

PLASMON V-SERIES LTO LIBRARY SYSTEM

SCSI REFERENCE MANUAL

PLASMON IDE

This publication describes the SCSI software interface to Plasmon's V-Series LTO (Linear Tape Open) tape cartridge library systems. It is intended to provide interfacing information to parties wishing to develop software and/or applications programs for the library system. This document corresponds to Product Revision Level 1.04 or later of the library system firmware.

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1.	Introduction.....	1
2.	Glossary of Terms Used.....	2
3.	Library System Operating Modes.....	4
3.1	Normal On-line.....	4
3.2	Library Set Up Mode.....	4
3.3	Library Maintenance Mode.....	4
4.	SCSI Command Overview.....	5
5.	SCSI Addresses.....	7
6.	Element Addresses and Counts.....	7
7.	SCSI Communication.....	8
7.1	Supported Messages.....	8
7.2	Supported Status Byte Codes.....	8
8.	Recommended Command Timeouts.....	9
9.	Special SCSI States/Conditions.....	9
9.1	Reset State.....	9
9.2	Not Ready State.....	9
9.3	Unit Attention Condition.....	10
10.	SCSI Commands.....	12
10.1	EXCHANGE MEDIUM Command.....	12
10.2	INITIALIZE ELEMENT STATUS Command.....	12
10.3	INITIALIZE ELEMENT STATUS WITH RANGE Command.....	13
10.4	INITIALIZE SINGLE ELEMENT Command.....	13
10.5	INQUIRY Command.....	13
10.5.1	Supported Vital Product Data Pages Page (00h).....	15
10.5.2	Unit Serial Number Page (80h).....	15
10.5.3	Additional Unit Information Page (C0h).....	16
10.6	LOG SELECT Command.....	17
10.6.1	Error Statistics Page (31h).....	17
10.6.2	Error Log Page (32h).....	18
10.6.3	Event History Page (33h).....	18
10.6.4	Micro-Operation Page (34h).....	18
10.6.5	Library Time Page (35h).....	19
10.6.6	Drive Load Counts Page (36h).....	19

10.6.7	Drive Over-Temperature Page (38h)	20
10.6.8	Drive Fan Tachometer Page (39h)	20
10.7	LOG SENSE Command	20
10.7.1	Supported Log Pages Page (00h)	21
10.7.2	Unit Statistics Page (30h)	21
10.7.3	Error Statistics Page (31h)	22
10.7.4	Error Log Page (32h)	23
10.7.5	Event History Page (33h)	26
10.7.6	Micro-Operation Page (34h)	27
10.7.7	Library Time Page (35h)	27
10.7.8	Drive Load Counts Page (36h)	28
10.7.9	Cumulative Counts Page (37h)	29
10.7.10	Drive Over-Temperature Page (38h)	30
10.7.11	Drive Fan Tachometer Page (39h)	32
10.8	MODE SELECT (6) Command	33
10.8.1	Library Mode Parameters Page (20h)	34
10.8.2	Library Special Modes Page (21h)	35
10.8.3	Front Panel Display Mode Page (23h)	36
10.9	MODE SELECT (10) Command	37
10.10	MODE SENSE (6) Command	37
10.10.1	Element Address Assignment Page (1Dh)	38
10.10.2	Transport Geometry Parameters Page (1Eh)	39
10.10.3	Device Capabilities Page (1Fh)	39
10.10.4	Library Mode Parameters Page (20h)	40
10.10.5	Library Special Modes Page (21h)	40
10.10.6	Drive Assignments Page (22h)	40
10.10.7	Front Panel Display Mode Page (23h)	41
10.11	MODE SENSE (10) Command	42
10.12	MOVE MEDIUM Command	43
10.13	OPEN/CLOSE MAILSLLOT Command	44
10.14	POSITION TO ELEMENT Command	44
10.15	PREVENT/ALLOW MEDIUM REMOVAL Command	45
10.16	READ BUFFER Command	46
10.16.1	Reading the Medium Changer Device SCSI ID	46

10.16.2	Reading the Drive Good / Bad Status Codes	46
10.16.3	Reading from the Echo Buffer to Test SCSI Communication.....	47
10.16.4	Reading the Network IP Address and Subnet Mask.....	47
10.17	READ ELEMENT STATUS Command	48
10.17.1	Medium Transport Element Descriptor	50
10.17.2	Storage Element Descriptor	51
10.17.3	Import / Export Element Descriptor	51
10.17.4	Data Transfer Element Descriptor	52
10.18	READ MAGAZINE STATUS Command.....	55
10.19	RELEASE ELEMENT Command.....	56
10.20	RELEASE MAGAZINE Command	56
10.21	REQUEST SENSE Command.....	56
10.22	REQUEST VOLUME ELEMENT ADDRESS Command	60
10.23	RESERVE ELEMENT Command.....	61
10.23.1	Reserve Element Element List Descriptor	62
10.24	RESTORE DRIVE Command.....	62
10.25	REZERO UNIT Command.....	62
10.26	SEND DIAGNOSTIC Command.....	63
10.26.1	Diagnostic Self Test.....	63
10.26.2	Change Drive SCSI ID Page (80h).....	63
10.26.3	Drive Power On/Off Page (81h).....	64
10.27	SEND VOLUME TAG Command	64
10.28	SERVICE DRIVE Command	65
10.29	SWAP TRANSPORT ASSYS Command	66
10.30	TEST UNIT READY Command	66
10.31	WRITE BUFFER Command	67
10.31.1	Downloading Firmware	67
10.31.2	Changing the Medium Changer Device SCSI ID.....	68
10.31.3	Assigning Drive Good / Bad Status Codes.....	68
10.31.4	Writing to the Echo Buffer to Test SCSI Communication	69
10.31.5	Assigning Network IP Address and Subnet Mask.....	69
11.	Event History Type and Event Description	71
12.	Error Codes	74
12.1	Medium Changer Device SCSI Error Codes	74

12.2	Medium Changer Device Error Host Recovery Procedures	76
12.3	Internal Error Codes.....	77
12.4	Internal Error Context Codes.....	79
13.	Developer Notes	80
13.1	Identifying the Library and Model.....	80
13.2	Maintaining an Inventory.....	80
13.3	Using the Library (Moving Cartridges).....	80
13.4	Use of the Cartridge Magazine	80
13.5	Servicing Drives	81
13.6	Examining Errors	82
13.7	Drive Temperature and Low Fan Speed Warnings.....	82

1. Introduction

Plasmon's LTO tape cartridge library systems are capable of holding a number of tape drives and cartridges. The robotic device within each library system is referred to as a medium changer device and it uses the protocols and commands for medium changer devices as defined in the American National Standards Institute SCSI Specification. The library system's medium changer device and the tape drives within the library system are all accessed independently.

There are a number of locations or elements within the library system which are capable of holding tape cartridges. These consist of the import/export elements, the storage elements, the medium transport element, and the data transfer elements.

The import/export elements, IE1 - IE6, are externally accessible slots through which tape cartridges are added to or removed from the library system. The first import/export element, IE1, is a fixed operator accessible slot through which single cartridges can be added to or removed from the library system. It is also known as the mailslot. Import/export elements IE2 - IE6 are slots in a removable magazine from which one to five cartridges can be added or removed at a time. For maximum software compatibility, either the mailslot or the magazine slots can be disabled via the front panel interface or by a command from the host software. By default, only the magazine slots are enabled.

The storage elements, ST1 - STn, are locations within the library system's medium store used to store cartridges.

The medium transport element, MT1, is the tape transport mechanism used to remove tapes from or return tapes to the import/export elements, the storage elements, or the data transfer elements (the tape drives). The medium transport element is also referred to as the picker.

The data transfer elements, DT1 - DTn, are the library system's tape drives.

The medium changer device within the library system responds to commands as defined by and in accordance with the ANSI X3.301-1997 standard - SCSI-3 Primary Commands (SPC), and the ANSI NCITS 314-1998 standard - SCSI-3 Medium Changer Commands (SMC). The commands are sent to the medium changer device by a logical protocol and physical interconnect in accordance with the ANSI SCSI-3 Architecture Model (SAM) standard. The currently supported logical protocol is the SCSI-3 Interlocked Protocol (SIP). The currently supported physical interconnect is the SCSI-3 Parallel Interface, version 2 (SPI-2).

Each command is structured in the form of a Command Descriptor Block (CDB). Some commands require an list of parameters to be sent along with the command in the form of a separate outgoing block of data. Other commands return a block of information from processing the command into a buffer in the host application software. The contents of this buffer may be interpreted by the application at the completion of the command and acted upon accordingly. This document does not specify how this information is to be used by the application.

This document describes the SCSI commands (CDB's) for the library system's medium changer device. Refer to the corresponding drive reference manual for information on SCSI commands for the library system's tape drives. SCSI reference manuals for the library system's tape drives may be obtained by contacting Plasmon Technical Support.

The aforementioned SCSI standards may be obtained by contacting ANSI at the following address.

American National Standards Institute, Inc.
11 West 42nd Street, New York, NY 10036
+1-212-642-4900
Internet: www.ansi.com

2. Glossary of Terms Used

A number of terms are used throughout this document. Some of these terms are defined here.

Alternate MTA: In library systems equipped with a redundant MTA, the MTA used when the primary MTA is malfunctioning.

ASC/ASCQ: Additional Sense Code/ Additional Sense Code Qualifier. Bytes 12 and 13 of the Sense Data block returned by the Request Sense command in response to a CHECK CONDITION from a target device. These bytes, along with the Sense Key in byte 2, indicate the type of error sensed.

Automatic MTA Switch-Over: On library systems equipped with a redundant MTA, the library system will automatically switch from the primary to the alternate MTA when the primary MTA is not performing to a minimum criteria.

CDB: Command Descriptor Block. The structure used to communicate commands from a SCSI initiator device to a SCSI target device.

Data Transfer Elements (DT's): The tape drives within the library system.

Drive Service: Unloading a drive, turning it off (removing drive power), and disconnecting it from the SCSI bus to allow an operator to remove or replace the drive.

Drive Type: A numeric classification of the type of library drive installed. This value is encoded in the connector to the drive from the library system drive interface board.

Element: An addressable location within the library system. The library system contains four types of elements: medium transport elements (MT's), storage elements (ST's), import/export element (IE's), and data transfer elements (DT's).

Event History/ Event List: A list of code bytes associated with events occurring within the library system or communication occurring between the library system and an associated drive. The particular code bytes logged depend upon the value of the event history type. This list is used only for error analysis and debugging.

Event History Type: A bit-encoded value defining the type of bytes logged in the event history list.

Front Service Door: The door on the front of the library system through which the library on/off switch may be accessed, library drives may be inserted or removed, and the library's printed circuit boards and cables may be accessed.

Export: Moving a cartridge to the mailslot or a magazine slot so that the operator may remove it from the library system.

Flash: A nonvolatile, electrically erasable area of memory used to store microcode for the library system.

Hot Swap: To replace a power supply or drive while the library system remains on-line.

Import: Retrieving a cartridge from the mailslot or a magazine slot so that it may be used in the library system.

Import/Export Elements (IE's): The externally accessible slots through which tape cartridges are added to or removed from the library system. This includes the mailslot and the magazine slots.

LSB: Least significant bit.

Lift: The medium transport assembly particularly when moving vertically.

Magazine: An operator-accessible carrier containing up to five cartridges. Individual cartridges may be imported from or exported to the magazine when it is attached to the library system.

Magazine Access Door: The door through the magazine is inserted or removed. Once closed, this door can only be opened through the front panel or a SCSI Release Magazine or Prevent/Allow command.

Mailslot: The operator accessible media slot through which individual cartridges are added to or removed from the library system.

Medium Transport Element (MT): The cartridge transport mechanism in the library system. The library system contains one medium transport element. It is also referred to as the picker.

Medium Transport Assembly (MTA): The medium transport element and its housing. All library systems contain a primary MTA and some contain an alternate MTA.

Micro-Operation List: A list of operations performed by the library system for a single cartridge movement command.

MSB: Most significant bit.

Pass-Through: Moving a cartridge from one library system to another. Not all models have this capability.

Pass-Through Elements: The internal locations used to temporarily store cartridges before and after they are transferred to or from other library systems. On library systems equipped with the pass-through capability, there is a pass-through element associated with each adjacent library system.

Picker: A medium transport element particularly when pulling or pushing a cartridge.

Pivot: The portion of the library system responsible for rotating the medium transport assembly between columns of slots or drives.

Primary MTA: The MTA used in normal library system operation.

Printed Wire Assembly (PWA): A populated library system circuit board.

Rear Access Door: The door on the rear of the library system through which cartridges may be manually mass loaded or removed, or through which maintenance service may be performed.

SCSI: Small Computer System Interface. An ANSI specification defining the transfer of commands and data between two devices such as a host computer and a computer peripheral. The third version of this specification is known as SCSI-3.

SCSI ID: A unique address for each device on an SCSI bus. The host and the medium changer device must each have an SCSI ID between 0 and 7, inclusive. The drives must each have an SCSI ID between 0 and 15 if Wide SCSI is supported.

SCSI Initiator: An SCSI device, such as a host computer, that issues SCSI commands.

SCSI Target: An SCSI device that performs an operation requested by an initiator. The library system contains several SCSI targets: an SCSI medium changer device, and one or more SCSI random access storage devices (the drives).

Storage Elements (ST's): Locations within the library system's medium store used to store tape cartridges.

3. Library System Operating Modes

The library system can operate in one of three modes: on-line, library set up, and library maintenance.

3.1 Normal On-line

This is the normal operating mode of the library system. Element statuses are displayed on the front panel of the library system. A menu may be selected for accessing the 5-slot cartridge magazine, displaying library status values, turning drives on or off, servicing and restoring drives, and entering one of the other two operating modes of the library.

3.2 Library Set Up Mode

This mode may only be invoked from the front panel. It takes the medium changer device completely off-line (the drives remain on-line). For more information refer to the LTO Series User's Guide and Service Manuals.

3.3 Library Maintenance Mode

This mode may only be invoked from the front panel. It takes the medium changer device completely off-line. For more information refer to the LTO Series User's Guide and Service Manuals.

4. SCSI Command Overview

The following is a brief description of each of the SCSI commands supported.

The **Inquiry** command requests medium changer device parameters be sent to the SCSI initiator device.

The **Mode Select (6)** and **Mode Select (10)** commands provide a means of selecting medium changer device parameters.

The **Mode Sense (6)** and **Mode Sense (10)** commands provide a means for reporting medium changer device parameters to the initiator.

The **Send Diagnostic** command provides a means for performing diagnostic tests on the medium changer device, changing a drive SCSI ID, or turning drive power on/off.

The **Rezero Unit** command is used to 'reset' the medium changer device.

The **Test Unit Ready** and **Request Sense** commands are necessary to interface the medium changer device.

The **Reserve Element** and **Release Element** commands are used to reserve the medium changer device or elements within it for multiple initiator applications. Many implementations will not require these commands.

The **Position to Element** command instructs the medium changer device to position the medium transport element (MT) in front of an element in preparation for a move from the element. Use of this command is not required.

The **Move Medium** command instructs the medium changer device to move a unit of media from a source element to a destination element (e.g.: move a cartridge from the mailslot to slot ST3).

The **Exchange Medium** command instructs the medium changer device to exchange a cartridge in a source element with a cartridge in a destination element and place that cartridge in another destination element.

The **Open/Close Mailslot** command instructs the medium changer device to open or close the mailslot thus enabling cartridge insertion or removal.

The **Prevent/Allow Medium Removal** command instructs the medium changer device to either inhibit or permit opening of the mailslot for cartridge insertion or removal, or to inhibit or permit the releasing of the cartridge magazine for operator access.

The **Initialize Element Status** command, which would normally cause the medium changer device to test all elements for the presence of media, performs no function because the library performs this operation automatically.

The **Initialize Single Element** command causes the medium changer device to test a single element for the presence of media.

The **Read Element Status** command is used to determine status of elements (e.g.: make a directory of cartridges in the library system).

The **Release Magazine** command instructs the medium changer device to energize a solenoid to release the cartridge magazine for operator access. It will also open the magazine access door to allow magazine insertion or removal.

The **Read Magazine Status** command is used to determine the status of the magazine.

The **Service Drive** command prepares a drive for service by turning it off.

The **Restore Drive** command restores a drive to service by turning it on.

The **Swap Transport Assys** command is used to switch to the alternate medium transport assembly when the primary assembly is found to be non-functional.

The **Log Sense** command provides a means for reporting medium changer device statistical and error log information.

The **Log Select** command provides a means of clearing certain unit statistics, error statistics, and error log information, and setting the library system date and time.

The **Write Buffer** command is used to write new firmware to the library system or to change certain parameters within the library system.

The **Read Buffer** command is used to read certain parameters from the library system.

5. SCSI Addresses

The default SCSI ID's for the library system devices are as follows.

Default SCSI ID's

Device	Default SCSI ID
Library Drive 1	0
Library Drive 2	1
Library Drive 3	2
Library Drive 4	3
Library Drive 5	4
Library Drive 6	5
Library Drive 7	8
Library Drive 8	9
Library Drive 9	10
Library Drive 10	11
Medium Changer Device	6

6. Element Addresses and Counts

The following element address scheme has been implemented for the library system:

Element Addresses

Element Type	Address
MT	8001
ST	1 – n
IE	4001 – 4006
DT	6001 – 6010

The following table lists the supported models and corresponding element counts.

Element Counts

Model	Number of Medium Transport Elements	Number of Storage Elements	Number of Import/Export Elements	Number of Data Transfer Elements
FTA 20	1	20	5	maximum of 2
FTA 40	1	40	5	maximum of 4
FTA 60	1	60	5	maximum of 4
FTA 34	1	34	1, 5, or 6	maximum of 6
FTA 68	1	68	1, 5, or 6	maximum of 6
FTA 102	1	102	1, 5, or 6	maximum of 6
FTA 220	1	220	1, 5, or 6	maximum of 10
FTA 385	1	385	1, 5, or 6	maximum of 10
FTA 550	1	550	1, 5, or 6	maximum of 10

7. SCSI Communication

7.1 Supported Messages

In the course of communication between a SCSI initiator device, such as a host computer, and a SCSI target device, such as the library system medium changer device, messages are sent as part of protocol services. This includes both task and link management messages. The following messages are accepted by and/or sent by the medium changer device. The direction field indicates the direction of message transfer. The MESSAGE REJECT message is sent for all unaccepted messages.

