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RLS

SCSI Interface Reference

501551 Rev. B

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1. Introduction

This manual is intended for use by system integrators who have an understanding of the Small Computer Systems Interface (SCSI). It describes the functional extent to which Qualstar's Medium-changer devices (MC) implement the ANSI SCSI-2 Interface Standard for the RLS product line. For detailed information about the ANSI SCSI-2 Interface Standard, please refer to the appropriate specifications and/or application notes.

1.1 References

The primary reference for this interface manual is ANSI X3.131-1994.

1.2 Terminology Used in this Document

Conditions and command names are capitalized as in "Mode Sense command", and "*…generates a Unit Attention condition…*"; status's, signals, message names, sense keys and bus phases are written in all capital letters, as in *"…return a* CHECK CONDITION *status"*, and "*…set the sense key to* ILLEGAL REQUEST*"*.

In describing buffer sizes and transfer lengths, "K" equals 1024 bytes; therefore, 4K is the same as 4096 bytes.

Unless otherwise specified, all numerical references are decimal. Binary numbers are indicated by a subscript "b" (011_b), and hexadecimal numbers are indicated by a subscript "h" ($1A3_h$). A field of one or more italicized questions marks (????h) indicates a variable field whose value is dependent upon other factors or commands.

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2. General Information

The MC functions as a target. The initiator sends a command to the MC by sending a Command Descriptor Block (CDB) that defines the command and its parameters. The MC then examines certain fields in the CDB and will report an error if any is invalid. It then attempts to execute the command. This chapter contains information common to all commands. Information about specific commands is found in subsequent chapters.

2.1 SCSI Bus Timing

The MC conforms to the timing specifications stated in the ANSI specification.

2.2 Logical Interface

The MC implements the logical characteristics of SCSI as described in Section 5 of the ANSI specification with the following options and exceptions:

- **Bus Phases** – The MC supports all SCSI bus phases.
- **Selection Time-out Option** – The Select and Reselect Time-outs are 250 milliseconds.
- **Reselection Time-out Option** – The MC follows the reselection time-out procedure as defined in the ANSI specification, Paragraph 5.1.4.2 Option 2.
- **Phase Interruptions** – Phases can only be interrupted by the following exception conditions:

    a. Reset Condition – The Reset condition can occur when the SCSI RST signal is asserted or when a Power-Fail/Power-Off condition in the device occurs. In this case, the MC terminates the phase and the connection established during SELECTION/RESELECTION with the release of the BSY signal.

    b. **Parity Error Condition during Any Out Phase** – If the MC detects a parity error, the resulting action depends upon the `Configuration\Advanced\SCSI\Parity` menu item:

    `MESSAGE` – The MC will perform retries before aborting the command.

    `ABORT` – The MC will not perform retries but will attempt to abort the command by going to the STATUS phase, sending a CHECK CONDITION status, and then going to the BUS FREE phase. If it is unable to successfully send the status byte, it will go to the BUS FREE phase. Sense data will be available.

    `IGNORE` – The MC will accept the bad data.

- **Synchronous Data Transfer REQ/ACK Offset** – The REQ/ACK offsets from 0 to 16 are supported using extended messages.
- **Reset Option** – The MC implements the hard reset option. Upon detection of a Reset condition, the MC will:
  a. Immediately clear all incomplete or pending operations.
  b. Release all SCSI device reservations.
  c. Return any SCSI device operating modes (MODE SELECT, etc.) to their power-on conditions.
  d. Perform a limited set of self-test diagnostics.
  e. Set the Unit Attention condition.

2.2.1 Messages

The MC supports the message protocol described in Section 5 of the ANSI specification and implements the messages listed in Table 2-1.

MESSAGE CODE	DESCRIPTION
00_h	COMMAND COMPLETE
01_h	*Extended Message Prefix*
02_h	SAVE DATA POINTER
03_h	RESTORE POINTERS
04_h	DISCONNECT
05_h	INITIATOR DETECTED ERROR
06_h	ABORT
07_h	MESSAGE REJECT
08_h	NO OPERATION
09_h	MESSAGE PARITY ERROR
$0C_h$	BUS DEVICE RESET
$80\text{-}87_h$ or $C0\text{-}C7_h$	IDENTIFY

Table 2-1 Supported Messages

2.2.2 Extended Messages

The MC supports the SYNCHRONOUS DATA TRANSFER REQUEST and WIDE DATA TRANSFER REQUEST extended messages.

If the `Configuration\Advanced\SCSI\Synchronous` menu item is set to `ON`, it will negotiate the synchronous data transfer mode, otherwise it will respond with asynchronous parameters. In all cases however, it will not MESSAGE REJECT the SYNCHRONOUS DATA TRANSFER REQUEST extended message.

The MC will always negotiate the wide data transfer mode to 8 bits. It will never MESSAGE REJECT the WIDE DATA TRANSFER REQUEST message.

2.3 SCSI Command Descriptor Block Structure

The MC supports the command descriptor blocks (CDBs) as defined in the ANSI specification. This section explains options and exceptions specific to Qualstar's implementation. The format of a generic CDB is shown in Table 2-2.

NOTE

Values other than those in parentheses in the CDBs will result in a CHECK CONDITION status. In the case of returned data, such as Mode Sense pages, values in parentheses are constants that do not change.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Operation Code							
1	LUN			Multi-Bit field				
2	Single-Byte field							
3-4	Multi-Byte field							
5	Vendor Specific (0)		Reserved (0)				Flag (0)	Link (0)

Table 2-2 Generic CDB Format

2.3.1 Operation Code

Table 2-3 lists the commands that the MC supports.

Operation Code	Command
00h	Test Unit Ready
01h	Rezero Unit
03h	Request Sense
07h	Initialize Element Status
12h	Inquiry
15h	Mode Select
16h	Reserve
17h	Release
1Ah	Mode Sense
1Dh	Send Diagnostic
1Eh	Prevent/Allow Medium Removal
2Bh	Position to Element
3Bh	Write Buffer
4Dh	Log Sense
A5h	Move Medium
B5h	Request Volume Element Address
B6h	Send Volume Tag
B8h	Read Element Status
E7h	Initialize Element Status with Range

Table 2-3 Supported Commands

If an error or exception condition exists when the command is received, the MC will return a CHECK CONDITION status.

2.3.2 Logical Unit Implementation

Part of the configuration process when setting up the MC is assigning a Logical Unit Number (LUN) to the MC. This is done using the `Configuration\Advanced\SCSI\LUN` menu item. The MC will respond to values from `0` through `7`, and will also respond to any LUN value if you choose the value `ANY` in this menu item.

The initiator can specify the LUN by using either the SCSI-2 implementation (Selection *with* the Attention signal and IDENTIFY message) or the SCSI-1 implementation (Selection *without* the Attention signal and the LUN field in the CDB) as follows:

- **Selection with Attention Signal (SCSI-2 Implementation)** – If you select the MC with the Attention signal, specify the LUN by sending an IDENTIFY message during the first MESSAGE OUT phase. In this case the MC ignores the LUN value in the subsequent CDB.
- **Selection without Attention Signal (SCSI-1 Implementation)** – If you select the MC without the Attention signal, you must specify the LUN value in the subsequent CDB.

2.3.2.1 Preservation of Sense Data

Sense data for a given LUN is preserved in the event a command is issued to an invalid LUN, as shown in the following sequence (SCSI-1 implementation is being used):

- The MC has been assigned a LUN value of 2.
- The MC receives a command with a LUN of 2 and the command terminates with a CHECK CONDITION status.
- The MC receives a Request Sense command, but with a LUN of 1. This does not match the MC's assigned LUN value, so the MC returns a sense key of ILLEGAL REQUEST with an Additional Sense Code (ASC) of LOGICAL UNIT NOT SUPPORTED. The MC returns a GOOD status.

The MC receives another Request Sense command, but this time with a matching LUN of 2. The sense data it returns reflects the outcome of the command that resulted in the CHECK CONDITION status.

2.3.3 Reserved Fields

Reserved bits, bytes, fields, and code values are checked for non-zero conditions. The MC will return a CHECK CONDITION status and set the sense key to ILLEGAL REQUEST if any of these are set to 1.

2.3.4 Single-Byte Fields

The values of some fields are predetermined by the ANSI specification. In these cases, the actual values are indicated in the CDB for each command. Reserved fields are shown with a value of 0.

Supported fields that must have one particular value are shown with the field name followed by the required value within parentheses.

Other supported fields are shown with the field name only. Valid values are listed in the explanatory paragraphs.

2.3.5 Multi-Byte Fields

Multi-byte fields are *big-endian*. The numerically lower byte contains the field's most significant byte (MSB), and the numerically higher byte contains the field's least significant byte (LSB).

2.3.6 Vendor Specific

The value of this field is not specified in the ANSI specification. Vendors are allowed to extend the command's specification using these bits. For most commands the value of this field must be 0.

2.3.7 Flag

Linked commands are not supported and the value of this field must be 0.

2.3.8 Link

Linked commands are not supported and the value of this field must be 0.

2.4 Status Structures

2.4.1 Completion Status Byte

The MC sends a Completion Status Byte (referred to in this document as *Status byte* or *status*) to the initiator during the STATUS phase after each command, unless the command is cleared by an ABORT or BUS DEVICE RESET message, or by a hard reset condition. The contents of the Status byte is shown in Table 2-4. At any time, additional information is available in the Sense data (returned by the Request Sense command).

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved (0)		Status					Reserved (0)

Table 2-4 Completion Status Byte Contents

Table 2-5 lists the values and names for the Status field. The values are the individual field values not the values for the entire Completion Status Byte.

Status	Name
0	GOOD

1	CHECK CONDITION
4	BUSY
18	RESERVATION CONFLICT

Table 2-5 Status Field Values

The following is a description of the Status field values:

GOOD	A GOOD status (all bits zero) indicates that the MC has completed the command without errors.
CHECK CONDITION	CHECK CONDITION status indicates that the command terminated with an error, exception, or abnormal condition, and that this condition should be checked. CHECK CONDITIONs are reported when the error is detected and include: • The specified LUN does not match the MC's assigned LUN. • The MC receives a command with in which a reserved field is not 0. • The MC receives a command with an invalid parameter. • A parity error occurs while receiving the command and the message system is not enabled. • The message system is enabled and a message error occurs while the MC is processing the command. • The initiator sends a command other than an Inquiry or Request Sense command while a pending Unit Attention condition exists. • The MC is not ready. • The MC has an unrecoverable hardware error and receives a command that requires motion. • A special condition unique to the command being processed has occurred. These special conditions are explained in the individual command chapters.
BUSY	The MC returns a BUSY status whenever it is unable to accept a command.
RESERVATION CONFLICT	The MC will return a RESERVATION CONFLICT if any access other than a Request Sense, Inquiry, or Release Unit command is received and the MC (or affected elements of the MC) is reserved for another initiator.

2.4.2 Internal Unit Attention Condition

The MC generates a Unit Attention condition when:

- The MC is power-cycled.
- The SCSI bus is reset.
- It receives a BUS DEVICE RESET message.
- The inventory of the MC is altered by manual intervention.
- The MC receives a SCSI Mode Select command that alters the configuration of the MC.

Possible initiator responses to these events are:

- Request Sense
- Inquiry
- Any other command

The following paragraphs describe these commands when a Unit Attention condition exists.

2.4.2.1 Request Sense

If a Unit Attention condition exists and the MC receives a Request Sense command, then it will return a GOOD status, set the sense key to UNIT ATTENTION, and will then clear the Unit Attention condition for that initiator. Subsequent commands will return an appropriate status and sense key to that initiator.

2.4.2.2 Inquiry

If the MC receives an Inquiry command, then it will return a GOOD status, but will not clear the Unit Attention condition. This will repeat as long as the MC receives Inquiry commands from that initiator.

2.4.2.3 Any Other Command

If the MC receives any command other than Request Sense or Inquiry command, it will return a CHECK CONDITION status and will not perform that command.

2.4.3 Parity Errors Detected by the MC

If the MC detects a parity error, the action it takes depends upon the value of the `Configuration\Advanced\SCSI\Parity` menu item:

- `MESSAGE` - The MC will perform retries before aborting the command.

- ABORT - The MC will not perform retries but will attempt to abort the command by going to the STATUS phase, sending a CHECK CONDITION status, and then going to the BUS FREE phase. If it is unable to successfully send the status byte, it will go to the BUS FREE phase. Sense data will be available.
- IGNORE - The MC will accept the bad data.

2.4.3.1 Parity Error During SELECTION Phase

NOTE

The initiator creates the SELECTION phase when it wants to select a particular target, and the MC will confirm its selection by asserting BSY. If the MC detects a parity error during the SELECTION phase, it will not assert BSY. After an election abort time-out delay, the initiator then either asserts RST, or releases SEL and goes to the BUS FREE state.

2.4.3.2 Parity Error During MESSAGE OUT Phase

The MC normally creates the MESSAGE OUT phase in response to an ATN signal from the initiator. It then transfers a message of one or more bytes out from the Initiator. If the MC detects a parity error on one or more of these bytes and the Configuration\Advanced\SCSI\Parity menu item is set to MESSAGE, it will indicate its desire, up to four times, to retry the message by asserting the REQ signal after detecting the ATN signal has gone false and prior to changing to any other phase. If the Configuration\Advanced\SCSI\Parity menu item is set to ABORT, the MC will attempt to abort the command as previously explained.

2.4.3.3 Parity Error During COMMAND Phase

If the MC detects a parity error during the COMMAND phase and the Configuration\Advanced\SCSI\Parity menu item is set to MESSAGE, it will indicate its desire, up to four times, to receive the command. If it cannot complete the COMMAND phase after four retries, the MC will go to a BUS FREE phase. If the Configuration\Advanced\SCSI\Parity menu item is set to ABORT, the MC will attempt to abort the command as previously explained. The retry sequence is explained in Section 2.4.5.

2.4.3.4 Parity Error During DATA OUT Phase

If the MC detects a parity error during a DATA OUT phase and the Configuration\Advanced\SCSI\Parity menu item is set to MESSAGE, it will send a RESTORE POINTERS message and attempt to receive the data again. This will happen until the data is successfully received or until four retries have failed. If it cannot complete the COMMAND phase after four retries, the MC will go to a BUS FREE phase. If the Configuration\Advanced\SCSI\Parity menu item is set

to ABORT, the MC will attempt to abort the command as previously explained. The retry sequence is explained in Section 2.4.5.

2.4.4 Parity Errors Detected by the Initiator

2.4.4.1 Parity Error During DATA IN Phase

Parity errors detected during a DATA IN phase are handled the same way as when detected during the MESSAGE IN or STATUS phases. The initiator sends an INITIATOR DETECTED ERROR message and the MC replies with a RESTORE POINTERS message. It will then re-send the data beginning at the point specified by the last SAVE DATA POINTER message, or from the beginning if there was no SAVE DATA POINTER message.

2.4.5 Retries

The MC will perform up to four retries in an attempt to overcome error conditions. For each retry, it enters the MESSAGE IN phase, sends a RESTORE POINTERS message, and then repeats the phase which resulted in the error.

What happens after four unsuccessful retries depends upon whether or not the requested LUN is known:

- If the LUN is known, the MC terminates the command with a CHECK CONDITION status, sets the sense key to ABORTED COMMAND, the Additional Sense Code (ASC) to 47 and the Additional Sense Code Qualifier (ASCQ) to 0 to indicate a SCSI Parity Error
- If the LUN is not known, then the MC goes to a BUS FREE phase without setting any sense data.

2.5 Element Addressing

Resources under control of the MC are referred to as elements. The SCSI specification defines four types of elements: Data Transfer, Import/Export, Medium Transport, and Storage. Internally to the MC, resources are referred to as locations and fall into four types: Drive, Fixed Slot, Handler, and Magazine Slot. Some models may not have all location types present. The mapping of location types to element types is shown in Table 2-6

Location Type	Element Type
Drive	Data Transfer
Fixed Slot	Storage
Handler	Medium Transport
Magazine Slot	Storage or Import/Export

Table 2-6 Location to Element Type Mapping

Locations have defined identifiers that cannot be altered (see your libraries Installation and Operation Manual for details of the location identifiers). Elements also have identifiers that the SCSI specification refers to as element addresses. The assignment of element addresses is programmable and can be altered from the front panel as well as over the SCSI interface via the Mode Select command. Each element type has a defined starting address. Within the range of that type, elements are assigned consecutive addresses beginning with the starting address and increasing by ones. Element addresses are a 16-bit binary number and therefore have a range of 0 to 65535. The addresses for an element type are not allowed to wrap around from 65535 to 0.

