EXABYTE MAMMOTH-2 TAPE DRIVE

SCSI REFERENCE

330876-002

Exabyte

PART NUMBER 330876-002

REVISION HISTORY

Revision	Date	Description
000	March 1999	Preliminary release
001	December 1999	Updated to add SmartClean media information and other new information
002	June 2002	Update to add Inquiry Device Identification page and revise miscellaneous information.

Note: The most current information about this product is available at Exabyte's World Wide Web site (www.exabyte.com).

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About This Manual

This manual provides reference information for developing software application support for the Exabyte Mammoth-2 (M2™) tape drive.

! Important If you are developing device drivers for the Fibre Channel version of the M2 tape drive, you also need to read the *Mammoth-2 Tape Drive Fibre Channel Supplement* for information about changes to the SCSI commands used by the tape drive to support the Fibre Channel interface.

Contents of This Manual

This manual contains the following information:

- Chapter 1 provides an overview of how M2 implements the Small Computer System Interface (SCSI). It also provides information about adapting device drivers developed for Mammoth-1 for use with M2.
- Chapter 2 provides background information and instructions for implementing common M2 operations in your application.
- Chapter 3 through Chapter 27 describe the SCSI commands supported by the tape drive. To help you find the information you need quickly, the SCSI commands are listed in alphabetic order.
- Appendix A lists the possible combinations of values for the Additional Sense Code (ASC) and Additional Sense Code Qualifier (ASCQ) fields returned by the REQUEST SENSE (03h) command for each sense key. It also lists the Fault Symptom Codes (FSCs) that may be returned by the REQUEST SENSE command and recommends error recovery procedures (ERPs) for each error.
- Appendix B explains how to update your tape drive's microcode (firmware).

Conventions Used in This Manual

This manual uses the following conventions to highlight important information:

Note: Notes provide additional information or suggestions about the topic or procedure being discussed.

! Important Read information marked by the "Important" icon for information that will help you complete a procedure or avoid extra steps.

Caution Read the information marked by the "CAUTION" icon for information you must know to avoid damaging the tape drive or losing data.

Related Publications

This manual provides information about the Exabyte Mammoth-2 tape drive SCSI command protocol and the parallel SCSI bus communication interface. The following publications provide additional, related information. To order an Exabyte publication, see "Contacting Exabyte" on page iii. To download a PDF version of an Exabyte publication, visit the Exabyte web site (www.exabyte.com).

Exabyte Mammoth-2 Tape Drive

Note: The following publications are included as PDF files on the M2 CD that accompanies the tape drive. This CD also includes diagnostic tools and device drivers for the M2 tape drive.

- *Exabyte Mammoth-2 Tape Drive Product Specification*, 330874
- *Exabyte Mammoth-2 Tape Drive Installation and Operation*, 330875
- *Exabyte Mammoth-2 Tape Drive Fibre Channel Supplement* (limited Ecopy), 1003790
- *Exabyte Mammoth-2 Tape Drive Fibre Channel Supplement* (full Ecopy), 1009140

Standards

The following standards are related to the SCSI command protocol and parallel SCSI bus communication interface used by the tape drive. See the *Exabyte Mammoth-2 Tape Drive Fibre Channel Supplement* for additional standards that apply to the Fibre Channel model of the tape drive.

- ANSI *Small Computer System Interface-2 (SCSI-2)*, X3.131 – 1994
- *ANSI SCSI-3 Fast20 Parallel Interface (Fast-20)*, X3.277 – 1996
- *ANSI SCSI Parallel Interface-2 (SPI-2)*, X3.302 – 1999
- *ANSI Information Technology SCSI Primary Commands-2 (SPC-2)*, T10/1236-D, Revision 20 (ANSI NCITS 351-2001)
- *Standard ECMA-293, 8 mm Wide Magnetic Tape Cartridge for Information Interchange – Helical Scan Recording – MammothTape-2 Format*, December 1999
- *TapeAlert Specification*, Version 2.0, November, 1997

Notes

1

SCSI COMMAND PROTOCOL OVERVIEW

This chapter provides an overview of how the Small Computer System Interface (SCSI) command protocol is implemented for the Exabyte Mammoth-2 (M2™) tape drive. It discusses the following topics:

- Communication interface versus command protocol
- SCSI commands supported by the tape drive
- Format of the SCSI command descriptor blocks
- Command status supported by the tape drive
- Converting an existing Mammoth driver

Note: The *Exabyte Mammoth-2 Tape Drive Fibre Channel Supplement* provides information about the Fibre Channel communication interface and changes to the SCSI command protocol that are unique to that interface.

1.1 COMMUNICATION INTERFACE VERSUS COMMAND PROTOCOL

When two devices are connected across a bus or a network, their interaction is accomplished through a *communication interface* (for example, a parallel SCSI bus, a Fibre Channel arbitrated loop, or an Ethernet network). The communication interface allows multiple devices to share connections, yet operate and exchange data independently. The communication interface is comprised of the physical interface and the signaling protocol used during communication.

The physical interface determines the number of devices that can be attached to a bus or network loop, the maximum length of the cables, and the physical characteristics of the cable itself (for example, the number of wires, shielding, and so forth). The signaling protocol defines the electrical characteristics and timing of signals carried by the cable, the message system requirements, transmission speeds and maximum data transfer rates, as well as the encoding and decoding of the individual bit patterns representing commands passing between the individual devices.

The format and content of the information carried over the communication interface, as well as how each device uses and responds to the information, is governed by a *command protocol*. The command protocol determines how the host (or initiator) interacts with the target device (for example, the tape drive) by issuing commands, transferring data, and responding to status information. The command protocol also defines the individual bits in the command data passing between the individual devices. The target device responds to commands from the host by performing the requested operation (for example, writing or reading data on magnetic tape) and returning status information to the host.

The M2 tape drive is available with either a parallel SCSI bus communication interface or a Fibre Channel communication interface. The differences between the two interfaces arise primarily from how each interface handles device addressing and how each handles transmitting SCSI commands, data, and status between the host and the tape drive. Regardless of the communication interface, the operation of the tape drive is governed by the SCSI command protocol.

1.2 SUPPORTED SCSI COMMANDS

The tape drive supports the SCSI commands shown in Table 1-1.

Table 1-1 *Supported SCSI commands*

Command	Operation code (hex)	What the tape drive does in response to this command	Described in...
ERASE	19h	Erases the tape starting from the current legal position to the physical end of tape (PEOT). Rewinds the tape when finished.	Chapter 3
INQUIRY	12h	Provides the initiator with information about the tape drive's device parameters, including product and vendor identification.	Chapter 4
LOAD/ UNLOAD	1Bh	Loads or unloads a data cartridge. When loading a cartridge, the tape drive places the tape in the tape path and positions it at the logical beginning of tape (LBOT) or the logical beginning of the default partition. When unloading a data cartridge, the tape drive writes any buffered information to the tape, rewinds the tape to the physical beginning of the tape (PBOT), removes the tape from the tape path, and ejects the data cartridge (unless ejection has been prevented by a PREVENT/ALLOW MEDIUM REMOVAL command).	Chapter 5
LOCATE	2Bh	Positions the tape at a specified logical position. (Typically, this position is determined by data that was obtained through a previous READ POSITION command.)	Chapter 6

Table 1-1 Supported SCSI commands (continued)

Command	Operation code (hex)	What the tape drive does in response to this command	Described in...
LOG SELECT	4Ch	Manages a set of internal counters regarding read and write error recovery operations and amounts of data compressed. The initiator can set threshold and cumulative values for the counters or reset the counters.	Chapter 7
LOG SENSE	4Dh	Returns the values of the counters managed by the LOG SELECT command.	Chapter 8
MODE SELECT	15h and 55h	Changes the tape drive's internal medium, logical unit, or device parameters to values specified by the initiator.	Chapter 9
MODE SENSE	1Ah and 5Ah	Provides the initiator with information about the tape drive's internal medium, logical unit, and device parameters.	Chapter 10
PREVENT/ ALLOW MEDIUM REMOVAL	1Eh	Prevents or allows the removal of the data cartridge from the tape drive. When the PREVENT MEDIUM REMOVAL command is in effect, the tape drive's unload button is disabled.	Chapter 11
READ	08h	Transfers data from the tape to the initiator.	Chapter 12
READ BLOCK LIMITS	05h	Provides the initiator with information about the maximum and minimum logical block lengths that the tape drive can support for read and write operations in the current operating mode.	Chapter 13
READ BUFFER	3Ch	Creates a diagnostic listing of the tape drive's current state or the contents of the tape drive's data buffer.	Chapter 14
READ POSITION	34h	Reports the current logical position of the tape to the initiator. This allows the initiator to store the position for later use in locating data with a LOCATE command.	Chapter 15
RECEIVE DIAGNOSTIC RESULTS	1Ch	Reports the results of diagnostic tests to the initiator.	Chapter 16
RELEASE UNIT	17h and 57h	Releases the tape drive from exclusive use by the initiator that had previously reserved it with a RESERVE UNIT command.	Chapter 17
REQUEST SENSE	03h	Provides the initiator with sense information describing a condition that just occurred.	Chapter 18
RESERVE UNIT	16h and 56h	Reserves the tape drive for exclusive use by the initiator that issued the command or for a third party.	Chapter 19
REWIND	01h	Rewinds the tape to the logical beginning of the tape (LBOT) or the logical beginning of the current partition.	Chapter 20

Table 1-1 Supported SCSI commands (continued)

Command	Operation code (hex)	What the tape drive does in response to this command	Described in...
SEND DIAGNOSTIC	1Dh	Performs diagnostic functions specified by the initiator. (For the initiator to receive the results of the tests, this command must be followed by a RECEIVE DIAGNOSTIC RESULTS command.)	Chapter 21
SPACE	11h	Searches forward or backward on the tape a specified number of logical blocks, filemarks, or setmarks.	Chapter 22
TEST UNIT READY	00h	Indicates whether the tape drive is ready to accept a medium access command (such as READ or WRITE) from the initiator.	Chapter 23
VERIFY	13h	Verifies the type or length of one or more logical blocks of data on the tape.	Chapter 24
WRITE	0Ah	Accepts data from the initiator to be written to the tape.	Chapter 25
WRITE BUFFER	3Bh	Transfers new microcode from the initiator into the tape drive's control memory.	Chapter 26
WRITE FILEMARKS	10h	Writes any data remaining in the tape drive's buffer to the tape, then writes a specified type and number of filemarks or setmarks following the data.	Chapter 27

1.3 SCSI COMMAND DESCRIPTOR BLOCK FORMAT

The following sections describe the general formats for the six- and ten-byte command descriptor blocks (CDBs) used by the tape drive, the format of the Operation Code, and the typical format for the Control byte. The formats for the six- and ten-byte CDBs are implemented according to the *ANSI Small Computer System Interface 2 (SCSI-2)* standard.

The word *Reserved* or *RSVD* has one of the following meanings when used in a SCSI command field definition:

- The field is defined as reserved by the *ANSI Small Computer System Interface 2 (SCSI-2)* standard. The tape drive checks these fields for a value of 0. If zeros are not present, the tape drive returns Check Condition status with the sense key set to Illegal Request (5h).

- The field has not been defined in the Exabyte implementation of the command. These fields are reserved for future enhancements. The tape drive ignores these fields and does not check for illegal values.

CDB FOR SIX-BYTE COMMANDS

Bit / Byte	7	6	5	4	3	2	1	0
00	Operation Code							
01	Logical Unit Number			Command Dependent				
02	(MSB)							
03	Logical Block Address							
04								(LSB)
05	Control Byte							

CDB FOR TEN-BYTE COMMANDS

Bit / Byte	7	6	5	4	3	2	1	0
00	Operation Code							
01	Logical Unit Number			Command Dependent				
02	(MSB)							
⋮	Logical Block Address							
05								(LSB)
06	Reserved							
07	(MSB) Transfer, Parameter List, or Allocation Length							
08								(LSB)
09	Control Byte							

FORMAT OF THE OPERATION CODE

Bit / Byte	7	6	5	4	3	2	1	0
00	Group Code			Command Code				

TYPICAL FORMAT OF THE CONTROL BYTE

Bit / Byte	7	6	5	4	3	2	1	0
nn	Vendor Unique		Reserved				Flag	Link

1.4 Field Definitions for the Command Descriptor Block

The following sections provide field definitions for the six- and ten-byte command descriptor blocks (CDB).

1.4.1 Field Definitions for Six-Byte CDBs

Byte 00 – Operation Code

The Operation Code consists of two subfields, the Group Code and the Command Code, which are defined as follows:

Bits 7 through 5 – Group Code The Group Codes supported by the tape drive are defined by the specific command.

Bits 4 through 0 – Command Code The Command Codes supported by the tape drive are defined by the specific command.

Byte 01, Bits 7 through 5 – Logical Unit Number (LUN)

The LUN designates a specific unit within a group of devices associated with the target. Since the tape drive is a single device target and does not support multiple devices, the LUN must be 0 for all commands.

Byte 01, Bits 4 through 0 – Command Dependent

These bits are used as defined in the specific commands.

Bytes 02 through 04 – Logical Block Address

These bytes are used as defined in the specific commands.

Byte 05 – Control Byte

The Control Byte field consists for four subfields, which are defined as follows:

Bits 7 and 6 – Vendor Unique These bits, if used, contain vendor-unique information defined for the specific command. The values for these bits are command unique.

Bits 5 through 2 – Reserved The value for this field must be 0.

Bit 1 – Flag The tape drive does not recognize the Flag bit. The value for this field must be 0.

Bit 0 – Link The tape drive does not support linked commands. The value for this field must be 0.

1.4.2 FIELD DEFINITIONS FOR TEN-BYTE CDBS

Byte 00 – Operation Code

The Operation Code consists of two subfields, the Group Code and the Command Code, which are defined as follows:

Bits 7 through 5 – Group Code The Group Codes supported by the tape drive are defined by the specific command.

Bits 4 through 0 – Command Code The Command Codes supported by the tape drive are defined by the specific command.

Byte 01, Bits 7 through 5 – Logical Unit Number (LUN)

The LUN designates a specific unit within a group of devices associated with the target. Since the tape drive is a single device target and does not support multiple devices, the LUN must be 0 for all commands.

Byte 01, Bits 4 through 0 – Command Dependent

These bits are used as defined in the specific commands.

Bytes 02 through 05 – Logical Block Address

These bits are used as defined in the specific commands.

Byte 06 – Reserved

The value for this field must be 0.

Bytes 07 and 08 – Transfer, Parameter List, or Allocation Length

These bytes contain the transfer length, the parameter list length, or the allocation length as required by the specific command.

Byte 09 – Control Byte

The Control Byte field consists for four subfields, which are defined as follows:

Bits 7 and 6 – Vendor Unique These bits, if used, contain vendor-unique information defined for the specific command. The values for these bits are command unique.

Bits 5 through 2 – Reserved The value for this field must be 0.

Bit 1 – Flag The tape drive does not recognize the Flag bit. The value for this field must be 0.