Message Codes

Code	Message Name	Direction
06h	ABORT TASK SET (was ABORT in SCSI-2)	Out
0Ch	TARGET RESET (was BUS DEVICE RESET in SCSI-2)	Out
00h	TASK COMPLETE (was COMMAND COMPLETE in SCSI-2)	In
04h	DISCONNECT	In/Out
01h	Extended messages - SYNCHRONOUS DATA TRANSFER (01h) REQUEST and WIDE DATA TRANSFER REQUEST (03h)	In/Out
80h+	IDENTIFY	In/Out
05h	INITIATOR DETECTED ERROR	Out
09h	MESSAGE PARITY ERROR	Out
07h	MESSAGE REJECT	In/Out
08h	NO OPERATION	Out
02h	SAVE DATA POINTER	In
Key: In = Target (medium changer device) to Initiator, Out = Initiator to Target (medium changer device) 80h+ = Codes 80h through FFh are used for IDENTIFY messages		

7.2 Supported Status Byte Codes

A status byte code is sent from the medium changer device to the initiator at the termination of each command. The supported status byte code values are listed below.

Status Byte Codes

Status Byte Code	Status
0h	GOOD
2h	CHECK CONDITION
8h	BUSY
18h	RESERVATION CONFLICT
All other codes	Not Returned

GOOD. The medium changer device has successfully completed the command.

CHECK CONDITION. Any error, exception, or abnormal condition resulting in sense data being set causes a CHECK CONDITION status. A Request Sense command should be issued following a CHECK CONDITION status to determine the nature of the condition.

BUSY. The medium changer device is busy and cannot accept a command.

RESERVATION CONFLICT. A command has been sent by an initiator to the medium changer device when it is already reserved by another initiator.

8. Recommended Command Timeouts

The following values are the recommended timeout values for host software to use when issuing commands the medium changer device. The actual command execution times depend upon the various mode settings in effect (see Section 10.8.1), the type of drives used, concurrent front panel operations, and the number of retries performed to successfully complete a command.

Suggested Timeout Values

SCSI Command	Timeout
Inquiry, Mode Select, Mode Sense, Prevent/Allow Medium Removal, Request Sense, Reserve Element, Release Element, Release Magazine, Read Element Status, Read Magazine Status, Test Unit Ready, Initialize Element Status, Service Drive, Log Select, Log Sense, Write Buffer (mode 2), Read Buffer	10 sec
Send Diagnostic, Position to Element, Move Medium, Exchange Medium, Rezero Unit (without RecalOffs bit set), Initialize Single Element, Restore Drive, Swap Transport Assys, Write Buffer (mode 7)	5 min
Rezero Unit with RecalOffs bit set	10 min

9. Special SCSI States/Conditions

9.1 Reset State

When the RST signal is asserted or a TARGET RESET message is received from the host, the medium changer device within the library system enters the RESET state. As a result, the following events will take place.

- All SCSI bus signals (except RST) will be released.
- All I/O processes (commands) will be terminated. The library system will be restored to the state it was in before the reset occurred.
- All device reservations will be released.
- All operating (Mode Select) modes will be restored to default or saved values.
- The library system will be reset to the Mailslot Allow and Magazine Allow states (see Prevent/Allow Medium Removal command).
- A Unit Attention condition will be generated.

Note that the medium changer device will itself never assert the RST signal.

9.2 Not Ready State

The medium changer device returns CHECK CONDITION status in response to Test Unit Ready command, or any cartridge movement commands, when it is in a state in which it is unable to process such commands. A subsequent Request Sense command issued to the medium changer device yields return data containing a Sense Key of 2h - Not Ready. The device will remain in such a state for a specified period of time or until an action by an operator takes place.

The events triggering Not Ready state in the library system are as follows.

- Upon power-up. The medium changer device will be Not Ready while drive power is being restored and the library system is initializing.
- While the rear access door is opened. The medium changer device will be Not Ready until the access door is closed (A Unit Attention condition will be generated when the door is closed).
- Selecting ‘Service Drive’ via the front panel menus. The medium changer device will be Not Ready for 5 seconds after this option is selected to allow time for SCSI initiator devices to poll the changer device, sense the Not Ready state, and stop SCSI activity to the selected drives.
- If a drive is turned off and placed in Service state because of a drive over-temperature or fan underspeed condition. After an appropriate delay to allow the drive to be unloaded, the medium changer device will be Not Ready for 5 seconds before the drive is turned off and placed in the Service state.
- Selecting ‘Turning Drive Off’ via the front panel menus. The medium changer device will be Not Ready for 5 seconds after this option is selected to allow time for SCSI initiator devices to poll the changer device, sense the Not Ready state, and stop SCSI activity to the drive being turned off.
- During automatic MTA switch-over. The medium changer device will be Not Ready while the library is switching to the alternate MTA.

9.3 Unit Attention Condition

The medium changer device returns CHECK CONDITION status in response to SCSI commands other than Inquiry, Read Element Status, or Read Magazine Status, when one or more conditions indicating a change in state of the library system has occurred. A subsequent Request Sense command issued to the medium changer device yields return data containing a Sense Key of 6h — Unit Attention. This does not indicate a problem with the particular command that was issued but rather a normal or abnormal change in the state of the library system. This change may signal a failure or require that a different sequence of commands be issued to the changer device. For instance, after the cartridge magazine is inserted, a sequence of Move Medium or Exchange Medium commands may be required to move all tapes in the magazine to drives in order to read them. In some cases, no action is required at all, other than reissuing the original command.

The events triggering Unit Attention condition in the library system are as follows.

- The initial application of power to the library system or a bus or device reset.
- The insertion of the magazine - unless magazine operation is disabled or the medium changer device is in the Magazine Prevent state (in this case, the Unit Attention condition will be triggered on the command following the one which returns the medium changer device to the Magazine Allow state).
- The start or end of drive service via the front panel ‘Service Drive’ or ‘Restore Drive’ selections, or the Service Drive or Restore Drive command from a host.
- A change to one or more of the library system settings via the front panel ‘Set Up Library’, ‘Turn Drive Off’, or ‘Turn Drive On’ selections, or a Mode Select command from a host.
- A change to one or more of the log values via the front panel ‘Set Up Library’ selection or a Log Select command from a host.
- Closing the rear access door signalling a transition from a Not Ready to a Ready state. The host software should do a reinventory of the library because of possible tampering by the operator.
- The removal or insertion of a library power supply.
- The conclusion of an automatic MTA switch-over.

- A change in the library system Flash microcode via a Write Buffer command.

When a Unit Attention condition occurs as a result of an SCSI command issued by an initiator, it is only reported to other initiators on the same SCSI bus and not to the initiator which issued the command.

10. SCSI Commands

10.1 EXCHANGE MEDIUM Command

The **Exchange Medium** command instructs the medium changer device to exchange a cartridge in a source element with a cartridge in a first destination element and place that cartridge in a second destination element.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (A6h)							
1	Reserved (00h)							
2 - 3	(MSB)	Transport Element Address						(LSB)
4 - 5	(MSB)	Source Element Address						(LSB)
6 - 7	(MSB)	First Destination Address						(LSB)
8 - 9	(MSB)	Second Destination Address						(LSB)
10 - 11	Reserved (00h)							

The cartridge in the source element is moved to the first destination element and the cartridge which previously occupied the first destination element is moved to the second destination element.

Transport Element Address specifies the medium transport element. An address of zero may be used.

Source Element Address specifies the source element.

First Destination Address and **Second Destination Address** specify the two destination elements. The first is the destination of the cartridge originally in the Source Element Address. The second is the destination of the cartridge originally in the First Destination Address. The second destination element may not be the same as the source element.

10.2 INITIALIZE ELEMENT STATUS Command

The **Initialize Element Status** command, which would normally cause the medium changer device to test all elements for the presence of media, performs no function because the library performs this operation automatically.

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

The **NBL** field is not used and is ignored.

10.3 INITIALIZE ELEMENT STATUS WITH RANGE Command

The **Initialize Element Status with Range** command, which would normally cause the medium changer device to test a range of elements for the presence of media, performs no function because the library performs this operation automatically.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (E7h)							
1	Reserved (0)							Range
2-3	Element Address							
4-5	Reserved (00h)							
6-7	Number of Elements							
8	Reserved (00h)							
9	NBL	Reserved (0)						

The **Range, Element Address, Number of Elements, and NBL** fields are not used and are ignored.

10.4 INITIALIZE SINGLE ELEMENT Command

The **Initialize Single Element** command causes the medium changer device to test a single element for the presence of media. The status of the element can then be read using the Read Element Status command.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (C7h)							
1	Reserved (00h)							
2-3	(MSB)	Element Address						(LSB)
4-5	Reserved (00h)							

10.5 INQUIRY Command

The **Inquiry** command is issued by the initiator to request medium changer device information.

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

EVPD (Enable Vital Product Data) equals 1 if the vital product data page as specified by the Page Code field is to be returned or zero if standard Inquiry data is to be returned.

Page Code defines the parameter page for vital product to be returned. A value of 00h, 80h, or C0h must be used. These pages are described following the standard Inquiry data format.

Allocation Length specifies how many bytes of data are to be returned.

The following page details the standard Inquiry Data Format for an Allocation Length of 36.

Standard INQUIRY Data Format

Bit Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type (08h)				
1	RMB (1)	Device-Type Qualifier (0)						
2	ISO Version (0)		ECMA Version (0)			ANSI-Approved Version (3)		
3	AERC (0)	Reserved (0)			Response Data Format (2)			
4	Additional Length (20h)							
5	Reserved (00h)							
6	Reserved (0)							Addr16(1)
7	RelAdr (0)	Rsvd (0)	Wbus16 (1)	Sync (1)	Linked (0)	Rsvd (0)	CmdQue(0)	Rsvd(0)
8 - 15	Vendor Identification ("PLASMON ")							
16 - 31	Product Identification							
32 - 35	Product Revision Level (e.g., "101 ")							
36	Model Identification							

Peripheral Qualifier equals 0 indicating connection to a logical unit, or 3h indicating an invalid Logical Unit Number.

Peripheral Device Type equals 08h indicating a medium changer device, or 1Fh indicating an invalid Logical Unit Number.

RMB (Removable Media Bit) equals bit of 1 indicating medium is removable.

ANSI-Approved Version equals 3 indicating compliance with SCSI-3 standard.

AERC (Asynchronous Event Reporting Capability) equals 0 indicating no support of this feature.

Response Data Format equals 2 indicating compliance with SCSI-3 standard.

Addr16 (Address - 16 bits) equals 1 indicating support of 16-bit SCSI addresses.

RelAdr (Relative Address) equals 0 indicating no support of this feature.

WBus16 (Wide Bus - 16 bit) equals 1 indicating support of 16-bit wide data transfers.

Sync (Synchronous Data Transfers) equals 1 indicating support of this feature.

Linked (Linked Commands) equals 0 indicating no support of this feature.

CmdQue (Command Queuing) equals 0 indicating no support of this feature.

Vendor Identification is "PLASMON ".

Product Identification and **Model Identification** are set according to the following table.

Product Revision Level starts with "101 " (1.01).

Model	Product Identification	Model Identification
FTA 34	"FTA34 "	1
FTA 68	"FTA68 "	2
FTA 102	"FTA102 "	3
FTA 220	"FTA220 "	4
FTA 385	"FTA385 "	5
FTA 550	"FTA550 "	6
FTA 20	"FTA102 "	7
FTA 40	"FTA102 "	8
FTA 60	"FTA102 "	9

10.5.1 Supported Vital Product Data Pages Page (00h)

The Supported Vital Product Data Pages Page is as follows.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Peripheral Qualifier (0)			Peripheral Device Type (08h)				
1	Page Code (00h)							
2	Reserved (00h)							
3	Page Length (03h)							
4	1st Supported Page (00h)							
5	2nd Supported Page (80h)							
6	3rd Supported Page (C0h)							

10.5.2 Unit Serial Number Page (80h)

The Unit Serial Number Page is as follows.

Bit	7	6	5	4	3	2	1	0	
Byte									
0	Peripheral Qualifier (0)			Peripheral Device Type (08h)					
1	Page Code (80h)								
2	Reserved (00h)								
3	Page Length (14h)								
4 - 23	(MSB)			Product Serial Number					(LSB)

Product Serial Number is a twenty character ASCII representation of the library system's factory serial number. The least significant digit is in byte 23. ASCII spaces (20h) will be prepended to the serial number in order to fill the field.

Peripheral Qualifier and **Peripheral Device Type** are as in the Standard Inquiry Data Format.

10.5.3 Additional Unit Information Page (C0h)

The Additional Unit Information Page is as follows.

Bit Byte	7	6	5	4	3	2	1	0	
0	Peripheral Qualifier (0)			Peripheral Device Type (08h)					
1	Page Code (C0h)								
2	Reserved (00h)								
3	Page Length (35h)								
4	Firmware Development Level								
5	Hardware Development Level								
6	Rsvd (0)	Number of Magazines	Number of Pass-Throughs	Red. MTA	BC Reader	Rsvd(0)			
7 - 8	(MSB)			Total Number of Storage Slots				(LSB)	
9	Maximum Number of Drives Supported								
10	Number of Last Library Column								
11	Number of Slots in Column 1								
12	Number of Slots in Column 2								
13	Number of Slots in Column 3								
14	Number of Slots in Column 4								
15	Number of Slots in Column 5								
16	Number of Slots in Column 6								
17	Number of Slots in Column 7								
18	Number of Slots in Column 8								
19	Number of Slots in Column 9								
20	Number of Slots in Column 10								
21 - 24	Reserved (00h)								
25 - 34	Firmware Part Number ("755101-000")								
35 - 44	Reserved (00h)								
45 - 46	(MSB)			Firmware Checksum				(LSB)	
47 - 48	Reserved (00h)								
49 - 54	Library Electronic Signature								
55 - 56	Reserved (00h)								

Firmware Development Level equals one of the following.

Alpha	0
Beta	1
Release	2

Hardware Development Level equals one of the following.

Prototype	0
Pre-Production	1
Production	2

Number of Magazine equals the number of five-slot magazines supported.

Number of Pass-Throughs equals the number of pass-through elements supported.

Red. MTA equals 1 if the redundant MTA option is supported.

BC Reader equals 1 if a bar code reader is installed.

Total Number of Storage Slots does not include the magazine slots.

10.6 LOG SELECT Command

The **Log Select** command provides a means of clearing certain unit statistics, error statistics, and error log information, and setting the library system date and time.

Bit	7	6	5	4	3	2	1	0	
Byte									
0	Operation Code (4Ch)								
1	Reserved (0)						PCR (0)	SP (1)	
2	PC (1)		Reserved (0)						
3-6	Reserved (00h)								
7-8	(MSB)				Parameter List Length				(LSB)
9	Reserved (00h)								

PCR (Parameter Code Reset) equals 0 indicating that not all log parameters are to be reset. Certain parameters, such as the total power-on hours count and library cycle count, cannot be reset.

SP (Save Parameters) equals 1 indicating that all parameter value changes are to be saved in non-volatile memory.

PC (Page Control) equals 1 indicating that current cumulative values are to be affected.

Parameter List Length specifies the length in bytes of the Log Select parameters list.

The Log Select parameter list consists of one or more of the following supported pages.

10.6.1 Error Statistics Page (31h)

The Log Select Error Statistics Page is as follows.

Bit	7	6	5	4	3	2	1	0	
Byte									
0	Reserved (0)		Page Code (31h)						
1	Reserved (00h)								
2-3	(MSB)				Page Length (00h)				(LSB)

Sending this page will clear all library error statistics information.

10.6.2 Error Log Page (32h)

The Log Select Error Log Page is as follows.

Bit	7	6	5	4	3	2	1	0	
Byte									
0	Reserved (0)		Page Code (32h)						
1	Reserved (00h)								
2-3	(MSB)		Page Length (00h)						(LSB)

Sending this page will clear all library error log information.

10.6.3 Event History Page (33h)

The Log Select Event History Page is as follows.

Bit	7	6	5	4	3	2	1	0	
Byte									
0	Reserved		Page Code (33h)						
1	Reserved (00h)								
2-3	(MSB)		Page Length (02h)						(LSB)
4-5	(MSB)		Number of Events Recorded (00h)						(LSB)

Sending this page will clear all event history information.

10.6.4 Micro-Operation Page (34h)

The Log Select Micro-Operation Page is as follows.

Bit	7	6	5	4	3	2	1	0	
Byte									
0	Reserved		Page Code (34h)						
1	Reserved (00h)								
2-3	(MSB)		Page Length (01h)						(LSB)
4	Number of Micro-Operations Recorded (00h)								

Sending this page will clear all micro operation information.

10.6.5 Library Time Page (35h)

The Log Select Library Time Page is as follows.

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved (0)		Page Code (35h)					
1	Reserved (00h)							
2 - 3	(MSB)		Page Length (08h)				(LSB)	
4	Current Library Time - Seconds (0 - 59)							
5	Current Library Time - Minutes (0 - 59)							
6	Current Library Time - Hour (0 - 23)							
7	Reserved (ignored)							
8	Current Library Time - Day (1 - 31)							
9	Current Library Time - Month (1 - 12)							
10	Current Library Time - Year (0 for 2000, 1 for 2001, ...)							
11	Reserved (00h)							

Current Library Time is the current time as maintained by the library system. Sending this page sets the library system time clock.

10.6.6 Drive Load Counts Page (36h)

The Log Select Drive Load Counts Page is as follows.

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved (0)		Page Code (36h)					
1	Reserved (00h)							
2 - 3	(MSB)		Page Length (21h)				(LSB)	
4 - 6	(MSB)		Drive 1 Load Count				(LSB)	
7 - 9	(MSB)		Drive 2 Load Count				(LSB)	
10 - 12	(MSB)		Drive 3 Load Count				(LSB)	
13 - 15	(MSB)		Drive 4 Load Count				(LSB)	
16 - 18	(MSB)		Drive 5 Load Count				(LSB)	
19 - 21	(MSB)		Drive 6 Load Count				(LSB)	
22 - 24	(MSB)		Drive 7 Load Count				(LSB)	
25 - 27	(MSB)		Drive 8 Load Count				(LSB)	
28 - 30	(MSB)		Drive 9 Load Count				(LSB)	
31 - 33	(MSB)		Drive 10 Load Count				(LSB)	
34 - 36	Reserved (00h)							

If any of the **Drive 1-10 Load Count** fields is equal to zero, the load count of the corresponding drive will be set to zero.