The mapping of element addresses to locations within an element type is under sole control of the MC. The rules are given by element type below:

Data Transfer	T1 is assigned the data transfer starting address, T2 is assigned the starting address + 1, etc.
Medium Transport	There is only one handler that is assigned the medium transport starting address.
Import/Export	Assignment of magazine slots to be Import/Export elements is controlled by `Configuration\Advanced\Library\?\VIOP First` and `Configuration\Advanced\Library\?\VIOP Last`. If any slots are assigned, they will be numbered in order from left or right.
Storage	Assignment of magazine and fixed slots is controlled by the `Configuration\Advanced\Library\?\Storage Order` menu items. By default, the items are set to `MAG`. With that setting, the MA1 magazine slot (leftmost slot of magazine MA) is assigned the storage starting address, MA2 the next and so on until all magazine slots are addressed. Then the fixed slots are assigned in order (F1, F2 depending on model). If the `Configuration\Advanced\Library\?\Storage Order` menu item is set to `FIX`, the fixed slots are assigned first followed by the magazine slots.

2.6 Errors

Errors that occur during the receipt or execution of a command fall into two categories: General and Command Specific. Command specific errors are listed at the end of each individual command chapter (where applicable). General errors are listed in Table 2-7. See Section 14.2 for a description of the Request Sense command's Sense Data format.

In the following error code tables (and all others throughout this document), a C/D Bit entry that is blank indicates that the SKSV field of the Request Sense data is 0 (and therefore there is no Sense Key Specific data). A Bit Pointer entry that is blank indicates that the BPV field is 0 (and therefore there is no Bit Pointer). Field and Bit Pointer entries that contain ? indicate that many errors of that type may occur in different fields and so there is more than one possible value.

Sense Key	ASC	ASCQ	C/D Bit	Field Pointer	Bit Pointer	Description
2	04h	00h				Logical Unit Not Ready, Cause Not Reportable. No free slot available or operation aborted by operator.
2	04h	01h				Logical Unit Is In Process Of Becoming Ready: Inventory scan is in progress, or sequential mode operation in progress.
2	04h	82h				VIOP window is open.
2	04h	83h				Front door is open.
4	00h	00h				General Unit hardware failure.
5	20h	00h	1	0000h		Invalid Command Operation Code.
5	24h	00h	1	????h	?	Invalid Field In CDB. Usually a reserved bit set.
5	25h	00h				Logical Unit Not Supported. A CDB for a LUN other than the configured LUN was received.
5	3Dh	00h				Invalid bits in Identify message.
6	28h	00h				Not Ready To Ready Transition, Medium May Have Changed.
6	29h	00h				Power-On Reset or Bus Device Reset occurred.
11	43h	00h				Message Error. Initiator sent an improper message sequence.
11	47h	00h				SCSI Parity Error.
11	48h	00h				Initiator Detected Error Message Received.
11	4Eh	00h				Overlapped Commands Attempted. The initiator sent a CDB while it was disconnected from a previous CDB.

Table 2-7 General Errors

2.7 Connector Pin Assignments

Wide single-ended and differential interfaces are shown in Table 2-8 and Table 2-9. Additional information can be found in the ANSI SCSI specification.

Signal Name	Cable Conductor Number		Signal Name
Ground	1	2	-DB12 *
Ground	3	4	-DB13 *
Ground	5	6	-DB14 *
Ground	7	8	-DB15 *
Ground	9	10	-DBP1 *
Ground	11	12	-DB0
Ground	13	14	-DB1
Ground	15	16	-DB2
Ground	17	18	-DB3
Ground	19	20	-DB4
Ground	21	22	-DB5
Ground	23	24	-DB6
Ground	25	26	-DB7
Ground	27	28	-DBP
Ground	29	30	Ground
Ground	31	32	Ground
TERMPWR	33	34	TERMPWR
TERMPWR	35	36	TERMPWR
Reserved	37	38	Reserved
Ground	39	40	Ground
Ground	41	42	-ATN
Ground	43	44	Ground
Ground	45	46	-BSY
Ground	47	48	-ACK
Ground	49	50	-RST
Ground	51	52	-MSG
Ground	53	54	-SEL
Ground	55	56	-C/D
Ground	57	58	-REQ
Ground	59	60	-I/O
Ground	61	62	-DB8 *
Ground	63	64	-DB9 *
Ground	65	66	-DB10 *
Ground	67	68	-DB11 *

Table 2-8 Wide Single-Ended SCSI Connector Pins (* These signals only used by tape drives)

Signal Name	Cable Conductor Number		Signal Name
+DB12 *	1	2	-DB12 *
+DB13 *	3	4	-DB13 *
+DB14 *	5	6	-DB14 *
+DB15 *	7	8	-DB15 *
+DBP1 *	9	10	-DBP1 *
Ground	11	12	Ground
+DB0	13	14	-DB0
+DB1	15	16	-DB1
+DB2	17	18	-DB2
+DB3	19	20	-DB3
+DB4	21	22	-DB4
+DB5	23	24	-DB5
+DB6	25	26	-DB6
+DB7	27	28	-DB7
+DBP	29	30	-DBP
DIFFSENS	31	32	Ground
TERMPWR	33	34	TERMPWR
TERMPWR	35	36	TERMPWR
Reserved	37	38	Reserved
+ATN	39	40	-ATN
Ground	41	42	Ground
+BSY	43	44	-BSY
+ACK	45	46	-ACK
+RST	47	48	-RST
+MSG	49	50	-MSG
+SEL	51	52	-SEL
+C/D	53	54	-C/D
+REQ	55	56	-REQ
+I/O	57	58	-I/O
Ground	59	60	Ground
+DB8 *	61	62	-DB8 *
+DB9 *	63	64	-DB9 *
+DB10 *	65	66	-DB10 *
+DB11 *	67	68	-DB11 *

Table 2-9 Wide Differential SCSI Connector Pinouts (* These signals only used by tape drives)

3. Initialize Element Status

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	07_h							
1	LUN			0				
2-4	0							
5	NBL	0	0				Flag (0)	Link (0)

3.1 Command Description

The Initialize Element Status command instructs the MC to scan all elements for the presence of a data cartridge. If the unit is equipped with a barcode reader, the NBL field is not set, and the `Configuration\Advanced\Changer\Labels\Fixed`, `Configuration\Advanced\Changer\Labels\Magazine`, and `Configuration\Advanced\Changer\Labels\Sequential` menu items are set to `SOME` or `ALL`, the MC will also scan for barcode labels.

In general, the use of this command is to remove the 'unknowns' from the element descriptor data that is returned by the Read Element Status and Request Volume Element Address commands.

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4. Initialize Element Status with Range

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	E7h							
1	LUN			0				Range
2-3	Element Address							
4-5	0							
6-7	Number of Elements							
8	0							
9	NBL	0	0				Flag (0)	Link (0)

4.1 Command Description

The Initialize Element Status with Range command instructs the MC to scan some elements for the presence of a data cartridge. If the unit is equipped with a barcode reader, the NBL field is not set, and the `Configuration\Advanced\Changer\Labels\Fixed`, `Configuration\Advanced\Changer\Labels\Magazine`, and `Configuration\Advanced\Changer\Labels\Sequential` menu items are set to `SOME` or `ALL`, the MC will also scan for barcode labels.

The results of this scan are stored and can be retrieved using the Read Element Status command (see Chapter 12).

4.1.1 Range

This field specifies which elements are to be scanned. If its value is 0, all elements are to be scanned, otherwise, the Element Address and Number of Elements fields specify the range to be scanned. In a ranged scan, any element address greater than or equal to Element Address and less than Element Address + Number of Elements, will be scanned.

4.1.2 Element Address

This field specifies the starting element address for the range of elements to be checked. Its value does not have to be a valid element address.

4.1.3 Number of Elements

This field specifies the maximum number of elements to be scanned.

4.1.4 NBL

This field specifies whether barcode labels should be scanned. A value of 0 specifies that barcodes should be scanned in accordance with the unit's configuration. A value of 1 specifies that no barcodes should be scanned and takes precedence over the unit's configuration.

NOTE

If the unit is not configured with a barcode reader and the NBL field is set to 0, the unit will return a CHECK CONDITION.

4.2 Command Specific Errors

Sense Key	ASC	ASCQ	C/D Bit	Field Pointer	Bit Pointer	Description
5	85h	01h	1	0009h	7	No Barcode Reader installed.

5. Inquiry

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	12_h							
1	LUN			0				EVPD (0)
2	Page Code (0)							
3	0							
4	Allocation Length							
5	Vendor Specific (0)			0			Flag (0)	Link (0)

5.1 Command Description

The Inquiry command instructs the MC to return Inquiry Data. The Inquiry Data consists of a set of fields that describe the MC.

5.1.1 EVPD

The EVPD (Enable Vital Product Data) field tells the MC to return the Vital Product Data page specified in the Page Code field. If the EVPD field is set, the MC will return Vital Product Data (if possible) rather than the standard inquiry data.

5.1.2 Page Code

When the EVPD field is set, this field specifies the Vital Product page to be returned. Table 5-1 lists the pages supported by the MC.

Page Code	Page Name
00_h	Supported Vital Product Data
80_h	Unit Serial Number
83_h	Device Identification

Table 5-1 Supported Vital Product Page Codes

5.1.3 Allocation Length

The Allocation Length field tells the MC the maximum number of bytes that the initiator has allocated for the returned Inquiry Data (or Vital product Data). It will return the specified number of bytes or all available data whichever is less.

5.2 Inquiry Data

The default format of the Inquiry Data is shown in Table 5-2. The MC returns the values shown in parentheses unless a predefined or custom data has been selected, in which case different values are returned. Three exceptions to this are:

- **Peripheral Qualifier** – The MC will return a 0 or a 3 as described later in this section.
- **Sync** – The MC will return a value of 0 or 1 as described later in this section.
- **BarC** – The MC will return a value of 0 or 1 as described later in this section.

Predefined inquiry strings are available and you can also create your own custom Inquiry string. Instructions for selecting a predefined Inquiry string and for customizing an Inquiry string are given in your Installation and Operation Manual. The predefined Inquiry strings are shown in Table 5-4. For an exact definition of each field, refer to the ANSI Specification.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Peripheral Qualifier			Peripheral Device Type (8)				
1	RMB (1)	Device-Type Modifier (0)						
2	ISO Version (0)		ECMA Version (0)			ANSI Version (2)		
3	AENC (0)	TrmIOP (0)	0		Response Data Format (2)			
4	Additional Length							
5-6	0							
7	RelAdr (0)	Wbus32 (0)	Wbus16 (0)	Sync	Linked (0)	0	CmdQue (0)	SftRe (0)
8-15	Vendor Identification							
16-31	Product Identification							
32-35	Product Revision Level							
36-54	Vendor Specific (0)							
55	Vendor Specific (0)							BarC

Table 5-2 Default Inquiry Data

5.2.1 Peripheral Qualifier

The value which the MC returns depends upon the value of the `Configuration\Advanced\SCSI\LUN` menu item and the LUN supplied by the command. If the command's LUN matches the configured LUN (or if the configured

LUN is ALL), the field returns 0, otherwise it returns 3. The SCSI specification defines these values according to Table 5-3.

Qualifier	Description
0	The specified peripheral device type is currently connected to this logical unit. If the target cannot determine whether or not a physical device is currently connected, it shall also use this peripheral qualifier when returning the INQUIRY data. This peripheral qualifier does not mean that the device is ready for access by the initiator.
3	The target is not capable of supporting a physical device on this logical unit. For this peripheral qualifier the Peripheral Device Type shall be set to $1F_h$ to provide compatibility with previous versions of SCSI. All other peripheral device type values are reserved for this peripheral qualifier.

Table 5-3 Peripheral Qualifier Values

5.2.2 Peripheral Device Type

The MC always returns a value of 8 (Medium-changer device). Also, if the initiator uses an unsupported LUN, a value of $1F_h$ (unknown or no device type) will be returned

5.2.3 RMB

The MC returns a value of 1 for the Removable Medium Bit unless overridden by custom inquiry data.

5.2.4 Device Type Modifier

The MC returns a value of 0 in the Device-Type Modifier field unless overridden by custom inquiry data.

5.2.5 ISO Version

The MC returns a value of 0 in the International Standards Organization field unless overridden by custom inquiry data.

5.2.6 ECMA

The MC returns a value of 0 in the European Computer Manufacturers Association field unless overridden by custom inquiry data.

5.2.7 ANSI

The MC returns a value of 2 unless overridden by custom inquiry data, indicating compliance with ANSI SCSI-2 specifications.

5.2.8 AENC

The MC does not support Asynchronous Event Notification Capability and will return a value of 0 in this field unless overridden by custom inquiry data.

5.2.9 TrmIOP

The MC does not support Terminate I/O Process and will return a value of 0 in this field unless overridden by custom inquiry data.

5.2.10 Response Data Format

The MC will return a value of 2 in this field unless overridden by custom inquiry data.

5.2.11 Additional Length

The Additional Length field specifies how many more bytes will follow Byte 7 in the Inquiry Data. Its value is 33_h by default. This value is configurable, but should never exceed 33_h. If the Allocation Length in the Inquiry CDB is less than the number of bytes in the Inquiry Data, the MC will truncate the Inquiry Data and will not adjust the Additional Length value to reflect this truncation.

5.2.12 RelAdr

The MC does not support relative addressing and will return a value of 0 in this field unless overridden by custom inquiry data.

5.2.13 WBus32

The MC does not support 32-bit wide bus transfers and will return a value of 0 in this field unless overridden by custom inquiry data.

5.2.14 WBus16

The MC does not support 16-bit wide bus transfers and will return a value of 0 in this field unless overridden by custom inquiry data.

5.2.15 Sync

The value of the Synchronous field will be 1 if the `Configuration\Advanced\SCSI\Synchronous` menu item is set to `ON`, otherwise it will be 0.

5.2.16 Link

The MC does not support linked commands and will return a value of 0 in this field unless overridden by custom inquiry data.

5.2.17 CmdQue

The MC does not support command queuing and will return a value of 0 in this field unless overridden by custom inquiry data.

5.2.18 SftRe

The MC does not support soft resets and will return a value of 0 in this field unless overridden by custom inquiry data.

5.2.19 BarC

This bit has a value of 1 if the MC is configured with a barcode reader; otherwise its value is 0.

NOTE

This field is vendor specific and may not be supported on other vendors' SCSI implementations.

5.2.20 Vendor Specific

The contents these bytes are 0 unless overridden by custom inquiry data.

5.2.21 Vendor Identification

This field contains 8 ASCII characters identifying the Vendor of the product. The value in this field is left justified and padded with spaces as necessary. The predefined values are given in Table 5-4. This field may be configured to a custom value as well.

5.2.22 Product Identification

This field contains 16 ASCII characters identifying the product. The value in this field is left justified and padded with spaces as necessary. The predefined values are given in Table 5-4. This field may be configured to a custom value as well.

5.2.23 Product Revision Level

This field contains 4 ASCII characters identifying the product revision. When configured to use any of the predefined inquiry data, the MC will return the actual firmware revision. The revision format is xxxx (where x represents a hexadecimal digit). This field may be configured to a custom value as well.

Inquiry Data	Vendor ID	Product ID
QUALSTAR RLS-4221	QUALSTAR	RLS-4221
QUALSTAR RLS-4445	QUALSTAR	RLS-4445
QUALSTAR RLS-6227	QUALSTAR	RLS-6227
QUALSTAR RLS-8236	QUALSTAR	RLS-8236

Table 5-4 Predefined Inquiry Strings

NOTE

When qualifying Inquiry Data, it is recommend that only the Vendor ID and the "RLS-" part of the Product Id be used.

5.3 Vital Product Data Pages

The general format of Vital Product Data pages is shown in Table 5-5.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Peripheral Qualifier			Peripheral Device Type (8)				
1	Page Code							
2	0							
3	Data Length (n-3)							
4-n	Page Data							

Table 5-5 General Vital Product Data Page Format

The Peripheral Qualifier and Peripheral Device Type fields will have the same values as in the Inquiry Data.