Bit 0 – Link The tape drive does not support linked commands. The value for this field must be 0.

1.5 Command Format Errors

A command format error may occur when:

- The Operation Code in the CDB is not supported by the tape drive.
- The Logical Unit Number (LUN) in the CDB is not 0.
- The value of the bytes or bits in a Reserved field (as defined by the ANSI SCSI-2 standard) is not 0.
- The value of the Link or Flag fields in the Control byte (bits 1 and 0) of the CDB are not 0, or the value of the Vendor Unique fields (bits 7 and 6) are not valid as defined for the specific command.

For all command format errors, the tape drive terminates the command and returns Check Condition status to the initiator. The sense data is set as follows:

- The sense key is set to Illegal Request (5h).
- Depending on the specific error, the Additional Sense Code (ASC) is set to Illegal Operation Code (20h), Logical Unit Not Supported (25h), or Invalid Field in CDB (24h).
- The Additional Sense Code Qualifier (ASCQ) is set to 0.
- The sense key specific data indicates the location of the error.

1.6 Command Status

The tape drive sends one status byte to the initiator at the completion of a command. The status byte is formatted as follows:

Bit Byte	7	6	5	4	3	2	1	0
00	Reserved		Status Byte Code					

Table 1-2 lists the meanings of the Status Byte Codes supported by the tape drive. Note that the value of bit 0 is always 0. The following sections provide more detailed explanations of the status bytes and the reasons they are sent.

Table 1-2 *Definition of the Status Byte code*

Hex value	Bit						Meaning
	5	4	3	2	1	0	
00h	0	0	0	0	0	0	**Good**. Indicates that the tape drive successfully completed the command.
02h	0	0	0	0	1	0	**Check Condition.** Indicates any error, exception, or abnormal condition that causes sense information to be set.
08h	0	0	1	0	0	0	**Busy.** Indicates that the tape drive is busy. This status is sent whenever the tape drive is unable to accept a command from an initiator.
18h	0	1	1	0	0	0	**Reservation Conflict.** Indicates that the tape drive is reserved for the exclusive use of another initiator.

1.6.1 GOOD

Good status indicates that the operation specified by the CDB completed normally. For those commands that support the immediate return of status, Good status indicates that the tape drive has accepted the command and will attempt to perform the operation specified by the CDB. If the specified operation does not complete normally, Check Condition status will be reported to the initiator when the next command is received by the tape drive from the same initiator.

1.6.2 CHECK CONDITION

The tape drive returns Check Condition status to indicate that a situation occurred during the execution of a command that should be checked by the initiator. Check Condition status does not necessarily mean that the command has failed to complete successfully.

The reporting of Check Condition status is immediate or deferred as follows:

- If status for the command is to be returned when the command is completed, Check Condition status is reported when the condition occurs (immediate error reporting).
- If status for the command was returned when the command was initiated (that is, before the condition occurred), Check Condition status is reported when the next command is received from the same initiator (deferred error reporting).
- If the condition occurs while the command is executing and the tape drive is disconnected from the initiator, Check Condition status is reported to the initiator after the reconnect process.

For specific situations that return Check Condition status, refer to the command descriptions in Chapter 3 through Chapter 27.

Check Condition status is reported when a command is received in the following cases:

- There is a bus parity error or format check error in a CDB.
- The command is the first command sent to the tape drive after it was reset by a SCSI bus reset or a Bus Device Reset message or after the data cartridge was replaced. The sense key in the sense data indicates Unit Attention (6h).
- A log counter has overflowed.

Always issue a REQUEST SENSE command to determine the cause of the Check Condition status.

1.6.3 Busy

Busy status indicates that the tape drive is in the busy state. The tape drive is in a busy state when it is performing an internal operation that will not allow another command to be accepted until the operation is complete.

The tape drive returns Busy status for a command request until the busy state is released. For this reason, the initiator must reissue the command to the tape drive. Once the busy state is released, selection operation and commands can be executed normally.

1.6.4 Reservation Conflict

Reservation Conflict status indicates that the tape drive is currently reserved for the exclusive use of another initiator. This status is reported until the initiator that reserved the tape drive issues a RELEASE UNIT command or a reset condition occurs.

Note: The tape drive does not report Reservation Conflict status for REQUEST SENSE (03h) or INQUIRY (12h) commands.

1.7 Converting an Existing Mammoth Driver

If you have been supporting the Mammoth (Mammoth-1) or Mammoth-LT tape drive and want to convert an existing driver to provide support for the M2 tape drive, you need to consider the changes summarized in Table 1-3.

Table 1-3 *Converting an existing Mammoth device driver to an M2 device driver*

Consider these differences between Mammoth and M2 when implementing device driver changes...	Look here for more information....
▪ M2 is capable of SCSI Ultra2 transfer rates of up to 80 MB/sec on a wide LVD bus. The transfer rate is established by the SCSI host adapter through the Synchronous Data Transfer Request message. This is done by setting Transfer Period to the desired time. M2 accepts Transfer Periods as small as 25ns. The fastest Transfer Period accepted by Mammoth-1 is 100ns (20 MB/sec wide). ▪ M2 is also available with a Fibre Channel communication interface. ▪ In M2 the allowable REQ/ACK Offset has increased to 32 outstanding REQ pulses, compared to 16 for Mammoth-1.	See the *Exabyte Mammoth-2 Product Specification* and the *Exabyte Mammoth-2 Fibre Channel Supplement*.
The following changes have been made in the INQUIRY command: ▪ Byte 07, Bit 5 - Wbus16 of the Inquiry data is always 1, indicating that the drive supports 16-bit wide transfers on the SCSI bus. In Mammoth-1 this bit is 0 if a narrow configuration is being used and 1 if a wide configuration is being used. ▪ Support for the Device Identification Page (Page Code=83) has been added. ▪ Check the product identification value returned by M2 in the Inquiry data. The value returned for bytes 16 through 31 is Mammoth2, followed by the eight ASCII space characters. A new field, the Submodel ID (bytes 36 through 43), has been added. This field contains the ASCII representation of the EEPROM image identifier (for example, MH000105).	Chapter 4, "INQUIRY (12h)"
The following changes have been made in the LOG SENSE command: ▪ A new parameter has been added to Tape History Log (Page Code = 35h), which is Parameter Code 27h – Lifetime SmartClean Cycles. This is a 4-byte parameter.	Chapter 8, "LOG SENSE (4Dh)"

Table 1-3 *Converting an existing Mammoth device driver to an M2 device driver (continued)*

Consider these differences between Mammoth and M2 when implementing device driver changes...	Look here for more information....
The following changes have been made in the MODE SELECT and MODE SENSE commands: ▪ M2 uses an Adaptive Lossless Data Compression (ALDC) algorithm, which is more powerful than that used by Mammoth-1. The drive reports the type of compression algorithm in the Data Compression page of MODE SENSE. ▪ M2 accepts and uses all AME media tape lengths, including three lengths of Exabyte AME with SmartClean™ media. The drive reports the tape length in the Medium Type field of the Parameter List header for MODE SELECT and MODE SENSE. M2 does not support MP tapes. ▪ In the Block Descriptor, the Density Code is 28h, indicating that the drive uses the Mammoth-2 format to write data. A Density Code of 27h, indicating Mammoth-1 format, is reported when a Mammoth-1 tape is inserted in the drive. Older MP media Density Codes are no longer reported. ▪ In the Vendor-Unique Parameters (Non-Page Format and Page Code =20h), the 112M, CT, and NBE fields are ignored in M2. These fields are pertinent when reading older MP tapes on Mammoth-1. Also, in Page 20h, the RTF field (Read Tape Format) will report either Mammoth-2 format (101b) or Mammoth-1 format (100b) as appropriate. Older MP formats will not be reported. ▪ In the Data Compression page, M2 reports a 04h in the Compression Algorithm field bytes 04 through 07, indicating that the drive uses ALDC compression. In the Decompression Algorithm field, M2 reports a 04h for ALDC if the tape inserted is in Mammoth-2 format or a 10h for IDRC if the tape inserted is in Mammoth-1 format. ▪ In the Medium Partition page (Page Code = 11h) the size of SDP drive defined partitions has been changed from 50MB to 250MB.	Chapter 9, "MODE SELECT (15h, 55h)" Chapter 10, "MODE SENSE (1Ah, 5Ah)"
The following change has been made in the READ BLOCK LIMITS command: The minimum block size has been changed to 4.	Chapter 13, "READ BLOCK LIMITS (05h)"
The following changes have been made in the REQUEST SENSE command: ▪ Byte 20 bit 6, TMD (Tape Mark Detect Error) is no longer used. This bit was for 8200 format only. ▪ Byte 21 bit 7, Cleaning Wheel Failure (CWF) has been added to advise the host that a test of the Cleaning Wheel mechanism has failed. The Cleaning Wheel test is performed once during Power-On Self-Test. CWF = 0 means the test passed. CWF = 1 means the test failed. The tape drive does not treat this condition as a hard failure. This bit is not used in Mammoth-1. ▪ Byte 29 of the Extended Sense Bytes information (Cleaning Reason), is used to indicate the reason that the drive is currently requesting or requiring cleaning. This field was reserved in Mammoth-1.	Chapter 18, "REQUEST SENSE (03h)"

Table 1-3 *Converting an existing Mammoth device driver to an M2 device driver (continued)*

Consider these differences between Mammoth and M2 when implementing device driver changes...	Look here for more information....
The following change has been made in the WRITE BUFFER command: The size of the microcode for M2 is approximately 1 MB, but has room to grow as large as 2 MB. This is larger than Mammoth-1 and should be taken into account if a microcode download function is being modified.	Chapter 26, "WRITE BUFFER (3Bh)"
In M2, several Fault Symptom Codes have been redefined or eliminated.	Appendix A, "Error Codes"

Notes

2

IMPLEMENTING TAPE DRIVE OPERATIONS

This chapter explains how to implement common tape drive operations in your application. It includes information about the following:

- Using data cartridges for M2
- Using data compression
- Setting the size of logical blocks
- Using filemarks and setmarks
- Maximizing data transfer efficiency
- Formatting and using partitioned tapes
- Handling Unit Attention conditions
- Resetting the tape drive

2.1 USING DATA CARTRIDGES FOR M2

The M2 tape drive reads and writes to advanced metal evaporated (AME) data cartridges with Exabyte SmartClean™ technology. Table 2-1 provides the approximate data capacities for each length of SmartClean cartridge, when written by M2 using the Mammoth-2 format.

Table 2-1 *Data capacities of Exabyte SmartClean AME cartridges*

Tape length (meters of AME media)	Native recording capacity	Compressed recording capacity[a]
225m	60 GB	150 GB
150m	40 GB	100 GB
75m	20 GB	50 GB

[a] Assumes a 2.5:1 compression ratio. Actual compressed capacity varies depending on the type of data being recorded.

Although not recommended, M2 can also read and write to AME cartridges without SmartClean using the Mammoth-2 format. When these cartridges are used, M2 will require regularly scheduled manual cleaning using a MammothTape cleaning cartridge. Such maintenance is greatly reduced by using only SmartClean media in M2. Table 2-2 provides the approximate data capacities for each length of standard AME cartridge when used with M2.

Table 2-2 *Data capacities of Exatape AME data cartridges*

Tape length (meters of AME media)	Native recording capacity	Compressed recording capacity[a]
170 m	45 GB	113 GB
125 m	30 GB	83 GB
45 m	12 GB	30 GB
22 m	5.5 GB	13.8 GB

[a] Assumes a 2.5:1 compression ratio. Actual compressed capacity varies depending on the type of data being recorded.

The tape drive writes data in Mammoth-2 format only. It can read data written in either Mammoth-1 or Mammoth-2 format. The tape drive cannot read or write metal particle (MP) tapes. When you attempt to read MP tape, the tape drive automatically ejects the cartridge.

2.1.1 LOADING A DATA CARTRIDGE

When you insert a data cartridge into the tape drive, the tape drive automatically loads the tape into the tape path. It determines the tape's format and length, and positions the tape at the logical beginning of tape (LBOT). The tape drive then goes to the ready state (middle LED on).

! Important Do not insert a cartridge until the tape drive has finished its power-on self-test (indicated when all three LEDs are off). If you try to insert a cartridge before POST is complete, the tape drive will eject the cartridge.

If you want to prevent the tape drive from automatically loading the tape into the tape path, you can disable autoload using the NAL bit of the MODE SELECT command (see page 9-9 and page 9-31). If you use this method to prevent autoloading, you must issue a LOAD (1Bh) command to load the tape.

2.1.2 UNLOADING A DATA CARTRIDGE

When you press the unload button or issue an UNLOAD command (1Bh), the following actions occur (assuming that a data cartridge is loaded and the tape drive is ready).

Note: If you previously issued a PREVENT/ ALLOW MEDIUM REMOVAL command to prevent media removal, the tape drive does not perform the unload operation when you press the unload button.

1. The drive completes any command or operation currently in progress.

2. The drive writes any buffered information to tape, then writes an EOD mark to indicate the end of data.

3. The drive rewinds the tape to the physical beginning of tape (the point where the clear tape recognition system “window” separates the cleaning material from the recording media).

4. The drive unloads the tape from the tape path.

5. The drive ejects the data cartridge.

Status Reported for Unload Procedure

If you issue a command to the tape drive during the unload procedure, the tape drive returns Check Condition status with the sense key set to Unit Attention (6h). After reporting a Unit Attention condition, the tape drive returns Check Condition with the sense key set to Not Ready (2h) for all subsequent commands (except INQUIRY and REQUEST SENSE). (For information about clearing a Unit Attention condition, see page 2-16.)

Error During Unload Procedure

If an error exists before or during the unload procedure, the tape drive suspends the unload sequence; the tape drive’s top LED flashes to indicate an error. If you press the unload button again, the tape drive reattempts the unload sequence. Be aware that unwritten data in the buffer will not be written to tape. The buffer and any errors will be cleared.

2.2 Using Data Compression

M2 writes data in Mammoth-2 format only. By default, data is compressed when it is written. M2 uses an ALDC algorithm to compress data at an average ratio of 2.5:1. However, the actual compression ratio may be higher or lower depending on the type of data.

You can use the DCE (data compression enable) bit of the MODE SELECT command to specify compressed or uncompressed format at any position on the tape (see page 9-17).

2.3 Setting the Size of Logical Blocks

Logical blocks are the basic units of data transfer between the initiator and the tape drive.

When you use the WRITE or READ commands, you can specify fixed-length or variable-length logical blocks. If you write or read fixed-length logical blocks, you can transfer one or more logical blocks with each command. You specify the block length using the Block Length field in the Block Descriptor of the MODE SELECT command. If you write or read variable-length logical blocks, you transfer just one logical block with each command. You specify the block length in the Transfer Length field of the WRITE or READ command.

You can set the size of the logical data blocks to values between 1 byte and 240 KB. However, for tape drive efficiency, choose a size that is an even number between 256 bytes and 64 KB. For variable-length logical blocks, try to use a block size no smaller than 4 KB. In general, larger logical blocks transfer more efficiently than smaller logical blocks.