10.6.7 Drive Over-Temperature Page (38h)

The Log Select Drive Over-Temperature Page is as follows.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved (0)		Page Code (38h)					
1	Reserved (00h)							
2-3	(MSB)		Page Length (00h)				(LSB)	

Sending this page will reset the library Drive Over-Temperature values.

10.6.8 Drive Fan Tachometer Page (39h)

The Log Select Drive Fan Tachometer Page is as follows.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved (0)		Page Code (39h)					
1	Reserved (00h)							
2-3	(MSB)		Page Length (00h)				(LSB)	

Sending this page will reset the library Drive Fan Tachometer values.

10.7 LOG SENSE Command

The **Log Sense** command provides a means for reporting medium changer device statistical and error log information.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (4Dh)							
1	Reserved (00h)							
2	PC (1)		Page Code					
3-6	Reserved (00h)							
7-8	(MSB)		Allocation Length				(LSB)	
9	Reserved (00h)							

PC (Page Control) equals 1 indicating that current cumulative values are to be returned.

Page Code defines the parameter page to be returned. A value of 00h, 30h, 31h, 32h, 33h, 34h, 35h, 36h, 37h, 38h or 39h must be used. The corresponding page as described below is returned.

Allocation Length specifies how many bytes of data are to be returned.

10.7.1 Supported Log Pages Page (00h)

The Log Sense Supported Log Pages Page is as follows.

Bit Byte	7	6	5	4	3	2	1	0	
0	Reserved (0)		Page Code (00h)						
1	Reserved (00h)								
2 - 3	(MSB)			Page Length (0Bh)					(LSB)
4	1st Supported Page (00h)								
5	2nd Supported Page (30h)								
6	3rd Supported Page (31h)								
7	4th Supported Page (32h)								
8	5th Supported Page (33h)								
9	6th Supported Page (34h)								
10	7th Supported Page (35h)								
11	8th Supported Page (36h)								
12	9th Supported Page (37h)								
13	10th Supported Page (38h)								
14	11th Supported Page (39h)								

10.7.2 Unit Statistics Page (30h)

The Log Sense Unit Statistics Page is as follows.

Bit Byte	7	6	5	4	3	2	1	0	
0	Reserved (0)		Page Code (30h)						
1	Reserved (00h)								
2 - 3	(MSB)			Page Length (0Ch)					(LSB)
4 - 6	(MSB)			Library Power-On Hours					(LSB)
7	Library Power-On Minutes								
8	Library Power-On Seconds								
9 - 12	(MSB)			Library Cycle Count					(LSB)
13 - 15	(MSB)			Reserved (00h)					(LSB)

Library Power-On Time equals the total number of hours, minutes, and seconds that power has been applied to the library.

Library Cycle Count equals the total number of times that a cartridge has been loaded into any of the drives in the library – even if those drives were later removed or replaced.

10.7.3 Error Statistics Page (31h)

The Log Sense Error Statistics Page is as follows.

Bit	7	6	5	4	3	2	1	0	
Byte									
0	Reserved (0)		Page Code (31h)						
1	Reserved (00h)								
2 - 3	(MSB)		Page Length (64h)						(LSB)
4 - 13	1st Most Frequent Error Info								
14 - 23	2nd Most Frequent Error Info								
	:								
94 - 103	10th Most Frequent Error Info								

Each set of most frequent error parameters contains error rate information for one of the most frequently occurring errors. The format of these error parameters is as follows.

Bit	7	6	5	4	3	2	1	0	
Byte									
0	Error Code								
1 - 2	(MSB)		Error Count						(LSB)
3 - 4	(MSB)		Number of Recoverable Errors						(LSB)
5 - 6	(MSB)		Number of Unrecoverable Errors						(LSB)
7 - 9	(MSB)		Power-On Hours at Last Occurrence						(LSB)

Error Code is a code for the error which occurred. The error codes are listed in Section 12.3. Only hardware errors are recorded.

Error Count is a count of the number of times that the error occurred. A value of 65535 indicates that the error occurred this many or more times.

Number of Recovered Errors is a count of the number of times that the library system was able to recover from this error - that is, the number of times that it returned Sense Key 1 Recovered Error status to the host in response to a Request Sense command issued after this error was generated; or that it was able to successfully complete the operation in progress when this error was generated in maintenance or setup modes.

Number of Unrecovered Errors is a count of the number of times that the library system was unable to recover from this error even after performing retries.

Power-On Hours at Last Occurrence is equal to the number of library system power-on hours when this error last occurred.

10.7.4 Error Log Page (32h)

The Log Sense Error Log Page is as follows.

Bit Byte	7	6	5	4	3	2	1	0	
0	Reserved (0)		Page Code (32h)						
1	Reserved (00h)								
2 - 3	(MSB)			Page Length (1D9h)				(LSB)	
4 - 46	1st Most Recent Error Info Block								
47 - 89	2nd Most Recent Error Info Block								
90 - 132	3rd Most Recent Error Info Block								
133 - 175	4th Most Recent Error Info Block								
176 - 218	5th Most Recent Error Info Block								
219 - 261	6th Most Recent Error Info Block								
262 - 304	7th Most Recent Error Info Block								
305 - 347	8th Most Recent Error Info Block								
348 - 390	9th Most Recent Error Info Block								
391 - 433	10th Most Recent Error Info Block								
434 - 476	Reserved (00h)								

Each set of the most recent error parameters contains information for one of the most recently occurring errors. The format of these errors is as follows.

Bit Byte	7	6	5	4	3	2	1	0
0	Error Code							
1	Initiating Command							
2 - 3	(MSB) _____		Source Element Address				_____ (LSB)	
4 - 5	(MSB) _____		Destination Element Address				_____ (LSB)	
6 - 7	(MSB) _____		Failure Element Address				_____ (LSB)	
8 - 9	(MSB) _____		Recurrence Count				_____ (LSB)	
10	Component Number							
11	Error Subcode							
12	Error Type							
13	Error Context							
14 - 15	Internal Error Location							
16 - 17	Reserved (0)							
18	Lift Elevation State							
19 - 22	(MSB) _____		Lift Offset				_____ (LSB)	
23 - 24	(MSB) _____		Picker Step Count				_____ (LSB)	
25 - 26	(MSB) _____		Pivot Offset				_____ (LSB)	
27	Reserved (0)					MTA	Rsvd(0)	
28 - 29	Reserved (00h)							
30 - 31	(MSB) _____		Mailslot or Pass-Through Step Count				_____ (LSB)	
32	Time at First Occurrence – Year (0 for 2000, 1 for 2001, ...)							
33	Time at First Occurrence – Month (1 - 12)							
34	Time at First Occurrence – Day (1 - 31)							
35	Time at First Occurrence – Hour (0 - 23)							
36	Time at First Occurrence – Minutes (0 - 59)							
37	Time at First Occurrence – Seconds (0 - 59)							
38 - 41	(MSB) _____		Library Cycle Count at First Occurrence				_____ (LSB)	
42	Reserved (00h)							

Error Code is a code for the error that occurred. The error codes are listed in Section 12.3. Only hardware errors are recorded.

Initiating Command is the operation code of the SCSI command that initiated the operation or a value from the following table.

Command	Meaning
0 - F7h	Operation code of initiating SCSI command
F8h	Error occurred during library and drive power-up
F9h	Error occurred during on-line library initialization
FAh	Error occurred while performing some operator-initiated action (such as opening or closing the mailslot from the front panel)
FBh	Error occurred during routine sensor and cable checks
FCh	Error occurred during some remotely initiated operation
FDh	Error occurred while performing some on-line menu operation
FEh	Error occurred while in library set up mode
FFh	Error occurred while in library maintenance mode

Source Element Address and **Destination Element Address** are the source and destination addresses for the Position to Element, Move Medium, and Exchange Medium commands. For the Exchange Medium command, these represent either the Source and First Destination Addresses, the First and Second Destination Address or some other intermediate addresses.

Failure Element Address is the address of the closest element to which the medium transport element specified by the Medium Transport Element Number was positioned when the error occurred.

Recurrence Count is a count of the number of consecutive times that the error occurred, including retries, with all other information being identical between instances. The total of these identical instances is recorded as one log entry.

Error Type indicates the general type of error and the interpretation of the **Component Number** and **Error Subcode** fields. The relationship between Error Type and Component Number is shown in the following table. The Error Subcodes are listed in the LTO Series User’s Guide and Service Manuals.

Error Type	Meaning of Error Type	Component Number
1	General hardware errors	Not used
2	Errors associated with a specific element position	Not used
3	Errors associated with a specific library system column	Column number
4	Errors associated with a specific library system drive	Drive number
6	Errors associated with a specific power supply	Power supply number
7	Errors associated with a specific drive module	Drive module number
8	Errors associated with the magazine	Not used
9	Errors associated with a specific printed wire assembly	PWA number

Error Context is a code for the context in which the error occurred. The error context codes are listed in Section 12.4.

Internal Error Location is a number which is useful to Plasmon technical support.

Lift Elevation State is the current state of the lift’s elevation for performing various library operations. The lift elevation states are as follows.

State	Meaning
0	Lift at elevation at which to pick a cartridge from a slot
1	Lift at elevation at which to store a cartridge to a slot
2	Lift at elevation at which to load a cartridge into a drive
3	Lift at elevation at which to unload a cartridge from a drive
FFh	Lift at indeterminate elevation

Lift Offset is a signed lift encoder count offset from the count associated with the Failure Element Address in block A at the Lift Elevation State above.

Picker Step Count is a signed motor step count for the picker when the error occurred.

Pivot Offset is a signed pivot step count offset from the count associated with the Failure Element Address in block A.

MTA is the MTA (0 or 1) in effect when the error occurred. MTA 0 is the primary MTA, MTA 1 is the alternate MTA.

Mailslot or Pass-Thru Step Count is a signed motor step count for the mailslot or a pass-thru element, depending upon the failing element.

Time at First Occurrence is equal to the library time (see Library Time page) when this error first occurred (recurrence count = 1).

Library Cycle Count at First Occurrence is the number of times that a cartridge has been loaded into the drives in the library at the time of the first error.

10.7.5 Event History Page (33h)

The Log Sense Event History Page is as follows.

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved (0)		Page Code (33h)					
1	Reserved (00h)							
2 - 3	(MSB) _____			Page Length (0802h)				_____ (LSB)
4 - 5	(MSB) _____			Number of Events Recorded				_____ (LSB)
6 - 2053	Event List							

Number of Events Recorded is the number of significant bytes in the Event List.

Event List is a list of events from most recent to least recent within the library system. The contents of this list is determined by the Event History Type field of the Vendor Unique Modes Parameters Page of the Mode Select command (see Section 10.8.1). For a description of possible events within this list see Section 11. This list may be helpful to technical support personnel in diagnosing problems with the library system.

10.7.6 Micro-Operation Page (34h)

The Log Sense Micro-Operation Page is as follows.

Bit Byte	7	6	5	4	3	2	1	0	
0	Reserved (0)		Page Code (34h)						
1	Reserved (00h)								
2 - 3	(MSB) _____			Page Length (x-3)					_____ (LSB)
4	Number of Micro-Operations Recorded								
5	Size of Block for Each Micro-Operation								
6 - x	Micro-Operation List								

Number of Micro-Operations Recorded is the number of blocks of information recorded in the micro-operation list.

Size of Block for Each Micro-Operation is the size of each block of information in the micro-operation list.

Micro-Operation List is a list of operations performed by the library system for the last failing cartridge movement command. This list may be helpful to technical support personnel in diagnosing problems with the library system.

10.7.7 Library Time Page (35h)

The Log Sense Library Time Page is as follows.

Bit Byte	7	6	5	4	3	2	1	0	
0	Reserved (0)		Page Code (35h)						
1	Reserved (00h)								
2 - 3	(MSB) _____			Page Length (08h)					_____ (LSB)
4	Current Library Time – Seconds (0 - 59)								
5	Current Library Time – Minutes (0 - 59)								
6	Current Library Time – Hour (0 - 23)								
7	Current Library Time – Day of Week (1=Sunday, 2=Monday, ...)								
8	Current Library Time – Day (1 - 31)								
9	Current Library Time – Month (1 - 12)								
10	Current Library Time – Year (0 for 2000, 1 for 2001, ...)								
11	Reserved (00h)								

Current Library Time is the current time as maintained by the library system. The time may be set using the Log Select command.

10.7.8 Drive Load Counts Page (36h)

The Log Sense Drive Load Counts Page is as follows.

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved (0)		Page Code (36h)					
1	Reserved (00h)							
2 - 3	(MSB) _____			Page Length (21h)				_____ (LSB)
4 - 6	(MSB) _____			Drive 1 Load Count				_____ (LSB)
7 - 9	(MSB) _____			Drive 2 Load Count				_____ (LSB)
10 - 12	(MSB) _____			Drive 3 Load Count				_____ (LSB)
13 - 15	(MSB) _____			Drive 4 Load Count				_____ (LSB)
16 - 18	(MSB) _____			Drive 5 Load Count				_____ (LSB)
19 - 21	(MSB) _____			Drive 6 Load Count				_____ (LSB)
22 - 24	(MSB) _____			Drive 7 Load Count				_____ (LSB)
25 - 27	(MSB) _____			Drive 8 Load Count				_____ (LSB)
28 - 30	(MSB) _____			Drive 9 Load Count				_____ (LSB)
31 - 33	(MSB) _____			Drive 10 Load Count				_____ (LSB)
34 - 36	Reserved (00h)							

Drive 1-10 Load Count equals the number of times the corresponding drive has been loaded.

10.7.9 Cumulative Counts Page (37h)

The Log Sense Cumulative Counts Page is as follows.

Bit Byte	7	6	5	4	3	2	1	0	
0	Reserved (0)		Page Code (37h)						
1	Reserved (00h)								
2 - 3	(MSB) _____		Page Length (44h)						(LSB)
4 - 7	(MSB) _____		Cumulative Lift Movement Count						(LSB)
8 - 11	(MSB) _____		Cumulative Picker Movement Count						(LSB)
12 - 15	(MSB) _____		Cumulative Pivot Movement Count						(LSB)
16 - 19	(MSB) _____		Cumulative Mailslot Open Count						(LSB)
20 - 23	(MSB) _____		Cumulative Lift Up/Down Distance Count						(LSB)
24 - 27	(MSB) _____		Cumulative Picker In/Out Distance Count						(LSB)
28 - 31	(MSB) _____		Cumulative Pivot Left/Right Rotation Count						(LSB)
32 - 35	Reserved (00h)								
36 - 39	(MSB) _____		Cumulative Magazine Release Count						(LSB)
40 - 43	(MSB) _____		Cumulative Lift Movement Count – Alt MTA						(LSB)
44 - 47	(MSB) _____		Cumulative Picker Movement Count - Alt MTA						(LSB)
48 - 51	(MSB) _____		Cumulative Lift Up/Down Distance Count - Alt MTA						(LSB)
52 - 55	(MSB) _____		Cumulative Picker In/Out Distance Count - Alt MTA						(LSB)
56 - 59	Reserved (00h)								
60 - 63	(MSB) _____		Cumulative Pass-Through 1 Count						(LSB)
64 - 67	(MSB) _____		Cumulative Pass-Through 2 Count						(LSB)
68 - 71	Reserved (00h)								

The **Cumulative Lift Movement Count** is incremented every time the medium transport element is moved vertically (up or down).

The **Cumulative Picker Movement Count** is incremented every time the medium transport element is moved horizontally (in or out).

The **Cumulative Pivot Movement Count** is incremented every time the lift assembly is pivoted to reach another column of slots or drives, or the mailslot.

The **Cumulative Mailslot Open Count** is incremented every time the mailslot is opened.

The **Cumulative Lift Up/Down Distance Count** is incremented by the distance traveled every time the medium transport element is moved vertically (up or down). The count is in units of meters.

The **Cumulative Picker In/Out Distance Count** is incremented by the distance traveled every time the medium transport element is moved horizontally (in or out). The count is in units of meters.

The **Cumulative Pivot Left/Right Rotation Count** is incremented by the angular distance traveled every time the medium transport element is rotated (left or right). The count is in units of radians.

The **Cumulative Magazine Release Count** is incremented every time the magazine release solenoid is activated.

The **Cumulative Lift Movement Count – Alt MTA** is incremented every time the alternate medium transport element is moved vertically (up or down).

The **Cumulative Picker Movement Counts – Alt MTA** is incremented every time the alternate medium transport element is moved horizontally (in or out).

The **Cumulative Lift Up/Down Distance Count – Alt MTA** is incremented by the distance traveled every time the alternate medium transport element is moved vertically (up or down). The count is in units of meters.

The **Cumulative Picker In/Out Distance Count – Alt MTA** is incremented by the distance traveled every time either alternate picker in the alternate medium transport element is moved (in or out). The count is in units of meters.

The **Cumulative Pass-Through 1,2 Count** is incremented every time the corresponding pass-through mechanism is used.

See the LTO Series Library System User’s Guide or Service Manual for further information about these values.

10.7.10 Drive Over-Temperature Page (38h)

The Log Sense Drive Over-Temperature Page is as follows.