5.3.1 Supported Vital Product Data Page

The Supported Vital Product Data page specifies which Vital Product Data pages the MC supports. The codes for the supported pages are listed in numerical order starting at byte 4 as shown in Table 5-6.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Peripheral Qualifier			Peripheral Device Type (8)				
1	Page Code (0)							
2	0							
3	Data Length (3)							
4	Supported Vital Product Data (0)							
5	Unit Serial Number (128)							
6	Device Identification (131)							

Table 5-6 Supported Vital Product Data Page

5.3.2 Unit Serial Number Vital Product Data Page

The Unit Serial Number Vital Product Data page reports the unique Serial Number for your library. The number is a decimal number formatted as a 10-character ASCII array (with leading zeros) as shown in Table 5-7. The serial number is unique for each Qualstar library but might be the same as another manufacturers unit serial number. If a globally unique identifier is required it can be retrieved using EVPD page 131.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Peripheral Qualifier			Peripheral Device Type (8)				
1	Page Code (128)							
2	0							
3	Data Length (10)							
4-13	Unit Serial Number							

Table 5-7 Unit Serial Number Vital Product Data Page

5.3.3 Device Identification Vital Product Data Page

The Device Identification Vital Product Data page provides a list of Identification Descriptors each of which gives a differently formatted identifier for the MC. The overall format for the page is shown in Table 5-8.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Peripheral Qualifier			Peripheral Device Type (8)				
1	Page Code (131)							
2	0							
3	Data Length (n-3)							
4-n	Identification Descriptors							

Table 5-8 Device Identification Vital Product Data Page

5.3.3.1 T10 Vendor Identification Descriptor

The T10 Vendor Identification descriptor supplies a globally unique identifier for the MC based on the T10 Vendor Identifier QUALSTAR and the MC's serial number as shown in Table 5-9.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0				Code Set (2)			
1	0		Association (0)		Identifier Type (1)			
2	0							
3	Identifier Length (34)							
4-11	Vendor Identification (QUALSTAR)							
12-37	Vendor Specific Identifier							

Table 5-9 T10 Vendor Identification Descriptor

5.3.3.1.1 Code Set

This field specifies the type of data being returned. The value 2 indicates the data is ASCII.

5.3.3.1.2 Association

This field's value specifies that the identifier is associated with the addressed logical unit (that is the MC) rather than the port through which the request was received (for example the SCSI port).

5.3.3.1.3 Identifier Type

This field's value specifies that the identifier is of type T10 Vendor Identification.

5.3.3.1.4 Vendor Identification

This field returns Qualstar's T10 Vendor Identifier which the 8 character value QUALSTAR. This is a globally unique value assigned to Qualstar by the T10 committee of the InterNational Committee on Information Technology Standards (which is accredited by ANSI).

5.3.3.1.5 Vendor Specific Identifier

This field returns the MC's Product ID and serial number, which is a unique number to Qualstar units. The Product ID is the first 16 characters which is left justified and space filled. The last 10 characters hold the same data as is returned by the Unit Serial Number Vital Product Data page. Combined with the value in the Vendor Identification field, the resulting 34 character value forms a globally unique identifier for the MC.

5.3.3.2 EUI-64 Identification Descriptor

The EUI-64 Identification descriptor supplies a globally unique identifier for the MC based on the IEEE Company ID for Qualstar and the MC's serial number as shown in Table 5-10.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0				Code Set (1)			
1	0		Association (0)		Identifier Type (2)			
2	0							
3	Identifier Length (8)							
4-6	IEEE Company ID (00_h 08_h $4F_h$)							
7-11	Vendor Specific Extension Identifier							

Table 5-10 EUI-64 Identification Descriptor

5.3.3.2.1 Code Set

This field specifies the type of data being returned. The value 1 indicates the data is binary.

5.3.3.2.2 Association

This field's value specifies that the identifier is associated with the addressed logical unit (that is the MC) rather than the port through which the request was received (for example the SCSI port).

5.3.3.2.3 Identifier Type

This field's value specifies that the identifier is of type EUI-64.

5.3.3.2.4 IEEE Company ID

This field returns Qualstar's IEEE company ID triplet. This is a globally unique value assigned to Qualstar by the IEEE organization.

5.3.3.2.5 Vendor Specific Extension Identifier

This field returns the library's serial number, which is a unique number to Qualstar units. Combined with the value in the IEEE Company ID field, the resulting 8 byte number forms a globally unique identifier for the MC. Note that since Qualstar unit serial numbers have only 4 bytes of significance, the first byte of this field will always have the value 0.

5.3.3.3 NAA Identification Descriptor

The NAA Identification descriptor supplies a globally unique identifier for the MC based on the IEEE Company ID for Qualstar and the MC's serial number as shown in Table 5-11.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0				Code Set (1)			
1	0		Association (0)		Identifier Type (3)			
2	0							
3	Identifier Length (8)							
4	NAA (5)							
5-6	IEEE Company ID (00_h 08_h $4F_h$)							
7								
8-11	Vendor Specific Identifier							

Table 5-11 NAA Identification Descriptor

5.3.3.3.1 Code Set

This field specifies the type of data being returned. The value 1 indicates the data is binary.

5.3.3.3.2 Association

This field's value specifies that the identifier is associated with the addressed logical unit (that is the MC) rather than the port through which the request was received (for example the SCSI port).

5.3.3.3.3 Identifier Type

This field's value specifies that the identifier is of type NAA.

5.3.3.3.4 NAA

The Name Address Authority field specifies the format of the data being returned. The value 5 indicates the data is IEEE Registered.

5.3.3.3.5 IEEE Company ID

This field returns Qualstar's IEEE company ID triplet. This is a globally unique value assigned to Qualstar by the IEEE organization.

5.3.3.3.6 Vendor Specific Identifier

This field returns the MC's serial number, which is a unique number to Qualstar units. Combined with the value in the IEEE Company ID field, the resulting 60 bit number forms a globally unique identifier for the MC. Note that since Qualstar unit serial numbers have only 4 bytes of significance, the first nibble of this field will always have the value 0.

6. Log Sense

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	$4D_h$							
1	LUN			0			PPC	SP (0)
2	PC (1)			Log Sense Page Code				
3-4	0							
5-6	Parameter Pointer							
7-8	Allocation Length							
9	Vendor Specific (0)			0			Flag (0)	Link (0)

6.1 Command Description

The Log Sense command instructs the MC to return a log page containing certain statistical information about itself. The format of the log pages is described in Section 6.3.

6.1.1 PPC

If the value of the Parameter Pointer Control field is 1, the MC will return only those Parameter Code values which have changed since the last Log Select or Log Sense command, starting with the Parameter Code specified in the following Parameter Pointer field.

A value of 0 tells the MC to return Parameter Code values beginning with the one specified in the following Parameter Pointer field and continuing until the number of bytes specified in the following Allocation Length field has been returned. If the value of the Parameter Pointer is also 0, the MC will return all available log parameters for the specified log page (subject to the specified Allocation Length).

6.1.2 SP

The MC does not save log parameters, and the value of the Save Parameters field must be 0.

6.1.3 PC

Because the MC only maintains cumulative values, the value of the Page Control field must be 1.

6.1.4 Log Sense Page Code

Each log page has its own unique page code number. The Log Sense Page Code field 2 tells the MC which log page to return. The MC supports the log pages shown in Table 6-1.

Page Code	Page Name	Description
00_h	Supported Log Page	Returns a list of log pages which the MC Supports.
32_h	Event History Log Page	Returns a history of the most recent events that occurred during the operation of the MC.

Table 6-1 Valid Log Sense Page Codes

6.1.5 Parameter Pointer

This two-byte field identifies the first parameter code the MC is to return (described in Section 6.2.3). The MC stops returning data after returning either the maximum parameter code it supports or the number of bytes specified by Allocation Length, whichever is less.

If this field is 0, the MC will return *all* available log parameters for the specified page up to the specified allocation length.

6.1.6 Allocation Length

This two-byte field specifies the maximum number of bytes to send. The MC will return the specified number of bytes or all requested data, whichever is less.

The MC will not return partial log parameters. If the allocation length is such that only part of the last requested parameter would be returned, the MC will stop after sending the last *complete* log parameter.

6.2 Log Page Structure

A *log page* is a collection of data pertaining to a particular facet of the MC. The log pages that the MC supports are shown in Table 6-1.

The MC returns the log page specified in the Log Sense Page Code field. Each log page begins with a four-byte header (bytes 0 - 3) followed by one page of zero or more variable length log parameters. Table 6-2 shows the format of a log page.

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

2-3	Page Length (n-3)
4-x	First byte of first Log Parameter (x-3 bytes long)
n	Last byte of last Log Parameter

Table 6-2 Log Page Structure

6.2.1 Log Sense Page Code

This field identifies the following Log page. Valid Log Sense Page codes are shown in Table 6-1

6.2.2 Page Length

This field tells the initiator how many bytes follow and equals the byte number of the last byte transferred (n) minus 3. For example, for a 32-byte log page, n would equal 31 and the Page Length field would equal 28.

6.2.3 Log Parameters

The remaining bytes are the log parameters themselves. Each log parameter begins with a four-byte header containing a two-byte identification code, a control byte that describes the parameter, and the length of the log parameter. The generic format of a log parameter is shown in Table 6-3. The header is followed by one or more bytes of log parameter data. The log parameter data can be one of the following:

- A value indicating the number of occurrences of a particular event
- A value indicating the status of the MC hardware
- A list of strings that contain the MC event history

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	Log Parameter Code							
2	DU	DS	TSD	ETC	TMC		0	LP
3	Log Parameter Length (n-3)							
4-n	Log Parameter Value							

Table 6-3 Generic Log Parameter Format

6.2.3.1 Log Parameter Code

Every log parameter has a unique log parameter code. This two-byte field identifies the log parameter in the log page being returned.

6.2.3.2 Byte 2 - Parameter Control Byte

Most log parameters contain this Parameter Control byte which provides information about that particular parameter. The byte contains the following fields:

- **DU** – Disable Update. A value of 0 indicates that before the MC returns the value, it updates it to reflect all events that should be noted by that parameter. A value of 1 indicates the MC will not update the log parameter except when it receives another Log Sense command that has a new value for that parameter.
- **DS** – Disable Save. A value of 0 indicates that the MC can save the value of that log parameter; a value of 1 indicates that it cannot. The MC will always return a value of 1 in this field.
- **TSD** – Target Save Disable. A value of 0 indicates that the MC will provide a self-defined method for saving log parameters. A value of 1 indicates either that the MC will not provide a self-defined method for saving log parameters, or that the initiator has disabled the self-defined method. The MC will always return a value of 1 in this field.
- **ETC** – Enable Threshold Comparison. A value of 0 indicates that a comparison to the threshold value is not performed whenever the cumulative value is updated. A value of 1 indicates that the comparison is performed. The MC will always return a value of 0 in this field.
- **TMC** – Threshold Met Criteria. This bit defines the basis for comparison of the cumulative and threshold values and is only valid if the ETC bit is 1.
- **LP** – List Parameter. This bit indicates the format of the log parameter. If this bit is 0, the parameter is a data counter. If this bit is 1, the parameter is a list parameter.

6.2.3.3 Log Parameter Length

This field specifies the length of the following parameter in bytes. If the specified length is less than the actual length of the parameter, the MC will truncate the parameter.

6.2.3.4 Log Parameter Value

The Log Parameter can be one of the following types:

- A two- or four-byte event counter
- A value indicating the on/off state of a particular piece of the MC's hardware
- A string describing a MC history event

The bytes following the Log Parameter Length field contain the actual Log Parameter data.

6.3 Log Page Formats

This section describes the formats of the log pages that the MC supports.

6.3.1 Supported Log Page

The Supported log page (Page Code 00h) is a list of the log pages which the MC supports. Unlike the other log pages, the Supported log page does not contain a Parameter Control Byte and does not have log parameters. Its format is shown in Table 6-4.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0		Page Code (00_h)					
1	0							
2-3	Page Length (0002_h)							
4	Supported Log Page (00_h)							
5	Event History Log Page (32_h)							

Table 6-4 Support Log Page Format

6.3.2 Event History Log Page

The Event History log page returns the most recent events that occurred in the MC. Each event string is variable length. The format of the Event History log page is shown in Table 6-5.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	Event Parameter Code							
2	DU (1)	DS (1)	TSD (0)	ETC (0)	TMC (0)		0	LP (1)
3	Event Parameter Length (n-3)							
4-n	Event Parameter Character(s)							

Table 6-5 Event History Log Parameter Format

6.3.2.1 Event Parameter Code

This field contains the index number of the event. 0 is the most recent event, -1 ($FFFF_h$) is the next most recent, and so on.

6.3.2.2 Event Parameter Length

This field contains the number of bytes that follow.

6.3.2.3 Event Parameter Character(s)

This field contains the string of ASCII characters that describe the event. The string is not terminated in any way. The Event Parameter Length field determines the number of characters.

This page left blank intentionally.

7. Mode Select

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	15_h							
1	LUN			PF (1)	0			SP
2-3	0							
4	Parameter List Length							
5	Vendor Specific (0)		0				Flag (0)	Link (0)

7.1 Command Description

The Mode Select command sends a Mode Select Parameter list to the MC to specify various operating parameters. The Mode Select Parameter list consists of a four-byte header followed by zero or more optional Mode pages (described in Section 7.2). The parameters are used to configure the MC upon subsequent power-ups, SCSI bus resets, or BUS DEVICE RESET messages.

If an initiator sends a Mode Select command that changes any parameters, the MC returns a CHECK CONDITION status with a UNIT ATTENTION sense key, and an ASC/ASCQ combination of MODE PARAMETERS CHANGED to all other initiators that issue a request to the MC.

If the value of any Mode Select parameter is invalid, the MC will return the appropriate error and will not change any other of the parameters associated with that command.

7.1.1 The Relationship between Current and Saved Data

The following paragraphs explain the relationship between current and saved data.

7.1.1.1 Current Data

Current data is that data which reflects the current operation condition of the MC. It is stored in RAM. Current data can be changed in three ways:

- **Manually** – You can change the current data manually using the `Configuration\SET TO DEFAULTS` and by editing menu items that relate to mode data.. Changes are effective at the time you make them.
- **SCSI command** – You can change the current data by sending a Mode Select command. Changes are immediate.
- **Upon reset** – Any power up or reset event causes the current data to immediately assume the saved data values.

7.1.1.2 Saved Data

Saved Data is that data which is stored in non-volatile RAM. Each time the MC is switched on and whenever a reset occurs, the saved data is copied to the current data. Saved data can be changed in two ways:

- **Manually** – You can change the saved data manually the `Configuration\SET TO DEFAULTS` and by editing menu items that relate to mode data.. Changes are effective at the time you make them.
- **SCSI command** – You can change the saved data by sending a Mode Select command with the SP bit in the Mode Select command set to 1. If the SP bit is 0, only the current data will be changed. Changes are immediate.

7.1.2 PF

The MC supports the SCSI-2 Mode Select parameter format and the Page Format field must be 1.

7.1.3 SP

If the value of the Saved Page field is 0, the MC will change the current configuration values to the values in this command, but will not change the saved values stored in non-volatile memory.

If the value of the Saved Page field is 1, the MC will save current configuration values specified by this command in non-volatile memory for subsequent operations.

NOTE

The Configuration and External Data pages may alter non-volatile memory regardless of the state of the SP field.

7.1.4 Parameter List Length

The Mode Select Parameter List Length specifies the number of bytes that will be transferred during the DATA OUT phase and equals the number of bytes in the requested page(s) plus four (the header). A value of zero specifies that no data is to be transferred.

7.2 Mode Pages

The format of the Mode Select Parameter list is shown in Table 7-1.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-3	0							
4-n	Mode Page(s)							

Table 7-1 Mode Select Parameter List

The MC supports the following Mode pages in a Mode Select command:

- Element Address Assignment Page
- LCD Page
- Configuration Page
- External Data Page

You may send any number of pages (including none) in one command, but any page may appear only once. The pages may be sent in any order.