If you use logical blocks that are smaller than the recommended range, tape drive efficiency is reduced in the following areas:

- **Tape capacity.** The tape drive adds header and error correction information to each logical block it writes to tape. If you use very small logical blocks, significant overhead is added to the data recorded on the tape.

- **Compression.** The tape drive compresses data on a block-by-block basis by building a translation table for each logical block. Very small logical blocks slightly reduce compression efficiency because a new table has to be built for each block.

If you use logical blocks that are larger than the recommended range, tape drive efficiency is reduced in the following areas:

- **Buffer use.** The tape drive does not transfer partial logical blocks. Before a logical block can be written to tape or sent to the host, the full logical block must be present in the tape drive's buffer. Very large logical blocks reduce buffer efficiency because the tape drive has to hold the block in the buffer for a longer amount of time than a smaller logical block.

- **Error recovery.** Error recovery is performed on a block-by-block basis. Although error recovery is rarely necessary, it requires the retransmission of data. Large logical blocks require a longer retransmission time than small blocks and make less efficient use of the buffer.

2.4 Using Filemarks and Setmarks

Filemarks and setmarks enable an initiator to locate particular blocks of data using high-speed search. When writing data to tape, an initiator can use WRITE FILEMARKS commands to write filemarks or setmarks to indicate data boundaries. When reading the tape, the initiator can use a SPACE command to position the tape to data marked by a filemark at high speeds. Setmarks provide an additional way to indicate data boundaries on the tape; in a sense, they can be thought of as a "hierarchically superior" filemark.

2.4.1 Long Filemarks

The long filemark is 198 KB long and consists of six tracks of information:

- Two gap tracks at the beginning
- Two tracks of long filemark physical blocks
- Two gap tracks at the end

The information in the filemark physical blocks identifies the filemark's number and location on the tape. This information cannot be accessed or changed by the user. The gap tracks at the beginning and the end allow file append and file splice operations. The tape drive may write additional gap tracks and gap blocks before the filemark to ensure that all data has been written to tape correctly or to complete tracks that are not completely filled with data blocks.

2.4.2 Short Filemarks

The short filemark consists of a single 33-KB physical block. The physical block contains information identifying the filemark's number and location on the tape. Short filemarks cannot be used as splice points.

If you do not need a splice point, it is recommended that you use short filemarks instead of long filemarks to conserve tape space.

2.4.3 Setmarks

Setmarks function similarly to the long filemark. You can issue a SPACE (11h) command to space to setmarks in the same way you space to filemarks; however, you can also use a MODE SELECT (15h) command to suppress setmark detection during read, verify, space block, and space filemark operations.

The setmark is the same length as the long filemark. For additional information about using setmarks, refer to Chapter 27.

2.5 MAXIMIZING DATA TRANSFER EFFICIENCY

When reading or writing data, the tape drive can operate as either a *streaming* or *start/stop* tape device, depending on the data transfer rate of the host system. Streaming occurs when the data transfer rate to or from the host closely matches the tape drive's data transfer rate, allowing the drive to read or write data in a continuous stream. If the host can't supply data fast enough to keep the tape drive operating in streaming mode, the drive must operate in stop/start mode as it waits for data from the host.

Streaming Mode When operating in streaming mode, the tape drive transfers data continuously (to tape or to the host) without stopping tape motion. If your system permits, operating the tape drive in streaming mode can maximize the amount of data you can store on a tape and minimize the amount of wear on the tape and recording heads. To enable the tape drive to operate in streaming mode, the host must be able to transfer data at a minimum of 12.5 MB per second if the tape drive is writing uncompressed data or approximately 30 MB per second if the tape drive is writing compressed data.

During streaming operation, the tape drive adapts to variations in the host's data transfer rate by disconnecting from and reconnecting to the SCSI bus. The tape drive determines when to reconnect to the SCSI bus by comparing how full the buffer is to the *reconnect threshold*, as follows:

- During a write operation, if the tape drive's buffer fills with data from the host faster than the tape drive can write the data to tape, the tape drive disconnects from the SCSI bus while continuing to write data until the amount of space available in the buffer is equal to the reconnect threshold. The tape drive then reconnects to the SCSI bus to accept more data.

- During a read operation, if the host can accept data from the tape drive's buffer faster than the tape drive can fill the buffer with data from the tape, the tape drive disconnects from the SCSI bus until it has filled the buffer back up to a level equal to the reconnect threshold. Then the tape drive reconnects to the SCSI bus to transfer more data.

Start/Stop Mode When operating in start/stop mode, the tape drive stops and restarts tape motion to accommodate a slow host transfer rate. The tape drive determines when to restart tape motion by comparing how full the buffer is to the *motion threshold*, as follows:

- During a write operation, the tape drive waits until the buffer is filled to a certain level (the motion threshold), starts the tape, records the buffered data, then stops the tape until the buffer can be filled to that level again by the host.

- During a read operation, the tape drive fills the buffer with data from the tape, stops the tape, waits for the host to accept enough data to empty the buffer to the motion threshold, then starts the tape and fills the buffer again.

2.5.1 ADAPTIVE DATA BUFFERING

No matter what data transfer rate the host uses, the tape drive uses its 32-MB data buffer to adapt to the data transfer rate of the host and provide optimum data transfer efficiency (*adaptive data buffering*). This large buffer means that the drive can continue writing while waiting for the host to transfer more data to the buffer. By monitoring buffer thresholds, the tape drive determines the optimum point to transfer data between the buffer and host or between the buffer and tape. Although the total throughput rate remains dependent on how fast the host can supply data to the tape drive, adaptive data buffering helps reduce stops and starts, thereby improving performance.

2.5.2 AUTO-THRESHOLDING

By default, the tape drive continually monitors the data flow from the host and automatically adjusts both the reconnect and motion thresholds to match variations in the host's data transfer rate and optimize throughput (*auto-thresholding*). By adapting to the host's transfer rate, M2 maximizes the effectivity of the data buffer and minimizes the need for stopping and starting the tape.

To ensure optimum performance, you should operate the tape drive with auto-thresholding on at all times. However, if you want to test different thresholds, you can turn auto-thresholding off and set the thresholds manually, as described in the following sections.

Turning Auto-Thresholding Off

To turn auto-thresholding off, you must set either the motion threshold or the reconnect threshold (or both) to a non-zero value between 20h and D0h. Each 1h = 0.39% of the buffer (for example, 80h equals half the buffer).

To turn auto-thresholding off, use the MODE SELECT command as summarized in Table 2-3.

Note: If you send conflicting values on different pages of the MODE SELECT command, the value that is received last by the tape drive takes precedence.

Table 2-3 *Methods for turning off auto-thresholding*

To turn auto-thresholding off, use the MODE SELECT command as follows...		
Send any of these pages...	**With this field (or fields) set to a non-zero value between 20h and D0h...**	**Notes**
Disconnect-Reconnect Page (02h)	Buffer Full Ratio – Byte 02 **AND** Buffer Empty Ratio – Byte 03 (Must be the same value.)	These values set the reconnect threshold. If you send no other page, the motion threshold returns to the non-zero value last set by a MODE SELECT command.
Device Configuration Page (10h)	Write Buffer Full Ratio – Byte 04 **AND** Read Buffer Empty Ratio – Byte 05 (Must be the same value.)	These values set the motion threshold. If you send no other page, the reconnect threshold returns to the non-zero value last set by a MODE SELECT command.
Vendor Unique Parameters Page 1 (20h)	Motion Threshold – Byte 04	If you send no other page, the reconnect threshold returns to the non-zero value last set by a MODE SELECT command.
Non-page Format	Reconnect Threshold – Byte 03 of the vendor-unique parameters **OR** Motion Threshold – Byte 02 of the vendor-unique parameters	You can set both fields to a non-zero value if you want. If you set just one, the other returns to the non-zero value last set by a MODE SELECT command.

Guidelines for Setting the Thresholds If you turn auto-thresholding off, choose a setting for the motion or reconnect threshold based on the following guidelines:

- A good starting point for both thresholds is 80h, which represents one half of the buffer.
- If the tape drive is operating in streaming mode, you can reduce the number of disconnects and reconnects between the tape drive and host by increasing the reconnect threshold.
- If the tape drive is operating in start/stop mode, you can reduce the number of start/stop operations by increasing the motion threshold.

Turning Auto-Thresholding Back On

To turn auto-thresholding back on, you must set both the motion and reconnect threshold to 0 using a single MODE SELECT command, as summarized in Table 2-4.

Table 2-4 *Methods for turning on auto-thresholding*

To turn auto-thresholding back on, use the MODE SELECT command as follows...	
Send any of these page combinations...	**With these fields set to 0...**
Disconnect-Reconnect Page (02h) **AND** Device Configuration Page (10h)	Disconnect-Reconnect Page: ▪ Buffer Full Ratio – Byte 02 ▪ Buffer Empty Ratio – Byte 03 **AND** Device Configuration Page: ▪ Write Buffer Full Ratio – Byte 04 and ▪ Read Buffer Empty Ratio – Byte 05
Disconnect-Reconnect Page (02h) **AND** Vendor Unique Parameters Page 1 (20h)	Disconnect-Reconnect Page: ▪ Buffer Full Ratio – Byte 02 ▪ Buffer Empty Ratio – Byte 03 **AND** Vendor Unique Parameters Page 1 ▪ Motion Threshold – Byte 04of
Non-page Format	Vendor-Unique Parameters: ▪ Reconnect Threshold – Byte 03 ▪ Motion Threshold – Byte 02

Note: It is not an error to set just one of the thresholds to 0. However, if you set just one threshold to 0, the tape drive ignores the setting and neither threshold value is changed.

Example: Turning Auto-Thresholding Off and On

The following example demonstrates what happens when you use the MODE SELECT command to turn auto-thresholding off and on:

1. The tape drive is powered on. By default, auto-thresholding is on, and the motion and reconnect thresholds are set to their power-on defaults (80h).

2. A MODE SELECT command is issued that sets the reconnect threshold to 21h and the motion threshold to 50h. This turns auto-thresholding off.

   The thresholds remain at these values during all subsequent write and read operations until they are changed by another MODE SELECT command or until a power cycle occurs.

3. A MODE SELECT command is issued that sets both the reconnect and motion thresholds to 0. This turns auto-thresholding back on.

   During subsequent write and read operations, the thresholds are automatically adjusted to optimize throughput. A MODE SENSE command after any read or write operation would reflect the new adjusted values for the thresholds.

4. A MODE SELECT command is issued that sets the motion threshold to 80h, but does not set the reconnect threshold. This turns auto-thresholding off. The motion threshold is set to 80h, and the reconnect threshold is set to the last value set by a MODE SELECT command before auto-thresholding was turned on (21h from step 2).

5. A MODE SELECT command is issued that sets the reconnect threshold to 0, but does not set the motion threshold. This is not an error, but neither threshold is changed and auto-thresholding remains off.

6. The tape drive is powered off and back on. Auto-thresholding turns on as a result of the power cycle.

2.6 Formatting and Using Partitioned Tapes

M2 can write and read tapes containing up to 64 partitions. A *partition* is a self-contained writable and readable area on a tape. A standard tape is considered a single-partition tape. That is, there are no divisions on the tape; the entire capacity of the tape is dedicated to a single data set, regardless of how large that set is. When data at the beginning of the partition is overwritten, any previously written data past the new end of data (EOD) mark on the tape becomes inaccessible.

A multi-partition tape is a tape that has been divided into two or more separate writable and readable areas (partitions). When data is recorded on a partitioned tape, each partition is treated as a separate "virtual" tape. When data in one partition is overwritten, data in other partitions on the tape is still accessible. Each partition can be updated and rewritten without affecting the data in the other partitions. Note that partitions are not the divisions between separate areas on the tape; rather, they are the separate areas themselves.

Each partition on a tape contains a logical and physical beginning (LBOP and PBOP) and a logical and physical end (LEOP and PEOP). The tape drive considers each partition a completely self-contained recording area independent of the other partitions on the tape. The tape drive cannot move the tape beyond the beginning or end of a partition unless specifically requested to by a LOCATE (2Bh) or MODE SELECT (15h) command. In effect, the tape drive treats each partition as if it were a separate tape.

2.6.1 CREATING A PARTITIONED TAPE

To create a partitioned tape, you format the tape using the Medium Partition page (11h) of the MODE SELECT (15h) command. The Medium Partition page lets you specify how many partitions will be on the tape and what their sizes will be.

Note that a standard blank tape is considered to have one partition. You do not need to format a blank tape if you want only one partition. The only time you would specify one partition when you are formatting a tape is if you want to change a multi-partition tape back to a single-partition tape.

The following is a summary of the steps you take to create a multi-partition tape from an unformatted (or single-partition) tape. (Refer to Chapter 9 for specific details about using the MODE SELECT command.)

1. Load a tape into the tape drive, or rewind the current tape to the logical beginning of tape (LBOT). The tape must be positioned at LBOT or at the logical beginning of a partition (LBOP) before you can format the tape with new partitions.

2. Issue a MODE SELECT command and specify page format (PF=1). Specify the following parameters for the partitions in the Medium Partition page (Page Code=11h):

   - For Additional Partitions Defined, specify the number of partitions you want defined in addition to the original partition (the entire tape).

   - Set FDP (Fixed Data Partitions), SDP (Select Data Partitions), or IDP (Initiator Defined Partitions) to 1 depending on how you want the size of the partition determined.

     Note: You can set only one of these fields. If FDP=1, the partition will encompass the entire tape, resulting in a single-partition tape. If SDP=1, the partitions will be a size that is predefined by the tape drive. If IDP=1, the partitions will be the size you specify.

- If you choose to define the partition sizes yourself (IDP=1), use PSUM (Partition Size Unit of Measure) to specify the units of measure you will use to specify the size. Use the Partition Size fields to specify each partition's size.

  Note: If you specify a total value for the Partition Sizes that is larger than the amount of space available on the tape, the format will fail with a sense key of Illegal Request (5h).

3. Wait for the formatting process to be completed (several minutes depending on the partition sizes). When the tape drive has finished formatting the tape, it will position the tape at the beginning of the default partition (the last partition on the tape). At this point, you can begin writing data or performing other tape operations as described in the following section.

2.6.2 Using a Multi-Partition Tape

The easiest way to use a multi-partition tape is to think of it as separate tapes. Just as you would have to physically change tapes to access data on another tape, you have to specifically request that the tape be moved to another partition before you can perform actions in that partition. The following sections describe how to perform several typical actions on a multi-partition tape.

Loading a Partitioned Tape

You load a multi-partition tape exactly as you would a standard tape. However, you have a choice of which partition the tape drive positions the tape to immediately after it is loaded. By default, the tape drive positions to the last partition on the tape.

If you want to override the default partition, issue a MODE SELECT command before loading the tape (or while the previous tape is loaded). Specify page format (PF=1) and send Vendor Unique Parameters Page 2 page (Page Code=21h). For LPART (Load Partition), indicate which partition you want the tape to be positioned to.