Bit	7	6	5	4	3	2	1	0	
Byte									
0	Reserved (0)		Page Code (38h)						
1	Reserved (00h)								
2-3	(MSB)			Page Length (43h)					(LSB)
4	Drive 1 Over-Temp. Temperature								
5	Time of Last Occurrence – Year								
6	Time of Last Occurrence - Month								
7	Time of Last Occurrence – Day								
8	Time of Last Occurrence – Hour								
9	Time of Last Occurrence - Minute								
10	Drive 2 Over-Temp. Temperature								
11	Time of Last Occurrence – Year								
12	Time of Last Occurrence - Month								
13	Time of Last Occurrence – Day								
14	Time of Last Occurrence – Hour								
15	Time of Last Occurrence - Minute								
16	Drive 3 Over-Temp. Temperature								
17	Time of Last Occurrence – Year								
18	Time of Last Occurrence - Month								
19	Time of Last Occurrence – Day								
20	Time of Last Occurrence – Hour								

21	Time of Last Occurrence - Minute
22	Drive 4 Over-Temp. Temperature
23	Time of Last Occurrence – Year
24	Time of Last Occurrence - Month
25	Time of Last Occurrence – Day
26	Time of Last Occurrence – Hour
27	Time of Last Occurrence - Minute
28	Drive 5 Over-Temp. Temperature
29	Time of Last Occurrence – Year
30	Time of Last Occurrence - Month
31	Time of Last Occurrence – Day
32	Time of Last Occurrence – Hour
33	Time of Last Occurrence - Minute
34	Drive 6 Over-Temp. Temperature
35	Time of Last Occurrence – Year
36	Time of Last Occurrence - Month
37	Time of Last Occurrence – Day
38	Time of Last Occurrence – Hour
39	Time of Last Occurrence - Minute
40	Drive 7 Over-Temp. Temperature
41	Time of Last Occurrence – Year
42	Time of Last Occurrence - Month
43	Time of Last Occurrence – Day
44	Time of Last Occurrence – Hour
45	Time of Last Occurrence - Minute
46	Drive 8 Over-Temp. Temperature
47	Time of Last Occurrence – Year
48	Time of Last Occurrence - Month
49	Time of Last Occurrence – Day
50	Time of Last Occurrence – Hour
51	Time of Last Occurrence - Minute
52	Drive 9 Over-Temp. Temperature
53	Time of Last Occurrence – Year
54	Time of Last Occurrence - Month
55	Time of Last Occurrence – Day
56	Time of Last Occurrence – Hour
57	Time of Last Occurrence - Minute
58	Drive 10 Over-Temp. Temperature
59	Time of Last Occurrence – Year
60	Time of Last Occurrence - Month
61	Time of Last Occurrence – Day
62	Time of Last Occurrence – Hour
63	Time of Last Occurrence - Minute
64 - 70	Reserved (00h)

Drive 1–10 Over-Temp. Temperature is the drive temperature in degrees Celsius which caused a drive over-temperature condition.

Time of Last Occurrence is the time of the last over-temperature condition.

See the appropriate LTO Series Library System User’s Guide or Service Manual for further information about these values.

10.7.11 Drive Fan Tachometer Page (39h)

The Log Sense Drive Fan Tachometer Page is as follows.

Bit Byte	7	6	5	4	3	2	1	0	
0	Reserved (0)		Page Code (39h)						
1	Reserved (00h)								
2 - 3	(MSB)		Page Length (58h)						(LSB)
4	Drive 1 Fan 1 Tachometer Value								
5	Drive 1 Fan 2 Tachometer Value								
6	Time of Last Occurrence - Year								
7	Time of Last Occurrence - Month								
8	Time of Last Occurrence - Day								
9	Time of Last Occurrence - Hour								
10	Time of Last Occurrence - Minute								
11	Drive 2 Fan 1 Tachometer Value								
12	Drive 2 Fan 2 Tachometer Value								
13	Time of Last Occurrence - Year								
14	Time of Last Occurrence - Month								
15	Time of Last Occurrence - Day								
16	Time of Last Occurrence - Hour								
17	Time of Last Occurrence - Minute								
18	Drive 3 Fan 1 Tachometer Value								
19	Drive 3 Fan 2 Tachometer Value								
20	Time of Last Occurrence - Year								
21	Time of Last Occurrence - Month								
22	Time of Last Occurrence - Day								
23	Time of Last Occurrence - Hour								
24	Time of Last Occurrence - Minute								
25	Drive 4 Fan 1 Tachometer Value								
26	Drive 4 Fan 2 Tachometer Value								
27	Time of Last Occurrence - Year								
28	Time of Last Occurrence - Month								
29	Time of Last Occurrence - Day								
30	Time of Last Occurrence - Hour								
31	Time of Last Occurrence - Minute								
32	Drive 5 Fan 1 Tachometer Value								
33	Drive 5 Fan 2 Tachometer Value								
34	Time of Last Occurrence - Year								
35	Time of Last Occurrence - Month								
36	Time of Last Occurrence - Day								
37	Time of Last Occurrence - Hour								
38	Time of Last Occurrence - Minute								
39	Drive 6 Fan 1 Tachometer Value								
40	Drive 6 Fan 2 Tachometer Value								
41	Time of Last Occurrence - Year								
42	Time of Last Occurrence - Month								
43	Time of Last Occurrence - Day								
44	Time of Last Occurrence - Hour								
45	Time of Last Occurrence - Minute								

46	Drive 7 Fan 1 Tachometer Value
47	Drive 7 Fan 2 Tachometer Value
48	Time of Last Occurrence - Year
49	Time of Last Occurrence - Month
50	Time of Last Occurrence - Day
51	Time of Last Occurrence - Hour
52	Time of Last Occurrence - Minute
53	Drive 8 Fan 1 Tachometer Value
54	Drive 8 Fan 2 Tachometer Value
55	Time of Last Occurrence - Year
56	Time of Last Occurrence - Month
57	Time of Last Occurrence - Day
58	Time of Last Occurrence - Hour
59	Time of Last Occurrence - Minute
60	Drive 9 Fan 1 Tachometer Value
61	Drive 9 Fan 2 Tachometer Value
62	Time of Last Occurrence - Year
63	Time of Last Occurrence - Month
64	Time of Last Occurrence - Day
65	Time of Last Occurrence - Hour
66	Time of Last Occurrence - Minute
67	Drive 10 Fan 1 Tachometer Value
68	Drive 10 Fan 2 Tachometer Value
69	Time of Last Occurrence - Year
70	Time of Last Occurrence - Month
71	Time of Last Occurrence - Day
72	Time of Last Occurrence - Hour
73	Time of Last Occurrence - Minute
74 - 91	Reserved (00h)

Drive 1–10 Fan 1, 2 Tachometer Value is the value of the fan tachometer which caused a drive fan under-speed condition. The value given is the percentage of full (rated) fan speed.

Time of Last Occurrence is the time of the last fan under-speed condition.

See the appropriate LTO Series Library System User’s Guide or Service Manual for further information about these values.

10.8 MODE SELECT (6) Command

The **Mode Select (6)** command provides a means for the initiator to select medium changer device parameters.

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

PF (Page Format) equals 1 indicating that parameters are structured as pages of related parameters.

SP (Save Pages) equals 1 if the target is to save changeable parameters in pages, i.e., if values are to be saved to non-volatile memory. If this bit is 0, values are not saved when power is cycled to the library or when it receives a Bus Device Reset message or the SCSI Reset line is asserted.

Parameter List Length specifies the length in bytes of the Mode Select (6) parameter list.

The Mode Select (6) parameter list consists of a 4 byte header followed by one or more of the medium changer device's supported pages. The header is shown below followed by the supported pages.

Mode Select (6) Mode Parameter Header

Bit Byte	7	6	5	4	3	2	1	0
0	Mode Data Length (00h)							
1	Medium Type (00h)							
2	Device-Specific Parameter (00h)							
3	Block Descriptor Length (00h)							

10.8.1 Library Mode Parameters Page (20h)

The Mode Select Library Mode Parameters Page is as follows.

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved (0)		Page Code (20h)					
1	Parameter Length (08h)							
2	Reserved (0)			ChgrEject	Rsvd (0)	WaitLoad	Reserved (0)	
3 - 7	Reserved (00h)							
8	SetType	Event History Type (bits 8 - 14)						
9	Event History Type (bits 0 - 7)							

ChgrEject equals 1 if the medium changer device is to eject a cartridge from an tape drive in response to a Move Medium or Exchange Medium command with the drive specified as the Source Element (or First Destination). If this bit is not set then the host software is responsible for ejecting the cartridge from the tape drive before the Move Medium or Exchange Medium command is issued. The default for this bit is 0.

WaitLoad equals 1 if the medium changer device is to wait for a Ready response from a tape drive in response to a Move Medium or Exchange Medium command with the drive specified as the Destination Element (or Second Destination). Command completion status is not returned to the host until the host is ready, or 60 seconds have elapsed in which case a failing status is returned. If this bit is not set then the host is responsible for waiting until the tape drive is ready. The default for this bit is 0.

SetType equals 1 if the Event History Type is to be set or 0 if it is to remain unchanged.

Event History Type (bits 0-7,8-14) specifies the type of event history to collect for diagnostic purposes (see Section 11). No history information will be collected for a value of 0. For a further description of this byte see Section 11. The default for this byte is 00BBh (187).

10.8.2 Library Special Modes Page (21h)

The Mode Select Library Special Modes Page is as follows.

Bit	7	6	5	4	3	2	1	0
0	Reserved (0)		Page Code (21h)					
1	Parameter Length (08h)							
2	LightOff	Reserved (0)						
3	Reserved (00h)							
4	SetOptions4	Reserved (0)		EnabMag	EnabMslot	EnabBCR	EnabAMS	Rsvd (0)
5-6	Reserved (00h)							
7	SetBCType	Bar Code Type						
8	SetOptions8	Reserved (0)						EnabAllUA
9	Reserved (00h)							

LightOff equals 1 if the medium changer device is to leave its front panel ACTIVE light off for future SCSI bus activity. This is useful for element status polling. The ACTIVE light will remain enabled for any motor activity regardless of the setting of this bit. A 0 in this field reenables the ACTIVE light for SCSI bus activity.

SetOptions4 equals 1 if any of the options in byte 4 are to be changed, or 0 if they are to remain unchanged.

EnabMag equals 1 if the magazine is to be enabled. The default for this bit is 1.

EnabMslot equals 1 if the mailslot is to be enabled. The default for this bit is 0. This field cannot be changed for the Model 20, 40, and 60 library systems since they do not have a mailslot.

EnabBCR equals 1 if the bar code reader is to be enabled. The default for this bit is 1.

EnabAMS equals 1 if automatic MTA switch-over (from the primary MTA to the alternate MTA) is to be enabled. The default for this bit is 0.

SetBCType equals 1 if the bar code type is to be changed, or 0 if it is to remain unchanged.

Bar Code Type specifies the type of bar code labels used in the library. The default for this field is 1.

SetOptions8 equals 1 if any of the options in byte 8 are to be changed, or 0 if they are to remain unchanged.

EnabAllUA equals 1 if all Unit Attention conditions are to be enabled. If this bit is 0, only three Unit Attention conditions will be returned: Power-On, Reset, Bus Device Reset; Log Parameters Changed; and Mode Parameters Changed. The default for this bit is 1.

10.8.3 Front Panel Display Mode Page (23h)

The Mode Select Front Panel Display Mode Page is as follows.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved (0)		Page Code (23h)					
1	Parameter Length (52h)							
2	Tone	LightOff	Section1	Reserved (0)			ClrKeys	DispMode
3 - 22	Line 3 Display Text							
23 - 42	Line 4 Display Text							
43	Blink	Rsvd (0)	Section2	Reserved (0)				
44 - 63	Line 1 Display Text							
64 - 83	Line 2 Display Text							

Tone equals 1 if a short alert tone is to be sounded within the library system. This bit is only effective if DispMode is set to 1 and Section1 is set to 0.

LightOff equals 1 if the front panel ACTIVE light is to be left in the off state for SCSI bus activity while the DispMode bit is set. This is useful for element status and key polling.

Section1, Section2 indicates equals the section of the display to control if DispMode equals 1.

Section1	Section2	Section to Control
0	0	Entire four lines of display including keypad
0	1	Lines 3 and 4 including keypad
1	0	Lines 1 and 2 (display only - no keypad polling)
1	1	Reserved

ClrKeys equals 1 to clear all front panel key flags in preparation for subsequent key polling with the Mode Sense command. This bit is only effective if DispMode is set to 1 and Section1 is set to 0.

DispMode equals 1 to gain and maintain control a section of the library system front panel display or 0 to release control. DispMode will not be effective while the on-line menu is selected at the library front panel interface (see the MenuSeld bit in the Mode Sense front panel display mode page - Section 10.10.7).

Blink equals 1 if the backlight on the display is to repeatedly blink on and off. This can be used to give visual indication of an error or service required condition. This bit is only effective if DispMode is set to 1.

Line 1-4 Display Text is the ASCII representation of text to be displayed on the corresponding line of the library system front panel display.

In addition to the ASCII characters 20h (‘ ’) through 7Dh (‘}’), the following characters are available: FEh=‘[’, 01h=‘]’, 02h=‘⌘’, 04h=‘⌘’, 05h=‘□’, 06h=‘⌘’, 07h=‘■’, 7Eh=‘⌘’, and 7Fh=‘⌘’, and A5h=‘▪’.

10.9 MODE SELECT (10) Command

The **Mode Select (10)** command provides a means for the initiator to select medium changer device parameters. It performs the same function as the Mode Select (6) command.

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

PF (Page Format) equals 1 indicating that parameters are structured as pages of related parameters.

SP (Save Pages) equals 1 if the target is to save changeable parameters in pages.

Parameter List Length specifies the length in bytes of the Mode Select (10) parameter list.

The Mode Select (10) parameter list consists of a 8 byte header followed by one or more of the medium changer device's supported pages. The header is shown below.

Mode Select (10) Mode Parameter Header

Bit Byte	7	6	5	4	3	2	1	0
0-1	Mode Data Length (00h)							
2	Medium Type (00h)							
3	Device-Specific Parameter (00h)							
4-5	Reserved (00h)							
6-7	Block Descriptor Length (00h)							

See the Mode Select (6) command (Section 10.8) for information about supported mode pages.

10.10 MODE SENSE (6) Command

The **Mode Sense (6)** command provides a means for reporting medium changer device to an initiator.

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

DBD (Disable Block Descriptor) is ignored.

PC (Page Control) defines the type of parameter values to be returned. Normally, a value of 0 is used to return the current values.

Page Code defines the parameter page(s) to be returned. A value of 00h, 1Dh, 1Eh, 1Fh, 20h, 21h, 22h, 23h, or 3Fh must be used. If a value of 0 is used, no pages are returned. If a value of 1Dh, 1Eh, 1Fh, 20h, 21h, 22h, or 23h, is used, the corresponding page as described below is returned. If a value of 3Fh is used, all supported pages are returned.

The **Allocation Length** specifies how many bytes of data are to be returned.

The Mode Sense (6) data block consists of a 4 byte header followed by one or more supported pages. The header is shown below followed by the supported pages.

Mode Sense (6) Mode Parameter Header

Bit Byte	7	6	5	4	3	2	1	0
0	Mode Data Length							
1	Medium Type (00h)							
2	Device-Specific Parameter (00h)							
3	Block Descriptor Length (00h)							

Mode Data Length is the length in bytes of the remainder of the Mode Sense (6) return data.

10.10.1 Element Address Assignment Page (1Dh)

The Mode Sense Element Address Assignment Page is as follows.

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

See the tables in Section 6 for the element addresses and counts returned in this page. It should be noted that the number of data transfer elements is the number of the last installed drive which is turned on. Examine the IDValid bit or the ASC/ASCQ values in the Read Element Status data transfer element descriptors (see Section 10.17.4) to determine if specific drives are present and turned on.

10.10.2 Transport Geometry Parameters Page (1Eh)

The Mode Sense Transport Geometry Parameters Page is as follows.

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

10.10.3 Device Capabilities Page (1Fh)

The Mode Sense Device Capabilities Page is as follows.

Bit	7	6	5	4	3	2	1	0	
Byte									
0	PS(0)	Rsvd (0)	Page Code (1Fh)						
1	Parameter Length (12h)								
2	Reserved (0)				StorD(1)	StorI(1)	StorS(1)	StorM(0)	
3	Reserved (00h)								
4	Reserved (0)				M → D(1)	M → I(1)	M → S(1)	M → M(1)	
5	Reserved (0)				S → D(1)	S → I(1)	S → S(1)	S → M(1)	
6	Reserved (0)				I → D(1)	I → I(1)	I → S(1)	I → M(1)	
7	Reserved (0)				D → D(1)	D → I(1)	D → S(1)	D → M(1)	
8 - 11	Reserved (00h)								
12	Reserved (0)				M ↔ D(0)	M ↔ I(0)	M ↔ S(0)	M ↔ M(0)	
13	Reserved (0)				S ↔ D(1)	S ↔ I(1)	S ↔ S(1)	S ↔ M(1)	
14	Reserved (0)				I ↔ D(0)	I ↔ I(0)	I ↔ S(0)	I ↔ M(0)	
15	Reserved (0)				D ↔ D(1)	D ↔ I(1)	D ↔ S(1)	D ↔ M(1)	
16 - 19	Reserved (00h)								

Where **D** is a data transfer element
I is the Import / Export Element
S is a storage element
M is the medium transport element
Stor indicates storage capability
→ indicates Move Medium capability (first element type is for Source, second element type is for Destination)
↔ indicates Exchange Medium capability (first element type is for Source and Second Destination, second element type is for First Destination)

and the available capabilities are as indicated (1 means yes in all cases and 0 means no in at least some cases).

10.10.4 Library Mode Parameters Page (20h)

The Mode Sense Library Mode Parameters Page is as follows.

Bit Byte	7	6	5	4	3	2	1	0	
0	PS (1)	Rsvd (0)	Page Code (20h)						
1	Parameter Length (08h)								
2	Reserved (0)			ChgrEject	Rsvd (0)	WaitLoad	Reserved (0)		
3	Library Type (1)			Reserved (0)					
4 - 6	Reserved (00h)								
7	Model Identification								
8	Rsvd(0)	Event History Type (bits 8 - 14)							
9	Event History Type (bits 0 - 7)								

ReportRec, ChgrEject, WaitLoad, and Event History Type are as set by the Mode Select command.
Library Type is 1 for LTO.

Model Identification is as in the standard Inquiry data (see Section 10.5).

10.10.5 Library Special Modes Page (21h)

The Mode Sense Library Special Modes Page is as follows.

Bit Byte	7	6	5	4	3	2	1	0	
0	PS (1)	Rsvd (0)	Page Code (21h)						
1	Parameter Length (08h)								
2	LightOff	Reserved (0)							
3	Reserved (00h)								
4	Reserved (0)			EnabMag	EnabMslot	EnabBCR	EnabAMS	Rsvd (0)	
5	Reserved (00h)								
6	Element Addressing Scheme (01h)								
7	Rsvd(0)	Bar Code Type							
8	Reserved (0)							EnabAllUA	
9	Reserved (00h)								

LightOff, EnabMag, EnabMslot, EnabBCR, EnabAMS, Bar Code Type, and EnabAllUA, are as set by the Mode Select command.

10.10.6 Drive Assignments Page (22h)

The Mode Sense Drive Assignments Page is as follows.