7.2.1 Element Address Assignment Page

The Element Address Assignment page lets you assign your own SCSI element addresses to the elements inside the MC. The Element Address Assignment page format is shown in Table 7-2.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	Element Address Assignment Page Code ($1D_h$)					
1	Parameter List Length (12_h)							
2-3	Medium Transport Element Address							
4-5	Number of Medium Transport Elements (0001_h)							
6-7	Storage Element Starting Address							
8-9	Number of Storage Elements							
10-11	Import/Export Element Address							
12-13	Number of Import/Export Elements							
14-15	Data Transfer Element Starting Address							
16-17	Number of Data Transfer Elements							
18-19	0							

Table 7-2 Element Address Assignment Page

7.2.1.1 Element Address Assignment Page Code

This is the code number of the Element Address Assignment page and its value must be 1Dh.

7.2.1.2 Parameter List Length

This field tells the MC how many more bytes follow, and its value must be 18 (12h).

7.2.1.3 Medium Transport Element Address

This field contains the address to be assigned to the handler.

7.2.1.4 Number of Medium Transport Elements

The only valid value for this field is 1.

7.2.1.5 Storage Element Starting Address

This field contains the address to be assigned to the first storage element.

7.2.1.6 Number of Storage Elements

The only valid value for this field is the number returned by a Mode Sense command for this page. This value is configured using `Configuration\Advanced\Library\?\Slot First`, `Configuration\Advanced\Library\?\Slot Last`, `Configuration\Advanced\Library\?\Fixed First` and `Configuration\Advanced\Library\?\Fixed Last`.
The factory defaults are shown in Table 7-3.

7.2.1.7 Import/Export Element Starting Address

This field contains the address to be assigned to the I/O port.

7.2.1.8 Number of Import/Export Elements

The only valid value for this field is the number returned by a Mode Sense command for this page. This value is configured using `Configuration\Advanced\Library\?\VIOP First` and `Configuration\Advanced\Library\?\VIOP Last`.
The factory defaults are shown in Table 7-3.

7.2.1.9 Data Transfer Element Starting

This field contains the address to be assigned to the first cartridge drive.

7.2.1.10 Number of Data Transfer Elements

The only valid value for this field is the number returned by a Mode Sense command for this page. This value is configured using `Configuration\Advanced\Library\?\Drive First` and `Configuration\Advanced\Library\?\Drive Last`.
The factory defaults are shown in Table 7-3.

7.2.1.11 Element Address Default Values

The default element address assignments are shown in Table 7-3.

Field	4221	4445	6227	8236
Medium Transport Element Address	65000			
Number of Medium Transport Elements	1			
Storage Element Starting Address	0			
Number of Storage Elements	22	45	27	36
Import/Export Element Starting Address	64000			
Number of Import/Export Elements	0			
Data Transfer Element Starting Address	63000			
Number of Data Transfer Elements	2	4	2	2

Table 7-3 Element Address Default Values

7.2.2 LCD Mode Page

The LCD page lets you display your own information on the MC's LC display. Normally, display Line 1 shows the model number of the library system. Display Line 2 shows the time and date. Display Line 3 presents status information about the handler. While you can replace the data on these lines with your own information using this page, Qualstar recommends you use Display Line 4 for messages or other data. The format of the LCD page is shown in Table 7-4.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	LCD Page Code (22_h)					
1	Parameter List Length (52_h)							
2	0				Write Line 1	Write Line 2	Write Line 3	Write Line 4
3	0							
4-23	Display Line 1							
24-43	Display Line 2							
44-63	Display Line 3							
64-83	Display Line 4							

Table 7-4 LCD Page

7.2.2.1 LCD Page Code

This is the code number of the LCD page and its value must be 22_h.

7.2.2.2 LCD Parameter List Length

This field tells the MC how many more bytes follow and its value must be 52_h.

7.2.2.3 Write Line 1

This field controls the text for Display Line 1 (the top line). If its value is 0, the MC displays its own internal text. If its value is 1, the MC displays the text specified in the Display Line 1 field of this page.

7.2.2.4 Write Line 2, 3, and 4

These fields are identical to Write Line 1, except they determine what is displayed in Display Lines 2, 3, and 4 of the MC.

7.2.2.5 Display Line 1, 2, 3, and 4

These fields let you specify what text will be displayed on the MC's control panel. You can specify up to twenty characters in each field. If you specify less than twenty characters in a field, at least one byte following the last text character in that field must be 0.

By default, lines 2, 3 and 4 of the display are blank for the RLS Series units.

7.2.3 Configuration Mode Page

The Configuration page lets set the value of various configuration items. Each configuration item has a name and a value. The Mode Select command is used to both change the value of an item as well as set the name of the item that will be returned by a subsequent Mode Sense command for the Configuration page. The format of the Configuration page is shown in Table 7-5.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	Configuration Page Code ($3D_h$)					
1	Parameter List Length ($2C_h$)							
2	Write	Type		Length				
3	0							
4-23	Variable Name							
24	0							

25-44	Variable Value
45	0

Table 7-5 Configuration Page

7.2.3.1 Configuration Page Code

This is the code number of the Configuration page and its value must be $3D_h$.

7.2.3.2 Configuration Parameter List Length

This field tells the MC how many more bytes follow and its value must be $2C_h$.

7.2.3.3 Write

This field indicates whether the Mode Select command is attempting to alter the variable or just set it as the variable to be returned by the next Mode Sense command on this page. A value of 1 indicates that a new value has been supplied and the variable is to be altered. Alteration requires that the Type, Length, and Variable Name fields be set properly and that the item is alterable.

7.2.3.4 Type

This field indicates the type of data that is stored in the Variable Value field. The type must match the Variable's data type. The type code values are listed in Table 7-6.

Type	Type Name	Description
0	ASCII	ASCII character data. If the Length field is 0, this is a zero-terminated string; otherwise, the length field determines the number of characters. A zero-terminated string may be up to 20 characters in length by using the 0 at byte 45 as the terminator. Bytes after the last character (or terminator) are ignored and may be any value.
1	Byte	Byte array data. The Length field indicates the size of the byte array up to 16 bytes.
2	Signed	Signed integer data. The length field indicates the size of the integer in bytes and will have the values: 1, 2, or 4. Signed integers are stored in 2's complement form with the most significant byte first.
3	Unsigned	Unsigned integer data. The length field indicates the size of the integer in bytes and will have the values: 1, 2, or 4. Unsigned integers are stored most significant byte first.

Table 7-6 Configuration Page Type Values

7.2.3.5 Length

This field indicates the size in bytes of the Variable Value. For ASCII zero-terminated strings, the Length field's value is 0.

7.2.3.6 Variable Name

This field holds a zero-terminated ASCII string that selects the variable by name. The variable name may be up to 20 characters in length (in which case the zero terminator will be at byte 24). If the Mode Select is being used to alter a variable's value, this field must exactly match one of the existing variable names. If the Mode Select is being used to select a variable to be returned by a subsequent Mode Sense command, this field may be set to a null string (that is byte 4 may be set to 0). The null string will cause the first variable to be returned by the next Mode Sense command for the Configuration page.

7.2.3.7 Variable Value

This field holds the new value for a variable that is to be altered. Its length and format is determined by the contents of the Length and Type fields. This field is only relevant if the Write field is set to 1.

7.2.3.8 Configuration Variables

Following is a list of configuration variables, their types, and their values as of the version 0.0 release of the firmware. Multiple choice type items have the default value listed first.

Name	Write	Length	Type	Value(s)	Comment
AlarmDoorOpen	1	2	Unsigned		Configuration\Advanced\Control Panel\Alarm\Door Open
AlarmHandlerError	1	2	Unsigned		Configuration\Advanced\Control Panel\Alarm\Handler Error
AlarmInventoryViolation	1	2	Unsigned		Configuration\Advanced\Control Panel\Alarm\Inventory Vio
AlarmIoWaiting	1	2	Unsigned		Configuration\Advanced\Control Panel\Alarm\I/O Waiting
ChangerBcr	0	0	ASCII	NONE LHA7127RR1S	Configuration\Advanced\Changer\ Mechanics\BCR
ChangerBusy	1	0	ASCII	WAIT BUSY NOT READY	Configuration\Advanced\Changer\Busy
ChangerDoorOpen	1	0	ASCII	ABORT HOLD	Configuration\Advanced\Changer\Door Open
ChangerFilterDays	1	2	Unsigned		Configuration\Advanced\Changer\Filter Days
ChangerLabelCheckChr	1	0	ASCII	YES NO	Configuration\Advanced\Changer\Labels\ CheckCharacter
ChangerLabelFixed	1	0	ASCII	SOME ALL NONE	Configuration\Advanced\Changer\Labels\ Fixed
ChangerLabelMagazine	1	0	ASCII	SOME ALL NONE	Configuration\Advanced\Changer\Labels\ Magazine

Name	Write	Length	Type	Value(s)	Comment
ChangerLabelSequentl	1	0	ASCII	SOME ALL NONE	Configuration\Advanced\Changer\Labels\ Sequential
ChangerModel	0	0	ASCII	4221 4445 6227 8236	Configuration\Advanced\Changer\ Mechanics\Model
ChangerPowerOnClear	1	0	ASCII	YES NO	Configuration\Advanced\Changer\Power On Clear
ChangerViopDoorOpen	1	0	ASCII	NOT READY BUSY	Configuration\Advanced\Changer\VIOP\ Open
ChangerViopExport	1	0	ASCII	YES NO	Configuration\Advanced\Changer\VIOP\ Export
ChangerViopImport	1	0	ASCII	YES NO	Configuration\Advanced\Changer\VIOP\ Import
DriveT?Cleaning	1	0	ASCII	…..	Configuration\Drive\T?\Clean Loc.
DriveT?Eject	1	0	ASCII	HOST BOTH	Configuration\Drive\T?\Eject
DriveT?Enabled	1	0	ASCII	YES	Configuration\Drive\T?\Enabled
DriveT?InputFirst	1	0	ASCII	…..	Configuration\Drive\T?\Input First
DriveT?InputLast	1	0	ASCII	…..	Configuration\Drive\T?\Input Last
DriveT?Mode	1	0	ASCII	RANDOM DUAL-BIN RECYCLE SEQUENTIAL	Configuration\Drive\T?\Mode
DriveT?Model	0	0	ASCII		Configuration\Drive\T?\Mdl
DriveT?OutputFirst	1	0	ASCII	…..	Configuration\Drive\T?\OutputFirst
DriveT?OutputLast	1	0	ASCII	…..	Configuration\Drive\T?\Output Last
DriveT?ScsiBus	1	0	ASCII	CHANGER INVALID OTHER	Configuration\Drive\T?\SCSI Bus
DriveT?ScsiId	1	1	Unsigned		Configuration\Drive\T?\SCSI Id
DriveT?SerialNumber	0	0	ASCII		Configuration\Drive\T?\SN
DriveT?Start	1	0	ASCII	MANUAL INVENTORY POWER-ON	Configuration\Drive\T?\Start
DriveT?TermPower	1	0	ASCII	OFF ON	Configuration\Drive\T?\Term Power

Name	Write	Length	Type	Value(s)	Comment
Library	1	0	ASCII	a	This is the library letter that the initiator that executes the Mode command is currently connected to. Changing this value is similar to changing the ScsiInitiators value for the letter corresponding to the initiator's SCSI Id. In the rest of the Library? Items below, the ? in the name is the letters a, b, c, d, or is not present. When not present, the information is for the library that the initiator is connected to (the letter that would be returned by Library).
Library?DriveFirst	1	0	ASCII		Configuration\Library\?\Drive First
Library?DriveLast	1	0	ASCII		Configuration\Library\?\Drive Last
Library?Drives	0	1	Unsigned		Configuration\Library\?\Drives
Library?DtSerial	1	0	ASCII	00 FILL NONE SPC FILL	Configuration\Library\?\DT Serial
Library?Enabled	1	0	ASCII	ON OFF	Configuration\Library\?\Enable
Library?FixedFirst	1	0	ASCII		Configuration\Library\?\Fixed First
Library?FixedLast	1	0	ASCII		Configuration\Library\?\Fixed Last
Library?Fixeds	0	1	Unsigned		Configuration\Library\?\Fixeds
Library?InqFields	1	8	Byte		Configuration\Library\?\Inquiry\ <line 2>
Library?InqProduct	1	16	ASCII		Configuration\Library\?\Inquiry\ <line 4>
Library?InqRevision	1	4	ASCII		Configuration\Library\?\Inquiry\ <line5>
Library?InqSpecific	1	20	Byte	All zeros	Configuration\Library\?\Inquiry\ <line 6 & 7>
Library?InqVendor	1	8	ASCII	QUALSTAR	Configuration\Library\?\Inquiry\ <line 3>
Library?Inquiry	1	0	ASCII	NATIVE CUSTOM	Configuration\Library\?\Inquiry\Inquiry
Library?SlotFirst	1	0	ASCII		Configuration\Library\?\Slot First
Library?SlotLast	1	0	ASCII		Configuration\Library\?\Slot Last
Library?Slots	0	2	Unsigned		Configuration\Library\?\Slots
Library?StorageOrder	1	0	ASCII	MAG FIX	Configuration\Library\?\Storage Order
Library?ViopFirst	1	0	ASCII	…..	Configuration\Library\?\VIOP First
Library?ViopLast	1	0	ASCII	…..	Configuration\Library\?\VIOP Last
Library?Viops	0	2	Unsigned	0	Configuration\Library\?\VIOPs
Library?VolumeTagPad	1	0	ASCII	SPC 00	Configuration\Library\?\Volume Tag Pad
LogBdc	1	0	ASCII	OFF ON	Configuration\Advanced\Log\Bdc
LogCarousel	1	0	ASCII	OFF ON	Configuration\Advanced\Log\Carousel
LogCarrier	1	0	ASCII	OFF ON	Configuration\Advanced\Log\Carrier

Name	Write	Length	Type	Value(s)	Comment
LogClean	1	0	ASCII	OFF ON	Configuration\Advanced\Log\Clean
LogConfiguration	1	0	ASCII	OFF ON	Configuration\Advanced\Log\Configuration
LogContend	1	0	ASCII	ON OFF	Configuration\Advanced\Log\Contend
LogControl	1	0	ASCII	OFF ON	Configuration\Advanced\Log\Control
LogDrivebay	1	0	ASCII	OFF ON	Configuration\Advanced\Log\Drivebay
LogI2c	1	0	ASCII	OFF ON	Configuration\Advanced\Log\I2c
LogInventory	1	0	ASCII	OFF ON	Configuration\Advanced\Log\Inventory
LogPic	1	0	ASCII	ON OFF	Configuration\Advanced\Log\Pic
LogProcess	1	0	ASCII	OFF ON	Configuration\Advanced\Log\Process
LogRbtActions	1	0	ASCII	OFF ON	Configuration\Advanced\Log\RBT Actions
LogRbtActivity	1	0	ASCII	ON OFF	Configuration\Advanced\Log\RBT Activity
LogRbtEvents	1	0	ASCII	ON OFF	Configuration\Advanced\Log\RBT Events
LogRbtIsr	1	0	ASCII	ON OFF	Configuration\Advanced\Log\RBT Isr
LogRbtJob	1	0	ASCII	OFF ON	Configuration\Advanced\Log\RBT Job
LogRbtOperation	1	0	ASCII	OFF ON	Configuration\Advanced\Log\RBT Operation
LogRbtResults	1	0	ASCII	OFF ON	Configuration\Advanced\Log\RBT Results
LogRs485	1	0	ASCII	OFF ON	Configuration\Advanced\Log\Rs485
LogScsiCommands	1	0	ASCII	ON OFF	Configuration\Advanced\Log\SCSI Commands
LogScsiInterrupts	1	0	ASCII	OFF ON	Configuration\Advanced\Log\SCSI Interrupts
LogScsiPhases	1	0	ASCII	ON OFF	Configuration\Advanced\Log\SCSI Phases
LogScsiStates	1	0	ASCII	ON OFF	Configuration\Advanced\Log\SCSI States
LogSensor	1	0	ASCII	OFF ON	Configuration\Advanced\Log\Sensor
LogSequential	1	0	ASCII	OFF ON	Configuration\Advanced\Log\Sequential
LogStorageArray	1	0	ASCII	OFF ON	Configuration\Advanced\Log\Storage Array

Name	Write	Length	Type	Value(s)	Comment
PartNumber	0	0	ASCII	700118	Maintenance\Display Revision\Part Number
PcbNumber	0	0	ASCII		Private\Executive\PCB Number
PcbRevision	0	0	ASCII		Private\Executive\PCB Revision
Revision	0	0	ASCII		Private\Executive\FwRev
ScsiDisconnect	1	0	ASCII	ON OFF	Configuration\Advanced\SCSI\Disconnect
ScsiEnable	1	0	ASCII	ON BUSY INFO ONLY OFF	Configuration\Advanced\SCSI\Enable
ScsiInitiators	1	16	ASCII	aaaaaaaaaaaaaaaa	Configuration\Advanced\SCSI\Library
ScsiParity	1	0	ASCII	ABORT IGNORE MESSAGE	Configuration\Advanced\SCSI\Parity
ScsiSynchronous	1	0	ASCII	OFF ON	Configuration\Advanced\SCSI\Synchronous
SerialNumber	0	4	Unsigned		Maintenance\SN

Table 7-7 Configuration Variables

7.2.4 External Data Mode Page

The External Data page is used to access a non-volatile, 32 byte memory which can be used to store data in the MC. This data is not used or altered by the MC in any way. Only a Mode Select command for the External Data page can alter this memory's contents. A Mode Sense command can be used to read its contents.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	External Data Page Code ($3E_h$)					
1	Parameter List Length (20_h)							
2-33	External Data							

Table 7-8 External Data Page

7.2.4.1 External Data Page Code

This is the code number of the External Data mode page and its value is $3E_h$.