Note: The setting of LPART remains in effect until the tape drive is reset.

Changing Partitions

If you want to move the tape from one partition to the logical beginning of another partition (LBOP), use either of the following methods:

Method 1 – LOCATE command Issue a LOCATE (2Bh) command. Specify the following parameters:

- Set CP (Change Partitions) to 1 to indicate you want to change partitions.
- For Block Address, specify the block to which you want the tape moved.
- Set Partition to the number of the partition to which you want to change.

Method 2 – MODE SELECT command Issue a MODE SELECT command. Specify page format (PF=1) and send the Device Configuration page (Page Code=10h). Specify the following parameters:

- Set CAP (Change Active Partition) to 1 to indicate that you want the tape to be moved to another partition.
- Set Active Partition to the number of the partition to which you want to move.

Note: The tape drive does not reposition the tape until it receives a tape motion command that requires the repositioning, such as READ (08h), WRITE (0Ah), or SPACE (11h).

Writing Data in Partitions

To write data, use the WRITE (0Ah) command as you would with a standard tape. However, remember that if you want to write data in the partition the tape is not currently in, you must first use the MODE SELECT or LOCATE command to change partitions. If you use MODE SELECT, the tape drive repositions the tape to the new partition after it receives a tape motion command such as SPACE (11h).

Writing to PEOP When you are writing data to a partition, you can never overwrite the end of the partition. If the tape drive encounters the logical end of the partition (LEOP), it returns Check Condition status as if it had encountered the logical end of the tape (LEOT). You can choose to write to the physical end of the partition (PEOP), but you cannot overwrite PEOP. If you encounter PEOP, the tape drive reacts as if it encountered the physical end of the tape (PEOT). The write operation stops and any buffered data is not written to tape.

Locating Data Blocks in Partitions

Use the READ POSITION (34h) command to identify the position of a specific data block on a partitioned tape as you would on a standard tape. The READ POSITION data returned by the tape drive indicates the block address at the current location. It also indicates the number of the partition the tape is located in.

When you use the LOCATE (2Bh) command on a partitioned tape, first specify which partition the tape drive should search for the requested block. If you need to change partitions, set the CP (Change Partition) bit to 1. Then, specify the number of the partition you want the tape moved to in the Partition field. The tape drive moves the tape to the requested partition, then searches for the requested block.

Reading Data on a Partitioned Tape

To read data, use the READ (08h) command as you would with a standard tape. However, remember that if you want to read data in a partition the tape is not currently in, you must use the LOCATE or MODE SELECT command to reposition the tape to that partition. After you have issued a command to relocate to a new partition, you can use a LOCATE command or SPACE command to move the tape to a legal position for reading data.

Rewinding a Partitioned Tape

When you issue a REWIND (01h) command, the tape drive rewinds the tape to the beginning of the current partition. If the tape is positioned in the first partition, the tape drive rewinds the tape to the logical beginning of the tape (LBOT).

If you want to rewind to LBOT and the tape is positioned in a partition other than the first, do not use the REWIND command. Instead, use the LOCATE command to position the tape to the beginning of the first partition (LBOT).

Erasing a Partitioned Tape

The ERASE command acts on only one partition at a time. After erasing the partition, the tape drive rewinds the tape to the beginning of that partition. To erase the data from an entire tape without eliminating the partitions, you must erase each partition separately.

Erasing Data From One Partition If you want to erase the data from just one partition, use the ERASE command as you would with a standard tape. Start from the beginning of the partition you want to erase and issue the ERASE command. The tape drive rewrites the LBOP information, erases forward from LBOP, stops at the end of the partition, then rewinds to LBOP. When you erase the data from one partition, no data in other partitions is erased.

Erasing the Entire Tape If you want to erase the entire tape, you can erase each partition separately and preserve the partition information. Or, you can reformat the tape as a single-partition tape, then erase the entire tape.

! Important

If you reformat a partitioned tape to create a single-partition tape, all of the information defining the original partitions is erased. However, the actual data is not erased and remains on the tape (although it is not accessible by commercial software). For this reason, if you are concerned about data remaining on a tape, do not use reformatting as a way to erase data. You must explicitly perform a long erase operation (see page 3-2) to remove the data from the tape after reformatting it to remove the partition information.

Unloading a Partitioned Tape

The UNLOAD command works exactly as it would for a standard tape. You can issue the UNLOAD command from any partition. The tape drive rewinds the tape to the physical beginning of tape (PBOT), unloads the tape from the tape path, and ejects the cartridge.

2.7 HANDLING UNIT ATTENTION CONDITIONS

The tape drive creates a Unit Attention condition for each initiator when any of the following conditions occurs:

- A data cartridge is inserted and automatically loaded.
- A data cartridge is inserted and rejected because the media is incompatible with the tape drive.
- The unload button is pressed and the data cartridge is ejected.
- The MODE SELECT parameters are changed by an initiator other than the one attempting to communicate with the tape drive.
- The tape drive is reset (see page 2-16).
- A log parameter (counter) reaches a specified threshold value — assuming that the Report Log Exception Condition (RLEC) bit on the MODE SELECT Control Mode page is set to 1.
- The internal microcode (firmware) is changed by a SCSI download (WRITE BUFFER command).

2.7.1 EFFECT OF CHANGING DATA CARTRIDGES

After you press the unload button, the tape drive returns Check Condition status with the sense key set to Unit Attention (6h) in response to the first command it receives. Then, it returns Check Condition status with the sense key set to Not Ready (2h) to all subsequent commands that require tape motion.

Note: If you press the unload button and a data cartridge is loaded, the tape drive first unloads the tape. It then returns Check Condition status with the sense key set to Unit Attention (6h) in response to the first command it receives during the unload procedure. It returns Check Condition status with the sense key set to Not Ready (2h) to all subsequent commands that require tape motion.

When you insert a data cartridge into the tape drive, the tape drive returns Check Condition status with the sense key set to Unit Attention (6h). However, if you insert a data cartridge and autoloading is prevented (that is, autoload was disabled with a MODE SELECT command and a LOAD (1Bh) command was not received), the tape drive returns Check Condition status with the sense key set to Not Ready (2h).

2.7.2 CLEARING THE UNIT ATTENTION CONDITION

The Unit Attention condition persists for each initiator until that initiator issues any command other than INQUIRY (12h) or REQUEST SENSE (03h).

First Command Received after Unit Attention

If the first command received after a Unit Attention condition occurs is an INQUIRY or REQUEST SENSE command, the tape drive executes the command, reports any pending status, and preserves the Unit Attention sense data. If the first command is any other command, the tape drive does not execute the command and returns Check Condition status with the sense key set to Unit Attention (6h).

Next Command Received after Unit Attention

If the next command received after a Unit Attention is reported is a REQUEST SENSE or an INQUIRY command, the tape drive executes the command and preserves the Unit Attention sense data. If the next command is any other command, the command is executed and the Unit Attention sense data is cleared.

Note: If multiple Unit Attention conditions occur before the initiator selects the tape drive, only the sense data for the latest Unit Attention condition is presented.

2.8 RESETTING THE TAPE DRIVE

You can use any of the following methods to reset the tape drive:

- Power the tape drive off and back on again (*power-on reset*).
- Press and hold the unload button for at least 10 seconds, then release the button. This clears any error, resets the tape drive, and ejects any cartridge that is in the tape drive (unless a hardware or servo error occurred).
- Send a RST pulse on the SCSI bus for a minimum of 25 µsec (*SCSI bus reset*). A SCSI bus reset immediately clears all devices from the bus, resets their associated equipment, and terminates all pending I/O processes.
- Issue a Bus Device Reset (0Ch) message to the tape drive (*device reset*). A device reset clears the tape drive from the bus, causes all commands sent to it to be cleared, and terminates all pending I/O processes.

Note: If a SCSI bus or device reset occurs during a power-on reset, the power-on reset operation will be restarted.

2.8.1 EFFECT OF POWER-ON RESET

Performing a power-on reset causes the tape drive to complete its power-on self-test. A power-on reset also has the following effects:

- If the tape drive is connected to the SCSI bus, the SCSI bus goes to the Bus Free phase.
- A cyclic redundancy check (CRC) of the control code is performed.
- The servo is reset and a servo self-test is performed.
- All tape drive parameters are reset to their default states.
- A test of the microprocessor's external memory is performed.
- A buffer memory test is performed.

After a power-on reset, the tape drive will respond on the SCSI bus within three seconds.

2.8.2 EFFECT OF SCSI BUS AND DEVICE RESETS

If the tape drive is set for buffered operation (see page 9-5) and there is data in the buffer from a WRITE or WRITE FILEMARKS command, the tape drive writes the buffered data to tape before resetting. Then, if the tape drive is connected to the SCSI bus, the SCSI bus goes to the Bus Free phase. After a SCSI bus or device reset, the tape drive will respond on the SCSI bus within 250 msec.

Note: If the device that supplies SCSI bus terminator power is powered off, the RST line is left in an indeterminate state (either reset or not, depending on the voltages). It may be impossible to communicate with the tape drive or to unload a data cartridge when the device is in this state. To remove the data cartridge, restore power to the terminating device or remove the SCSI cable from the tape drive to allow independent tape drive operation.

2.8.3 RESET PROCESSING

The tape drive processes resets differently depending on whether a data cartridge is present or not.

Data Cartridge Present before Reset

If a data cartridge is present before the reset occurs and the tape has only one partition, the tape drive rewinds the tape and positions it at the beginning of the partition. If the tape has more than one partition, the tape drive rewinds the tape then positions it at the logical beginning of the partition (LBOP) of the default partition. When the reset is complete, the tape drive is ready to process tape motion commands.

When a data cartridge is present, the tape drive responds to the reset as follows:

- It returns Check Condition status to the first command received. The sense key is set to Unit Attention (6h), and the Additional Sense Code (ASC) and Additional Sense Code Qualifier (ASCQ) fields indicate that a reset occurred.
- It processes all non-motion commands. The default status returned by the TEST UNIT READY (00h) command is Check Condition status with the sense key set to Not Ready (2h). The ASC and ASCQ fields indicate that the device is becoming ready.
- If it receives tape motion commands, the tape drive queues (holds) one tape motion command from each initiator (and disconnects, if allowed) until the reset operation is complete and the tape is loaded. Once the load is complete, it processes the queued commands.

If the tape is already rewound when the reset occurs, the reset takes about one minute to complete. Additional time is required if the tape drive needs to rewind the tape.

Data Cartridge Not Present before Reset

When a data cartridge is not present, the tape drive responds to the reset as follows:

- It returns Check Condition status to the first command received. The sense key is set to Unit Attention (6h), and the ASC and ASCQ fields indicate that a reset occurred.
- It processes all non-motion commands. The TEST UNIT READY (00h) command returns Check Condition status with the sense key set to Not Ready (2h). The ASC and ASCQ fields indicate that no tape is present.
- It returns Check Condition status to all tape motion commands. The sense key is set to Not Ready (2h), and the ASC and ASCQ fields indicate that no tape is present.

! Important After a reset, do not insert a cartridge into the tape drive until all three LEDs are off. If you try to insert a cartridge before the LEDs are off, the tape drive will eject the cartridge.

3

ERASE (19h)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	1	0	0	1
01	Logical Unit Number			Reserved			Immed	Long
02	Reserved							
03								
04								
05	Vendor Unique		Reserved				0	0

3.1 About This Command

The ERASE command causes the tape drive to perform one the following types of erase operations:

- A short erase (byte 01, bit 0 equals zero) clears the partition information and writes an EOD at the logical beginning of the partition (LBOP).
- A long erase (byte 01, bit 0 equals one) erases all data from the tape (long erase), starting at the current valid tape position to the physical end of tape (PEOT) or, if the tape is partitioned, to the physical end of the current partition (PEOP).

When the erase operation is successfully completed, the tape drive rewinds the tape to the logical beginning of tape (LBOT) or, if the tape is partitioned, to the logical beginning of the current partition (LBOP).

The ERASE command performs the erase operation at the same speed as it performs the READ and WRITE commands.

Notes:

- The tape drive erases data written in Mammoth-1 or Mammoth-2 format only.
- If the ERASE command is received after a WRITE (0Ah) or WRITE FILEMARKS (10h) command, the tape drive writes buffered data, filemarks, and setmarks to tape before performing the erase operation.

  If an error occurs during the writing of the data in the buffer to the tape, the tape drive returns Check Condition status and the erase operation is not performed.
- To erase all of the data from a partitioned tape without eliminating the partitions, you must erase each partition separately.

3.2 CDB Field Definitions

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 01, Bit 1 – Immed

This bit determines when command status is returned to the initiator:

0 – Status is returned when the ERASE command is completed.
1 – Status is returned when the ERASE command is started.

If the buffer contains data from a previous WRITE command, the tape drive disconnects from the SCSI bus (if disconnect was enabled) and writes the data in the buffer to the tape.

- **If the Immed bit is set to 1,** the tape drive reconnects to the initiator when the write operation has been completed successfully. It then returns Good status and performs the erase operation.
- **If the Immed bit is set to 0**, the tape drive reconnects and returns status when the erase and rewind operations are complete.

Byte 01, Bit 0 – Long

This bit determines the amount of tape to be erased, as follows:

0 – The partition information is cleared and an EOD mark is written at the logical beginning of the partition (LBOP). No data is erased. The tape drive returns Good status.

1 – The partition information and the data for the current partition is erased beginning at the current position to the physical end of partition (PEOP).

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for these bits. The value for this field must be 0.

3.3 TAPE POSITIONING

The following are the legal tape positions for an erase operation:

- Logical beginning of tape (LBOT) or logical beginning of partition (LBOP)
- End of data mark (EOD)
- Beginning of tape (BOT) or end of tape (EOT) side of a filemark
- BOT or EOT side of a setmark

3.4 EXCEPTIONS AND ERROR CONDITIONS

Table 3-1 lists exceptions and error conditions that cause the tape drive to return Check Condition status for the ERASE command. See Appendix A for additional information about these errors.

Table 3-1 *REQUEST SENSE data for ERASE command errors and exceptions*

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Explanation
04h	01h	2h	**Not Ready.** Tape drive is not ready, but is in process of becoming ready (rewinding or loading tape).
15h	01h	4h	**Hardware Error.** The tape drive cannot position the media correctly.
27h	00h	7h	**Data Protect.** An erase operation was attempted on a data cartridge that is write protected.
30h	00h	6h	**Unit Attention.** Incompatible media was rejected after the cartridge was inserted.
30h	01h	3h	**Medium Error.** Incompatible format. The format of the currently loaded tape is not compatible with the tape drive.
30h	02h	5h	**Illegal Request.** The tape format is incompatible with the command.
3Ah	00h	2h	**Not Ready.** Tape drive is not ready. Command requires a tape, and no tape is present.
50h	01h	5h	**Illegal Request.** Illegal position for erase.