Bit Byte	7	6	5	4	3	2	1	0
0	PS (1)	Rsvd (0)	Page Code (22h)					
1	Parameter Length (1Ah)							
2	Drive 1 Type							
3	Drive 1 SCSI ID							

4	Drive 2 Type
5	Drive 2 SCSI ID
6	Drive 3 Type
7	Drive 3 SCSI ID
8	Drive 4 Type
9	Drive 4 SCSI ID
10	Drive 5 Type
11	Drive 5 SCSI ID
12	Drive 6 Type
13	Drive 6 SCSI ID
14	Drive 7 Type
15	Drive 7 SCSI ID
16	Drive 8 Type
17	Drive 8 SCSI ID
18	Drive 9 Type
19	Drive 9 SCSI ID
20	Drive 10 Type
21	Drive 10 SCSI ID
22 – 27	Reserved (00h)

Drive 1-10 Type are the drive type designators for the tape drives in the library system. If a drive is off-line (powered-off), it's drive type will be 0.

Drive 1-10 SCSI ID are the SCSI ID's of the tape drives in the library system. If a drive is off-line (powered off), its SCSI ID will not be used until the drive is brought back on-line (powered on).

10.10.7 Front Panel Display Mode Page (23h)

The Mode Sense Front Panel Display Mode Page is as follows.

Bit	7	6	5	4	3	2	1	0
Byte								
0	PS (0)	Rsvd (0)	Page Code (23h)					
1	Parameter Length (01h)							
2	Rsvd (0)	LightOff	Rsvd (0)	Key Pressed			MenuSeld	DispMode

LightOff and **DispMode** are as set by the Mode Select command.

Key Pressed equals 0 if no key was pressed or one of the following:

Key Pressed	Meaning
1	First (left-most) key was pressed
2	Second key was pressed
3	Third key was pressed
4	Fourth (right-most) key was pressed

The Key Pressed field is cleared every time that this page is returned so that each Mode Sense command returns key presses since the last Mode Sense command was issued.

MenuSeld equals 1 if the on-line menu has been selected at the library front panel interface. KeyPressed is not updated if this bit is set.

10.11 MODE SENSE (10) Command

The **Mode Sense (10)** command provides a means for reporting medium changer device to an initiator. It performs the same function as the Mode Sense (6) command.

Bit Byte	7	6	5	4	3	2	1	0	
0	Operation Code (5Ah)								
1	Reserved (00h)								
2	PC			Page Code					
3-6	Reserved (00h)								
7-8	(MSB)			Allocation Length					(LSB)
9	Reserved (00h)								

DBD (Disable Block Descriptor) is ignored.

PC (Page Control) defines the type of parameter values to be returned. Normally, a value of 0 is used to return the current values.

Page Code defines the parameter page(s) to be returned.

The **Allocation Length** specifies how many bytes of data are to be returned.

The Mode Sense (10) data block consists of a 8 byte header followed by one or more supported pages. The header is shown below.

Mode Sense (10) Mode Parameter Header

Bit Byte	7	6	5	4	3	2	1	0	
0-1	(MSB)			Mode Data Length					(LSB)
2	Medium Type (00h)								
3	Device-Specific Parameter (00h)								
4-5	Reserved (00h)								
6-7	Block Descriptor Length (00h)								

Mode Data Length is the length in bytes of the remainder of the Mode Sense (10) return data.

See the Mode Sense (6) command (Section 10.10) for information about supported mode pages.

10.12 MOVE MEDIUM Command

The **Move Medium** command instructs the medium changer device move a unit of media from a source element to a destination element.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (A5h)							
1	Reserved (00h)							
2 - 3	(MSB) _____			Transport Element Address				_____ (LSB)
4 - 5	(MSB) _____			Source Element Address				_____ (LSB)
6 - 7	(MSB) _____			Destination Address				_____ (LSB)
8 - 10	Reserved (00h)							
11	IE Option			Reserved (0)				

Transport Element Address specifies the medium transport element. A default value of zero may be used.

Source Element Address specifies the source element.

Destination Address specifies the destination element.

IE Option selects an alternate function to be performed if the Source and Destination Element Address both designate the same import/export element (mailslot or magazine slot). The function performed is based on the type of import/export element according to the following table. If the Source or Destination Element Address is not that of a mailslot or a magazine slot, this field is reserved and should be set to 0. The mechanism (mailslot or magazine) for the selected import/export element must be enabled (See Section 10.8.2).

IE Option	Source and Destination	Action
0	Mailslot	No alternate function, cartridge is moved from mailslot to mailslot.*
1	Mailslot	Mailslot is opened.*
2	Mailslot	Mailslot is closed.*
3	Mailslot	Reserved (do not use).
0	Magazine slot	No alternate function, cartridge is moved from magazine slot to magazine slot.
1	Magazine slot	Magazine is released; magazine inserted unit attention disabled until next Move Medium command.
2	Magazine slot	No effect to magazine; magazine inserted unit attention reenabled.
3	Magazine slot	Reserved (do not use).
1 - 3	Not Import/Export	Reserved (do not use).

* not available for the Model 20, 40, and 60 library systems.

10.13 OPEN/CLOSE MAILSLLOT Command

The **Open/Close Mailslot** command instructs the medium changer device to open the mailslot thus enabling operator cartridge insertion or removal, or to close the mailslot thus disabling operator cartridge insertion and removal. The mailslot must be enabled (see Section 10.8.2) before issuing this command. This command has no effect if the changer has been placed in the Mailslot Prevent state by the Prevent/Allow Medium Removal command. The IE Option bits in the Move Medium command may also be used to open or close the mailslot. This command is not available in the Model 20, 40, and 60 library systems.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (0Ch)							
1 - 3	Reserved (00h)							
4	Reserved (0)							Open
5	Reserved (00h)							

Open equals 1 if the medium changer device is to open rather than close the mailslot.

10.14 POSITION TO ELEMENT Command

The **Position to Element** command positions the medium transport element in front of the specified Destination Element so that no further movement of the MT is necessary to execute a subsequent Move Medium or Exchange Medium command.

Bit	7	6	5	4	3	2	1	0	
Byte									
0	Operation Code (2Bh)								
1	Reserved (00h)								
2 - 3	(MSB) _____			Transport Element Address				_____ (LSB)	
4 - 5	(MSB) _____			Destination Element Address				_____ (LSB)	
6 - 9	Reserved (00h)								

Transport Element Address specifies the medium transport element to be positioned. A default value of 0 may be used.

Destination Address specifies the element to position in front of.

10.15 PREVENT/ALLOW MEDIUM REMOVAL Command

The **Prevent/Allow Medium Removal** command instructs the medium changer device to either prevent or allow the removal of media (cartridges) from the library system, depending upon the value of the Prevent bit. If the Prevent bit equals 1, cartridge removal is prevented. If the Prevent bit is 0, cartridge removal is allowed.

Removal of media can take place from either the mailslot or via the removable cartridge magazine. The PA Option field specifies whether this command applies to the mailslot or the magazine. When applied to mailslot, the medium changer device is either placed in or removed from the Mailslot Allow state. When applied to the magazine, the medium changer device is either placed in or removed from the Magazine Allow state.

If left in the Mailslot Allow state, the mailslot can be opened by the Open/Close Mailslot command or by a button on the front panel. If not in the Mailslot Allow state, the mailslot cannot be opened.

If left in the Magazine Allow state, the magazine and magazine access door can be released by using the Release Magazine command or by a button on the front panel. If not in the Magazine Allow state, the magazine cannot be released and the magazine access door is latched if it is closed.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (1Eh)							
1-3	Reserved (00h)							
4	Reserved (0)							Prevent
5	PA Option		Reserved (0)					

Prevent equals 1 if opening of the mailslot or releasing of the magazine is to be inhibited, or 0 if the opening of the mailslot or releasing of the magazine is to be allowed.

PA Option specifies whether the mailslot and/or the magazine is to be effected according to the following table.

PA Option	Prevent	Action
0	1	Prevent the operator from opening the mailslot, or releasing and removing the magazine.
0	0	Allow the operator to open the mailslot, and release and remove the magazine.
1	1	Reserved (do not use).
1	0	Reserved (do not use).
2	1	Prevent the operator from opening the mailslot.*
2	0	Allow the operator to open the mailslot.*
3	1	Prevent the operator from releasing and removing the magazine.
3	0	Allow the operator to release and remove the magazine.

* not available for the Model 20, 40, and 60 library systems.

If the appropriate import/export mechanism (mailslot or magazine) is not enabled, it will not be effected.

The Prevent states remain effective until one of the following conditions occurs:

1. All initiators which have issued the Prevent/Allow Medium Removal command with Prevent set to 1 reissue the command with Prevent set to 0 (when applied to the same device, mailslot and/or magazine, as specified by the Option field).
2. The medium changer device receives a TARGET RESET message.
3. The medium changer device receives a hard reset or power is cycled.
4. The medium changer device completes download of new firmware or the SCSI ID of the medium changer device is changed by the Write Buffer command (see Section 10.31.2).

10.16 READ BUFFER Command

The **Read Buffer** command is used to read the current SCSI ID of the medium changer device, to read a good / bad status code for each drive, or to read a buffer to test the integrity of communication with the medium changer device via the SCSI bus.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (3Ch)							
1	Reserved (0)					Mode		
2	Buffer ID							
3 - 5	(MSB)		Buffer Offset				(LSB)	
6 - 8	(MSB)		Allocation Length				(LSB)	
9	Reserved (00h)							

Mode and **Buffer ID** select the function to be performed based on the following table.

Mode	Buffer ID	Function
2	0	Read SCSI ID of medium changer device.
2	1	Read drive status code.
2	2	Read from echo buffer to test SCSI data transfer.
2	3	Read library IP address.
2	4	Read library subnet mask.

Buffer Offset is the beginning byte offset within the designated buffer from which data is to be returned.

Allocation Length specifies how many bytes of data are to be returned.

10.16.1 Reading the Medium Changer Device SCSI ID

To read the SCSI ID of the medium changer device, set Mode to 2, Buffer ID to 0, Buffer Offset to 0, and Allocation Length to 1. The return data consists of a single byte containing the current SCSI ID of the medium changer device.

The returned medium changer device SCSI ID data is shown below.

Medium Changer Device SCSI ID Data

Bit Byte	7	6	5	4	3	2	1	0
0	Current Medium Changer Device SCSI ID							

10.16.2 Reading the Drive Good / Bad Status Codes

To read the drive status codes, set Mode to 2, Buffer ID to 1, Buffer Offset to 0, and Allocation Length to 12. The return data consists of an array of bytes containing a status code for each drive. These values are only changed by a corresponding Write Buffer command.

The returned drive status codes data is shown below.

Drive Good / Bad Status Code Data

Bit Byte	7	6	5	4	3	2	1	0
0	Drive 1 Status							
1	Drive 2 Status							
2	Drive 3 Status							
3	Drive 4 Status							
4	Drive 5 Status							
5	Drive 6 Status							
6	Drive 7 Status							
7	Drive 8 Status							
8	Drive 9 Status							
9	Drive 10 Status							
10 - 11	Reserved (00h)							

Drive 1-10 Status is a user-defined value to indicate the good / bad status of a drive. For example, a 1 could indicate a good drive while a 2 could indicate a bad drive.

10.16.3 Reading from the Echo Buffer to Test SCSI Communication

A 256 byte echo buffer is supported to test communication with the medium changer device.

To read to the echo buffer, set Mode to 2 and Buffer ID to 2.

Buffer Offset can be any value between 0 and 255.

Allocation Length can be any value between 1 and 256. The sum of Buffer Offset and Allocation Length cannot exceed 256.

The returned Echo Buffer data is shown below.

Echo Buffer Data

Bit Byte	7	6	5	4	3	2	1	0
0 - n	Echo Buffer Data							

The echo buffer should first be written by the Write Buffer command (Section 10.31.4). After the buffer is read, its contents should be compared with the data originally written.

10.16.4 Reading the Network IP Address and Subnet Mask

To read the network IP address or subnet mask of the library system, set Mode to 2, Buffer ID to 3 for IP address or 4 for subnet mask, Buffer Offset to 0, and Allocation Length to 4. The return data consists of four octets (bytes) of address or mask information.

The returned IP address or subnet mask data is shown below.

Network IP Address or Subnet Mask Parameter Data

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

Octet 1-4 are four bytes of IP address or subnet mask data. For example, an IP address of 101.102.103.104 would be represented as the values 101, 102, 103, and 104.

10.17 READ ELEMENT STATUS Command

The **Read Element Status** command requests the medium changer device report the status of its internal elements to the initiator.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (B8h)							
1	Reserved (0)			VolTag	Element Type Code			
2-3	(MSB)			Starting Element Address				(LSB)
4-5	(MSB)			Number of Elements				(LSB)
6	Reserved (0)					CurData	DVCID	
7-9	(MSB)			Allocation Length				(LSB)
10	Reserved (00h)							
11	Drive SN's	Drive Mfr	Reserved (0)					

VolTag equals 1 if the medium changer device is to return bar code information in the form of SCSI volume tags.

Element Type Code specifies an element type to be returned as follows.

Code	Element Types Returned
0	All element types
1	Medium transport elements
2	Storage elements
3	Import/export elements
4	Data transfer elements

Starting Element Address specifies the minimum element address to report. Only elements with an element type permitted by the Element Type Code and the Starting Element Address are reported.

Number of Elements specifies the maximum number of element descriptor tags to be reported 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 elements to report.

CurData (Current Data) specifies that the element status data is to be returned without causing any device motion. This field is ignored as the library system will always return element status data without causing device motion.

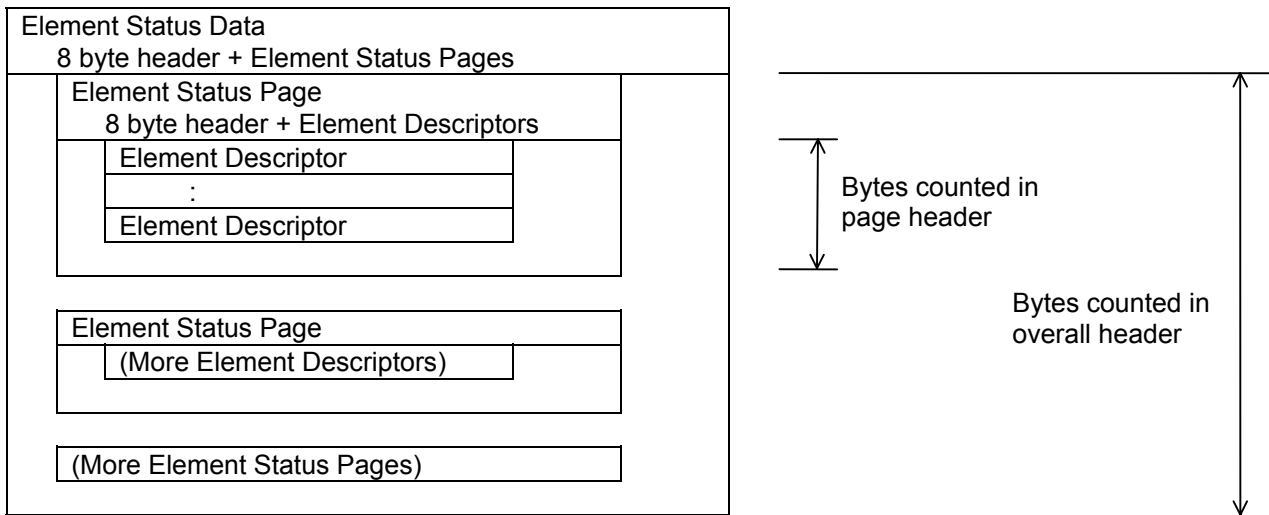
DVCID (Device ID) equals 1 if the medium changer device is to return device identifiers (drive serial numbers) for each drive in a format consistent with the SCSI-3 standard. The serial numbers are returned in the data transfer element descriptor for each drive. If this bit is set, neither the Drive SN's nor the Drive Mfr bits may be set.

Drive SN's equals 1 if the medium changer device is to return drive serial numbers for each drive in a vendor-unique format as described in this document. The serial numbers are returned in the data transfer element descriptor for each drive. If this bit is set, the DVCID bit cannot be set.

Drive Mfr equals 1 if the medium changer device is to return a code for the drive manufacturer for each drive in a vendor-unique format as described in this document. The drive manufacturer codes are returned in the data transfer element descriptor for each drive. If this bit is set, the DVCID bit cannot be set.

Allocation Length specifies the length of the Element Status Data to be returned

The structure of the **Element Status Data** returned is as follows:



The element status data header format is shown following.

Element Status Data

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

The element status page header format is shown following.

Element Status Page Header

Bit Byte	7	6	5	4	3	2	1	0	
0	Element Type Code								
1	PVolTag	Reserved (0)							
2 - 3	(MSB)		Element Descriptor Length (z + 1)					(LSB)	
4	Reserved (00h)								
5 - 7	(MSB)		Byte Count of Descriptor Data Available (this page, y - 7)					(LSB)	
8 - y	Element Descriptor(s)								

PVolTag (Primary Volume Tag) should be set to 1 if bar code information is to be returned.

The format of the element descriptors follows. Descriptors are returned in element address order.

10.17.1 Medium Transport Element Descriptor

The medium transport element descriptor is as follows.

Bit Byte	7	6	5	4	3	2	1	0	
0 - 1	(MSB)		Element Address					(LSB)	
2	Reserved (0)					Except	Rsvd (0)	Full	
3	Reserved (00h)								
4	Additional Sense Code								
5	Additional Sense Code Qualifier								
6 - 8	Reserved (00h)								
9	Svalid	Reserved (0)							
10 - 11	(MSB)		Source Storage Element Address					(LSB)	

Format 1. No bar codes requested (VolTag=0):

12 - 15	Reserved (00h)
---------	----------------

Format 2. Bar codes requested (VolTag=1):

12 - 43	Bar Code
44 - 51	Reserved (00h)

Except equals 1 if the element is in an abnormal state. In this case, additional information is given in the Additional Sense Code and in the Additional Sense Code Qualifier fields.

Full equals 1 if the element contains a unit of media.

Additional Sense Code (ASC) and **Additional Sense Code Qualifier** indicate detailed information related to a condition of the element. The following values are used.

ASC	ASCQ	Meaning
30h	03h	Cleaner cartridge present.
83h	00h	Bar code not scanned.
83h	09h	Unable to read bar code.

SValid (Storage Element Valid) equals 1 if Source Storage Element Address and Invert bit are valid.

Source Storage Element Address provides the address of the last storage element this unit of media was moved from.

Bar Code contains the bar code of the cartridge if it is known. The bar code will be returned as eight ASCII characters followed by spaces if a valid bar code was read. Zeros will be returned if the bar code was not scanned or is not valid.