7.2.4.2 Parameter List Length

This field specifies how many more bytes follow, and its value is 20_h.

7.2.4.3 External Data

This field contains 32 bytes of data to be saved by the MC in non-volatile RAM.

7.3 Command Specific Errors

Sense Key	ASC	ASCQ	C/D Bit	Field Pointer	Bit Pointer	Description
5	$1A_h$	00_h	1	0004_h		Parameter List Length Error.
5	26_h	00_h	0	$????_h$		Invalid Field in Parameter List.
5	26_h	00_h	0	$????_h$	7	Invalid Field in Parameter List. PS bit set.

8. Mode Sense

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	$1A_h$							
1	LUN			0	DBD	0		
2	PC		Page Code					
3	0							
4	Allocation Length							
5	Vendor Specific (0)		0				Flag (0)	Link (0)

8.1 Command Description

The Mode Sense command is the complement to the Mode Select command, and tells the MC to send a Mode Sense Parameter list. The list contains a four-byte header followed by zero or more mode pages.

8.1.1 DBD

The MC does not support block descriptors and the value of the Disable Block Descriptors field is ignored.

8.1.2 PC

The Page Control field tells the MC which type of parameters to return. Table 8-1 lists the Page Control field values.

PC	Name	Description
0	Current Values	The MC will return the requested pages with each supported parameter set to its current value. Current values are: The parameters set in the last successful Mode Select command; The saved values, if a Mode Select command has not been executed since the last power-on, SCSI bus reset, or BUS DEVICE RESET message; The default values, if saved values are not available.
1	Changeable Values	The MC will return the requested pages with each bit of each field set to 1 if that bit in that field is changeable. The Page Code and Parameter List Length fields will contain their actual values.
2	Default Values	The MC will return the requested pages with each supported parameter set to its default value. The MC will return a value of 0 for all unsupported parameters.
3	Saved Values	The MC will return the requested pages with each supported parameter set to its saved value. The MC will return a value of 0 for all unsupported parameters. If no page has been saved, the MC will return default values.

Table 8-1 Page Control Values

8.1.3 Mode Sense Page Code

This field tells the MC which page to return. Table 8-2 lists the mode pages supported by the MC.

Page Code	Page Name
$1D_h$	Element Address Assignment
$1E_h$	Transport Geometry
$1F_h$	Device Capabilities
22_h	LCD
$3D_h$	Configuration
$3E_h$	External Data
$3F_h$	All pages in page code order.

Table 8-2 Supported Mode Pages

8.1.4 Allocation Length

The Allocation Length specifies the number of bytes the initiator has allocated for returned mode sense data. If the MC receives an allocation length of zero, it will not transfer any mode sense data.

The MC will stop when it has transferred the requested amount of data or the number specified by the Allocation Length, whichever is less.

8.2 Mode Sense Parameter List

The format of the Mode Sense Parameter List is shown in Table 8-3.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Mode Sense Data Length (n-3)							
1-3	0							
4-n	Mode Page(s)							

Table 8-3 Mode Sense Parameter List

8.3 Mode Pages

8.3.1 Element Address Assignment Mode Page

The Element Address Assignment page provides information to the initiator about the MC's element address assignment capabilities. Its format is shown in Table 8-4.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	PS (1)	0	Element Address Assignment Page Code ($1D_h$)					
1	Parameter List Length (12_h)							
2-3	Medium Transport Element Address							
4-5	Number of Medium Transport Elements (1)							
6-7	Storage Element Starting Address							
8-9	Number of Storage Elements							
10-11	Import/Export Element Address							
12-13	Number of Import/Export Elements							
14-15	Data Transfer Element Starting Address							
16-17	Number of Data Transfer Elements							
18-19	0							

Table 8-4 Element Address Assignment Page

8.3.1.1 PS

The MC returns a value of 1 in the Parameters Savable field, indicating that it can save this page to non-volatile memory.

8.3.1.2 Element Address Assignment Page Code

This is the code number of the Element Address Assignment page and its value is $1D_h$.

8.3.1.3 Parameter List Length

This field tells the initiator how many more bytes follow, and its value is 18 (12_h).

8.3.1.4 Bytes 2 through 17

These bytes are described in Section 7.2.1.

8.3.2 Transport Geometry Descriptor Mode Page

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	PS (0)	0	Transport Geometry Page Code ($1E_h$)					
1	Parameter List Length (02_h)							
2	0							Rotate (0)
3	Member Number in Transport Element Set (0)							

Table 8-5 Transport Geometry Page

8.3.2.1 PS

The MC returns a value of 0 in the Parameters Savable field because it does not save this page to non-volatile memory.

8.3.2.2 Transport Geometry Page Code

This is the code number of the Transport Geometry page and its value is $1E_h$.

8.3.2.3 Transport Geometry Parameter Length

This field tells the initiator how many more bytes follow, and its value is 02_h.

8.3.2.4 Member Number in Transport Element Set

The MC has only one transport element and the value of this field will always be 0.

8.3.3 Device Capabilities Mode Page

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	PS (0)	0	Device Capabilities Page Code ($1F_h$)					
1	Parameter List Length (12_h)							
2	0				StorDT (1)	StorI/E (1)	StorST (1)	StorMT (1)
3	0							
4	0				MT→DT (1)	MT→I/E (1)	MT→ST (1)	MT→MT (0)
5	0				ST→DT (1)	ST→I/E (1)	ST→ST (1)	ST→MT (1)
6	0				I/E→DT (1)	I/E→I/E (0)	I/E→ST (1)	I/E→MT (1)
7	0				DT→DT (1)	DT→I/E (1)	DT→ST (1)	DT→MT (1)
8-11	0							
12	0				MT↔DT (0)	MT↔I/E (0)	MT↔ST (0)	MT↔MT (0)
13	0				ST↔DT (0)	ST↔I/E (0)	ST↔ST (0)	ST↔MT (0)
14	0				I/E↔DT (0)	I/E↔I/E (0)	I/E↔ST (0)	I/E↔MT (0)
15	0				DT↔DT (0)	DT↔I/E (0)	DT↔ST (0)	DT↔MT (0)

Legend: DT = Data Transfer Element,
I/E = Import/Export Element,
MT = Medium Transport Element,
ST = Storage Element

Table 8-6 Device Capabilities Page

8.3.3.1 PS

The value of the Parameters Savable field is 0, indicating that the MC cannot save this page to non-volatile memory.

8.3.3.2 Device Capabilities Page Code

This is the code number of the Device Capabilities page and its value is $1F_h$.

8.3.3.3 Device Capabilities Parameter Length

This field tells the initiator how many more bytes follow, and its value is 12_h.

8.3.3.4 Byte 2 - Medium Storage Capability

Byte 2 indicates which elements of the MC are media storage elements. A value of 1 indicates that an element is a media storage element. See Table 8-6.

8.3.3.5 Bytes 4 through 7 - Medium Movement Capabilities

Bytes 4 through 7 indicate when the MC will support the Move Medium command. Referring to Table 8-6, a value of 1 indicates the MC supports the Move Medium command when the source is the first specified element and the destination is the second.

For example: The value of byte 4, bit 3 will be 1, because the MC can move a cartridge from the handler (MT = Medium Transport element) to a drive (DT - Data Transfer element). The value of byte 6 bit 2, however, will be 0, because having only one I/O port (I/E = Import/Export element), the MC cannot move a cartridge from one I/O port to another.

8.3.3.6 Bytes 12 through 15 - Medium Exchange Capabilities

Bytes 4 through 7 indicate when the MC will support the Exchange Medium command. Referring to Table 8-6, a value of 1 indicates the MC supports the Exchange Medium command between the two specified elements.

8.3.4 LCD Mode Page

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	PS (1)	0	LCD Page Code (22_h)					
1	Parameter List Length (52_h)							
2	0				Write Line 1	Write Line 2	Write Line 3	Write Line 4
3	0							
4-23	Display Line 1							
24-43	Display Line 2							
44-63	Display Line 3							
64-83	Display Line 4							

Table 8-7 LCD Page

8.3.4.1 PS

The value of the Parameters Savable field is 1, indicating that the MC can save this page to non-volatile RAM.

8.3.4.2 LCD Page Code

This is the code number of the LCD Mode page and its value is 22_h.

8.3.4.3 LCD Mode Parameter List Length

This field tells the initiator how many more bytes follow, and its value is 52_h.

8.3.4.4 Write Line 1, 2, 3, and 4

These fields tell the initiator whether the data on the MC's LC display are internally generated or are the result of a previous Mode Select command. They refer to display lines 1 through 4 on the MC control panel. A value of 0 indicates the data on the LCD is internally generated by the MC, and a value of 1 indicates the data came from a previous Mode Select command.

8.3.4.5 Display Line 1, 2, 3, and 4

These fields reflect the current contents of the LC display on the MC control panel.

8.3.5 Configuration Mode Page

The Configuration page is used to return the values of various non-volatile configuration items. These items are set using either the front panel or the Mode Select command (using the Configuration page). Reading the configuration variables involves using a Mode Select (with the Configuration page) to select a variable by name and then a Mode Sense (for the Configuration page) to return the value. If multiple Mode Sense commands are issued for the Configuration page, each Mode Sense will return the next variable after the previous command's returned variable. Thus the entire variable space may be read in Variable Name order by issuing one Mode Select followed by n Mode Sense commands (where n is the number of variables).

NOTE

The number of variables may change over time as the MC firmware is revised. It is possible that variables may be removed or added in subsequent revisions of the firmware. In addition, the values for a variable may also change (e.g. the values allowed for tape drive models will increase as the MC supports more models). See Table 7-7 for a list of variables and values.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	PS (1)	0	Configuration Page Code ($3D_h$)					
1	Parameter List Length ($2C_h$)							
2	Write	Type		Length				
3	0							
4-23	Variable Name							
24	0							
25-44	Variable Value							
45	0							

Table 8-8 Configuration Page

8.3.5.1 PS

The value of the Parameters Savable field is 1, indicating that the MC can save this page to non-volatile RAM.

8.3.5.2 Configuration Page Code

This is the code number of the Configuration Mode page and its value is $3D_h$.

8.3.5.3 Parameter List Length

This field tells the initiator how many more bytes follow, and its value is $2C_h$.

8.3.5.4 Write

This field indicates whether the returned configuration variable can be altered. A 0 indicates the variable is read-only and cannot be altered, whereas a 1 indicates the variable's value can be changed.

8.3.5.5 Type

This field indicates the format of the variable's value as returned in the Variable Value field. The type code values are listed in Table 8-9.

Type	Type Name	Description
0	ASCII	ASCII character data. If the Length field is 0, this is a zero-terminated string, otherwise, the length field determines the number of characters. A zero-terminated string may be up to 16 characters in length by using the 0 at byte 41 as the terminator. Bytes after the last character (or terminator) are ignored and may be any value.
1	Byte	Byte array data. The Length field indicates the size of the byte array up to 16 bytes.
2	Signed	Signed integer data. The length field indicates the size of the integer in bytes and will have the values: 1, 2, or 4. Signed integers are stored in 2's complement form with the most significant byte first.

3	Unsigned	Unsigned integer data. The length field indicates the size of the integer in bytes and will have the values: 1, 2, or 4. Unsigned integers are stored most significant byte first.

Table 8-9 Configuration Page Type Values

8.3.5.6 Length

This field indicates the size in bytes of the Variable Value. For ASCII zero-terminated strings, the Length field's value is 0.

8.3.5.7 Variable Name

This field holds a zero-terminated ASCII string that specifies the variable by name. The variable name may be up to 20 characters in length (in which case the zero terminator will be at byte 24).

8.3.5.8 Variable Value

This field holds the value for the variable. Its length and format is determined by the contents of the Length and Type fields.

8.3.6 External Data Mode Page

The External Data page is used to access a non-volatile, 32 byte memory which can be used to store data in the MC. This data is not used or altered by the MC in any way. Only a Mode Select command for the External Data page can alter this memory's contents. A Mode Sense command can be used to read its contents.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	PS (1)	0	External Data Page Code ($3E_h$)					
1	Parameter List Length (20_h)							
2-33	External Data							

Table 8-10 External Data Page

8.3.6.1 PS

The value of the Parameters Savable field is 1, indicating that the MC can save this page to non-volatile RAM.

8.3.6.2 External Data Page Code

This is the code number of the External Data mode page and its value is $3E_h$.

8.3.6.3 Parameter List Length

This field tells the initiator how many more bytes follow, and its value is 20_h.

8.3.6.4 External Data

This field contains 32 bytes of data.

8.4 Command Specific Errors

Sense Key	ASC	ASCQ	C/D Bit	Field Pointer	Bit Pointer	Description
5	24_h	00_h	1	0002_h		Invalid Field In CDB. Unsupported page code.

This page left blank intentionally.

9. Move Medium

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	$A5_h$							
1	LUN			0				
2-3	Transport Element Address							
4-5	Source Element Address							
6-7	Destination Element Address							
8-9	0							
10	0							Invert (0)
11	Door Code		0				Flag (0)	Link (0)

9.1 Command Description

The Move Medium command asks the MC to move a data cartridge from the location specified in Source Element Address to the location specified in Destination Element Address. The MC returns a GOOD status after the cartridge has successfully been placed in its destination.

The addresses specified by the source and destination fields can be those of a storage slot, the I/O port, a drive, or of the handler itself. The MC checks the validity of the addresses and status of the element locations before the handler moves. If the source is empty or the destination is occupied, the MC will return a CHECK CONDITION status and will not move the handler. However, it is permissible for the Source and Destination Element Addresses to be equal. In the case of a Data Transfer Element (Tape Drive), this will cause an ejected tape to be re-inserted into the drive, for other element types, no operation will result. In all cases, the element must be occupied or a CHECK CONDITION will result.

The MC updates the cartridge inventory dynamically during the command to reflect the actual location of the cartridge being moved.

NOTE

Movement of cartridges to and/or from the VIOP is affected by the settings of the `Configuration\Advanced\Changer\VIOP\Export` *and* `Configuration\Advanced\Changer\VIOP\Import` *menu items. Attempted export and/or import of cartridges when these items are set to* `NO`*, will result in a CHECK CONDITION.*

9.1.1 Transport Element Address

This is the address of the handler or 0. If the value is 0, the MC internally supplies the address of the handler, otherwise the MC compares the value of this field with the value set by the last Mode Select command (or with the default if no Mode Select command was received). If the values do not compare, the MC returns the appropriate error message.

9.1.2 Source Element Address

This field tells the MC where the cartridge is to be taken from.

9.1.3 Destination Element Address

This field tells the MC where to place the cartridge.

9.1.4 Invert

The value of this field must be 0 because the MC handler cannot invert (turn or rotate) a data cartridge.

9.1.5 Door Code

Moving a cartridge from a source location to the VIOP slot does not make that cartridge available to the user until the VIOP window is opened. The VIOP may be opened by operator interaction with the control panel (if it has not been prevented by the application) or by use of the Move Medium command. This field provides a means of opening either the front door or VIOP window.