Notes

4

INQUIRY (12h)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	0	0	1	0
01	Logical Unit Number			Reserved				EVPD
02	Page Code							
03	Reserved							
04	Allocation Length							
05	Vendor Unique		Reserved				0	0

4.1 About This Command

The INQUIRY command requests that information about the tape drive's parameters be sent to the initiator.

4.2 CDB Field Definitions

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 01, Bit 0 – EVPD (Enable Vital Product Data)

This field indicates the type of inquiry data being requested by the initiator, as follows:

0 – Return Standard Inquiry Data.

1 – Return one of the Vital Product Data pages, based on the value of the Page Code field (byte 02).

Byte 02 – Page Code

This field specifies the page number of the Vital Product Data page to be returned to the initiator, as follows:

00h – Supported Vital Product Data page
80h – Unit Serial Number page
83h – Device Identification page

If the EVPD bit (byte 1, bit 0) is set to 0, the Page Code must be 00h.

Byte 04 – Allocation Length

This field specifies the number of bytes that the initiator has allocated for the return of inquiry data.

The tape drive terminates the Data In phase when the number of bytes specified in the Allocation Length field has been transferred or when all available inquiry data has been transferred, whichever is less.

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for these bits. The value for these bits must be 0.

4.3 What the Tape Drive Returns

The data returned by the tape drive depends on the values specified in the INQUIRY CDB. Table 4-1 summarizes the values you must specify in the INQUIRY CDB to return the different types of Inquiry data.

Table 4-1 *CDB values for different types of Inquiry data*

To return this Inquiry data...	Set these fields to...		And specify this value for the Allocation Length...	Number of bytes returned (hex)
	EVPD	Page Code		
Standard Inquiry Data	0	00h	any value from 0 to FFh	0 to 106 bytes (0h to 6Ah)
Supported Vital Product Data page	1	00h	07h	7 bytes (7h)
Unit Serial Number page	1	80h	0Eh	14 bytes (0Eh)
Device Identification page	1	83h	2Ah	42 bytes (2Ah)

4.3.1 STANDARD INQUIRY DATA

The tape drive returns the Standard Inquiry Data when the EVPD bit in the CDB is 0.

<table>
<tr><th>Bit
Byte</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>00</td><td colspan="3">Peripheral Qualifier</td><td colspan="5">Peripheral Device Type</td></tr>
<tr><td>01</td><td>RMB</td><td colspan="7">Device-Type Modifier</td></tr>
<tr><td>02</td><td colspan="2">ISO Version</td><td colspan="3">ECMA Version</td><td colspan="3">ANSI Version</td></tr>
<tr><td>03</td><td>AERC</td><td colspan="3">Reserved</td><td colspan="4">Response Data Format</td></tr>
<tr><td>04</td><td colspan="8">Additional Length</td></tr>
<tr><td>05</td><td colspan="8" rowspan="2">Reserved</td></tr>
<tr><td>06</td></tr>
<tr><td>07</td><td>RelAdr</td><td>Reserved</td><td>WBus16</td><td>Sync</td><td>Linked</td><td>Reserved</td><td>CmdQue</td><td>SftRe</td></tr>
<tr><td>08
⋮
15</td><td colspan="8">Vendor Identification</td></tr>
<tr><td>16
⋮
31</td><td colspan="8">Product Identification</td></tr>
<tr><td>32
⋮
35</td><td colspan="8">Product Revision Level</td></tr>
<tr><td>36
⋮
43</td><td colspan="8">Submodel ID</td></tr>
<tr><td>44
⋮
55</td><td colspan="8">Vendor Specific</td></tr>
<tr><td>56
⋮
95</td><td colspan="8">Reserved</td></tr>
<tr><td>96
⋮
105</td><td colspan="8">Unit Serial Number</td></tr>
</table>

Byte 00 – Peripheral Qualifier and Peripheral Device Type

The Peripheral Qualifier (byte 00, bits 7 through 5) and the Peripheral Device Type field (byte 00, bits 4 through 0) identify the device currently connected to the specified logical unit, as follows:

01h – The device currently connected to the logical unit is a sequential access device.

7Fh – The LUN is invalid (the LUN in the CDB or in the Identify message was not 0).

Byte 01, Bit 7 – RMB (Removable Media)

The value returned for this field is 1, which indicates that the media is removable.

Byte 01, Bits 6 through 0 – Device-Type Modifier

The tape drive does not support the Device-Type Modifier. The value for this field is 0.

Byte 02, Bits 7 and 6 – ISO Version

The value returned for this field is 0h, which indicates that the tape drive does not claim compliance with the International Standardization Organization (ISO) version of SCSI.

Byte 02, Bits 5 through 3 – ECMA Version

The value returned for this field is 0h, which indicates that the tape drive does not claim compliance with the European Computer Manufacturers Association (ECMA) version of SCSI.

Byte 02, Bits 2 through 0 – ANSI Version

The value returned for this field is 2h, which indicates that the tape drive supports the current version of the ANSI SCSI-2 standard (X3T9/89-042).

Byte 03, Bit 7 – AERC (Asynchronous Event Reporting Capability)

The value returned for this field is 0, which indicates that the tape drive does not have asynchronous event notification capability.

Byte 03, Bits 3 through 0 – Response Data Format

The value returned for this field is 2h, which indicates that the data found is in accordance with the ANSI SCSI-2 standard.

Byte 04 – Additional Length

The value returned for this field is 65h, which indicates that there are 101 additional bytes of Inquiry data available to be returned.

Byte 07, Bit 7 – RelAdr (Relative Address)

The value returned for this field is 0, which indicates that the tape drive does not support relative addressing.

Byte 07, Bit 5 – WBus16

The value returned for this field is 1, which indicates that the tape drive supports 16-bit-wide bus transfers.

Note: This field is specific to the parallel SCSI bus interface. It is reserved and must have a value of 0 for all other protocols.

Byte 07, Bit 4 – Sync

The value returned for this field is 1, which indicates that the tape drive supports synchronous data transfer.

Note: This field is specific to the parallel SCSI bus interface. It is reserved and must have a value of 0 for all other protocols.

Byte 07, Bit 3 – Linked

The value returned for this field is 0, which indicates that the tape drive does not support linked commands.

Byte 07, Bit 1 – CmdQue

The value returned for this field is 0, which indicates that the tape drive does not support tag command queuing.

Byte 07, Bit 0 – SftRe (Soft Reset)

The value returned for this bit is 0, which indicates that the tape drive does not support the soft reset alternative in response to a reset condition.

Bytes 08 through 15 – Vendor Identification

This field contains the ASCII representation of “EXABYTE”, followed by a single space.

Bytes 16 through 31 – Product Identification

This field contains the ASCII representation of the product name followed by sufficient spaces to fill the field (for example, Mammoth2________, where each “_” represents an ASCII space character).

Bytes 32 through 35 – Product Revision Level

This field contains the ASCII representation of the revision level (for example, “1000” or other Exabyte revision levels).

Bytes 36 through 43 – Submodel ID

This field contains the ASCII representation of the EEPROM image identifier (for example, MH000105).

Bytes 44 through 55 – Vendor Specific

This field contains the ASCII representation of blanks.

Bytes 96 through 105 – Unit Serial Number

This field contains the ASCII representation of the tape drive's serial number in the format *dddddddddd*, where *d* is a decimal digit (0-9). For example, 0000000123 represents serial number 123.

4.3.2 SUPPORTED VITAL PRODUCT DATA PAGE (PAGE CODE 00h)

The tape drive returns the Supported Vital Product Data page when the EVPD bit in the command CDB is 1 and the Page Code is 00h.

Bit / Byte	7	6	5	4	3	2	1	0
00	Peripheral Qualifier			Peripheral Device Type				
01	Page Code							
02	Reserved							
03	Page Length							
04	First Page Code Supported							
05	Second Page Code Supported							
06	Third Page Code Supported							

Byte 00, Bits 7 through 5 – Peripheral Qualifier

The value for this field is 0, indicating that this is a single LUN device.

Byte 00, Bits 4 through 0 – Peripheral Device Type

The value returned for this field is 01h, which identifies the tape drive as a sequential access device.

Byte 01 – Page Code

The Page Code for the Vital Product Data page is 00h.

Byte 03 – Page Length

The value returned for this field is 03h, which indicates that three additional bytes are available, excluding this byte.

Byte 04 – First Page Code Supported

The value for this field is 00h, which indicates support for the Vital Product Data page.

Byte 05 – Second Page Code Supported

The value returned for this field is 80h, which indicates support for the Unit Serial Number page.

Byte 06 – Third Page Code Supported

The value returned for this field is 83h, which indicates support for the Device Identification page.

4.3.3 Unit Serial Number Page (Page Code 80h)

The tape drive returns the Unit Serial Number page when the EVPD bit in the CDB is 1 and the Page Code is 80h.

Bit / Byte	7	6	5	4	3	2	1	0
00	Device Type Code							
01	Page Code							
02	Reserved							
03	Page Length							
04 ⋮ 13	Unit Serial Number							

Byte 00 – Device Type Code

The value returned for this field is 01h, which identifies the tape drive as a sequential access device. If the LUN in the CDB is not 0, the value returned is 7Fh, which indicates that the LUN is invalid.

Byte 01 – Page Code

The value returned for this field is 80h, which is the Page Code for the Unit Serial Number page.

Byte 03 – Page Length

The value returned for this field is 0Ah, which indicates that there are 10 additional bytes available, excluding this byte.

Bytes 04 through 13 – Unit Serial Number

This field contains the ASCII representation of the tape drive's serial number in the format *dddddddddd*, where *d* is a decimal digit (0-9). For example, 0000000123 represents serial number 123.

4.3.4 Device Identification Page (Page Code 83h)

The Device Identification page allows the tape drive to report its device identifiers, including its product name and serial number. The tape drive returns the Device Identification page when the EVPD bit in the CDB is 1 and the Page Code is 83h.

Note: The Fibre Channel model of the tape drive returns additional Device Identifiers. See the *Mammoth-2 Tape Drive Fibre Channel Supplement* for more information.

Bit Byte	7	6	5	4	3	2	1	0
00	Peripheral Qualifier			Peripheral Device Type				
01	Page Code							
02	Reserved							
03	Page Length (26h)							
04	Reserved				Code Set			
05	Reserved		Association		Identifier Type			
06	Reserved							
07	Identifier Length (22h)							
08 ⋮ 41	(MSB) Device Identifier 1 (LSB)							

Byte 00, Bits 7 through 5 – Peripheral Qualifier

The value for this field is 00h, indicating that the tape drive is a single LUN device.

Byte 00, Bits 4 through 0 – Peripheral Device Type

The value returned for this field is 01h, which identifies the tape drive as a sequential access device.

Byte 01 – Page Code

The value for this field is 83h, identifying the current page as the Device Identification page.

Byte 03 – Page Length

The value returned for this field is 26h, which indicates that there are 38 bytes of additional information available, excluding this byte.

Byte 04, Bits 3 through 0 – Code Set

The value returned for this field is 02h, which indicates that the Device Identifier 1 field contains ASCII data.

Byte 05, Bits 5 and 4 – Association

The value returned for this field is 0h, indicating that Identifier 1 is associated with the tape drive.

Byte 05, Bits 3 through 0 – Identifier Type

The value returned for this field is 1h, indicating that the first eight bytes of the field contain the Vendor Identification returned for the Standard Inquiry Data.

Byte 07 – Identifier Length

The value returned for this field is 22h, which indicates that the length of the Device Identifier 1 field is 34 bytes, excluding this byte.

Byte 08 through Byte 41 – Device Identifier 1

This field contains the Device Identifier for the tape drive, as follows:

- **Bytes 08 through 15** – The ASCII representation of "EXABYTE", followed by a single ASCII space character.
- **Bytes 16 through 31** – The ASCII representation of "Mammoth2" followed by eight ASCII space characters.
- **Bytes 32 through 41** – The tape drive's ten-digit serial number in the format *dddddddddd*, where *d* is the ASCII representation of a decimal digit (0-9). For example, 0000000123 represents serial number 123.

4.4 Exceptions and Error Conditions

The tape drive returns Good status in response to an INQUIRY command, even if it is not ready to accept commands. If the tape drive receives an INQUIRY command from an initiator that has a pending Unit Attention condition, the tape drive responds to the command and does not clear the Unit Attention condition.

Table 4-2 lists exceptions and error conditions that cause the tape drive to return Check Condition status for the INQUIRY command. See Appendix A for additional information about this error.

Table 4-2 *REQUEST SENSE data for INQUIRY command errors and exceptions*

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Explanation
24h	00h	5h	**Illegal Request.** Invalid field in the CDB.

Notes

5

LOAD/UNLOAD (1Bh)

<table>
<tr><th>Bit
Byte</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>00</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>01</td><td colspan="3">Logical Unit Number</td><td colspan="4">Reserved</td><td>Immed</td></tr>
<tr><td>02</td><td colspan="8" rowspan="2">Reserved</td></tr>
<tr><td>03</td></tr>
<tr><td>04</td><td colspan="5">Reserved</td><td>EOT</td><td>Re-Ten</td><td>Load</td></tr>
<tr><td>05</td><td colspan="2">Vendor Unique</td><td colspan="4">Reserved</td><td>0</td><td>0</td></tr>
</table>

5.1 About This Command

The LOAD/UNLOAD command causes the tape drive to load or unload the data cartridge.

During a load operation, the tape drive performs the following actions:

1. It loads the tape into the tape path. (If the tape is already loaded, the tape drive takes no action.)

   Note: The cartridge must be fully inserted into the tape drive when you issue the LOAD command. The tape drive does not pull the cartridge into the drive in response to a LOAD command.

2. If the tape is not partitioned, it positions the tape to the logical beginning of tape (LBOT). If the tape is partitioned, it positions the tape to the default partition or to the partition specified by the MODE SELECT command (see the discussion about loading partitioned tapes on page 5-2).

During an unload operation, the tape drive performs the following actions:

1. If necessary, it writes any data in the buffer to tape and writes the end of data (EOD) mark.
2. It rewinds the tape to the physical beginning of tape (PBOT).
3. It unloads the tape from the tape path.
4. It ejects the data cartridge as long as ejection has not been prevented by a PREVENT MEDIUM REMOVAL command (see Chapter 11).

5.1.1 Using the LOAD/UNLOAD Command on a Partitioned Tape

When the tape you are using is formatted with partitions, the LOAD/UNLOAD command performs as follows:

Loading a Partitioned Tape

The LOAD command positions the tape to the beginning of partition 0 (the last partition on the tape) by default, unless, before loading the tape, you specify a different partition using the LPART field of the MODE SELECT command (see page 9-32). Note that the LOAD command itself has no fields that specify to which partition the tape drive positions the tape.

Unloading a Partitioned Tape

The UNLOAD command unloads a partitioned tape just as it would a non-partitioned tape. You can issue the UNLOAD command from any partition. The tape drive rewinds the tape to PBOT, unloads the tape from the tape path, and ejects the cartridge (if ejection has not been prevented by a PREVENT MEDIUM REMOVAL command).

