	SValid	Invert	Reserved (0)					
10 11	Source Storage Element Address							

The element address field gives the address of the medium changer element whose status is reported by this element descriptor block.

An exception (Except) bit of one indicates the element is in an abnormal state. An exception bit of zero indicates the element is in a normal state.

When the door of the changer is opened or power up, the library will set the ELEMENT STATUS table EXCEPTION bit for all elements. Each EXCEPTION bit indicates that the status for that particular element may be unknown. When the door is opened, it is possible that the user is moving media or mechanisms within the unit. Consequently, the changer will place all elements in an EXCEPTION state.

The occurrence of an EXCEPTION condition for an element does not imply that the changer cannot process motion commands for that element. It simply means that the status of that element is unknown. If the changer receives a motion command that affects an element in an EXCEPTION state, the changer will attempt to determine the state of the element in carrying out the command. If the EXCEPTION bit is not set, the changer will rely on the other status flags within the ELEMENT STATUS tables in accepting and carrying out or rejecting the motion commands received. In this manner, the host can choose to attempt corrective operations or allow the changer to make these attempts itself.

A full bit value of one indicates that the element contains a unit of media. A value of zero indicates that the element does not contain a unit of media.

The additional sense code and additional sense code qualifier fields may provide specific information on an abnormal element state. The values in these fields are as defined for the additional sense code of the REQUEST SENSE data.

A source valid (SValid) bit value of one indicates that the source storage element address field is valid. A value of zero indicates that the value in this field is not valid.

An invert bit value of one indicates that the unit of media now in this element was inverted by MOVE MEDIUM or EXCHANGE MEDIUM operations since it was last in the source storage element. A value of zero indicates that no inversion occurred during the operation.

The source storage element address field provides the address of the last storage element this unit of media was moved from. This field is valid only if the SValid bit is one.

An Inner pallet (In Pallet) bit, when set to one, indicates that the pallet in an inner slot of picker exists in this element. The pallet may or may not hold the medium.

An Outer pallet (Out Pallet) bit, when set to one, indicates that the pallet in an outer slot of picker exists in this element. The pallet may or may not hold the medium.

An Up bit of one indicates that the picker associated with this element is on top.

5.11.5 Storage Element Descriptor Format

	7	6	5	4	3	2	1	0
0	Element Address							
1	Element Address							
2	Pallet	Reserved (0)			Access	Except	Rsvd (0)	Full
3	Reserved (0)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Reserved (0)							
8	Reserved (0)							
9	SValid	Invert	Reserved (0)					
10	Source Storage Element Address							
11	Source Storage Element Address							

The element address field gives the address of the medium changer element whose status is reported by this element descriptor block.

The Access bit indicates if the Medium Transport element can access the data cartridge stored at the specified location. A zero indicates access to the element by the medium transport element is denied. A one indicates access to the element by a medium transport element is allowed.

An exception (Except) bit of one indicates the element is in an abnormal state. An exception bit of zero indicates the element is in a normal state.

When the door of the changer is opened or power up, the library will set the ELEMENT STATUS table EXCEPTION bit for all elements. Each EXCEPTION bit indicates that the status for that particular element may be unknown. When the door is opened, it is possible that the user is moving media or mechanisms within the unit. Consequently, the changer will place all elements in an EXCEPTION state.

The occurrence of an EXCEPTION condition for an element does not imply that the changer cannot process motion commands for that element. It simply means that the status of that element is unknown. If the changer receives a motion command that affects an element in an EXCEPTION state, the changer will attempt to determine the state of the element in carrying out the command. If the EXCEPTION bit is not set, the changer will rely on the other status flags within the ELEMENT STATUS tables in accepting and carrying out or rejecting the motion commands received. In this manner, the host can choose to attempt corrective operations or allow the changer to make these attempts itself.

A full bit value of one indicates that the element contains a unit of media. A value of zero indicates that the element does not contain a unit of media.

The additional sense code and additional sense code qualifier fields may provide specific information on an abnormal element state. The values in these fields are as defined for the additional sense code of the REQUEST SENSE data.