Bit 7	Bit 6	Definition
0	0	Normal move (no I/O Port effect)
0	1	Open VIOP window (addresses ignored)
1	0	Ignored
1	1	Open front door (addresses ignored)

Table 9-1 Door Code Values

If the value of the Door Code field is other than zero, the MC ignores the values in the Transport, Source, and Destination Element Address fields. Therefore, to make a cartridge available to the operator, two Move Medium commands must be issued; one to move the cartridge from the source to the VIOP, and another to open the VIOP window.

Both the Front door and VIOP window will remain open until the operator closes them.

9.2 Command Specific Errors

Sense Key	ASC	ASCQ	C/D Bit	Field Pointer	Bit Pointer	Description
2	04_h	00_h				Logical Unit Not Ready, Cause Not Reportable. No free slot available or operation aborted by operator.
2	04_h	82_h				VIOP window is open.
2	04_h	83_h				Front door is open.
5	$3B_h$	$0D_h$	1	0006_h		Medium Destination Element Full. Second Destination Element full.
5	$3B_h$	$0E_h$	1	0004_h		Medium Source Element Empty.
5	53_h	02_h				Medium Removal Prevented. Front door and/or VIOP window cannot be opened because medium removal is prevented.
5	80_h	07_h	1	0004_h		I/O Port access or Import prohibited by configuration, Attempted use as Source Element.
5	21_h	01_h	1	0002_h		Invalid Element Address. Invalid Transport Element address.
5	21_h	01_h	1	0004_h		Invalid Element Address. Invalid Source Element address.
5	21_h	01_h	1	0006_h		Invalid Element Address. Invalid First Destination Element address.
5	21_h	01_h	1	0008_h		Invalid Element Address. Invalid Second Destination Element address.
5	$3B_h$	90_h	1	0004_h		Tape is not ejected from Source drive.
5	80_h	01_h	1	0002_h		Handler Full.
5	80_h	03_h				Source Magazine not installed.
5	80_h	04_h				Destination Magazine not installed.
5	80_h	05_h				Source Drive not installed.
5	80_h	06_h				Destination Drive not installed.
5	80_h	07_h	1	0006_h		VIOP access or Import/Export prohibited by configuration, Attempted use as Destination Element.

Table 9-2 Move Medium Command Specific Errors

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10. Position to Element

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	$2B_h$							
1	LUN			0				
2-3	Transport Element Address							
4-5	Destination Element Address							
6-7	0							
8	0							Invert (0)
9	Vendor Specific (0)		0				Flag (0)	Link (0)

10.1 Command Description

The Position to Element command tells the MC to move the handler to the specified destination. The addresses specified by the destination field can be those of a storage slot, the I/O port, a drive, or of the handler itself. The MC checks the validity of the addresses and status of the element locations before the handler moves.

Upon successful completion of this command, the handler will be positioned to insert or remove a cartridge at that location and the MC will return a GOOD status.

10.1.1 Transport Element Address

This is the address of the handler or 0. If the value is 0, the MC internally supplies the address of the handler, otherwise the MC compares the value of this field with the value set by the last Mode Select command (or with the default if no Mode Select command was received). If the values do not compare, the MC returns the appropriate error message.

10.1.2 Destination Address

The Destination address is the location to which you want to position the handler.

10.1.3 Invert

The value of this field must be 0 because the MC handler cannot invert (turn or rotate) the medium transport.

10.2 Command Specific Errors

Sense Key	ASC	ASCQ	C/D Bit	Field Pointer	Bit Pointer	Description
5	21_h	01_h	1	0002_h		Invalid Element Address. Invalid Transport Element address.
5	21_h	01_h	1	0004_h		Invalid Element Address. Invalid Source Element address.

Table 10-1 Position to Element Command Specific Errors

11. Prevent/Allow Medium Removal

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	$1E_h$							
1	LUN			0				
2-3	0							
4	0							Prevent
5	Vendor Specific (0)		0				Flag (0)	Link (0)

11.1 Command Description

The Prevent/Allow Medium Removal command controls the ability of the front panel to be used to open either the front door or the VIOP window. Initiators can use this command to provide a level of security over the cartridge inventory.

11.1.1 Prevent

A value of 1 in the Prevent field (i.e., a Prevent command) prevents the MC from opening the front door or the VIOP window; a value of 0 (i.e., an Allow command) allows the MC to open both doors. If either door is already open when the MC receives a Prevent command, the MC will not return an error.

The MC keeps track of Prevent and Allow commands from multiple initiators and will not allow the doors to be opened until it receives an Allow command from every initiator that sent a Prevent command.

If an initiator sends a Prevent command, while the MC is reserved for another initiator, the MC will return a RESERVATION CONFLICT error to the initiator sending the Prevent command. However, the MC will always accept an Allow command without regard to reservation status.

Following a Bus Reset, BUS DEVICE RESET message or a power-up, all initiators are set to Allow.

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12. Read Element Status

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	$B8_h$							
1	LUN			VolTag	Element Type Code			
2-3	Starting Element Address							
4-5	Number of Elements							
6	0							
7-9	Allocation Length							
10	0							
11	Vendor Specific (0)		0				Flag (0)	Link (0)

12.1 Command Description

The Read Element Status command tells the MC to report information about elements. This information returned is called Element Status Data and is explained in Section 12.2.

The MC builds a data set (Element Status Data) based upon the Starting Element Address and the Number of Elements data fields. Once built, its contents are not altered until the command completes. How much of the data set the MC returns is determined by the command's Allocation Length field as explained in Section 12.1.5.

12.1.1 VolTag

The MC may return volume tag information (usually derived from cartridge labels) if the value of the Volume Tag field is 1, and will not return volume tag information if the value is 0. The Volume Tag information is explained in Section 12.3.12.6.

12.1.2 Element Type Code

The value of this field tells the MC which type of element to report. Table 12-1 lists the values of this field.

Element Type Code	Type	Description
0	All element types	All element types are reported in element address order starting with the Starting Element Address.
1	Medium Transport Element	The handler element is reported.
2	Storage Element	Storage elements are reported (both magazine and fixed locations).
3	Import/Export Element	The I/O Port element is reported.
4	Data Transfer Element	Tape drive elements are reported.

Table 12-1 Element Type Code Values

12.1.3 Starting Element Address

This field specifies the lowest address to be reported in the overall Element Status Data. Only elements of the specified element type code whose element address equals or are greater than the Starting Element Address will be reported. The MC will not create an element descriptor for an undefined element address.

12.1.4 Number of Elements

The Number of Elements field tells the MC the number of element descriptors to return (beginning with the element specified in the Starting Element Address field.

12.1.5 Allocation Length

The Allocation Length field specifies how many bytes the initiator has reserved for element status data, and is processed differently than in the Mode Sense and Log Sense commands:

- If the allocation length is equal to or greater than the length of the data set, The MC ends the DATA OUT phase when the entire data set is returned.
- If the allocation length is such that it would cause a partial element descriptor to be returned, the MC ends the DATA OUT phase after it transmits the previous element descriptor. This means that even though the number of returned bytes would be less than the number of bytes specified by the allocation length, one or more element descriptors will not be returned. It is important to note that the MC will not alter the contents of the pre-built data set to reflect this truncation.
- If the allocation length is such that it would cause a partial header to be returned (either the Element Status Data header or an Element Status Page header), the MC ends the DATA OUT phase after it transmits the number of bytes specified by the allocation length. This means that even though all the expected number of bytes was transmitted, the last header will be incomplete and one or more element descriptors will not be returned. As before, the MC will not alter the contents of the pre-built data set to reflect this truncation.

The last two conditions are not considered errors by the SCSI specification.

12.2 Element Status Data

Figure 12-1 illustrates the hierarchical format of the Element Status data. Element Status data begins with an eight-byte header and contains zero or more element status pages. Each element type has its own Element Status page, and each page in turn begins with an eight-byte header and contains one or more element descriptors. Pages are only present if they contain descriptors. Pages and descriptors are returned in element address order. Since the element addresses are alterable (using the front panel or the Mode Select command), pages may not be returned in the same order from command to command.

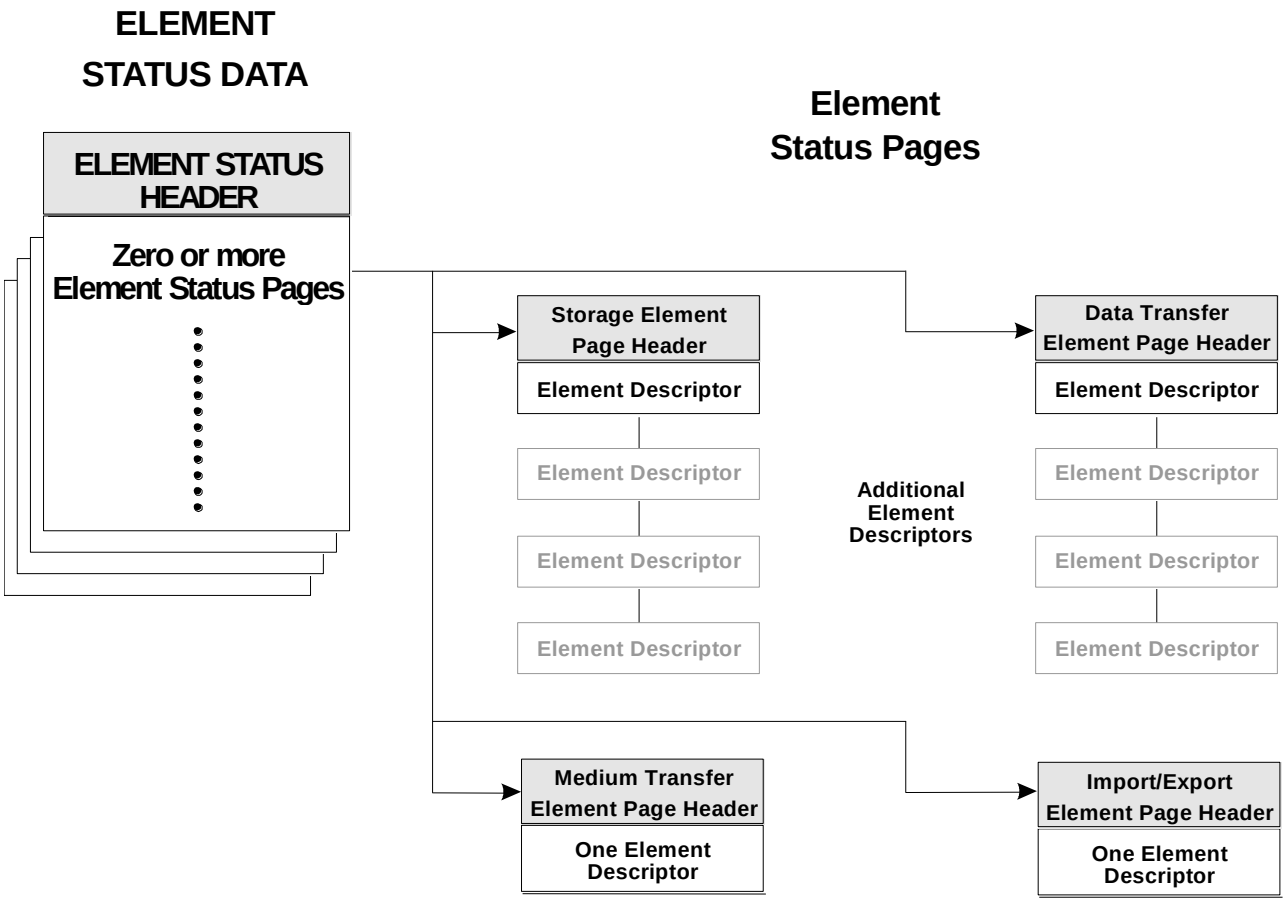

Figure 12-1 Element Status Data Hierarchy

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	First Element Address Reported							
2-3	Number of Elements Available							
4	0							
5-7	Byte Count of Report Available (n-7)							
8-n	Element Status Page(s)							

Table 12-2 Element Status Data

12.2.1 First Element Address Reported

This field contains the element address of the element having the lowest element address that meets the command specifiers.

12.2.2 Number of Elements Available

This field contains the number of element descriptors found which meet the command specifiers. If the specified Allocation Length was sufficient the MC will return status for this number of elements.

12.2.3 Byte Count of Report Available

The value in this field is the number of bytes of Element Status data the MC could return if the command's Allocation Length value permitted it to do so.

12.2.4 Element Status Page

Each Element Status page begins with an eight-byte header and contains one or more element descriptors. The format of an Element Status page is shown in Table 12-3.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Element Type Code							
1	PVolTag	AVolTag (0)	0					
2-3	Element Descriptor Length (10_h , $1C_h$, 34_h, or 38_h)							
4	0							
5-7	Byte Count of Descriptor Data Available (n-7)							
8-n	Element Descriptor(s)							

Table 12-3 Element Status Page

12.2.4.1 Element Type Code

Table 12-1 lists the values of this field (the 0 value will not occur).

12.2.4.2 PVolTag

The MC returns a value of 0 if the following element descriptors do not contain Primary Volume Tag information (label information), and a value of 1 if they do. Volume Tag information is explained in Section 12.3.12.6.

For units without barcode readers, the Primary Volume Tag field will always be 0.

12.2.4.3 AVolTag

The MC does not support the use of alternate volume tags and returns a value of 0 in the Alternate Volume Tag field.

12.2.4.4 Element Descriptor Length

This field indicates how many bytes are in a single element descriptor.

12.2.4.5 Byte Count of Descriptor Data Available

This value in this field is the number of bytes of Element Descriptor data the MC could return if the command's Allocation Length value permitted it to do so. The value equals the Element Descriptor Length times the number of element descriptors.

12.3 Element Descriptors

Element descriptors are very similar to one another. Fields common to all element descriptors are explained in this section, and differences or unique fields are explained in subsequent sections for each element descriptor.

12.3.1 Element Address

The first two bytes contain the element address of the element for which the descriptor was generated.

12.3.2 Except

The third byte contains an Except field whose value will be 0 if the element is in its normal state, and will be 1 if an exception condition exists. An exception indicates the MC is uncertain of an element's status. This could happen if, for example, the integrity of the inventory has been compromised (somebody opened the door and stuck their hand in the cartridge area).

In this case, the MC will set the Exception field to 1, return an ASC and ASCQ indicating that the validity of the information is questionable (see Section 12.3.4), and will return the last information it was sure of (Full field, and Primary Volume Tag field).

12.3.3 Full

The value of the Full field will be 1 if the element contains a cartridge, and 0 if the handler does not contain a cartridge.

12.3.4 ASC and ASCQ Fields

The Additional Sense Code and Additional Sense Code Qualifier fields together identify a specific exception condition when the Exception field is 1. The values for these fields are described in Table 12-4.

ASC	ASCQ	Description
83h	00h	Label information is questionable. The volume tag may contain data but this data may not be correct. Note that this exception does not occur on a unit without a barcode reader.
83h	01h	Label error. A label was scanned but was in error. Note that this exception does not occur in a unit without a barcode reader.
83h	02h	Magazine not present.
83h	03h	Full and label information questionable. The last known data is returned but may not be correct.
83h	04h	Drive not present. Either no drive is installed or `Configuration\Drive\T?\Mode` is set to `DUAL-BIN`, `RECYCLE`, or `SEQUENTIAL`.
83h	07h	Full information questionable. The last known data is returned but may not be correct. This exception is returned instead of Full and Label information questionable on units without a barcode reader.
83h	09h	No label information. The cartridge in this element has no label (or has a label sufficiently damaged that the scanner could not detect its presence). Note that this exception does not occur on a unit without a barcode reader.

Table 12-4 Element Descriptor Additional Sense Codes: All Emulations

12.3.5 SValid

If the value of the Source Valid field is 1, the values of the Invert and Source Storage Element Address fields are valid. A value of 0 indicates the values in the Invert and Source Storage Element Address fields are not valid.

12.3.6 Invert

The value of this field will always be 0 because the MC cannot invert cartridges.

12.3.7 Source Element Address

If the value of the Source Valid field is 1, the Source Element Address field contains the address of the last storage element from which the cartridge came. The value of this field is not valid if the value of the Source Valid field is 0.