5.1.2 Tape Motion Command Received During Load Operation

When the tape drive receives tape motion commands during a load operation, it queues (holds) one tape motion command per initiator (and disconnects, if allowed) until the load operation is complete. Then it attempts to execute the queued command.

Note: If another initiator has reserved the tape drive for its exclusive use, the tape drive returns Reservation Conflict status.

5.2 CDB Field Definitions

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 01, Bit 1 – Immed

This field specifies when the tape drive returns command status to the initiator:

0 – Status is reported when the load/unload operation is complete.
1 – Status is reported when the command is initiated by the tape drive.

If the buffer contains data from a previous WRITE command, the tape drive disconnects from the SCSI bus (if disconnect was enabled) and writes the data in the buffer to the tape.

- If the Immed bit is set to 1, the tape drive reconnects to the initiator when the write operation has been completed successfully. It then returns Good status and performs the load or unload operation.

  Note: Completing the write operation includes emptying the buffer and writing the EOD mark.

- If the Immed bit is set to 0, the tape drive reconnects and returns status when the load or unload operation is complete.

If an error occurs during the writing of the data from the buffer to the tape, the tape drive reconnects to the initiator and returns Check Condition status. The load or unload operation is not performed.

Byte 04, Bit 2 – EOT

This bit is ignored by the tape drive.

Byte 04, Bit 1 – Re-Ten (Retension)

The tape drive ignores this bit.

Byte 04, Bit 0 – Load

This field specifies which operation, load or unload, is to be performed:

0 – Unload operation.
1 – Load operation.

Table 5-1 indicates what action occurs based on the setting of the Load bit and the status of the data cartridge:

Table 5-1 *Action occurring based on the Load bit and data cartridge status*

If the Load bit is set to...	And the data cartridge is...	The following action occurs...
0	Out	No action.
1	Out	Check Condition status is returned with the sense key set to Not Ready (2h).
0	In	The data cartridge is unloaded.[a] If there is data in the write buffer, the data is written to tape. Then, the tape is rewound to PBOT and unloaded from the tape path, and the data cartridge is ejected from the tape drive.
1	In	The data cartridge is loaded and positioned at LBOT if the tape is not partitioned. If the tape is partitioned, the tape is positioned to the default partition (partition 0) or the partition specified by the MODE SELECT command, as explained on page 5-2. If the data cartridge is already loaded and there is data in the buffer, the data is written to the tape before the operation is performed.

[a] The unload operation is performed even if the PREVENT/ALLOW MEDIUM REMOVAL command was issued with the Prevent bit set to 1; however, the data cartridge is not ejected from the tape drive.

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for these bits. The value for this field must be 0.

5.3 Exceptions and Error Conditions

Table 5-2 lists exceptions and error conditions that cause the tape drive to return Check Condition status for the LOAD/UNLOAD command. See Appendix A for additional information about these errors.

Table 5-2 *REQUEST SENSE data for LOAD/UNLOAD command errors and exceptions*

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Explanation
04h	01h	2h	**Not Ready.** Tape drive is not ready, but is in process of becoming ready (rewinding or loading tape).
15h	01h	4h	**Hardware Error.** The tape drive cannot position the tape correctly.
24h	00h	5h	**Illegal Request.** Invalid field in the CDB.
30h	00h	3h	**Medium Error.** Incompatible media was ejected after a LOAD command was issued.
3Ah	00h	2h	**Not Ready.** Tape drive is not ready. Command requires a tape, and no tape is present.
53h	02h	5h	**Illegal Request.** Media removal prevented.

Notes

6

LOCATE (2Bh)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	1	0	1	0	1	1
01	Logical Unit Number			Reserved		BT	CP	Immed
02	Reserved							
03	(MSB)							
⋮	Block Address							
06								(LSB)
07	Reserved							
08	Partition							
09	Vendor Unique		Reserved				0	0

6.1 About This Command

The LOCATE command, in conjunction with the READ POSITION (34h) command, allows you to position the tape at a specified logical block address. During forward and backward locate operations, the tape drive moves the tape at its high-speed search speed.

Unlike space operations, locate operations do not detect filemarks and setmarks and do not return Check Condition status when these elements are encountered.

6.2 Using the LOCATE Command

To use the LOCATE command, follow these steps:

1. Determine the tape drive's current location by issuing a READ POSITION command (see Chapter 15).
2. In the initiator's memory, save the information returned for the First Block Location field (bytes 04 through 07) of the READ POSITION data.
3. Continue reading or writing data as required.
4. When you want to return to the previous location, issue a LOCATE command and specify the saved address in the Block Address field (bytes 03 through 06).

Notes:

- If the disconnect option is enabled, the tape drive can disconnect from the initiator while the LOCATE command is executing.
- If the tape drive receives a LOCATE command after a WRITE (0Ah) or WRITE FILEMARKS (10h) command, it writes any buffered data, filemarks, or setmarks to the tape before performing the locate operation.

  If an error occurs when the buffered data is being written, the tape drive returns Check Condition status and the locate operation is not performed.

Using the LOCATE Command on Partitioned Tapes

If the tape in the tape drive is formatted with partitions, you can use the LOCATE command to position the tape to a location within any partition. If necessary, the LOCATE command causes the tape drive to move from the current partition to another partition and then to find the requested block in the new partition. (See Section 2.6 starting on page 2-10 for information about creating and using partitioned tapes.)

6.3 CDB FIELD DEFINITIONS

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 01, Bit 2 – BT (Block Type)

This field specifies the type of block number contained in the Block Address field (bytes 03 through 06), as follows:

0 – SCSI logical block number, numbered sequentially from the beginning of the tape (or the beginning of the partition).

1 – Logical block number, not including setmarks. (This setting is not recommended for normal use.)

Byte 01, Bit 1 – CP (Change Partitions)

This field specifies whether the tape drive should move to the partition specified by the Partition field (byte 08) before positioning to the requested block, as follows:

0 – Ignore the Partition field. (Do not move the tape from the current partition.)
1 – Move to the partition specified in the Partition field.

Byte 01, Bit 0 – Immed

This field specifies when the tape drive returns command status to the initiator, as follows:

0 – Status is reported when the LOCATE command is completed.
1 – Status is reported when the LOCATE command is initiated by the tape drive.

If the tape drive buffer contains data from a previous WRITE command, the tape drive disconnects from the initiator (if disconnect was enabled) and writes the data to the tape before performing the locate operation.

- **If the Immed bit is set to 1**, the tape drive reconnects when the write operation has completed successfully. It then returns Good status and performs the locate operation.

  Note: Completing the write operation includes emptying the buffer to tape and writing the EOD mark.

- **If the Immed bit is set to 0**, the tape drive reconnects and returns status when the locate operation is complete.

Bytes 03 through 06 – Block Address

This field specifies the address of the block that the tape drive is to locate. The value for this field is returned in the First Block Address field in the READ POSITION data.

Byte 08 – Partition

This field specifies to which partition the tape drive moves the tape when the CP field (byte 01, bit 1) is set to 1 (change partitions), as follows:

n – Move to partition *n*, where *n* is a value from 0 to 63. Note that partitions are numbered consecutively from the *end* of the tape. Partition 0 is always the last partition on the tape.

The CP field must be set to 1 for the Partition byte to be in effect. If the CP field is 0, the tape drive ignores the Partition byte.

Byte 09, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for these bits. The value for this field must be 0.

6.4 Exceptions and Error Conditions

The following sections describe exceptions and error conditions that cause the tape drive to return Check Condition status for the LOCATE command.

6.4.1 PEOT or PEOP Encountered

The tape drive encountered the physical end of tape (PEOT) or the physical end of partition (PEOP) during a read operation. The REQUEST SENSE data is set as follows:

Valid	0 or 1
EOM	1
Sense Key	Medium Error (3h)
Information bytes	If Valid=1, indicate the difference between the requested logical position and the last logical position detected.
ASC	00h
ASCQ	02h
PEOT	1
FSC	34h

When the LOCATE command terminates, the logical position is the last logical position the tape drive detected on tape.

6.4.2 EOD DETECTED

The tape drive detected the end-of-data (EOD) mark during the locate operation. The REQUEST SENSE data is set as follows:

Valid	0 or 1
Sense Key	Blank Check (8h)
Information bytes	If Valid=1, indicate the difference between the requested logical position and the actual logical position.
ASC	00h
ASCQ	05h
FSC	33h

When the LOCATE command terminates, the logical tape position is after the last recorded data block, filemark, or setmark. Issue a READ POSITION command to determine the exact location.

6.4.3 UNRECOVERABLE ERROR

An unrecoverable media or hardware error occurred during the locate operation and the tape drive terminates the LOCATE command. The REQUEST SENSE data is set as follows:

Valid	0
Sense Key	Medium Error (3h) or Hardware Error (4h)
Other bits and bytes	Depend on the error condition

When the LOCATE command is terminated, the position of the tape drive is the same as it was before the LOCATE command was issued.

6.4.4 Additional Errors

Table 6-1 lists additional exceptions and error conditions that can cause the tape drive to return Check Condition status for the LOCATE command. See Appendix A for additional information about these errors.

Table 6-1 *REQUEST SENSE data for LOCATE command errors and exceptions*

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Explanation
00h	03h	0h	**No Sense.** A setmark was encountered during a locate operation.
00h	04h	0h	**No Sense.** PBOT or PBOP was encountered during a locate operation.
04h	01h	2h	**Not Ready.** Tape drive is not ready, but is in process of becoming ready (rewinding or loading tape).
11h	00h	3h	**Medium Error.** An uncorrectable block was encountered during a locate operation.
14h	00h	3h	**Medium Error.** The tape drive detected a medium error during the locate operation.
15h	01h	4h	**Hardware Error.** The tape drive cannot position the media correctly.
24h	00h	5h	**Illegal Request.** Invalid field in the CDB. This error is a result of any of the following: ▪ The Partition field contains a value greater than 1 and the CP bit is set to 1. ▪ The BT bit is set to 1.
30h	00h	6h	**Unit Attention.** Incompatible media was rejected after the cartridge was inserted.
30h	02h	3h	**Medium Error.** Incompatible format. The format of the currently loaded tape is not compatible with the tape drive.
31h	00h	3h	**Medium Error.** A tape format error was encountered during a locate operation.
3Ah	00h	2h	**Not Ready.** Tape drive is not ready. Command requires a tape, and no tape is present.

7

LOG SELECT (4Ch)

Bit Byte	7	6	5	4	3	2	1	0
00	0	1	0	0	1	1	0	0
01	Logical Unit Number			Reserved			PCR	SP
02	PC		Reserved					
03 ⋮ **06**	Reserved							
07	(MSB) Parameter List Length							
08								(LSB)
09	Vendor Unique		Reserved				0	0

7.1 About This Command

The LOG SELECT command allows you to manage the tape drive's parameter values for write and read error recovery operations and the amounts of data compressed. You can set threshold and cumulative values and you can reset the values.

To test the tape drive, you can reset the parameters, perform the operations you want to test, then issue a LOG SENSE (4Dh) command to check the updated values (refer to Chapter 8 for information about the LOG SENSE command).

You can also specify if and when you want to be notified about changes to the parameters. For example, you might want the tape drive to return Unit Attention when a counter reaches its threshold value.

! Important If you want the tape drive to return Unit Attention to notify you about changes to the parameters, first issue a MODE SELECT command and send the Control Mode page (Page Code=0Ah) with the Report Log Exception Condition (RLEC) bit set to 1. Refer to Chapter 9 for more information.

7.2 CDB Field Definitions

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 01, Bit 1 – PCR (Parameter Code Reset)

This field specifies whether the tape drive should reset all of the parameters or only selected parameters, as follows:

0 – Reset only selected parameters, as indicated by the PC field.

1 – Reset all of the parameters. Current cumulative values will be reset to 0, the Enable Threshold Comparison (ETC) bit will be reset to 0 (see page 7-7), and threshold values will be reset to all FFs.

Note: If you set the PCR bit to 1, be sure that the Parameter List Length is 0. Otherwise, the tape drive will return Check Condition status with the sense key set to Illegal Request (5h), the ASC and ASCQ set to 24h and 00h, and the Fault Symptom Code set to CEh.

Byte 01, Bit 0 – SP (Save Parameters)

The tape drive does not support the save parameters function. The value for this bit must be 0.

Byte 02, Bits 7 and 6 – PC (Page Control)

This field specifies which parameters the tape drive resets when the PCR bit is 0. Table 7-1 lists the valid values for the PC field.

If the PCR bit is set to 1, the tape drive ignores the PC bit.

Table 7-1 *Valid values for the LOG SELECT Page Control (PC) field*

PC Value	Description
00b	Set threshold values for the parameters listed in the parameter list.
01b	Set current cumulative values for the parameters listed in the parameter list.
10b	Set all threshold values to their default threshold values (all FFs). Set the ETC bit to 0 (see page 7-7).
11b	Set all current cumulative values to 0.

Note: If you set the PC field to 10b or 11b, be sure that the Parameter List Length is 0. Otherwise, the tape drive returns Check Condition status with the sense key set to Illegal Request (5h), the ASC and ASCQ set to 24h and 00h, and the Fault Symptom Code set to CEh.

Bytes 07 and 08 – Parameter List Length

This field specifies the total number of bytes to be transferred to the tape drive. The value for this field must equal the sum of the lengths of each log parameter page being sent, including four bytes for each Parameter List Header. Table 7-2 lists the page length, including the Parameter List Header, for each supported log page.

Table 7-2 *Page length of each supported log page*

Page Code	Description	Page Length
02h	Write Error Counters page	14h (20 bytes)
03h	Read Error Counters page	14h (20 bytes)
39h	Data Compression page	10h (16 bytes)

Multiple log parameter pages can be transferred with a single LOG SELECT command. The parameter list length must be sufficient to accommodate all of the log parameter pages being sent. The tape drive does not accept partial log parameter pages.

Valid values for this field are 0 to FFh (0 to 255 bytes). Setting the Parameter List Length to 0 indicates that no data is to be transferred.

Note: If the Parameter List Length is greater than 0, the PCR bit must be 0. Otherwise, the tape drive returns Check Condition status with the sense key set to Illegal Request (5h), the ASC and ASCQ set to 24h and 00h, and the Fault Symptom Code set to CEh.

Table 7-3 summarizes the valid settings for the PCR, PC, and Parameter List Length fields in the LOG SELECT CDB.

Table 7-3 *Valid combinations of values for the fields in the LOG SELECT CDB*

<table>
<tr><th>To specify these parameters values...</th><th>Set the PCR bit to...</th><th>Set the PC field to...</th><th>Set the Parameter List Length to...</th></tr>
<tr><td>Specified parameters to new threshold values</td><td>0</td><td>00b</td><td rowspan="2">The total number of bytes in all of the parameter lists (from 0 to 255)</td></tr>
<tr><td>Specified parameters to new cumulative values</td><td>0</td><td>01b</td></tr>
<tr><td>All parameters to default threshold values (do not reset cumulative values)</td><td>0</td><td>10b</td><td rowspan="3">0</td></tr>
<tr><td>All parameters to default cumulative values (do not reset threshold values)</td><td>0</td><td>11b</td></tr>
<tr><td>All cumulative parameters to 0, all thresholds to FFs, and ETC to 0</td><td>1</td><td>ignored</td></tr>
</table>

Byte 09, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for these bits. The value for this field must be 0.