The source storage location information is not kept for storage elements and therefore the SValid and Source Storage Element fields are always zero.

An invert bit value of one indicates that the unit of media now in this element was inverted by MOVE MEDIUM or EXCHANGE MEDIUM operations since it was last in the source storage element. A value of zero indicates that no inversion occurred during the operation.

A Pallet bit, when set to one, indicates that the pallet exists in this element. The pallet may or may not hold the medium and only the Full bit determines its presence.

5.11.6 Import Export Element Descriptor Format

	7	6	5	4	3	2	1	0
0 1	Element Address							
2	Pallet	Resv	InEna -b	ExEna -b	Access	Except	ImpEx -p	Full
3	Reserved (0)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6 8	Reserved (0)							
9	SValid	Invert	Reserved (0)					
10 11	Source Storage Element Address							

The element address field gives the address of the medium changer element whose status is reported by this element descriptor block.

The InEnab (import enable) bit indicates the ability to move media in the Import/Export element. A zero indicates that this element does not support import actions. A one indicates that the import export element supports movement of media into the scope of the medium changer device.

The ExEnab (import enable) bit indicates the ability to move media in the Import/Export element. A one indicates that the import export element supports movement of media out of the scope of the medium changer device. A zero indicates that this element does not support export actions.

The Access bit indicates if the Medium Transport element can access the media stored at the specified location. A zero indicates access to the element by the medium transport element is denied. A one indicates access to the element by a medium transport element is allowed. The access bit will be always set to one for AM750DVD.

An exception (Except) bit indicates the current state of the Import/Export medium slot. A value of zero indicates the element is in a normal state. A value of one indicates the element is in an abnormal state, and the Additional Sense Code and the Additional Sense Code Qualifier fields may contain information regarding the abnormal state.

The ImpExp (Import/Export) bit indicates the current state of the medium slot. A value of zero indicates the library placed the medium into the slot. A value of one indicates the operator placed the media into the slot.

A full bit value of one indicates that the element contains a unit of media. A value of zero indicates that the element does not contain a unit of media.

A source valid (SValid) bit value of one indicates that the source storage element address field is valid. A value of zero indicates that the value in this field is not valid.

An invert bit value of one indicates that the unit of media now in this element was inverted by MOVE MEDIUM or EXCHANGE MEDIUM operations since it was last in the source storage element. A value of zero indicates that no inversion occurred during the operation.

The source storage element address field provides the address of the last storage element this unit of media was moved from. This field is valid only if the SValid bit is one.

A Pallet bit, when set to one, indicates that the pallet exists in this element. The pallet may or may not hold the medium.

5.11.7 Data Transfer Element Descriptor Format

	7	6	5	4	3	2	1	0
0 1	Element Address							
2	Pallet	Reserved (0)			Access	Except	Rsvd (0)	Full
3	Reserved (0)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	NBs (0)	Rsvd (0)	IDV	LUV (0)	Rsvd (0)	LUN		
7	SCSI Bus Address							
8	Reserved (0)							
9	SValid	Invert	Reserved (0)					
10 11	Source Storage Element Address							

The element address field gives the address of the medium changer element whose status is reported by this element descriptor block.

The Access bit indicates if the Medium Transport element can access the data cartridge stored at the specified location. A zero indicates access to the element by the medium transport element is denied. A one indicates access to the element by a medium transport element is allowed.

An exception (Except) bit indicates the current state of the Import/Export cartridge slot. A value of zero indicates the element is in a normal state. A value of one indicates the element is in an abnormal state, and the Additional Sense Code and the Additional Sense Code Qualifier fields may contain information regarding the abnormal state.

A full bit value of one indicates that the element contains a unit of media. A value of zero indicates that the element does not contain a unit of media.

A source valid (SValid) bit value of one indicates that the source storage element address field is valid. A value of zero indicates that the value in this field is not valid.

The not this bus (NBs) bit is not supported and is set to 0.