NOTE

The MC only considers elements of type STORAGE to be source elements (this means magazine and fixed slots). When moving a cartridge from an Import/Export or Data Transfer element, the Source Element Address at the destination will be the same value as it was at the source.

12.3.8 Primary Volume Tag Information

If the PVolTag field in the element status page header is 1, this field contains 36 bytes of information that identify the cartridge residing in this element. This field is omitted if the PVolTag is 0. Volume Tag information is explained in Section 12.3.12.6.

The following sections provide information pertinent to specific element descriptors.

12.3.9 Medium Transport Element Descriptor

The MC contains one handler (medium transport element). The format of the Medium Transport Element Descriptor is shown in Table 12-5.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	Element Address							
	0					Except	0	Full
3	0							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6-8	0							
9	Svalid	Invert (0)	0					
10-11	Source Element Address							
12-47	Primary Volume Tag							
48-51	0							

Table 12-5 Medium Transport Element Descriptor

12.3.10 Storage Element Descriptor

The number of storage locations varies according to the model number and the number of installed magazines. Fixed slots are considered storage locations. The format of the Storage Element Descriptor is shown in Table 12-6.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	Element Address							
2	0				Access	Except	0	Full
3	0							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6-8	0							
9	Svalid	Invert (0)	0					
10-11	Source Element Address							
12-47	Primary Volume Tag							
48-51	0							

Table 12-6 Storage Element Descriptor

12.3.10.1 Access

The value of the Access field will be 1 if the magazine containing the element (or always for fixed slots) is installed. Otherwise, it will be 0 (access denied).

12.3.11 Import/Export Element Descriptor

The Import/Export element(s) are the VIOP slots. The VIOP is used to move cartridges into and out of the MC. The format of the Import/Export Element Descriptor is shown in Table 12-7.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	Element Address							
2	0		InEnab	ExEnab	Access	Except	ImpExp (0)	Full
3	0							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6-8	0							
9	Svalid	Invert (0)	0					
10-11	Source Element Address							
12-47	Primary Volume Tag							
48-51	0							

Table 12-7 Import/Export Element Descriptor

12.3.11.1 Access

The value of the Access field will be 1 if the magazine containing the element is installed. Otherwise, it will be 0 (access denied).

12.3.11.2 ExEnab

A value of 0 in the Export Enable field indicates that media movement from the handler to VIOP slots is not allowed; a value of 1 indicates that the movement is permitted.

NOTE

This field's value reflects the setting of the `Configuration\Advanced\Changer\VIOP\Export` *menu item.*

12.3.11.3 ImpExp

The value of the Import/Export field is always 0.

12.3.11.4 InEnab

A value of 0 in the Import Enable field indicates that media movement from the VIOP slots to the handler is not allowed; a value of 1 indicates that the movement is permitted.

NOTE

This field's value reflects the setting of the `Configuration\Advanced\Changer\VIOP\Import` *menu item.*

12.3.12 Data Transfer Element Descriptor

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	Element Address							
2	0				Access	Except	0	Full
3	0							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Not Bus	0	ID Valid	LU Valid	0	LUN (0)		
7	SCSI Bus Address							
8	0							
9	Svalid	Invert (0)	0					
10-11	Source Element Address							
12-15	0							
16-n	Drive Serial Number							

Table 12-8 Data Transfer Element Descriptor (without Volume Tag)

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	Element Address							
2	0				Access	Except	0	Full
3	0							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Not Bus	0	ID Valid	LU Valid	0	LUN (0)		
7	SCSI Bus Address							
8	0							
9	Svalid	Invert (0)	0					
10-11	Source Element Address							
12-47	Primary Volume Tag							
48-51	0							
52-n	Drive Serial Number							

Table 12-9 Data Transfer Element Descriptor (with VolumeTag)

12.3.12.1 Access

This value of 1 in the Access field indicates that a cartridge is not inside the tape drive; a value of 0 indicates that a cartridge is inside the tape drive.

12.3.12.2 ID Valid

The value of this field is dependent on the value of the `Configuration\Drive\T?\SCSI Bus` menu item for this drive. If the value is set to `CHANGER` or `OTHER`, this field will be returned with a value of 1, indicating that the value of the SCSI Bus Address field in Byte 7 is valid. If the value is set to `INVALID`, the field will be returned 0.

12.3.12.3 LUN

The value of this field will always be 0.

12.3.12.4 LU Valid

The value of this field is dependent on the value of the `Configuration\Drive\T?\SCSI Bus` menu item for this drive. If the value is set to `CHANGER` or `OTHER`, this field will be returned with a value of 1, indicating that the value of the LUN field in this byte is valid. If the value is set to `INVALID`, the field will be returned 0.

12.3.12.5 Not Bus

The value of this field is dependent on the value of `Configuration\Drive\T?\SCSI Bus` menu item for this drive. If the value is set to `OTHER`, this field will be returned with a value of 1, indicating that the value of the SCSI Bus Address field in Byte 7 is valid but refers to a different SCSI bus than the bus the MC is on. If the value is set to `CHANGER` or `INVALID`, the field will be returned 0.

12.3.12.6 SCSI Bus Address

This field contains the SCSI ID of the tape drive at this element address. A value will be returned whether or not a tape drive is actually present and/or configured. This value is the value of the `Configuration\Drive\T?\SCSI Id` menu item for this drive.

12.3.12.7 Drive Serial Number

This field contains serial number data from the drive (or from configuration memory for drive models from which a serial number cannot be extracted by the library). It will be present when the value of `Configuration\Advanced\Library\?\DT Serial` is `00 FILL` or `SPC FILL`. The Element Descriptor Length field of the Element Status Page header (see Section 12.2.4.4) should always be used to determine the length and presence of this data. See Section 12.5 for a description of the contents of this field.

12.4 Volume Tag Information

A Volume Tag contains information about the cartridge to which it is attached. The information may exist in the form of a barcode label on the cartridge or it may have been sent to the MC in a previous Send Volume Tag command. There is no requirement that the volume tag information be the same as the volume identification information recorded on the tape.

The format of Volume Tag information is shown in Table 12-10.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-31	Volume Identifier							
32-33	0							
34-35	Volume Sequence Number (0)							

Table 12-10 Volume Tag

12.4.1 Alternate Volume Tag Information

Alternate Volume Tag information pertains to the other side of double-sided media. The other side of the media is the side that would be accessed via a Move Medium command with the Invert field set to 1. Because the MC does not invert cartridges, Alternate Volume Tag information is not supported.

12.4.2 Volume Identifier

The Volume Identifier consists of 32 bytes of left-justified ASCII characters. Unused positions are filled with space (20_h). In order for the Send Volume Tag (translate) to work, there must be no asterisks, question marks or embedded blanks within the significant part of the Volume Identifier field. If Volume Tag information for a particular element is not defined, the Volume Identifier field will be 0.

NOTE

If the `Configuration\Advanced\Library\?\Volume Tag Pad` menu item is set to `00`, Volume Identifiers will be padded with 00_h instead of 20_h.

12.4.3 Volume Sequence Number

The Volume Sequence Number field contains a two-byte integer and its value must be 0.

12.5 Drive Serial Number Information

Drive Serial contains a sequence of ASCII characters. Different drive models present different lengths of serial number information. As it is possible that two different drives in the same library might have different lengths of serial number data and all element descriptors in the same page of the same report must have the same length, some of the returned descriptors may have serial numbers shorter than the field length. The actual serial number data will always be left justified within the field. The value of `Configuration\Advanced\Library\?\DT Serial` (`00 FILL` or `SPC FILL`) controls how the short fields are filled. If the value is `00 FILL`, the field will be filled with 00_h bytes. If the value is `SPC FILL`, the field will be filled with 20_h bytes (space character).

The Element Descriptor Length field of the Element Status Page header (see Section 12.2.4.4) should always be used to determine the length and presence of this data.

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13. Release

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	17_h							
1	LUN			3rd Party	3rd Party Device ID			Element
2	Reservation Identification							
3-4	0							
5	Vendor Specific (0)		0				Flag (0)	Link (0)

13.1 Command Description

The Release command lets an initiator release reservations made by previous Reserve commands from that initiator. The Reserve command is explained in Chapter 16. An initiator cannot release reservations that were reserved by other initiators. Releasing unreserved elements is not an error.

13.1.1 3rd Party

The MC supports third-party reservations. A value of 1 in the 3rd Party field indicates the release is a third party release.

13.1.2 3rd Party Device ID

If the 3rd Party field is 1, the 3rd Party Device ID specifies the device for which the release is made.

13.1.3 Element

A value of 0 in the Element field specifies that all previous unit and element reservations made by that initiator be released.

A value of 1 tells the MC that the following Reservation Identification field contains the number of the reservation to be released.

13.1.4 Reservation Identification

This field contains the number of the reservation identification to be released.

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14. Request Sense

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	03h							
1	LUN			0				
2-3	0							
4	Allocation Length							
5	Vendor Specific (0)		0				Flag (0)	Link (0)

14.1 Command Description

The Request Sense command tells the MC to return sense data to the initiator. The MC maintains separate sense data for up to eight initiators. It clears each initiator's sense data when:

- It executes the next command from the same initiator.
- It receives a BUS DEVICE RESET message or a SCSI bus reset condition.

If a CHECK CONDITION status occurs during a command from an unknown initiator, i.e., one that does not include its SCSI ID during the selection phase), the MC will maintain the sense data and will return it to the next unknown initiator as described in the preceding paragraph. It is not advisable to have more than one unknown initiator on the bus.

Sense data will be available to an initiator after any of the following:

- That initiator's previous command to the MC resulted in a CHECK CONDITION status.
- That initiator's previous command to the MC was terminated by an unexpected Bus Free error.
- The Request Sense command was issued to a LUN other than the unit's configured LUN as specified in the `Configuration\Advanced\SCSI\Handler LUN` menu item.

In the last case, The MC returns the following sense data:

Sense Key	ASC	ASCQ	C/D Bit	Field Pointer	Bit Pointer	Description
5	25h	00h				Logical Unit Not Supported

Table 14-1 Sense Data for Wrong LUN

If no sense data is available, the MC returns:

Sense Key	ASC	ASCQ	C/D Bit	Field Pointer	Bit Pointer	Description
0	00h	00h				No Sense and No Additional Sense Information.

Table 14-2 Sense Data for No Sense

If more than one error occurs during the processing of a SCSI command, the sense key reflects the last error that occurred.

14.1.1 Allocation Length

The MC supports 18 bytes of Sense data.

If the MC receives an Allocation Length value of 0, it will return no data.

If the allocation length is less than the number of bytes the MC has to transfer, the MC will only return the number of bytes specified in the Allocation Length field of the CDB.

If the allocation length is greater than the number of bytes the MC has to transfer, the MC will return all available bytes.

14.2 Sense Data Format

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Valid (0)	Error Code (00h or 70h)						
1	Segment Number (0)							
2	Filemark (0)	EOM (0)	ILI (0)	0	Sense Key			
3-6	Information (0)							
7	Additional Sense Length (0Ah)							
8-11	Command Specific Information (0)							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Field Replaceable Unit Code (0)							
15	SKSV	Sense Key Specific						
16-17								

Table 14-3 Sense Data

14.2.1 Valid

The MC does not support the Information field and returns a value of 0.

14.2.2 Error Code

The MC returns only current error information and returns a value of 70h in the Error Code field. A current error is one that occurs while the MC is executing the last received SCSI command. If there is no pending error, the MC returns a value of 0.

14.2.3 Segment Number

The MC does not support the Segment Number field and returns a value of 0.

14.2.4 Filemark

The MC does not support filemarks and returns a value of 0.

14.2.5 EOM

The MC does not support End-Of-Medium and returns a value of 0.

14.2.6 ILI

The MC does not support Illegal-Length-Indication and returns a value of 0.

14.2.7 Sense Keys

Sense Key	Name	Description
0	No Sense	There is no specific sense key currently stored for the requesting initiator (i.e., the command was successful).
2	Not Ready	The MC is not currently ready to process commands. Operator intervention may be required to correct this condition.
4	Hardware Error	This condition indicates that the MC detected an unrecoverable hardware error while attempting to perform a command or the power-up diagnostics.
5	Illegal Request	This condition indicates that either the CDB or the additional parameters supplied as data for some commands (i.e., Mode Select) contained an illegal parameter, or that the MC does not (currently) support the command.
6	Unit Attention	This condition indicates that the cartridge inventory may not be valid (i.e., the door was opened, a cartridge was manually moved from or to one of the magazines, etc.), or that the MC has received a BUS DEVICE RESET message or a hard reset condition (which may be as a result of a power-up or a SCSI Bus Reset).
11	Aborted Command	The MC aborted the command. The system may be able to recover by trying the command again.

Table 14-4 Supported Sense Keys

14.2.8 Information

The MC does not support the Information field and returns a value of 0.

14.2.9 Additional Sense Length

This byte tells the host that ten more bytes of Sense data follow.

14.2.10 Command Specific Information

The MC does not support this field and returns a value of 0.

14.2.11 Additional Sense Code (ASC)

The Additional Sense Code field, together with the Additional Sense Code Qualifier field, indicates a specific error condition.

14.2.12 Additional Sense Code Qualifier (ASCQ)

The Additional Sense Code Qualifier field, together with the Additional Sense Code field, indicates a specific error condition.

14.2.13 Field Replaceable Unit Code

The MC does not support the Field Replaceable Unit Code field and returns a value of 0.

14.2.14 SKSV

A value of 0 in the Sense Key Specific Valid field indicates the information in the Sense Key Specific field is not valid. A value of 1 indicates the information is valid. The value of the SKSV field will be 1 only for an ILLEGAL REQUEST sense key.

14.2.15 Sense Key Specific

When the SKSV field is 1, the Sense Key Specific field indicates which field in the CDB or parameter list of a command caused the CHECK CONDITION status. The format of this field is shown in Table 14-5.

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

Table 14-5 Sense Key Specific Field

14.2.15.1 C/D

The value of the Command/Data field will be 0 if the CHECK CONDITION status resulted from an illegal parameter in the parameter list (Data); it will be 1 if the CHECK CONDITION status resulted from an illegal parameter in the CDB (Command).

14.2.15.2 BPV

The value of the Bit Pointer Valid field will be 0 if the value contained in the Bit Pointer is not valid, and will be 1 if the Bit Pointer value is valid.

14.2.15.3 Bit Pointer

The Bit Pointer specifies which bit is in error in the byte identified by the Field Pointer field. If the error is in a multiple bit field, the Bit Pointer contains the value of

the most significant bit of the field (the most significant bit of a field is the one with the highest number).

14.2.15.4 Field Pointer

The Field Pointer specifies the erroneous byte, starting from byte 0000_h. If the error is in a multiple byte field, the Field Pointer contains the value of the most significant byte of the field (the most significant byte of a field is the one with the lowest number).

14.3 Request Sense Error Conditions

If a fatal error occurs while the MC is processing a Request Sense command, the MC will return a CHECK CONDITION status. Following a fatal error on a Request Sense command, the Sense data may not be valid. Examples of fatal errors are:

- A non-zero reserved bit is detected in the CDB
- An unrecoverable parity error occurs on the data bus
- A MC malfunction prevents the return of Sense data

If a nonfatal error occurs during the execution of the Request Sense command, the MC will return the Sense data with a GOOD status.

15. Request Volume Element Address

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	$B5_h$							
1	LUN			VolTag	Element Type Code			
2-3	Starting Element Address							
4-5	Number of Elements							
6	0							
7-9	Allocation Length							
10	0							
11	Vendor Specific (0)		0				Flag (0)	Link (0)

15.1 Command Description

The Request Volume Element Address command tells the MC to return information (Volume Element Address data) for element addresses whose flags were set as a result of a previous Send Volume Tag (Translate) command.

If no Send Volume Tag command was completed successfully since the unit was last reset, or if the Send Action Code of the last Send Volume Tag command was Assert, Replace, or Undefine, then the Request Volume Element Address command will return a CHECK CONDITION status with an ILLEGAL REQUEST sense key.

This command specifies a starting address and returns information in ascending element address order. Once it reports information for a given element address, the MC clears the flag for that element address.

The MC returns the information in the form of Element Status pages containing element descriptors. The Element Status pages returned in the Volume Element Address data are the same ones returned by the Read Element Status command, and are described beginning in Section 12.2.