10.17.2 Storage Element Descriptor

The storage element descriptor is as follows.

Bit Byte	7	6	5	4	3	2	1	0
0 - 1	(MSB) _____ Element Address _____							(LSB)
2	Reserved (0)			Access	Except	Rsvd (0)	Full	
3	Reserved (00h)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6 - 8	Reserved (00h)							
9	Svalid	Reserved (0)						
10 - 11	(MSB) _____ Source Storage Element Address _____							(LSB)
12 - z	(See Medium Transport Element Descriptor)							

Access equals 1 if element access by the medium transport element is allowed.

Other fields are the same as for the medium transport element descriptor.

10.17.3 Import / Export Element Descriptor

The import/export element descriptor is as follows.

Bit Byte	7	6	5	4	3	2	1	0
0 - 1	(MSB) _____ Element Address _____							(LSB)
2	Reserved (0)	InEnab(1)	ExEnab(1)	Access	Except	ImpExp	Full	
3	Reserved (00h)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6 - 8	Reserved (00h)							
9	Svalid	Reserved (0)						
10 - 11	(MSB) _____ Source Storage Element Address _____							(LSB)
12 - z	(See Medium Transport Element Descriptor)							

InEnab (Import Enable) equals 1 indicating that the import/export element supports movement of media into the scope of the medium changer device.

ExEnab (Export Enable) equals 1 indicating that the import/export element supports movement of media out of the scope of the medium changer device.

Access equals 1 if access to the import/export element by the medium transport element is allowed (the mailslot is closed or the magazine is installed and latched) or 0 if access is not allowed (the mailslot is open or the magazine has been released or removed).

ImpExp equals 1 if the unit of media in the import/export element was placed there by an operator, or 0 if the unit of media was placed there by the medium transport element.

Additional Sense Code (ASC) and **Additional Sense Code Qualifier** for import/export elements may contain the following values.

ASC	ASCQ	Meaning
30h	03h	Cleaner cartridge present.
83h	00h	Bar code not scanned.
83h	02h	No magazine installed.
83h	09h	Unable to read bar code.

Other fields are the same as for the medium transport element descriptor.

10.17.4 Data Transfer Element Descriptor

The data transfer element descriptor is as follows.

Bit	7	6	5	4	3	2	1	0
Byte								
0 - 1	(MSB) Element Address							(LSB)
2	Reserved (0)			Access	Except	Rsvd (0)	Full	
3	Reserved (00h)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	NotBus(1)	Rsvd (0)	IDValid	Reserved (0)				
7	SCSI Bus Address							
8	Reserved (00h)							
9	Svalid	Reserved (0)						
10 - 11	(MSB) Source Storage Element Address							(LSB)

Format 1. No bar codes requested, no drive serial numbers requested, no drive manufacturer requested (VolTag=0, DVCID=0, Drive SN's=0, Drive Mfr=0):

12 - 15	Reserved (00h)
---------	----------------

Format 2. No bar codes requested, no drive serial numbers requested, drive manufacturer requested (VolTag=0, DVCID=0, Drive SN's=0, Drive Mfr=1):

12 - 15	Reserved (00h)
16	Drive Manufacturer Code

Format 3. Bar codes requested, no drive serial numbers requested, no drive manufacturer requested (VolTag=1, DVCID=0, Drive SN's=0, Drive Mfr=0):

12 - 43	Bar Code
44 - 51	Reserved (00h)

Format 4. Bar codes requested, no drive serial numbers requested, drive manufacturer requested (VolTag=1, DVCID=0, Drive SN's=0, Drive Mfr=1):

12 - 43	Bar Code
44 - 51	Reserved (00h)
52	Drive Manufacturer Code

Format 5. No bar codes requested, drive serial numbers requested in vendor-unique format, no drive manufacturer requested (VolTag=0, DVCID=0, Drive SN's=1, Drive Mfr=0):

12 - 15	Reserved (00h)
16 - 25	Drive Serial Number

Format 6. No bar codes requested, drive serial numbers requested in vendor-unique format, drive manufacturer requested (VolTag=0, DVCID=0, Drive SN's=1, Drive Mfr=1):

12 - 15	Reserved (00h)
16 - 25	Drive Serial Number
26	Drive Manufacturer Code

Format 7. Bar codes requested, drive serial numbers requested in vendor-unique format, no drive manufacturer requested (VolTag=1, DVCID=0, Drive SN's=1, Drive Mfr=0):

12 - 43	Bar Code
44 - 51	Reserved (00h)
52 - 61	Drive Serial Number

Format 8. Bar codes requested, drive serial numbers requested in vendor-unique format, drive manufacturer requested (VolTag=1, DVCID=0, Drive SN's=1, Drive Mfr=1):

12 - 43	Bar Code
44 - 51	Reserved (00h)
52 - 61	Drive Serial Number
62	Drive Manufacturer Code

Format 9. No bar codes requested, drive serial numbers requested in SCSI-3 format (VolTag=0, DVCID=1, Drive SN's=0, Drive Mfr=0):

12	Code Set (2)
13	Identifier Type (1)
14	Reserved (00h)
15	Identifier Length (34)
16 - 49	Identifier

where Identifier consists of the following bytes:

16 - 23	Drive Vendor Identification
24 - 39	Drive Product Identification
40 - 49	Drive Serial Number

Format 10. Bar codes requested, drive serial numbers requested in SCSI-3 format (VolTag=1, DVCID=1, Drive SN's=0, Drive Mfr=0):

12 - 43	Bar Code
44 - 47	Reserved (00h)
48	Code Set (2)
49	Identifier Type (1)
50	Reserved (00h)
51	Identifier Length (34)
52 - 85	Identifier

where Identifier consists of the following bytes:

52 - 59	Drive Vendor Identification
60 - 75	Drive Product Identification
76 - 85	Drive Serial Number

Access bit of 1 indicates access to the data transfer element by the medium transport element is allowed. Access requires that the tape drive be installed and turned on. It may also require that a SCSI Load Unload command be sent to the corresponding drive to effect an unload.

Additional Sense Code (ASC) and **Additional Sense Code Qualifier** for data transfer elements may contain the following values.

ASC	ASCQ	Meaning
30h	03h	Cleaner cartridge present.
83h	00h	Bar code not scanned.
83h	04h	Tape drive not installed.
83h	09h	Unable to read bar code.
80h	5Dh	Drive operating in overheated state.
80h	5Eh	Drive being shut down due to overheat condition.
80h	63h	Drive operating with low module fan speed.
80h	5Fh	Drive being shut down due to low module fan speed.

IDValid equals 1 if the SCSI Bus Address field contains valid information. This bit will be set if the drive is installed and turned on.

SCSI Bus Address is the SCSI ID of the corresponding library drive.

Drive Serial Number is a ten character ASCII representation of the serial number of the corresponding library drive.

Drive Manufacturer Code equals a value representing the manufacturer of the corresponding library drive. The following values are returned.

Drive Manufacturer	Drive Manufacturer Code
IBM LTO	17

Code Set equals 2 indicating that the Identifier field will contain ASCII characters.

Identifier Type equals 1 indicating that the Identifier consists of the drive vendor identification following by bytes which uniquely identify the drive.

Other fields are the same as for the medium transport element descriptor.

10.18 READ MAGAZINE STATUS Command

The **Read Magazine Status** command is used to determine the status of the magazine.

Bit	7	6	5	4	3	2	1	0
0	Operation Code (B9h)							
1	Reserved (00h)							
2 - 3	(MSB)	First Magazine (1)						(LSB)
4 - 5	(MSB)	Number of Magazines (1)						(LSB)
6	Reserved (00h)							
7 - 9	(MSB)	Allocation Length						(LSB)
10 - 11	Reserved (00h)							

Allocation Length specifies the length of the Magazine Status Data.

The **Magazine Status Data** returned is as follows.

Magazine Status Data

Bit	7	6	5	4	3	2	1	0
0 - 1	(MSB)	First Magazine (1)						(LSB)
2 - 3	(MSB)	Number of Magazines (1)						(LSB)
4	Reserved (00h)							
5 - 7	(MSB)	Byte Count of Report Available (4)						(LSB)
8	Magazine Number (1)							
9 - 10	(MSB)	First Element Address in Magazine (1)						(LSB)
11	Reserved (0)					Changed	Rsvd(0)	Present

Present equals 1 if the magazine is present and latched in place.

Changed equals a value of 1 if this magazine has been recently removed, exchanged, or installed. This bit is cleared after this descriptor is returned.

10.19 RELEASE ELEMENT Command

The **Release Element** command is used to release reservations on a previously reserved medium changer device or previously reserved elements within it.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (17h)							
1	Reserved (0)							Element
2	Reservation Identification							
3-5	Reserved (00h)							

Element equals bit of 1 if a specific set of elements is to be released or 0 if the entire medium changer device is to be released.

Reservation Identification is a code byte used to identify a specific element reservation to be released.

Refer to the Reserve Element command for more information.

10.20 RELEASE MAGAZINE Command

The **Release Magazine** command instructs the medium changer device to energize a solenoid to release the magazine for operator access. The magazine access door will also open allowing magazine insertion or removal. After this command is issued, the magazine slots, IE2 – IE6, are no longer available as a source, destination, or second destination for the Move Medium and Exchange Medium commands. The magazine must be enabled (see Section 10.8.2) before issuing this command. This command has no effect if the changer has been placed in the Magazine Prevent state by the Prevent/Allow Medium Removal command. The IE Option bits in the Move Medium command may also be used to release the magazine.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (C3h)							
1-5	Reserved (00h)							

10.21 REQUEST SENSE Command

The **Request Sense** command requests that the medium changer device send Sense Data to the initiator.

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

The Sense Data will be valid for a CHECK CONDITION status returned on the prior command. The Sense Data will be preserved by the medium changer device until retrieved by the Request Sense command or until receipt of any other command.

The Request Sense command shall return a CHECK CONDITION status only to report fatal errors for the Request Sense command. For example:

- 1) The medium changer device detects a non-zero reserve bit in the CDB.
- 2) An unrecoverable parity error occurred on the DATA BUS.
- 3) An medium changer device malfunction prevents return of the sense data.

Any nonfatal error occurring during the execution of the Request Sense command shall return the sense data with GOOD status.

The Sense Data Format is as follows.

Sense Data Format

Bit Byte	7	6	5	4	3	2	1	0
0	Valid (0)	Error Code (70h)						
1	Reserved (00h)							
2	Reserved (0)				Sense Key			
3-6	Reserved (00h)							
7	Additional Sense Length (x-7)							
8-11	Reserved (00h)							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Reserved (00h)							
15	SKSV	Sense-Key Specific						
16-17								
18-x	Additional Sense Bytes							

Sense Key is described below.

Additional Sense Code and **Additional Sense Code Qualifier** indicate detailed information related to an error or exception condition. These error codes are listed in Section 12.1.

SKSV (Sense-Key Specific Valid) equals 1 if the Sense Key Specific field contains valid information.

Sense-Key Specific contains information that is specific to the type of error returned.

Additional Sense Bytes contain additional information about the error returned.

The following Sense Key values are returned by the medium changer device.

Sense Key Descriptions

Sense Key	Description
0h	NO SENSE. Indicates that there is no specific sense key information to be reported. This is the case for a successful command.
1h	RECOVERED ERROR. Indicates that the last command completed successfully with some recovery action performed. Information about the first hardware error encountered is available in the data fields above.
2h	NOT READY. Indicates that the medium changer device cannot be accessed.
4h	HARDWARE ERROR. Indicates that the medium changer device encountered a non-recoverable hardware failure while performing the command or during self test.
5h	ILLEGAL REQUEST. Indicates an illegal parameter in the CDB or in additional parameters supplied as data.
6h	UNIT ATTENTION. Indicates that parameters have been changed or the target has been reset.
Bh	ABORTED COMMAND. Indicates that the medium changer device aborted the command. This is typically due to a SCSI communication error.

If the Sense Key is equal to 5 (Illegal Request) and the SKSV is set to 1, the Sense-Key Specific fields contain the following information.

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

C/D (Command/Data) equals 1 if the illegal parameter is in the command descriptor block or 0 if the illegal parameter is in the data parameters sent.

BPV (Bit Pointer Valid) equals 1 if the value in the Bit Pointer field is valid.

Bit Pointer indicates the left-most (most-significant) bit of the field which is in error.

Field Pointer indicates the byte of the command descriptor block or of the parameter data which in error. When a multiple-byte field is in error, this field contains the first (most-significant) byte of the field which is in error.

If the Sense Key is equal to 4 (Hardware Error) or 1 (Recovered Error) and the SKSV is set to 1, the Sense-Key Specific fields contain the following information.

Bit	7	6	5	4	3	2	1	0	
Byte									
15	SKSV	Reserved (0)							
16 - 17	(MSB)		Actual Retry Count				(LSB)		

Actual Retry Count equals the number of retries used in attempting to recover from the error.

Also, for these types of errors, the **Additional Sense Bytes** field contains the following information.

Bit Byte	7	6	5	4	3	2	1	0
18	ChgrReady	Restored	Completed	AllReturned	MTFull	Reserved (0)		FailSecond
19	InfoValid	Reserved (0)						
20 - 21	(MSB)	(First) Source Element Address						(LSB)
22 - 23	(MSB)	(First) Destination Element Address						(LSB)
24	Info2Valid	Reserved (0)						
25 - 26	(MSB)	Second Source Element Address						(LSB)
27 - 28	(MSB)	Second Destination Element Address						(LSB)
29	Reserved (00h)							
30 - 31	(MSB)	Failure Element Address						(LSB)
32	Component Number							
33	Error Subcode							
34	Error Type							
35	Error Context							
36 - 37	Internal Error Location							
38 - 39	Reserved (0)							
40	Lift Elevation State							
41 - 44	(MSB)	Lift Offset						(LSB)
45 - 46	(MSB)	Picker Step Count						(LSB)
47 - 48	(MSB)	Pivot Offset						(LSB)
49	Reserved (0)					MTA	Rsvd (0)	
50 - 51	Reserved (00h)							
52 - 53	(MSB)	Mailslot or Pass-thru Step Count						(LSB)

ChgrReady equals 1 if the medium changer device is ready to accept new cartridge movement commands or 0 if the medium changer device is jammed and a Rezero Unit command is required to reinitialize the unit.

Restored equals 1 if all cartridges being moved have been returned to their source elements and the medium changer device has been restored to the state in which it was in before the last command was issued.

Completed equals 1 if cartridges have been moved and the last command completed successfully.

AllReturned equals 1 if all cartridges have been returned to their last storage element locations.

MTFull equals 1 if the medium transport element is full.

FailSecond equals 1 if the failure occurred on the second move of an Exchange Medium command (from the First Destination Element to the Second Destination Element) or 0 if the failure occurred on the first move (from the Source Element to the First Destination Element). The second move is actually executed first.

InfoValid equals 1 if bytes 19 to 23 contain valid information about the last cartridge movement command, or the first move of an Exchange Medium command (Source to First Destination Element).

Info2Valid equals 1 if bytes 24 to 28 contain valid information about the second move of an Exchange Medium command (First Destination Element to Second Destination Element).

(First) Source Element and **(First) Destination Element** are the addresses of Source and Destination Elements of the last cartridge movement command, or the Source and First Destination Elements of the last Exchange Medium command.

Second Source Element and **Second Destination Element** are the addresses of First and Second Destination Elements of the last Exchange Medium command.

Failure Element Address is the address of the closest element to which the medium transport element specified by the Medium Transport Element Number was positioned when the error occurred.

Error Type indicates the general type of error and the interpretation of the **Component Number** and **Error Subcode** fields. See Section 10.7.4 for more information.

Error Context is a code for the context in which the error occurred. The error context codes are listed in Section 12.4.

Internal Error Location is a number which is useful to Plasmon technical support.

Lift Elevation State is the current state of the lift's elevation for performing various library operations. See Section 10.7.4 for more information.

Lift Offset is a signed lift encoder count offset from the count associated with the Failure Element Address at the Lift Elevation State above.

Picker Step Count is a signed motor step count for the picker when the error occurred.

Pivot Offset is a signed pivot step count offset from the count associated with the Failure Element Address in block A.

MTA is the MTA (0 or 1) in effect when the error occurred. MTA 0 is the primary MTA, MTA 1 is the alternate MTA.

Mailslot or Pass-Thru Step Count is a signed motor step count for the mailslot or a pass-thru element, depending upon the failing element.

10.22 REQUEST VOLUME ELEMENT ADDRESS Command

The **Request Volume Element Address** command is used to transfer the results of a Send Volume Tag command. Multiple Request Volume Element Address commands may be used to recover the results of a single Send Volume Tag command.

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

For each Send Volume Tag command, the medium changer device will report, in element address order, multiple elements that match a volume tag template. Once information for a given element address has been reported, only higher element addresses will be reported by subsequent Request Volume Element Address commands.

VolTag equals 1 if the medium changer device is to report bar code information in the form of volume tags, or 0 if the bar code information in the form of volume tags is not to be reported.

Element Type Code specifies an element type to be returned as follows.

Code	Element Types Returned
0	All element types
1	Medium transport elements
2	Storage elements
3	Import/export elements
4	Data transfer elements

Element Address specifies the minimum element address to report. Only elements with an element type permitted by the Element Type Code and the Element Address are reported.

Number of Elements specifies the maximum number of element descriptor tags to be reported by the medium changer device 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 elements to report that match the last Send Volume Tag translate template.

Allocation Length specifies the length of the Element Status Data.

The structure of the **Element Status Data** returned is identical to that of the Read Element Status command. See the Read Element Status command (Section 10.17) for the format of the data returned by this command.

10.23 RESERVE ELEMENT Command

The **Reserve Element** command is used to reserve the medium changer device or specific elements within it. If the entire medium changer device is reserved, any other SCSI initiator will only be permitted to execute the following commands: Inquiry, Request Sense, Read Element Status, Read Magazine Status, and Release (ignored). Any other command will generate RESERVATION CONFLICT status.

Bit	7	6	5	4	3	2	1	0	
Byte									
0	Operation Code (16h)								
1	Reserved (0)							Element	
2	Reservation Identification								
3 - 4	(MSB)			Element List Length				(LSB)	
5	Reserved (00h)								

Element equals bit of 1 if specific elements are to be reserved or 0 if the entire medium changer device is to be reserved.

Reservation Identification provides a means for the initiator to identify each element reservation with a specified code byte. It is used in the Release Element command to specify which reservation is to be released and in a superseding Reserve Element command to specify which reservation is to be superseded.