The ID Valid (IDV) of one indicates that the SCSI Bus Address field is valid.

The LUN Valid (LUV) bit is not supported and is set to 0.

The logical unit number field (LUN) is not supported and is set to 0.

The SCSI bus address indicates the target id of the drive and is valid when IDV is one.

An invert bit value of one indicates that the unit of media now in this element was inverted by MOVE MEDIUM or EXCHANGE MEDIUM operations since it was last in the source storage element. A value of zero indicates that no inversion occurred during the operation.

The source storage element address field provides the address of the last storage element this unit of media was moved from. This field is valid only if the SValid bit is one.

A Pallet bit, when set to one, indicates that the pallet exists in this element. The pallet should hold the medium if this bit is set.

5.12 READ MAGAZINE STATUS Command

	7	6	5	4	3	2	1	0
0	Operation Code (F8h)							
1	LUN			Reserved(0)				
2	Element Address							
3								
4	Reserved(0)							
7	Reserved(0)							
8	Allocation Length							
9	Control (0)							

The READ MAGAZINE STATUS command requests the library to report the status of its internal magazines to the initiator.

The element address field is the address of any element within the magazine being requested.

The data returned by the READ MAGAZINE STATUS command consists of a four-byte header followed by a six-byte magazine tag. An allocation length of 4 –bytes will return the header only.

5.12.1 Magazine Tag Format

	7	6	5	4	3	2	1	0
0	First Element Address in Magazine							
1								
2	Reserved (0)			Chan- ge	Except	Rsvd (0)	Full	
3	Number of Elements in Magazine							
4	Magazine Tag Information							
15								

Fields zero and one returns the address of the first storage element contained in the magazine.

The change bit indicates that the tag has changed since last read.

An exception (Except) bit of one indicates that the magazine is present but a read error occurred and the change status of the magazine is unknown. The magazine tag last read will be reported.

A full bit value of one indicates that the magazine is present. A value of zero indicates that the magazine is not present.

The number of elements in magazine field defines the total number of storage elements contained in the magazine.

The magazine tag information if present, contains a six-byte hexadecimal string. If no function for the magazine tag is supported by the library system or the magazine tag is unreadable, then the magazine tag information will contain all spaces.

5.13 RELEASE Command

	7	6	5	4	3	2	1	0
0	Operation Code (17h)							
1	LUN			3rdPty	Third Party Device ID			Element
2	Reservation ID							
3	Reserved (0)							
4	Reserved (0)							
5	Control (0)							

The RELEASE command is used to release previously reserved units, or, previously reserved elements within units. It is not an error for an initiator to attempt to release a reservation that is not currently active. In this case, the target shall return GOOD status without altering any other reservation.

If the element bit is zero, this command shall cause the target to terminate all non-third party reservations that are active from the initiator to the specified LUN.

The third party (3rdPty) bit allows the request for a third-party release option. If the 3rdPty bit is zero, the third-party release option is not being requested. If a one, the target shall release the specified unit or elements, but only if the reservation was made using the third-party reservation option by the initiator that is requesting the release for the same SCSI device as specified in the third-party device ID field.

The Element bit, when zero shall cause the target to terminate all non-third party unit and element reservations that are active from the initiator to the specified logical unit. When a one, this command shall cause any reservation from the requesting initiator to be terminated.

5.14 REQUEST SENSE Command

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

The REQUEST SENSE command requests that the library transfer sense data to the initiator.

The library will be capable of returning 18 - 50 bytes of data in response to a REQUEST SENSE command. If the allocation length is eighteen or greater, the library will return nineteen bytes of data. If the allocation length is less than eighteen, the data transfer size will equal the allocation length. The additional sense length field of the sense data will not be adjusted to reflect truncation if the allocation length is less than the sense data available.

Sense data shall be available if the previous command to the target terminated with a CHECK CONDITION or a COMMAND TERMINATED status. The sense data is preserved by the target for the initiator until retrieved by the REQUEST SENSE command or until the receipt of any other command for the same initiator.