7.3 Log Parameter Data

With each LOG SELECT CDB, you send a parameter list for each page on which you are changing values. Each parameter list begins with a Parameter List Header that identifies the parameter page being sent and indicates the number of bytes that follow the header as log parameters. Immediately following the Parameter List Header is the list of values for each parameter on the page that you want to change.

Note: The total number of bytes in the parameter list equals the Page Length of the parameter page, plus four bytes for the Parameter List Header. The sum of the bytes in all the parameter lists must equal the value specified for the Parameter List Length in the CDB.

7.3.1 Parameter List Header

Each parameter page begins with a four-byte Parameter List Header. The Parameter List Header is followed by the parameters for the specified page.

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code					
01	Reserved							
02	(MSB) Page Length							
03								(LSB)

Byte 00, Bits 5 through 0 – Page Code

This field specifies the page code for the parameter page to be modified. Valid page codes are the following:

02h – Write Error Counters page
03h – Read Error Counters page
39h – Data Compression page

Note: Do not specify page codes 2Eh (TapeAlert page), 35h (Tape History Log page), 3Ch (Drive Usage Information page), or 3Eh (Drive Temperature page) in the LOG SELECT command. You cannot change or reset the parameters on these pages.

Bytes 02 and 03 – Page Length

This field indicates the number of bytes of log parameters that follow this field. Table 7-4 lists the valid value of this field for each supported log page.

Table 7-4 *Page length of each supported log page*

Page Code	Description	Page Length
02h	Write Error Counters page	10h (16 bytes)
03h	Read Error Counters page	10h (16 bytes)
39h	Data Compression page	0Ch (12 bytes)

7.3.2 LOG PARAMETERS

The Parameter List Header is followed by zero or more log parameters. Each log parameter includes four bytes of descriptive information followed by a variable-length parameter value. There is no required order for the log parameters.

The format of a log parameter is as follows:

Bit / Byte	7	6	5	4	3	2	1	0
00	(MSB) Parameter Code							
01								(LSB)
02	DU	DS	TSD	ETC	TMC		RSVD	LP
03	Parameter Length							
04	(MSB) Parameter Value							
⋮								
nn								(LSB)

Bytes 00 and 01 – Parameter Code

This field specifies the parameter for which you want to set the threshold or cumulative value. The definition of the parameter depends on which log parameter page you specified in the Parameter List Header.

The following tables describe the parameters for the supported pages:

- Table 7-5 lists the parameters for the Write Error Counters page.
- Table 7-6 lists the parameters for the Read Error Counters page.
- Table 7-7 lists the parameters for the Data Compression page.

Table 7-5 Parameter code values for the Write Error Counters page

Parameters for the Write Error Counters page			
Parameter code	**Parameter name**	**Description**	**Length (bytes)**
0002h	Total Rewrites	Indicates the number of physical blocks the tape drive rewrote because they contained errors detected during read-after-write operations. Only user data blocks and short filemark blocks are ever rewritten. This counter is equivalent to the Total Errors Corrected counter. Thresholds, threshold criteria, and cumulative values always use these counters and reflect the last set value.	3
0003h	Total Errors Corrected	Contains the same value as the Total Rewrites counter.	3
0004h	Total Times Errors Processed	Contains 0 since this is a read function only (write errors are rewritten). The default value is 0 and will never change.	3
0005h	Total Bytes Processed	Indicates the number of bytes successfully written to the tape. This counter only includes user data bytes, the gap bytes in user data blocks, and the bytes in short filemark blocks. Rewritten data is not counted.	5
0006h	Total Unrecoverable Errors	Indicates the number of times the tape drive could not write a block to the tape.	2

Table 7-6 Parameter code values for the Read Error Counters page

Parameters for the Read Error Counters page			
Parameter code	**Parameter name**	**Description**	**Length (bytes)**
0002h	Total Rereads	Indicates the number of times the tape drive moved the tape backward to reread a portion of tape because a block was missed.	3
0003h	Total Errors Corrected	Indicates the total number of blocks the tape drive recovered either by using the ECC algorithm or by successfully rereading the block.	3
0004h	Total Times Errors Processed	Contains the same value as the Total Errors Corrected counter.	3
0005h	Total Bytes Processed	Indicates the number of user data bytes transferred from tape to the tape drive’s buffer. Rewritten data is not counted.	5
0006h	Total Unrecoverable Errors	Indicates the number of blocks the tape drive could not read after exhausting all retries.	2

Table 7-7 Parameter code values for the Data Compression page

Parameters for the Data Compression page			
Parameter code	**Parameter name**	**Description**	**Length (bytes)**
0005h	KB of Data Transferred to Data Compressor	Indicates the amount of data, in KB, that was compressed during a write operation.	6
0007h	KB of Data Transferred to Tape	Indicates the amount of compressed data, in KB, that was written to tape.	6

Byte 02, Bit 7 – DU (Disable Update)

This bit indicates whether updates to the current cumulative value are enabled or disabled, as follows:

0 – The tape drive can update the current cumulative value, so comparisons of the current cumulative value and the threshold value can occur normally.

1 – The tape drive will not update the current cumulative value, so threshold conditions will not be met for this parameter.

! Important If you want the tape drive to compare the current cumulative value to the threshold value for the parameter and to return Unit Attention when the threshold criteria are met, first issue a MODE SELECT command and send the Control Mode page (Page Code=0Ah) with the RLEC bit set to 1. Then, set the DU bit to 0 and the ETC bit to 1.

Byte 02, Bit 6 – DS (Disable Save)

The tape drive ignores this bit.

Byte 02, Bit 5 – TSD (Target Save Disable)

The tape drive ignores this bit.

Byte 02, Bit 4 – ETC (Enable Threshold Comparison)

This bit indicates whether threshold comparisons for the parameter are enabled or disabled, as follows:

0 – Threshold comparisons for this parameter are disabled.
1 – Threshold comparisons are performed on this parameter.

Byte 02, Bits 3 and 2 – TMC (Threshold Met Criteria)

This field specifies the conditions under which the tape drive generates a Unit Attention (6h) sense key when comparing the current cumulative value to the threshold value. Threshold comparisons are made when the cumulative value is updated. Table 7-8 lists the valid values for the TMC field.

Table 7-8 Valid values for the LOG SELECT Threshold Met Criteria (TMC) field

TMC Value	Description
00b	Return Unit Attention when the cumulative value is updated.
01b	Return Unit Attention when the updated cumulative value equals the threshold value.
10b	Return Unit Attention when the updated cumulative value is not equal to the threshold value.
11b	Return Unit Attention when the updated cumulative value is greater than the threshold value.

If threshold comparisons are enabled, the tape drive compares the cumulative value to the threshold value when the cumulative value is updated. When the conditions specified by the Threshold Met Criteria (TMC) bit are met, the tape drive returns Check Condition status with the sense key set to Unit Attention (6h), the ASC and ASCQ set to 5Bh and 01h, and the Fault Symptom Code set to CAh.

Byte 02, Bit 0 – LP (List Parameter)

The value for this field must be 0. (List parameters are not supported.)

Byte 03 – Parameter Length

This field specifies the length of the threshold or cumulative value in bytes. See the tables starting on page 7-6 for the length of each parameter value.

Note: You can specify any value from 0 to FFh for the Parameter Length field. If you specify 0 for the Parameter Length, the Parameter Value will be set to 0.

Bytes 04 to *nn* – Parameter Value

This field contains either a new threshold value or a new current cumulative value for the parameter, depending on the value specified for the PC bit in the CDB. The length of the value is defined by the Parameter Length field.

You can specify any value for the parameter from 0 to all FFs.

- **If the specified parameter value is shorter than the actual length,** the tape drive pads the value with zeros from the parameter length to the most significant byte. That is, if you specify 8h for the parameter value and the length is two bytes, the tape drive pads the value to 0008h.

- **If the specified parameter value is longer than the actual length,** all extra bytes between the actual length and the most significant byte of the Parameter Value must be 0. That is, if the length is two bytes, specifying FFFFFFh for the value would be an error, specifying 00FFFFh would not.

7.4 Exceptions and Error Conditions

Table 7-9 lists the exceptions and error conditions that cause the tape drive to return Check Condition status for the LOG SELECT command. See Appendix A for additional information about these errors.

! Important If you want the tape drive to return Fault Symptom Codes to notify you about changes to the parameters, first issue a MODE SELECT command and send the Control Mode page (Page Code 0Ah) with the RLEC bit set to 1. Refer to Chapter 9 for more information. In addition, be sure to set the DU bit to 0 and the ETC bit to 1 for the log parameter.

Table 7-9 *REQUEST SENSE data for LOG SELECT command errors and exceptions*

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	FSC	Explanation
1Ah	00h	05h	D4h	**Illegal Request.** Invalid Parameter List Length in CDB. The value specified for the Parameter List Length caused the log parameter to be truncated.
24h	00h	05h	CEh	**Illegal Request.** Invalid field in CDB. This error is a result of any of the following: ▪ The PCR bit is set to 1 and the Parameter List Length is greater than 0. ▪ The SP bit is set to 1. ▪ The PC field is either 10b or 11b and the Parameter List Length is not 0.
2Ah	02h	06h	CBh	**Unit Attention.** Log parameter changed.
47h	00h	0Bh	E6h	**Aborted Command.** A SCSI parity error occurred during data transfer.
5Bh	01h	6h	CAh	**Unit Attention.** Threshold met. (For additional information about this error, look at the Log Parameter Page Code and Log Parameter Code bytes in the REQUEST SENSE data.)
5Bh	02h	1h	ECh	**Recovered Error.** Log parameter overflow (a cumulative parameter reached its maximum value). When this occurs, the parameter stays at its maximum, and the DU bit is set to 1 to disable updates, and the tape drive returns this error. This error indicates that the tape drive completed the command with no error. Check Condition status is returned only to alert the initiator that a parameter reached its maximum.

Notes

8

LOG SENSE (4Dh)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	1	0	0	1	1	0	1
01	Logical Unit Number			Reserved			PPC	SP
02	PC		Page Code					
03	Reserved							
04								
05	(MSB) Parameter Pointer							
06								(LSB)
07	(MSB) Allocation Length							
08								(LSB)
09	Vendor Unique		Reserved				0	0

8.1 About This Command

The LOG SENSE command enables you to retrieve statistical information about various tape drive parameter values. The tape drive maintains the following pages of parameters:

- Supported Pages page (00h)
- Write Error Counters page (02h)
- Read Error Counters page (03h)
- TapeAlert page (2Eh)
- Tape History Log page (35h)
- Data Compression page (39h)
- Drive Usage Information page (3Ch)
- Drive Temperature page (3Eh)

The LOG SENSE data returned by the tape drive consists of a four-byte Parameter List Header and a log page. Each log page contains log parameter data blocks that provide information about the parameters.

Note: You can use the LOG SELECT (4Ch) command to specify cumulative and threshold parameter values or to reset the parameters on pages 00h, 02h, 03h, and 39h (see Chapter 7 for more information). You cannot set cumulative and threshold values or reset the parameters on pages 2Eh, 3Ch, and 3Eh.

8.2 CDB Field Definitions

Byte 01, Bit 1 – PPC (Parameter Pointer Control)

The PPC bit specifies the type of parameters being requested from the tape drive. This bit must be 0, which indicates that the tape drive should return all parameters for the specified log page, beginning with the parameter specified in the Parameter Pointer field (bytes 05 and 06).

Byte 01, Bit 0 – SP (Save Parameters)

The tape drive does not support the save parameters function. The value for this bit must be 0.

Byte 02, Bits 7 and 6 – PC (Page Control)

This field specifies the type of parameter values the tape drive returns. Table 8-1 lists the valid values for the PC field.

Table 8-1 *Valid values for the LOG SENSE Page Control (PC) field*

PC Value	Description
00b	**Return the current threshold values.** These values are reset to their default settings after a power-on reset, SCSI bus reset, or Bus Device Reset message.
01b	**Return the current cumulative values.** These values are the values that have accumulated since the last power-on reset, SCSI bus reset, Bus Device Reset message, or setting by a LOG SELECT command. When a parameter reaches its maximum value, it is returned as all FFs. (For example, FFFFFFh is returned as the maximum value for a three-byte parameter.)
10b	**Return the default threshold values.** The default threshold values cannot be changed. The values returned represent the maximum values each parameter can obtain (all FFs).
11b	**Return the default cumulative values.** The default cumulative values cannot be changed. The values returned represent the values that each parameter is reset to (whether by power-on reset, SCSI bus reset, Bus Device Reset message, or LOG SELECT reset). The default cumulative value for all parameters is 0.

Byte 02, Bits 5 through 0 – Page Code

This field specifies which LOG SENSE page is being requested. The type of data returned for the page depends on the value specified for the PC bit. Table 8-2 lists the log pages supported by the tape drive.

Table 8-2 *Log pages supported by the tape drive*

Page Code	Description	Look here for information...
00h	**Supported Log Pages page.** This page lists the pages supported by the LOG SENSE command.	Section 8.3.2 on page 8-8
02h	**Write Error Counters page.** This page includes a log parameter data block for each write error counter.	Section 8.3.3 on page 8-9
03h	**Read Error Counters page.** This page includes a log parameter data block for each read error counter.	Section 8.3.3 on page 8-9
2Eh	**TapeAlert page.** This page reports information from the tape drive's internal TapeAlert firmware. This firmware constantly monitors the tape drive and the tape for errors and potential difficulties. When a problem is detected, the tape drive sets a flag on this page to identify the type of problem detected.	Section 8.3.4 on page 8-10
35h	**Tape History Log page.** This page reports statistics for the life of the tape currently loaded in the tape drive, including such information as number of blocks written, number of blocks read, and read and write retries.	Section 8.3.5 on page 8-13
39h	**Data Compression page.** This page reports the amount of data compressed or decompressed before and after read and write operations.	Section 8.3.6 on page 8-17
3Ch	**Drive Usage Information page.** This page reports tape drive lifetime totals for events such as the number of cartridge loads, number of blocks processed, power-on time, and cleaning cycles.	Section 8.3.7 on page 8-17
3Eh	**Drive Temperature page.** This page reports the most current temperature reading taken by the tape drive's internal sensor.	Section 8.3.8 on page 8-19

Bytes 05 and 06 – Parameter Pointer

This field specifies the Parameter Code of the first parameter to be returned for the requested page. As long as the value in the Allocation Length field is large enough, the tape drive returns all parameters with a Parameter Code greater than or equal to the code specified in this field.