Element List Length specifies the length in bytes of the Reserve Element element list.

The Reserve Element element list consists of zero or more of the following reserve element list descriptors.

10.23.1 Reserve Element Element List Descriptor

The Reserve Element Element List Descriptor is as follows.

Bit	7	6	5	4	3	2	1	0
Byte								
0 - 1	Reserved (00h)							
2 - 3	(MSB)			Number of Elements				(LSB)
4 - 5	(MSB)			Element Address				(LSB)

Element Address is the beginning element address to start assigning reservations for.

Number of Elements is the number of elements to reserve or zero if elements are to be assigned beginning at the specified element address through the last element address on the unit.

10.24 RESTORE DRIVE Command

The **Restore Drive** command restores a drive to service by turning it on. The Send Diagnostic command Drive Power On/Off Page (Section 10.26.3) may also be used to turn the drive on.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (C1h)							
1	Drive							
2 - 5	Reserved (00h)							

Drive equals the drive to turn on.

10.25 REZERO UNIT Command

The **Rezero Unit** command reinitializes the medium changer device. The medium changer device will go to its home position. If the RecalOffs bit is set, the library system offsets are recalibrated. If the Park bit is set, the medium transport element will move to its park position.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (01h)							
1 - 4	Reserved (00h)							
5	RecalOffs	Park	Reserved (0)					

RecalOffs equals 1 if all library system offsets are to be recalibrated.

Park equals 1 if the Media Transport Element is to be moved to its park position. This is required in preparation for shipment of the system.

10.26 SEND DIAGNOSTIC Command

The **Send Diagnostic** command instructs the medium changer device to perform a self-diagnostic test on itself, change the SCSI ID of a drive in the library, or turn on or off a drive in the library.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Dh)							
1	Reserved (0)			PF (1)	Rsvd (0)	SelfTest	DevOff (0)	UnitOff (0)
2	Reserved (00h)							
3 - 4	(MSB)			Parameter List Length				(LSB)
5	Reserved (00h)							

10.26.1 Diagnostic Self Test

Setting the SelfTest bit causes the library to perform a diagnostic self test on itself. All motors will be reinitialized and the MTA will be positioned to a known location. No parameter data is required.

SelfTest (Self Test) equals 1 indicating default self-test.

Parameter List Length equals 00h.

The Send Diagnostic command returns status of GOOD if no errors occur, else a CHECK CONDITION will be set. Send a Request Sense command to obtain information about the problem.

10.26.2 Change Drive SCSI ID Page (80h)

This page is used to change the SCSI ID of a drive in the library.

SelfTest (Self Test) equals 0 indicating no self-test.

Parameter List Length equals 07h.

The Send Diagnostic Change Drive SCSI ID Page is as follows:

Bit Byte	7	6	5	4	3	2	1	0
0	Page Code (80h)							
1	Reserved (00h)							
2 - 3	(MSB)			Page Length (03h)				(LSB)
4	Drive							
5	New Drive SCSI ID							
6	Reserved (00h)							

Drive is the number of the drive (1-10) whose SCSI ID is to be changed.

New Drive SCSI ID is the new SCSI ID of the tape drive.

This command returns status of GOOD if no errors occur, else a CHECK CONDITION will be set. Send a Request Sense command to obtain information about the problem.

10.26.3 Drive Power On/Off Page (81h)

This page is used to turn the power on a drive on or off.

SelfTest (Self Test) equals 0 indicating no self-test.

Parameter List Length equals 07h.

The Send Diagnostic Drive Power On/Off Page is as follows:

Bit Byte	7	6	5	4	3	2	1	0
0	Page Code (81h)							
1	Reserved (00h)							
2-3	(MSB) _____		Page Length (03h)				_____ (LSB)	
4	Drive							
5	Power							
6	Reserved (00h)							

Drive is the number of the drive (1-10) whose power is to be turned on or off.

Power equals 1 to turn the drive power on, or 0 to turn the drive power off.

This command returns status of GOOD if no errors occur, else a CHECK CONDITION will be set. Send a Request Sense command to obtain information about the problem.

10.27 SEND VOLUME TAG Command

The **Send Volume Tag** command transfers a template to be used to search for cartridges with specific bar codes (volume tags). Only this template matching “translate” function of the Send Volume Tag command is supported. The Request Volume Element Address command is used to transfer the results of the template matching operation.

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

Element Type Code specifies an element type for a translate action as follows.

Code	Element Types Returned
0	All element types
1	Medium transport elements
2	Storage elements
3	Import/export elements
4	Data transfer elements

Send Action Code specifies the function to be performed by the command as shown below.

Code	Function
00h (, 01h, 04h, 05h)	Translate - search all defined bar codes of the specified element types.
02h, 03h, 06h - 1Fh	Reserved

The specified elements are searched for a matching volume identification template. The results are stored and are available for return in the next Request Volume Element Address command (see Section 10.22).

The parameters required for the Send Volume Tag command are as follows.

Send Volume Tag Parameters Format

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

Volume Identification Template specifies a 32 character template to be used for matching bar codes, although only the first 20 characters are used. The template may contain bar code characters or the wildcard characters '*' and '?'. The '*' will match any string of characters and the '?' will match any single character.

Minimum/Minimum Volume Sequence Number are not used and are ignored.

10.28 SERVICE DRIVE Command

The **Service Drive** command prepares a drive for service by turning it off. The Send Diagnostic command Drive Power On/Off Page (Section 10.26.3) may also be used to turn the drive off.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (C0h)							
1	Drive							
2 - 5	Reserved (00h)							

Drive equals the drive to turn off.

10.29 SWAP TRANSPORT ASSYS Command

The **Swap Transport Assys** command is used to switch to the alternate medium transport assembly (MTA) when the primary assembly is found to be non-functional. It is also used to switch back to the primary transport assembly after it has been repaired.

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (C2h)							
1	Reserved (0)							NewMTA
2-5	Reserved (00h)							

NewMTA is the medium transport assembly to swap to: 0 for the primary assembly and 1 for the alternate assembly.

It should be noted that the library may automatically switch-over to the alternate MTA apart from this command if the primary MTA is found to be malfunctioning and automatic switch-over is enabled by the EnabAMS bit in the Mode Select Library Special Modes page (see Section 10.8.2).

10.30 TEST UNIT READY Command

The **Test Unit Ready** command provides a means of checking medium changer device ready status.

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

If the medium changer device is able to accept a medium access command without returning a CHECK CONDITION status, the Test Unit Ready command will return a GOOD status.

10.31 WRITE BUFFER Command

The **Write Buffer** command is used to write new firmware to the library system, to change the SCSI ID of the medium changer device, to assign a good / bad status code to each drive, to write to a buffer to test communication with the medium changer device via the SCSI bus, or to assign a network IP address or subnet mask to the library system.

Bit	7	6	5	4	3	2	1	0	
Byte									
0	Operation Code (3Bh)								
1	Reserved (0)					Mode			
2	Buffer ID								
3 - 5	(MSB)				Buffer Offset				(LSB)
6 - 8	(MSB)				Parameter List Length				(LSB)
9	Reserved (00h)								

Mode and **Buffer ID** select the function to be performed based on the following table.

Mode	Buffer ID	Function
7	0	Download firmware (microcode).
2	0	Change SCSI ID of medium changer device.
2	1	Assign drive status codes.
2	2	Write to echo buffer to test SCSI data transfer.
2	3	Assign library system IP address.
2	4	Assign library system subnet mask.

Buffer Offset is the beginning byte offset within the designated buffer to which data is to be written.

Parameter List Length specifies the length in bytes of the accompanying parameter list.

10.31.1 Downloading Firmware

To write new firmware to the library system, set Mode to 7 and Buffer ID to 0.

The Buffer Offset begins at 0 but may be incremented as described in the next paragraph.

The required Parameter List Length value can be obtained from the size of the firmware object file, or the first four bytes of the file, or multiple Write Buffer commands can be issued with smaller values of Parameter List Length and increasing values of Buffer Offset (the Buffer Offset for each command is incremented by the Parameter List Length of the previous command). The sum of the Parameter List Lengths of such a group of commands must equal the size of the firmware object file. Each such Write Buffer transfer may be repeated in the event of receiving a checksum error due to a communication failure. The Parameter List Length must always be a multiple of 258 (since data is transferred in blocks of 256 bytes with 2 byte checksums).

The Firmware Download parameter list is shown below.

Firmware Download Parameter Data

Bit	7	6	5	4	3	2	1	0
Byte								
0 - n	Library System Firmware Object File							

The format of the Library System Firmware Object File is as follows.

Bit	7	6	5	4	3	2	1	0
Byte								
0 - 3	(MSB)	Size of Library System Firmware Object File (n)						(LSB)
4 - n	Library System Firmware Object Code							

Upon completion of the Write Buffer command, the library system will reboot the library system controller board. Host software should again poll with the Request Sense command, waiting for GOOD status.

10.31.2 Changing the Medium Changer Device SCSI ID

To change the SCSI ID of the medium changer device, set Mode to 2, Buffer ID to 0, Buffer Offset to 0, and Parameter List Length to 1. The parameter data consists of a single byte specifying the new SCSI ID the medium changer device.

The medium changer device SCSI ID parameter list is shown below.

Medium Changer Device SCSI ID Parameter Data

Bit	7	6	5	4	3	2	1	0
Byte								
0	New Medium Changer Device SCSI ID							

After returning good status to this command, the medium changer device will respond to the new SCSI ID for subsequent SCSI commands issued to it.

10.31.3 Assigning Drive Good / Bad Status Codes

To assign drive status codes, set Mode to 2, Buffer ID to 1, Buffer Offset to 0, and Parameter List Length to 12. The parameter data consists of an array of bytes containing a status code for each drive.

The drive status code parameter data is shown below.

Drive Good / Bad Status Code Parameter Data

Bit Byte	7	6	5	4	3	2	1	0
0	Drive 1 Status							
1	Drive 2 Status							
2	Drive 3 Status							
3	Drive 4 Status							
4	Drive 5 Status							
5	Drive 6 Status							
6	Drive 7 Status							
7	Drive 8 Status							
8	Drive 9 Status							
9	Drive 10 Status							
10 - 11	Reserved (00)							

Drive 1-10 Status is a user-defined value to indicate the good / bad status of a drive. For example, a 1 could indicate a good drive while a 2 could indicate a bad drive.

10.31.4 Writing to the Echo Buffer to Test SCSI Communication

A 256 byte echo buffer is supported to test communication with the medium changer device.

To write to the echo buffer, set Mode to 2 and Buffer ID to 2.

Buffer Offset can be any value between zero and 255.

Parameter List Length can be any value between one and 256. The sum of Buffer Offset and Parameter List Length cannot exceed 256.

The Echo Buffer parameter list is shown below.

Echo Buffer Parameter Data

Bit Byte	7	6	5	4	3	2	1	0
0 - n	Application Supplied Data							

The data transferred is not defined by this specification and may be selected by the application. After the buffer is written, a Read Buffer command should be used to read the buffer and check its contents. The buffer is maintained when the library system is powered off.

10.31.5 Assigning Network IP Address and Subnet Mask

To assign a network IP address and subnet mask to the library system, set Mode to 2, Buffer ID to 3 for IP address or 4 for subnet mask, Buffer Offset to 0, and Parameter List Length to 4. The parameter data consists of four octets (bytes) of address or mask information. This information is simply retained for host access via the Read Buffer command.

The network IP address or subnet mask parameter data is shown below.

Network IP Address or Subnet Mask Parameter Data

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

Octet 1-4 are four bytes of IP address or subnet mask parameter data. For example, an IP address of 101.102.103.104 would be represented as the values 101, 102, 103, and 104.

11. Event History Type and Event Description

The event list is a buffer maintained in the library system's non-volatile memory and used for diagnostic debugging purposes. The Event History Type byte of the Library Mode Parameters Page (Section 10.8.1) determines which values will be recorded in the event list. The format of the Event History Type byte is as follows.

Event History Type (see Mode Select Library Mode Parameters Page)

Bit	15	14	13	12	11	10	9	8
	N/A	Reserved (0)				DriveCAN	MslotCAN	PthruCAN

Bit	7	6	5	4	3	2	1	0
	CmdFilter	SCSI Activity		Terse	Src/Dst	Rsvd(0)	Drive Pwr	Front Panel

The host can set this byte (via the Mode Select command) to specify the types of events to be recorded. The event list can then be examined using the Log Sense command Event History Page (Section 10.7.4).

The fields of the Event History Type byte to set and the corresponding bytes recorded in the event list for these settings are provided below. If the Event History Type byte is equal to zero, no further events will be recorded. This provides a means of retaining a previously recorded sequence of event bytes until they can be analyzed.

For a non-zero Event History Type, the following event bytes will always be recorded.

- FFh, 00h Power-on.
- FFh, 01h SCSI bus or device reset.
- F0h Beginning of medium changer command.
- F1h Beginning of library system initialize and recovery sequence, followed by byte values indicating the particular sequence followed.
- F2h End of library system initialize and recovery sequence.

DriveCAN equals 1 if CAN message activity to the drives is to be recorded.

The following bytes will be recorded for each drive CAN message if this bit is set.

- A1h NNh The second byte indicates the type and destination of the CAN message (it is the LSB of the CAN message id). These two bytes are followed by a (command and data) byte count, and the corresponding command and data bytes.

MslotCAN equals 1 if CAN message activity to the mailslot and magazine elements is to be recorded.

The following bytes will be recorded for each mailslot and magazine CAN message if this bit is set.

- A3h NNh The second byte indicates the type and destination of the CAN message (it is the LSB of the CAN message id). These two bytes are followed by a (command and data) byte count, and the corresponding command and data bytes.

PthruCAN equals 1 if CAN message activity to the pass-through elements is to be recorded.

The following bytes will be recorded for each pass-through CAN message if this bit is set.

- A7h NNh The second byte indicates the type and destination of the CAN message (it is the LSB of the CAN message id). These two bytes are followed by a (command and data) byte count, and the corresponding command and data bytes.

CmdFilter equals 1 if only SCSI commands which effect a change to the library are to be recorded in the Event List. If this bit is set, all Test Unit Ready, Request Sense, Inquiry, Mode Sense, Log Sense,

and Read Element Status commands will not be recorded in the Event List. If this bit is zero, all SCSI commands received will be recorded, subject to the SCSI Activity field and the Terse bit.

SCSI Activity equals one of the following:

- 0 No recording of SCSI activity
- 1 Record first byte (byte 0) of command only
- 2 Record all command bytes and all data bytes received by the changer device
- 3 Record first byte of command byte and all message and status bytes

The following bytes will be recorded in the event list for a non-zero SCSI Activity field.

- F3h Non-zero ASC/ASCQ returned to host. This byte is followed by the ASC and ASCQ bytes.
- F4h Non-zero ASC/ASCQ received from drive. This byte is followed by the ASC and ASCQ bytes.

The following bytes will be recorded in the event list, depending upon the setting of the SCSI Activity field. The E5 and E6 values are not recorded if the Terse bit is set to one below.

- E3h One or more message bytes received from host, followed by the message bytes.
- E4h One or more message bytes sent to the host, followed by the message bytes.
- E5h One or more command bytes received from the host, followed only by the first command byte (byte 0).
- E6h One or more command bytes received from the host, followed by a byte count and the command bytes.
- E7h One or more data bytes received from the host, followed by two bytes of byte count (MSB and LSB), and the data bytes.
- E8h A status byte sent to the host, followed by the status byte.

Terse should be set to a bit of one if all bytes specified by the SCSI Activity field are to be recorded except E5 and E6. This bit should only be set for SCSI Activity field settings of 1 or 2. Setting this bit increases the amount of SCSI activity data that may be stored in the list.

Src/Dst equals a bit of one if source and destination element addresses for Position To Element, Move Medium, and Exchange Medium commands; or front panel, Rezero Unit, or power-on cartridge movement operations; are to be recorded, or a bit of zero if no source and destination element addresses are to be recorded. Source and destination element addresses for front panel, Rezero Unit, or power-on cartridge movement operations are preceded by an F7h flag byte. Source and destination element addresses for Position To Element, Move Medium, and Exchange Medium commands are also preceded by an F7h flag byte but only if no command byte was recorded (i.e., if the SCSI Activity field is set to zero).

- F7h A cartridge was moved. The source and destination element addresses follow as described below.

For clarity and to save space in the Event List, drives are logged as D1h, D2h, etc.. The medium transport element is logged as E1h. Storage elements less than 200 (C8h) are logged as one byte; and storage element numbers greater than or equal to 200 are logged as two bytes - the first (MSB) being OR'd with FAh. The mailslot is logged as EEh. Magazine slots are logged as two bytes – F9 and then the magazine slot number (1-5).

For example, the following is the Event List of an Exchange Medium from ST3 to D1 to ST255:

F0 (E5) A6 (...) 03 D1 FA FF

DrivePwr equals 1 if flag bytes for drive power cycling are to be recorded, or 0 if no flag bytes for drive power cycling are to be recorded.

The following flag bytes are recorded for drive power cycling. The two bytes recorded are followed by a byte indicating the number of the drive effected.

- F5h, 05h Drive power removed because drive was taken off-line

- F5h, 06h Drive power applied because drive was brought back on-line
- F5h, 07h Drive power cycled because drive SCSI ID was changed

Front Panel equals a bit of one if events related to front panel functions are to be recorded.

The bytes recorded in the event history list related to front panel functions are as follows:

- F6h, 02h Drive Service mode was entered.
- F7h A cartridge was moved prior to turning off or servicing a drive. The source and destination addresses of the cartridge are recorded in the manner described in the Src/Dst field above. The Src/Dst field must be set to one to record these bytes.
- F8h A magazine was inserted and latched. The magazine number (1) is also recorded.
- F9h A magazine was released. The magazine number (1) is also recorded.
- FEh, 03h The mailslot was opened by the operator.
- FEh, 04h The mailslot was closed by the operator.

12. Error Codes

12.1 Medium Changer Device SCSI Error Codes

The following is a list of error codes returned by a Request Sense command issued to the medium changer device within the library. The codes are listed in ASC, ASCQ order. See the Request Sense command, Section 10.21, for a description of the Sense Key values. Errors listed here with a Sense Key of 04h, hardware error, may also be returned with a Sense Key of 01h, recovered error. This indicates that the command was successful although the library did have some difficulty in completing the command. Recovered errors indicate a possible problem with the library.

Error codes returned by tape drives within the library system are not listed — see the appropriate drive manuals for a description of these errors.