5.14.1 Standard Sense Data Format

	7	6	5	4	3	2	1	0
0	Valid	Error Code(70h)						
1	Reserved (0)							
2	Reserved (0)				Sense Key			
3	Information							
6								
7	Additional Sense Length (2Bh)							
8	Command Specific Information (0)							
11								
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Field Replaceable Unit Code (0)							
15	SKSV	Sense Key Specific Fields						
17								

The Sense Key field contains information about the current status of the most recent operations. This field may contain any of the values as described below.

Sense Key	Description
0h	No Sense
2h	Not Ready
4h	Hardware Error
5h	Illegal Request
6h	Unit Attention
Bh	Aborted Command

The Information field is not supported by the library and will contain zeros.

The Additional Sense Length field will contain a value representing the amount of data available in the sense data following the Additional Sense Length field. In the case of the library system, this value will be 43 (2bh).

The Command Specific Information field is not supported by the library and will contain zeros.

The Additional Sense Code and Additional Sense Code Qualifier fields will contain information relevant to the status of the unit. The possible values for these fields are documented in Annex A.

The Field Replaceable Unit Code field is not supported by the library and will contain zeros.

The sense-key specific fields are valid only when the SKSV bit is 1. The definition of the field is dependent upon the value of the sense key. The library supports two sense-key specific field definitions.

If the sense key is set to ILLEGAL REQUEST and SKSV is 1, then field pointer bytes shall be returned as shown below. The command data (C/D) bit of one indicates that the command descriptor block contains an illegal parameter. A (C/D) bit of zero indicates that the parameter list contains an illegal parameter.

	7	6	5	4	3	2	1	0
15	SKSV	C/D	Reserved		BPV	Bit Pointer		
16	(MSB) Field Pointer							
17	(LSB)							

The bit pointer valid (BPV) bit of 1 indicates that the value in the bit pointer field is valid and contains which bit of the bytes designated by the field pointer is in error. A BPV bit of zero means that the bit pointer field is not valid. When a multi-byte field is in error, the BPV bit indicates the most significant bit of that field.

The field pointer field indicates which byte of the command descriptor block or parameter list is in error. Bytes are numbered from zero and when a multi-byte field is in error, the field pointer shall indicate the most significant byte of the field.

If the sense key is set to HARDWARE ERROR and the SKSV bit is one, the sense-key specific data contains a vendor specific version of the actual retry count bytes shown below. The robot number field indicates which robot had the error which in a multiple library environment. The hardware element code indicates which library element experienced

	7	6	5	4	3	2	1	0
15	SKSV	Robot Number			Hardware Element Code			
16	(MSB)	Actual Retry Count						(LSB)
17								

the error. The following table contains the hardware element code definitions. The actual retry count field shows the number of times the operation was tried before declaring a failure.

Hardware Element Code	Description
0h	No Element Defined
1h	X-Axis
2h	Y-Axis
3h	Catch 1
4h	Catch 2
5h	Rotate Axis'
6h	Y-Theta-Axis'
7h	Theta-Axis
8h	Pass Through
9h	Mailbox
Ah	Y and Rotate Axis'
Bh	Theta and Rotate Axis'
Ch	Y, Theta and Rotate Axis'
Dh	Media Drive
Eh	I2C Bus
Fh	Internal Queue
10h	EEPROM
11h	Unit
12h	Soft

5.15 RESERVE Command

	7	6	5	4	3	2	1	0
0	Operation Code (16h)							
1	LUN			3rdPty	Third Party Device ID			Element
2	Reservation ID							
3	Element List Length							
4								
5	Control (0)							

The RESERVE command is used to reserve units for the use of the initiator. The RESERVE and RELEASE commands provide the basic mechanism for contention resolution in multiple-initiator systems.

This reserve command requests that a list of elements be reserved for the exclusive use of the initiator. The reservation is valid until it is superseded by another valid RESERVE command from the same initiator; released by a RELEASE command from the same initiator; released by a BUS DEVICE RESET message from any initiator; or terminated by a hard RESET condition or power cycle. A reservation shall not be granted if the unit is reserved by another initiator. If invalid overlaps or invalid elements are requested, a CHECK CONDITION status and ILLEGAL REQUEST are generated.