This command is the counterpart to the Send Volume Tag command explained in Chapter 19. Chapter 19 contains important information that you need to understand when working with the Request Volume Element Address command.

15.1.1 Considerations in a Multi-Initiator Environment

To insure successful completion of a Send Volume Tag and Request Volume Element Address sequence in a multi-initiator environment, first reserve the MC device by issuing a unit Reserve command prior to the Send Volume Tag command. Delay issuing the Release command until after issuing the last Request Volume Element Address command.

The Request Volume Element Address command ignores reservations. If an initiator has reserved some number of elements, and another initiator sends a Send Volume Tag (Translate) command to match all elements, and then sends a Request Volume Element Address command, the MC will report information for all elements, including those reserved by a different initiator.

Once reported, element information is not reported until after another Send Volume Tag command has been completed. If the MC is not first reserved, a problem will arise in the case where an initiator issues a Send Volume Tag (Translate) command and a second initiator issues a Request Volume Element Address before the first initiator can. When the first initiator then issues its request, it will receive no information, because the MC will have already reported that information to the second initiator.

15.1.2 VolTag

The MC reports volume tag information if the Volume Tag field is 1; otherwise, it does not report Volume Tag information.

15.1.3 Element Type Code

Table 12-1 lists the values of this field.

15.1.4 Starting Element Address

The effect of the value in the Starting Element Address field depends on the value of the Send Action Code field received in the last Send Volume Tag command:

Translate - This field identifies the minimum element address (starting address) to be reported by this command.

Assert, Replace, or Undefine - The MC will return a CHECK CONDITION status and no element address data.

15.1.5 Number of Elements

The Number of Elements field tells the MC the maximum number of element descriptors to return (beginning with the element specified in the Starting Element Address field).

15.1.6 Allocation Length

The Allocation Length field tells the MC the number of bytes that the initiator has allocated for the returned Volume Element Address data. The MC will return the specified number of bytes or all available data whichever is less.

It is not an error if the allocation length is not sufficient to transfer all the element descriptors. The MC will transfer as many complete element descriptors as it can.

If the Allocation Length is 0, the MC will not return any data.

15.2 Volume Element Address Data

The Volume Element Address data consists of an eight-byte header followed by one or more element type-specific status pages. Table 15-1 shows the format of the Volume Element Address data.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	First Element Address Reported							
2-3	Number of Elements Available							
4	0				Send Action Code			
5-7	Byte Count of Report Available (n-7)							
8-n	Element Status Page(s)							

Table 15-1 Volume Element Address Data

15.2.1 First Element Address Reported

This field contains the element address of the element having the lowest element address that meets the command specifiers.

15.2.2 Number of Elements Reported

This field contains the number of element descriptors found which meet the command specifiers. If the specified Allocation Length was sufficient, the MC will return status for this number of elements.

15.2.3 Send Action Code

The Send Action Code field contains the value of the Send Action Code field in the last Send Volume Tag command the MC completed.

15.2.4 Byte Count of Report Available

The value in this field is the number of bytes of Element Status data the MC could return if the command's Allocation Length value permitted it to do so.

15.3 Element Status Page

The Element Status pages returned in the Volume Element Address data are the same ones returned by the Read Element Status command, and are described beginning in Section 12.2.

15.4 Command Specific Errors

Sense Key	ASC	ASCQ	C/D Bit	Field Pointer	Bit Pointer	Description
5	2C$_h$	00$_h$				Command Sequence Error. The last SEND VOLUME TAG was not a FIND action or no previous SEND VOLUME TAG command has been executed.

Table 15-2 Request Volume Element Address Command Specific Errors

16. Reserve

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	16_h							
1	LUN			3rd Party	3rd Party Device ID			Element
2	Reservation Identification							
3-4	Element List Length							
5	Vendor Specific (0)		0				Flag (0)	Link (0)

16.1 Command Description

The Reserve command reserves the entire MC (*unit* reservation) or a portion thereof (*element* reservation) for the exclusive use of the requesting initiator or of another initiator (third party).

Once reserved, a unit or element reservation remains in effect until:

- The initiator that reserved the unit or element(s) specifically releases the unit or element(s).
- The initiator that reserved the unit or element(s) reserves different element(s) with the same Reservation Identification.
- The MC receives a BUS DEVICE RESET message.
- A hard reset condition occurs.

The following restrictions apply to reserving units and elements:

- An initiator cannot reserve an element that is reserved by another initiator.
- An initiator cannot reserve an element in a reserved unit, even if the unit was reserved by itself.
- A command cannot specify overlapping elements. For example, a command cannot reserve elements 1 through 6 and 4 through 8.
- An element cannot be reserved if it does not exist.

Element reservations have no effect on Initialize Element Status, Read Element Status, Send Volume Tag (Translate), and Read Volume Element Address commands. This means, for example, that if an initiator creates or modifies volume tags using the Send Volume Tag command and then reserves those elements, another initiator can issue an Initialize Element Status command and alter the Element Status data of all elements, including those reserved by the first initiator. Likewise, if the other initiator issues a Send Volume Tag (Translate) command, the match flags for *all* elements, including those reserved by the first initiator, will be cleared.

16.1.1 3rd Party

The MC supports third-party reservations. A value of 1 in the 3rdPty field indicates the reservation is being made for another device (i.e., the third party). A third party reservation can be either a unit or an element reservation.

16.1.2 3rd Party Device ID

If the 3rdPty field is 1, the Third Party Device ID specifies the device for which the reservation is made. Only the third party device can access the reserved entity. The third party cannot release reservations that have been reserved for it.

16.1.3 Element

A value of 0 in the Element field specifies unit reservation and reserves the entire unit; a value of 1 specifies element reservation and reserves the element(s) or a series of elements specified in the Element List Descriptor.

16.1.4 Reservation Identification

Reservation events may be assigned unique Reservation ID numbers for use by the Release command (described in Chapter 13). This field assigns a number to the reserved group of elements. A subsequent Release command can release all the elements in that group at once by specifying the group's Reservation ID number rather than the individual elements. The MC supports up to 256 reservation IDs.

16.1.5 Element List Length

The Element List Length field specifies the length of the following Element List Descriptors. Valid values are 0, 6 and multiples of 6. This field is only valid when the Element field is 1. If the value for this field is 0 and the Element field is 1, no elements are reserved.

16.2 Element List Descriptor

The Element List Descriptor contains the number of elements and their addresses that are to be reserved. The format of the Element List Descriptor is shown in Table 16-1.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	0							
2-3	Number of Elements							
4-5	Element Address							

Table 16-1 Element List Descriptor

The Element List Descriptor is sent after the CDB. You can send zero or more descriptors to reserve specific elements, and only one type element can be specified in each descriptor.

16.2.1 Number of Elements

This field specifies the number of elements (of a single type) to be reserved. If the value of this field is 0, all elements starting with the one specified in the following Element Address field, and ending with the last element address of that type will be reserved.

16.2.2 Element Address

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

16.3 Reservation Conflicts

The following events cause the MC to return a RESERVATION CONFLICT status:

- An attempt is made to reserve the MC, or an element, while it is reserved by another initiator.
- Any other initiator attempts to perform any command other than an Inquiry, Request Sense, or Release command on the MC while it is reserved.

16.4 Command Specific Errors

Sense Key	ASC	ASCQ	C/D Bit	Field Pointer	Bit Pointer	Description
5	$1A_h$	00_h	1	0003_h		Parameter List Length Error.
5	26_h	00_h	0	$????_h$		Invalid Field In Parameter List. Reserved field set.
5	26_h	02_h	0	$????_h$		Parameter Value Invalid. Invalid element address.

Table 16-2 Reserve Command Specific Errors

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17. Rezero Unit

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	01_h							
1	LUN			0				
2-4	0							
5	Vendor Specific (0)		0				Flag (0)	Link (0)

17.1 Command Description

The Rezero Unit command returns the carriage to its Park Left position.

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18. Send Diagnostic

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	$1D_h$							
1	LUN			PF (0)	0	SelfTest (1)	Dev Offline (0)	Unit Offline (0)
2	0							
3-4	Parameter List Length (0)							
5	Vendor Specific (0)		0				Flag (0)	Link (0)

18.1 Command Description

The Send Diagnostic command lets you tell the MC to perform its self-test function.

The MC supports the SelfTest function only. The SelfTest field must be 1, and the value of all other fields (except LUN) must be 0.

If the self-test function completes successfully, the MC returns a GOOD status; otherwise, it returns a CHECK CONDITION status.

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19. Send Volume Tag

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	$B6_h$							
1	LUN			0	Element Type Code			
2-3	Element Address							
4	0							
5	0			Send Action Code				
6-7	0							
8-9	Parameter List Length							
10	0							
11	Vendor Specific (0)		0				Flag (0)	Link (0)

19.1 Command Description

The Send Volume Tag command is used primarily to search elements for volume tags containing specific information. The command does this by sending a template containing the desired search criteria. When the MC receives the template, it searches all element volume tags and sets a match flag in those elements that fit the template. It then creates a list of flagged element addresses and returns that list in a subsequent Request Volume Element Address command. This use of the Send Volume Tag command can be referred to as the Translate function.

The other use of the Send Volume Tag command is to write, overwrite, or clear volume tags on a single element basis. These functions are supported for Primary Volume Tags only, and can be referred to as the Assert, Replace, and Undefine functions.

The results of consecutive Send Volume Tag commands are not additive, because every Send Volume Tag command clears all match flags. The Translate function, however, then sets them according to the template. This becomes important if the goal is to find element addresses that meet more than one set criterion. For example, to find the addresses of cartridges whose volume tags start with 1 or 2, two separate Send Volume Tag commands are required, each followed by a Request Volume Element Address command.

In a multi-initiator environment, it is good practice to reserve the entire unit when searching for volume tags. This prevents a second initiator from altering the inventory after the first initiator has completed a Translate function but before it has sent a Request Volume Element Address command.

The MC will preserve the results of a Send Volume Tag command for as long as possible and will clear an element's match flag whenever one of the following conditions occurs:

- Any Reset condition will cause the MC to clear all match flags.
- Any Send Volume Tag command will cause the MC to clear all match flags.
- Any user activity which leaves the inventory in question (i.e., placing a hand in the area of the magazines, or moving a single cartridge or magazine) will reset all match flags.
- If the MC receives a Send Volume Tag (Translate) command and then the inventory is altered (by a Move or Exchange command or manually from the control panel the match flags of the source and destination elements are updated if the cartridges in those elements were affected by the Send Volume Tag command.
- If the I/O Port element is flagged and the user then removes the cartridge from the I/O port, the MC clears that element's flag.
- A Request Volume Element Address command specifying that element.
- A Move and Exchange command will clear the flag of any element that is left empty, and may change the flag of the destination element(s).

19.1.1 Element Type Code

The Element Type Code identifies the type of element to which the command applies. If the Send Action Code indicates a Translate operation, the Element Type Code field indicates the type of elements to be searched. If the Send Action Code is other than Translate, the Element Type Code field must be 0.

Table 12-1 lists the values of this field.

19.1.2 Element Address

The effect of the value in this field depends on the value in the Send Action Code field:

- Translate - This field specifies the starting element to be examined for satisfaction of the search criteria.
- Assert, Replace or Undefine - This field specifies the address of a single element whose volume tag information modified.

19.1.3 Send Action Code

The Send Action Code specifies the type of operation the command will perform. Table 19-1 lists the supported values.

Send Action Code	Action	Description
4	Translate - All Tags	Search all defined tags and ignore sequence numbers. The Volume ID Template field in the Send Volume Tag parameter list specifies a search template.
5	Translate - Primary Tags	Search all primary tags and ignore sequence numbers. The Volume ID Template field in the Send Volume Tag parameter list specifies a search template. In effect, this is equivalent to 4h since the MC does not support alternate tags.
8	Assert - Primary Tag	The Volume ID Template field in the Send Volume Tag parameter list specifies new Primary Volume Tag information for a single element that does not already have volume tag information.
10	Replace - Primary Tag	The Volume ID Template field in the Send Volume Tag parameter list overwrites the existing Primary Volume Tag information. It is not an error if no Primary Volume Tag was previously defined.
12	Undefined - Primary Tag	Undefine, in the sense of clear. Clears the Primary Volume Tag information. The parameter list length must be 0. It is not an error if no Primary Volume Tag was previously defined.

Table 19-1 Send Action Code Values

19.1.4 Parameter List Length

The Parameter List Length field specifies the number of bytes in the Send Volume Tag parameter list. The minimum length is 32 bytes and the maximum length is 40. The format of the Send Volume Tag parameter list is shown in Table 19-2.

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

Table 19-2 Send Volume Tag Parameter List

19.1.4.1 Volume Identification Template

If the Send Action Code is 4 or 5, the Volume Identification Template field specifies a search template for translate function.

As a search template, it may contain the wildcard characters * and ? (2Ah and 3Fh). An asterisk matches any string of characters, and when it appears in a template, the remainder of the template is not used. A question mark matches any single character.

In Assert, Replace, and Undefine functions, wild cards are not allowed.

19.1.4.2 Minimum/Maximum Volume Sequence Numbers

The MC does not support these fields, and they will be ignored.

19.2 Command Specific Errors

Sense Key	ASC	ASCQ	C/D Bit	Field Pointer	Bit Pointer	Description
5	$1A_h$	00_h	1	0008_h		Parameter List Length Error.
5	21_h	01_h	1	0002_h		Invalid Element Address. Invalid Starting element address.
5	$3A_h$	00_h	1	0002_h		Medium Not Present. An ASSERT, REPLACE or UNDEFINE action was attempted on an empty element.

Table 19-3 Send Volume Tag Command Specific Errors

20. Test Unit Ready

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	00_h							
1	LUN			0				
2-4	0							
5	Vendor Specific (0)		0				Flag (0)	Link (0)

20.1 Command Description

The Test Unit Ready command returns the current status of the MC to the initiator. If the MC is ready to receive a motion command, the Test Unit Ready command will execute without a CHECK CONDITION.

21. Write Buffer

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	$3B_h$							
1	LUN			0		Mode (5)		
2	Buffer ID (0)							
3-5	Buffer Offset (0)							
6-8	Parameter List Length							
9	Vendor Specific (0)		0				Flag (0)	Link (0)

21.1 Command Description

The Write Buffer command is used to download new firmware into the MC (which then re-programs its internal Flash Prom with the new program). Firmware images can be obtained either in the form of a data file, or from an MC by using the Read Buffer command. The firmware data consists of some number of packets of 1030 bytes each. These packets contain the firmware data along with error checking and addressing information. Firmware images distributed by Qualstar also contain a variable length string of data before the packet data that can be displayed and describes the data file (version and revision data).

The firmware upgrade process involves issuing one or more Write Buffer commands. Each command may send as few as one or as many as all of the packets from the firmware image. Packets must be sent in order. However, if an error occurs or if the upgrade is to be aborted, the upgrade process can be restarted simply by re-sending the firmware data again starting from the first packet.

Internally, the unit stores the data until it has been completely received. It then checks the entire image for validity. Finally the unit shuts down and programs the data to the FLASH Prom. While this programming stage is running, the unit displays a message on the LC display warning against powering-down the unit. If the unit is powered-down during the last stage (which lasts approximately 30-60 seconds), the unit will require service to be restored to working condition.

21.1.1 Mode

This field is used to specify the command operation mode. The MC accepts only value 5 (Download Microcode and Save).

21.1.2 Buffer ID

This field specifies which buffer is to be downloaded and must contain 0.

21.1.3 Buffer Offset

This field specifies the offset into the buffer for the command's data. Since the firmware data is packetized and the packets contain an internal data address, this field must contain 0000_h.

21.1.4 Parameter List Length

This field contains the length of the data that is being sent with the command. This length must be a multiple of 1030. A complete firmware image contains some number of packets of 1030 bytes each. These packets can be sent in any number of Write Buffer commands. However, the complete data image must be sent in order.

21.2 Command Specific Errors

Sense Key	ASC	ASC Q	C/D Bit	Field Pointer	Bit Pointer	Description
4	$3F_h$	80_h				Flash prom programming error.
5	26_h	02_h	0	0000_h		Parameter Value Invalid. Bad firmware data packet.

Table 21-1 Write Buffer Command Specific Errors