Also listed are the internal error codes associated with the SCSI error returned, and the procedures that a host may use to recover when it has received one of the errors listed here. See Section 12.3 for a list of the internal library error codes, and the LTO Series User's Manual or Service Manual for the cause or corrective action for each code. Refer to the next section for a list of the suggested host error recovery procedures. Not all errors have host recovery procedures. It should be noted that the library system attempts extensive error recovery on its own.

Sense Key	ASC	ASCQ	Error Description	Internal Error	Recovery Procedure
02h	04h	01h	Not ready, in process of becoming ready	-	1
02h	04h	80h	Not ready, turning off a drive	-	1
02h	04h	81h	Not ready, beginning drive service	-	1
02h	04h	82h	Not ready, motors are running	-	1
02h	04h	83h	Not ready, library is parked	-	1
02h	04h	84h	Not ready, programming DSP	-	1
05h	1Ah	00h	Parameter list length error	-	2
05h	20h	00h	Invalid command operation code	-	2
05h	21h	01h	Invalid element address	-	2
05h	24h	00h	Invalid field in CDB	-	2
05h	25h	00h	Logical Unit not supported	-	3
05h	26h	00h	Invalid field in parameter list	-	4
06h	28h	00h	Not ready to ready transition (door closed)	-	9
05h	28h	01h	Import or export element accessed	-	5
06h	29h	00h	Power-on, Reset, or Bus Device Reset occurred	-	6
06h	2Ah	00h	Log Parameters changed	-	7
06h	2Ah	01h	Mode parameters changed	-	8
05h	2Ch	00h	Command sequence error (data blocks out of order)	-	19
05h	3Bh	0Dh	Medium destination element full	1Ch	22
05h	3Bh	0Eh	Medium source element empty	1Bh	22
06h	3Bh	14h	Magazine inserted and latched	-	20
06h	3Bh	15h	Magazine released	-	20
06h	3Fh	01h	Microcode has changed	-	10
04h	44h	00h	Internal target failure	-	-
0Bh	4Eh	00h	Overlapped commands	-	-
05h	53h	02h	Medium removal prevented	2Dh,82h	11
04h	80h	01h	Flash checksum error	-	21
04h	80h	0Eh	Flash program fail - main controller	0Eh	21
04h	80h	0Fh	Flash program fail - DSP	0Fh	21
04h	80h	1Ah	Drive not installed	1Ah	12
04h	80h	1Dh	Element unexpectedly empty	1Dh	9

Sense Key	ASC	ASCQ	Error Description	Internal Error	Recovery Procedure
04h	80h	1Eh	Element unexpectedly full	1Eh	9
04h	80h	20h	Pick cartridge failure	20h	13
04h	80h	21h	Store cartridge failure	21h	13
04h	80h	23h	Drive not ready	23h	14
04h	80h	24h	Drive load failure	24h	15
04h	80h	25h	Drive unload failure	25h	16
04h	80h	26h	Eject failure	26h	16
04h	80h	29h	SCSI terminator power is low	29h	-
04h	80h	2Bh	Cannot export cartridge	2Bh	17
02h	80h	2Ch	Mailslot is open	2Ch	18
04h	80h	2Fh	Pivot failure	2Fh	-
04h	80h	32h	Lift position failure	32h	-
04h	80h	33h	Cartridge projecting (lift blocked)	33h	-
04h	80h	3Bh	Picker position failure	3Bh	9,13
04h	80h	3Fh	Picker misposition	3Fh	24
04h	80h	40h	Pivot alignment failure	40h	-
04h	80h	43h	Cannot open mailslot	43h	25
04h	80h	45h	Element scan fail	45h	-
04h	80h	47h	Picker unexpectedly full	47h	29
04h	80h	49h	Bar code reader not installed	49h	-
02h	80h	4Ah	Rear door is open	4Ah	-
04h	80h	4Dh	Cannot configure drive	4Dh	23
04h	80h	4Eh	Drive not responding	4Eh	-
06h	80h	52h	Cannot close mailslot	52h	25
04h	80h	54h	Bad drive type	54h	-
06h	80h	56h	Overheat condition inside cabinet	56h	27
04h	80h	58h	Mailslot jammed	58h	-
04h	80h	59h	Power supply failure	59h	-
04h	80h	5Ah	Cable connect failure	5Ah	-
04h	80h	5Bh	Fuse overload	5Bh	-
04h	80h	5Ch	Circuit board fail	5Ch	-
04h	80h	5Dh	Overheat condition inside drive module	5Dh	27
04h	80h	5Eh	Drive temperature shutdown	5Eh	-
04h	80h	5Fh	Drive shutdown due to fan failure	5Fh	-
04h	80h	62h	Cartridge not a cleaning cartridge	62h	-
04h	80h	63h	Low module fan speed	63h	-
04h	80h	64h	Power supply voltage out of range	64h	-
04h	80h	65h	Main controller board SCSI terminator power	65h	-
04h	80h	66h	Mailslot motor position failure	66h	-
04h	80h	67h	Pass-through motor position failure	67h	-
04h	80h	68h	Mailslot motor position timeout	68h	-
04h	80h	69h	Pass-through motor position timeout	69h	-
06h	80h	6Ch	Start of drive service	6Ch	10
06h	80h	6Dh	End of drive service	6Dh	10
06h	80h	6Eh	Switch to alternate MTA	6Eh	10
06h	80h	6Fh	Switch to primary MTA	6Fh	10
04h	80h	70h	Communications timeout with DSP	70h	-
04h	80h	71h	CAN communications timeout with drive board	71h	-
04h	80h	72h	CAN communication timeout with mailslot board	72h	-
04h	80h	73h	CAN communications timeout with magazine board	73h	-
04h	80h	78h	Mailslot not installed	78h	-
04h	80h	80h	Magazine not installed	80h	-

Sense Key	ASC	ASCQ	Error Description	Internal Error	Recovery Procedure
04h	80h	84h	Magazine release failure	84h	-
04h	80h	91h	Pick offset failure	91h	-
04h	80h	92h	Lift offset failure	92h	-
04h	80h	93h	Pivot offset failure	93h	-
04h	80h	94h	Target offset failure	94h	-
04h	80h	95h	Reference offset failure	95h	-
04h	80h	96h	Mailslot linear offset failure	96h	-
06h	81h	00h	Component failure	-	-
06h	81h	01h	Power supply installed	-	-
06h	81h	02h	Power supply removed	-	-
05h	81h	03h	Download checksum error	-	-
05h	86h	00h	Transport element full	1Fh	29

12.2 Medium Changer Device Error Host Recovery Procedures

The following is a list of procedures that a host could use to recover from the SCSI errors listed in the previous section. In some, if not most cases, no action taken by the host will cause full recovery to take place and the LTO Series User's Guide or Service Manual should be consulted to determine the ultimate cause or corrective action to be taken to rectify the problem. Many situations call for operator intervention.

Procedure	Description
1	Delay a few seconds and then retry command.
2	Examine command block for errors. Sense data identifies offending byte and field.
3	Examine command block or Identify message for non-zero LUN value.
4	Examine parameter list for errors. Sense data identifies offending byte and field.
5	Use Mode Select command enable magazine or mailslot, or do not reference disabled magazine or mailslot.
6	Determine cause of reset, reselect mode parameters not previously saved, and resubmit command.
7	Issue Log Sense, if desired, to obtain log parameters changed via front panel or by another host, and then resubmit original command.
8	Issue Mode Sense, if desired, to obtain mode parameters changes via front panel or by another host, and then resubmit original command.
9	Issue Read Element Status commands to reinventory library.
10	Issue Bus Device Reset to changer device or assert SCSI bus reset line and retry command.
11	Wait for other host to issue Prevent/Allow Medium Removal command to allow access to mailslot, or issue Bus Device Reset to changer device and retry command.
12	Power up the drive and place it on-line via the Send Diagnostic command, Drive On/Off page, before trying to move to or from it.
13	Issue Position to Element command to any storage element. Retry the move or exchange command.
14	Reload drive by issuing a Move Medium command with the drive as the source and destination address. If this does not work, load the drive and then use the Send Diagnostic command, Drive On/Off Page, to first power-off the drive and then, after a few seconds, to power-on the drive again. Wait a few seconds before issuing a Test Unit Ready to the drive to check for ready status.
15	Issue the Initialize Single Element and Read Element Status commands to reinventory the drives. If the drive is truly empty, issue the Send Diagnostic command with the Drive On/Off page to cycle power to the drive as in procedure 14 and then reinventory the drives.

Procedure	Description
16	Issue the Initialize Single Element Status and Read Element Status commands to reinventory the drive. If the drive is truly full, issue the Send Diagnostic command with the Drive On/Off page to cycle power to the drive as in procedure 14 and then reinventory the drives.
17	If Rezero Unit command, move cartridges from the medium transport element and drives before issuing command. If not Rezero Unit, move cartridge from magazine and then retry command.
18	Issue Open/Close Mailslot command to close the mailslot and then retry command.
19	When using Write Buffer commands to download firmware, make sure that the firmware packets as defined by the Buffer Offset and Transfer Length fields are contiguous.
20	Issue Read Element Status commands referencing changed magazine slots to update host inventory. Possibly load new cartridges into drives to read contents.
21	Redownload Flash firmware to library using Write Buffer commands, and repeat failing command.
22	Issue the Initialize Single Element and Read Element Status commands to reinventory the elements.
23	Use Send Diagnostic command, Drive Power On/Off page to turn drive off and on again. Retry command when drive is ready.
24	Issue a Rezero Unit command and then retry the original command.
25	Wait a few seconds and then retry command.
27	Decrease drive read/write activity until drive temperature has cooled down significantly
29	Use the Move Medium command to move the cartridge out of the medium transport element.

12.3 Internal Error Codes

The following error codes are stored in the library system error log and error statistics buffers and are returned by the Log Sense command. For more information about the causes and corrective actions for these errors, refer to the appropriate LTO Series User's Guide or Service Manual.

Error Code	Error Description
01h	Flash checksum failure
02h	NV RAM failure
07h	SCSI chip failure
0Ah	Bad element code
0Ch	Operation stack overflow
0Dh	Bad operation stack index
0Eh	Flash program fail - main controller
0Fh	Flash program fail - DSP
1Ah	Drive not installed
1Bh	Source is empty
1Ch	Destination is full
1Dh	Element unexpectedly empty
1Eh	Element unexpectedly full
1Fh	Picker is full
20h	Pick cartridge failure
21h	Store cartridge failure
23h	Drive not ready
24h	Drive load failure
25h	Drive unload failure
26h	Eject failure
29h	SCSI terminator power is low
2Bh	Cannot export cartridge
2Ch	Mailslot is open

Error Code	Error Description
2Dh	Medium removal is prevented
32h	Lift position failure
33h	Cartridge projecting (lift blocked)
3Bh	Picker position failure
3Ch	Swap picker failure
3Fh	Picker misposition
40h	Pivot alignment failure
43h	Cannot open mailslot
44h	Picker not at drive
45h	Element scan fail
4Ah	Rear access door is open
52h	Cannot close mailslot
54h	Bad drive type
55h	Drive address conflict
56h	Overheat condition inside cabinet
58h	Mailslot jammed
59h	Power supply failure
5Ah	Cable connect failure
5Bh	Fuse overload
5Ch	Circuit board fail
5Dh	Overheat condition inside drive module
5Eh	Drive temperature shutdown
5Fh	Drive shutdown due to fan failure
62h	Cartridge not a cleaning cartridge
63h	Low module fan speed
64h	Power supply voltage out of range
65h	Main controller board SCSI terminator power
66h	Mailslot motor position failure
67h	Pass-through motor position failure
68h	Mailslot motor position timeout
69h	Pass-through motor position timeout
70h	Communication timeout with DSP
71h	CAN communications timeout with drive board
72h	CAN communication timeout with mailslot board
73h	CAN communication timeout with magazine board
74h	CAN communication timeout with pass-through board
78h	Mailslot not installed
80h	Magazine not installed
81h	Magazine not latched
82h	Magazine release prevented
84h	Magazine release failure
91h	Pick offset failure
92h	Lift offset failure
93h	Pivot offset failure
94h	Target offset failure
95h	Reference offset failure
96h	Mailslot linear offset failure
F7h	SCSI parity error
F9h	Abort message received
FDh	Host communication timeout (host stopped handshaking)

12.4 Internal Error Context Codes

The following error context codes are stored in the library system error log and are returned by the Log Sense command.

Context	Description
1	Powering up library and drives
2	Initializing library
3	Positioning to pick from source element
4	Picking from source element
5	Positioning to pick from destination element
6	Picking from destination element
7	Positioning to store to destination element
8	Storing to destination element
9	Positioning to store to destination 2 element
10	Storing to destination 2 element
11	Positioning to element
12	Checking element for media
13	Scanning bar codes
14	Opening mailslot
15	Closing mailslot
16	Sending pass-through
17	Recalling pass-through
18	Programming Flash
19	Setting offsets

13. Developer Notes

13.1 Identifying the Library and Model

To write software for an LTO Series library, it is not necessary to know the exact library model number, but rather the capacities and capabilities of the library model. For example, application code can be written in a more generic manner if information in the following Mode Sense pages is used by the application: Element Address Assignment page (1Dh), Transport Geometry Parameters page (1Eh), Device Capabilities page (1Fh), Library Mode Parameters page (20h), Library Special Modes page (21h), Drive Assignments page (22h), and Front Panel Display Mode page (23h). Additional library information can be found in the Inquiry command Additional Information page (C0h) and the Read Element Status data transfer element descriptors (for the SCSI ID's of the drives).

For example, the number and addresses of all element types can be found in the Mode Sense Device Capabilities page. In this page, the number of data transfer elements is equal to the number of drive bays present, not the number of drives - so the the Drive Assignments page must also be examined to determine which drives are present and powered on. The following table identifies which pages are supported by the of Plasmon Tape libraries. A Mode Sense command with a page code of 3Fh can be used to determine which Mode Sense pages are available. An Inquiry command with a vital product data page code of 00h can be used to determine which Inquiry vital product data pages are available.

Library and Model	Mode Sense Pages Supported	Inquiry Vital Product Data Pages Supported
all	1Dh, 1Eh, 1Fh, 20h, 21h, 22h, 23h	C0h

13.2 Maintaining an Inventory

The medium changer device in the library maintains an inventory of cartridges in the library in its non-volatile memory, but has no knowledge of the contents of the cartridges. For this reason, the host initiator device may wish to maintain its own inventory of library cartridges. To synchronize these two inventories, it may be necessary for the host to issue a Read Element Status command. Once the position of cartridges are know, the host may wish to load each cartridge into a drive to read content information. Obviously, this is a time-consuming operation so should be done only when necessary. In libraries equipped with a bar code reader, the Read Element Status command will return bar code information which can be used to identify specific cartridges.

13.3 Using the Library (Moving Cartridges)

Although cartridges can be moved by using the Move Medium command and specifying the medium transport elements as source or destination addresses, it is much easier to use the Exchange Medium command. For example, the command "Exchange Medium - ST1 to DT1 to ST2" will exchange the cartridge in storage element 1 with the one in drive 1 and return that one to storage element 2.

Various schemes can be used to optimize the performance of the library. For example, frequently used cartridges can be placed closer to the drives.

13.4 Use of the Cartridge Magazine

The cartridge magazine, allows the quick insertion, removal, or exchange of up to 5 cartridges via a portable carrier. Access to the magazine is via the magazine access door which, when closed, may only

be opened via the front panel or the SCSI Release Magazine command. If the magazine is in place, this will also energize a solenoid to release the magazine and allow it to be removed. Once the magazine has been released, its slots are no longer accessible to the library. When a new magazine is inserted, the empty/full status of its slots is detected by the library and notification of magazine insertion is sent to the host. It is up to the host to determine the contents of each of the cartridges in the magazine. Note that removal of the magazine may be prevented by the Prevent/Allow Medium Removal command, but that insertion can only be prevented if the magazine access door is already closed. Once the magazine has been released, it must be physically removed and reinserted for the library to regain access to its slots.

13.5 Servicing Drives

To remove or replace a library system drive, it must be properly prepared for servicing. Drives are prepared for servicing by the front panel “Service Drive” menu option or by the SCSI Service Drive command. If invoked from the front panel, there will be a 5 second delay before the drive is unloaded or powered-off in preparation for removal. This allows time for all SCSI initiators to poll the medium changer device and sense that drive is being prepared for servicing. If the host receives a Unit Attention condition indicating that a drive is ready to be serviced, it should discontinue activity on the SCSI bus to which the drive is attached. After the delay, the drive will automatically be unloaded and powered off.

After the drives are repaired or replaced, the drives may be restored to service by the front panel “Restore Drive” menu option or by the SCSI Restore Drive command. If drive service was invoked from the front panel and the drive was automatically powered off at that time, power will be restored when the “Restore Drive” option is selected at the front panel.

13.6 Examining Errors

After processing a command, the medium changer device or tape drive will normally return GOOD completion status or CHECK CONDITION status. If the host receives CHECK CONDITION status, it should issue a Request Sense command. The Sense Key field can then be examined to see if an error occurred and, if so, the severity of the error. The Additional Sense Code (ASC) and Additional Sense Code Qualifier (ASCQ) fields provide more information about the error or condition that triggered the CHECK CONDITION. Depending upon the Allocation Length specified in the Request Sense command, more information about the error will also be returned. The error codes listed in this manual are for the medium changer device only. Consult the specific tape drive manual for information about errors returned by the drives themselves.

13.7 Drive Temperature and Low Fan Speed Warnings

If, during normal operation conditions, one or more drives are found to be overheating or their modules have experienced a significant drop in fan speed, a drive warning Unit Attention will be generated. If the host receives this notification, it should stop reading from or writing any cartridges in those drives and unload those cartridges. If the drives continue to overheat or the fan speeds drops further, a drive shutdown Unit Attention condition will be generated. After 60 seconds, the drives will automatically be powered down. At this point, the drives are disconnected from the SCSI bus and a third Unit Attention condition will be generated indicating that drives have been placed in the service state. To restore a drive to service, use the Restore Drive menu selection on the front panel or the Restore Drive SCSI command.

The current state of any drive can be obtained by issuing a Read Element Status using the drive element address. The Additional Sense Code and Additional Sense Code Qualifier fields in the data transfer element descriptor identify the current normal/warning/or shutdown state of the drive. These fields should be examined in every data transfer element descriptor after being notified of any drive-related Unit Attention condition.

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