If, after honoring the reservation, any other initiator then subsequently attempts to perform any command on the reserved unit other than an INQUIRY command, a REQUEST SENSE command, a RESERVE command or a RELEASE command, which shall be ignored, the command shall be rejected with RESERVATION CONFLICT status.

The third party (3rdPty) bit allows the request for a third-party reserve option. If the 3rdPty bit is zero, the third-party reserve option is not being requested. If a one, the target shall reserve the specified unit or elements, for the same SCSI device as specified in the third-party device ID field.

The Element bit indicates if this command is intended to reserve one or more element, as opposed to reserving the entire unit. A value of zero indicates the entire library is to be reserved. A value of one indicates a specific set of elements, as indicated in the Element List, are to be reserved.

The Element List Length field indicates the length, in bytes, of the Element List Descriptors that follow this command. The valid values for the field are 0, 6, and increments of 6. If the Element bit (byte 1, bit 0) is 0, this field is ignored. If the value for this field is 0 and the Element bit is set to 1, no elements are reserved.

The Element List Descriptors are defined as follows:

5.15.1 Element List Descriptors Format

	7	6	5	4	3	2	1	0
0	Reserved (0)							
1	Reserved (0)							
2	Number of Elements							
3								
4	Element Address							
5								

The Number of Elements field indicates the number of elements to be reserved. If the value of this field is 0, all elements starting at the Element Address field through the last element address for the library system are reserved.

The Element Address field indicates the address of the element or the starting address of a series of elements to be reserved.

5.16 REZERO UNIT Command

	7	6	5	4	3	2	1	0
0	Operation Code (01h)							
1	LUN			Reserved (0)				
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Control (0)							

The REZERO UNIT command requests that the library set the logical unit to a specified state.

The library will position itself to a defined “home” location when a REZERO UNIT command is received. The “home” location is defined as placing the medium transport elements in front of the first storage (DEFAULT) element.

5.17 SEND DIAGNOSTIC Command

	7	6	5	4	3	2	1	0
0	Operation Code (1Dh)							
1	LUN			PF (0)	Rsv (0)	SlfT (1)	Dofl (0)	Uofl (0)
2	Reserved (0)							
3	Parameter List Length							
4								
5	Control (0)							

The SEND DIAGNOSTIC command requests the library to perform diagnostic operations on itself. This command is supported only if the self-test feature with the parameter list length of zero. Any other combination of bits and bytes the library will set the sense key set to ILLEGAL REQUEST.

The PF bit specifies the format of the parameter list for this command. The library systems support the vendor specific format. This bit shall be zero.

The SlfT bit indicates whether the unit should perform the diagnostics specified in the Vendor Specific page or standard self-test. Only self-test is supported. This bit shall be one.

THE Dofl bit specifies that the diagnostics are to be performed with the unit off-line. If this bit is one, then diagnostics that cause minor interruption to operations are performed.

The Uofl bit specifies that the diagnostics are to be performed with the logical unit off-line and behaves the same as Dofl.

The parameter list length specifies the number of bytes in the parameter list associated with this command. The field should be zero.

5.18 TEST UNIT READY Command

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

The TEST UNIT READY command provides a means to check if the logical unit is ready. This is not a request for a self-test. If the logical unit would accept an appropriate medium-access command without returning CHECK CONDITION status, this command will return a GOOD status.

If a TEST UNIT READY command is received while the door is open, the unit will respond with CHECK CONDITION and the sense data will be set to NOT READY, INTERVENTION REQUIRED.

ERROR CODES

Following table provides a listing of error codes returned by the library.

SENSE KEY, ASC and ASCQ Definitions

SENSE KEY	ASC	ASCQ	DESCRIPTION
0	00	00	NO ADDITIONAL SENSE
2	04	00	NOT READY
2	04	01	BECOMING READY
2	04	03	MANUAL INTERVENTION REQUIRED
2	04	80	U NIT OFFLINE
2	04	81	DOOR OPEN
2	04	82	MAILBOX DOOR OPEN
4	08	00	COMMUNICATION FAILURE
4	15	00	RANDOM POSITION ERROR
4	15	01	MECHANICAL POSITIONING ERROR
4	15	80	MOTOR TIME OUT
4	15	81	MECHANICAL ELEMENT OFFLINE
4	15	82	DRIVE START FAIL
4	15	83	DRIVE STOP FAIL
4	15	84	MEDIA LOST
4	15	85	PALLET LOST
4	15	86	SENSOR FAIL
4	15	87	TIME OUT
5	1A	00	PARAMETER LIST LENGTH ERROR
5	20	00	INVALID COMMAND CODE
5	21	01	INVALID ELEMENT ADDRESS
5	24	00	INVALID CDB FIELD
5	25	00	LOGICAL UNIT NOT SUPPORTED
5	26	00	INVALID FIELD IN PARAMETER LIST
5	26	01	PARAMETER NOT SUPPORTED
5	26	02	PARAMETER VALUE INVALID
6	28	00	NOT READY TO READY TRANSITION
6	28	01	IMPORT/EXPORT ELEMENT ACCESSED
6	29	00	POWER-ON, RESET OR BUS DEVICE RESET

SENSE KEY	ASC	ASCQ	DESCRIPTION
6	2A	01	MODE PARAMETERS CHANGED
5	3A	00	MEDIA NOT PRESENT
5	3B	0D	DESTINATION ELEMENT FULL
5	3B	0E	SOURCE ELEMENT EMPTY
5	3B	80	TRANSPORT OCCUPIED
5	3B	81	TOO MANY PALLETS
5	3B	82	ELEMENT OFFLINE
5	3B	83	ELEMENT BUSY
5	3B	84	MEDIA NOT EJECTED
5	3B	85	INTERNAL TRANSPORT SELECT ERROR
5	3B	86	DESTINATION CANNOT BE TRANSPORT
5	3B	87	SOURCE CANNOT BE TRANSPORT
5	3D	00	INVALID BITS IN IDENTIFY MESSAGE
4	40	80	BATTERY FAILURE
4	40	81	RAM OR ROM FAILURE
4	40	82	POWER FAILURE
4	42	00	POWER ON DIAGNOSTIC FAILURE
B	43	00	SCSI MESSAGE ERROR
B	44	00	INTERNAL TARGET FAILURE
B	44	80	INTERNAL COMMAND FAILURE
B	45	00	SELECT/RE-SELECT FAILURE
B	47	00	SCSI PARITY ERROR
B	48	00	INITIATOR DETECTED ERROR MESSAGE RECEIVED
B	49	00	INVALID MESSAGE ERROR
2	4C	00	FAILED CONFIGURATION
4	53	00	MEDIA LOAD/EJECT FAILURE
5	53	02	MEDIUM REMOVAL PREVENTED
4	55	00	SYSTEM RESOURCE FAILED
5	80	00	SOURCE DRIVE NOT INSTALLED
5	80	01	DESTINATION DRIVE NOT INSTALLED
5	80	02	SOURCE MAGAZINE NOT INSTALLED
5	80	03	DESTINATION MAGAZINE NOT INSTALLED
*	80	04	UNKNOWN ELEMENT STATUS
*	80	05	MEDIA PRESENCE UNKNOWN
*	80	06	NO PALLET

*	80	07	VOLUME TAG NOT PRESENT

Printing History

Revision			Descriptions
	5/16/98		Draft
1.0	5/22/98		Initial Release Removed Position Command.
1.1	12/16/98		Corrected typographical errors and added magazine ID commands
1.2	3/3/99		Corrected typographical errors. HIES of MODE SENSE/SELECT defaults to 1. SP field of MODE SENSE is reserved. Added OPEN/CLOSE IE (FCh) command and changed the length of READ MAGAZINE STATUS command to 12 bytes.