The parameters are returned in Parameter Code order (unsigned). If the parameter specified does not exist, the tape drive returns the first available parameter following the specified parameter.

Notes:

- If you set the Page Code field to 00h (Supported Log Pages page), the Parameter Pointer field is ignored.
- If the value for the Parameter Pointer is greater than the Parameter Code for any of the parameters, the tape drive returns Check Condition status with the sense key set to Illegal Request (5h), the ASC set to 24h, the ASCQ set to 00h, and the Fault Symptom Code set to CEh.

Bytes 07 and 08 – Allocation Length

This field specifies the maximum number of bytes allocated by the initiator to receive the data transferred by the tape drive. Valid values are from 0 to FFFFh.

Table 8-3 lists the minimum Allocation Length required to return each supported page. Each LOG SENSE command can return only one log page.

Note: It is not an error to specify a value for the Allocation Length field that would truncate the information on one of the pages.

Table 8-3 *Minimum Allocation Length required for each supported log page*

Page Code	Description	Minimum Allocation Length[a]
00h	Supported Log Pages page	0Dh (13 bytes)
02h	Write Error Counters page	2Ch (44 bytes)
03h	Read Error Counters page	2Ch (44 bytes)
2Eh	TapeAlert page	144h (324 bytes)
30h	Compression Statistics page	2Ch (44 bytes)
31h	Tape Capacity page	24h (36 bytes)
36h	Environmental Counter page	33h (53 bytes)
37h	Tape Usage page	FCh (252 bytes)
39h	Tape Last FSC page	72h (114 bytes)

[a] The minimum Allocation Length for each page includes the 4-byte Parameter List Header, a Log Parameter Data Block for each parameter on the page, and the actual parameter values.

Byte 09, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for these bits. The value for these bits must be 0.

8.3 What the Tape Drive Returns

This section describes the log page format and the log pages supported by the tape drive. The LOG SENSE command returns the single log page specified in the Page Code field of the CDB.

Each log page begins with a four-byte Parameter List Header (bytes 00 through 03), followed by zero or more variable-length log parameters defined for that page. The Parameter List Header specifies the page code for the log parameter data being returned and indicates the total length of the data to follow.

Bit Byte	7	6	5	4	3	2	1	0
00	0	0	Page Code					
01	Reserved							
02	(MSB) Page Length							
03								(LSB)

Byte 00, Bits 5 through 0 – Page Code

This field identifies the type of LOG SENSE data being returned by the tape drive. The value returned for this field matches the Page Code specified in the CDB. Table 8-2 lists the log pages supported by the tape drive.

Bytes 02 and 03 – Page Length

This field indicates the total number of bytes that will follow this byte if the Allocation Length specified in the CDB is sufficient. The value returned for this field depends on the value specified for the Page Code and the Parameter Pointer in the CDB. Table 8-3 lists the maximum Page Length of each supported page.

8.3.1 Log Parameter Format

The tape drive returns the log parameters for the specified page immediately after it returns the Parameter List Header. For each parameter on the page, the tape drive returns a data block that includes four bytes of descriptive information and a variable-length parameter value. The total number of bytes returned for each parameter is equal to the value in the Parameter Length field plus four bytes for the Parameter List Header.

The tape drive returns the log parameter data blocks for the specified LOG SENSE page in Parameter Code order (unsigned). The code for the first parameter will be equal to or greater than the value specified for the Parameter Pointer field in the CDB.

<table>
<tr><th>Bit
Byte</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>00</td><td colspan="8" rowspan="2">(MSB)
Parameter Code
(LSB)</td></tr>
<tr><td>01</td></tr>
<tr><td>02</td><td>DU</td><td>DS</td><td>TSD</td><td>ETC</td><td colspan="2">TMC</td><td>RSVD</td><td>LP</td></tr>
<tr><td>03</td><td colspan="8">Parameter Length</td></tr>
<tr><td>04</td><td colspan="8" rowspan="3">(MSB)
Parameter Value
(LSB)</td></tr>
<tr><td>⋮</td></tr>
<tr><td>nn</td></tr>
</table>

Bytes 00 and 01 – Parameter Code

This field identifies the code of the parameter for which the tape drive is returning a value. See the following sections for a list of the parameter codes for each page.

Byte 02, Bit 7 – DU (Disable Update)

This field indicates whether updates to the current cumulative value for this parameter are enabled or disabled, as follows:

0 – The tape drive can update the current cumulative value, so comparisons between the current cumulative value and the threshold value occur normally.

1 – The tape drive will not update the current cumulative value, so threshold conditions will not be met for this parameter.

Byte 02, Bit 6 – DS (Disable Save)

Tape drive always returns 1 for this bit, indicating that the tape drive does not support the saving of log parameters.

Byte 02, Bit 5 – TSD (Target Save Disable)

The value for the Target Save Disable bit indicates whether the tape drive provides a self-defined method for saving log parameters, as follows:

0 – The tape drive provides a self-defined method for saving the current cumulative value for this counter. The counter is not reset when the tape drive is reset.

1 – The tape drive does not support saving the current cumulative value for this counter. The counter is reset when the tape drive is reset.

Byte 02, Bit 4 – ETC (Enable Threshold Comparison)

This field indicates whether threshold comparisons are enabled or disabled for this parameter:

0 – Threshold comparisons are disabled for this parameter.
1 – Threshold comparisons are performed on this parameter.

When threshold comparisons are enabled (and the DU bit is 0), the tape drive compares the current cumulative value to the threshold value for the parameter. When the conditions specified by the TMC bit are met, the tape drive returns Check Condition status with the sense key set to Unit Attention (6h), the ASC and ASCQ set to 5Bh and 01h, and the FSC set to CAh.

Threshold comparisons are made when the cumulative value is updated.

Byte 02, Bits 3 and 2 – TMC (Threshold Met Criteria)

This field indicates the condition under which the tape drive generated the Unit Attention (6h) sense key. Table 8-4 lists the valid values for the TMC field.

Table 8-4 *Valid values for the LOG SENSE Threshold Met Criteria (TMC) field*

TMC Value	Description
00b	Unit Attention resulted when the cumulative value was updated
01b	Unit Attention resulted when the updated cumulative value equaled the threshold value
10b	Unit Attention resulted when the updated cumulative value did not equal to the threshold value
11b	Unit Attention resulted when the updated cumulative value was greater than the threshold value

Note: If you want the tape drive to return Unit Attention to notify you about changes to the parameters, first issue a MODE SELECT command and send the Control Mode page (Page Code=0Ah) with the Report Log Exception Condition (RLEC) bit set to 1. Refer to Chapter 9 for more information.

Byte 02, Bit 0 – LP (List Parameter)

The value for this bit is always 0, indicating that the tape drive does not support List Parameters.

Byte 03 – Parameter Length

This field indicates the length of the threshold or cumulative value in bytes.

Bytes 04 to *nn* – Parameter Value

This field contains either a threshold value or a cumulative value for the parameter indicated by the Parameter Code field, depending on what you specified for the PC bit in the CDB.

8.3.2 Supported Log Pages Page (Page Code 00h)

The tape drive returns the Supported Log Pages page when the Page Code in the CDB is 00h. The value in the Page Length field (bytes 2 and 3) of the Parameter List Header for this page is 08h (9 bytes).

Unlike other LOG SENSE pages, no parameter information is returned on this page. Instead, the Supported Log Pages page lists the page codes for the LOG SENSE pages supported by the tape drive. The page codes are listed in ascending order, as follows:

Bit Byte	7	6	5	4	3	2	1	0
00	Supported Log Pages Page Code (00h)							
01	Write Error Counters Page Code (02h)							
02	Read Error Counters Page Code (03h)							
03	TapeAlert Page Code (2Eh)							
04	Tape History Log Page Code (35h)							
05	Data Compression Page Code (39h)							
06	Drive Usage Information Page Code (3Ch)							
07	Drive Temperature Page Code (Eh)							

8.3.3 WRITE ERROR COUNTERS PAGE (PAGE CODE 02h) READ ERROR COUNTERS PAGE (PAGE CODE 03h)

Setting the Page Code in the CDB to 02h (Write Error Counters page) or 03h (Read Error Counters page) causes the tape drive to return the Write Error Counters page or the Read Error Counters page, respectively. The value in the Page Length field (bytes 2 and 3) of the Parameter List Header for either of these pages is 28h (40 bytes).

Table 8-5 lists the parameters used to return information about the write or read error on the Write Error Counters page and the Read Error Counters page. The default cumulative value for each parameter is 00h. The default threshold value for each parameter is all FFs.

Table 8-5 *Parameters returned for LOG SENSE Write Error Counters page*

Parameter code	Parameter name	Description	Length (bytes)
0002h	Total Rewrites	This parameter indicates the number of physical blocks the tape drive rewrote because they contained errors detected during read-after-write operations. Only user data blocks and short filemark blocks are ever rewritten. The Total Rewrites counter is equivalent to the Total Errors Corrected counter. Thresholds, threshold criteria, and cumulative values always use these counters and reflect the last set value.	3
	Total Rereads	This parameter contains the number of times the tape drive moved the tape backward to reread a portion of tape because a block was missed.	3
0003h	Total Errors Corrected	**Write error.** Contains the same value as the Total Rewrites counter.	3
		Read error. This parameter contains the number of blocks corrected by using the ECC algorithm plus the number of blocks recovered by rereads.	3
0004h	Total Times Errors Processed	**Write error.** Always contains 0 since write errors are rewritten.	3
		Read error. The number of blocks corrected by using the ECC algorithm.	3
0005h	Total Bytes Processed	**Write error.** This parameter contains the number of bytes successfully written to the tape. This counter only includes user data bytes, the gap bytes in user data blocks, and the bytes in short filemark blocks. Rewritten data is not counted.	5
		Read error. The number of user bytes read from tape and transferred to the tape drive's data buffer. Rewritten data is not counted.	5
0006h	Total Unrecoverable Errors	**Write error.** The number of times the tape drive could not write a block to the tape after all retries.	2
		Read error. The number of times a block could not be read from tape after all retries.	2

8.3.4 TapeAlert Page (Page Code 2Eh)

The tape drive's internal TapeAlert firmware constantly monitors the tape drive and the tape for errors and potential difficulties. Any problems identified are flagged on the TapeAlert page. There are two methods of accessing this information:

- If TapeAlert is enabled using the MODE SELECT command (see Section 9.3.10), the tape drive returns a Recovered Error message to the initiator on the next SCSI command whenever one or more TapeAlert flags are set. A pending Recovered Error will be returned on the first successful SCSI command after the TapeAlert flag is set. The TapeAlert log page should be read immediately after the Recovered Error message is received.

  Note: The command which receives the Recovered Error message will have executed correctly and should not be reissued by the initiator.

- The host software can periodically read the TapeAlert log page to determine if any new flags have been set. If this method is used, the initiator should read the log page whenever any of the following occur:
  - Immediately after a SCSI Check Condition status followed by a REQUEST SENSE.
  - At the end of each tape when a job spans multiple tapes. If the data cartridge will be ejected, then the TapeAlert page must be read before the tape is unloaded.
  - At the completion of an operation.
  - Before a tape is unloaded.
  - At some regularly scheduled interval (for example, once a minute).

Setting the Page Code in the CDB to 2Eh causes the tape drive to return the TapeAlert log page. The value in the Page Length field (bytes 2 and 3) of the Parameter List Header for this page is 0140h (320 bytes).

Table 8-6 lists the TapeAlert flags defined in the TapeAlert standard. Each TapeAlert flag includes four bytes of descriptive information (see page 8-6), followed by a one-byte parameter value for the flag. Bit 0 of the parameter value contains the value for the flag, as follows:

0 – The flag is not currently set.
1 – The flag is currently set.

The remaining 7 bits of the flag are not used.

Note:

- Issuing a LOG SENSE command to return the TapeAlert page resets all of the flags to 0. The flags are also reset whenever the tape drive is reset or when the condition indicated by the flag is corrected.
- The tape drive returns all 64 flags defined in the TapeAlert standard and listed in Table 8-6. However, it does not use all of TapeAlert flags. Unused flags are set to 0.

Table 8-6 *Parameters returned for the LOG SENSE TapeAlert page*

Parameter	Flag name	Type[a]	Description
01h	Read	W	The tape drive is having problems reading data. No data has been lost, but there has been a reduction in the performance of the tape drive.
02h	Write	W	The tape drive is having problems writing data. No data has been lost, but there has been a reduction in the capacity of the tape.
03h	Hard Error	W	A hard read/write error has occurred. The current operation has stopped because the tape drive cannot correct an error that occurred while the tape drive was reading or writing data.
04h	Media	C	Media performance is severely degraded. Your data is at risk. To safeguard the data on this tape, do the following: ▪ Copy any data you want to preserve to another tape. ▪ Do not use this tape again. ▪ Restart the current operation using a different tape. **Note:** The Tape History Log (THL) option must be enabled in the tape drive's EEPROM.
05h	Read Failure	C	The tape drive can no longer read data from the tape. Either the tape is faulty or the tape drive is not operating correctly. ▪ Try reading data from a known good tape. If you can read this tape, replace the damaged tape. ▪ If the problem persists, contact Exabyte Technical Support.
06h	Write Failure	C	The tape drive can no longer write data to the tape. Either the tape is faulty or the tape drive is not operating correctly. ▪ Try writing data to a known good tape. If you can write to this tape, replace the faulty tape. ▪ If the problem persists, contact Exabyte Technical Support.
07h	Media Life	W	The tape is past its specified life cycle. The data cartridge has reached the end of its useful life. ▪ Copy any data you want to preserve to another tape. ▪ Do not use this tape again.
08h	Not Data Grade	W	The tape drive cannot read the MRS stripes on the tape. The tape is not data-grade. Any data you back up onto the tape is at risk. Replace the cartridge with one containing data-grade tape.

Table 8-6 *Parameters returned for the LOG SENSE TapeAlert page (continued)*

Parameter	Flag name	Type[a]	Description
09h	Write Protect	C	The initiator attempted to write to a write-protected data cartridge. Remove the write protection or use another cartridge.
0Ah	No Removal	I	A data cartridge unload operation was attempted while the initiator was preventing media removal.
0Bh	Cleaning Media	I	A cleaning cartridge is currently in the tape drive. If you want to back up or restore, insert a data cartridge.
0Ch	Unsupported Format	I	The loaded tape contains data in an unsupported format.
0Dh	Snapped Tape	C	The data cartridge in the tape drive contains a broken tape. ▪ Discard the data cartridge. ▪ Restart the current operation with a different tape.
0Eh – 13h	Unassigned Read/Write condition	—	Not used.
14h	Clean Now	C	The tape drive needs cleaning. ▪ If the tape drive is not currently in use, eject any data cartridge and insert a cleaning cartridge to clean the tape drive. ▪ If the tape drive is in use, wait until the current operation is complete, then insert a cleaning cartridge to clean the tape drive. **Note:** This flag does not normally occur if you are using AME with SmartClean cartridges exclusively in your tape drive.
15h	Clean Periodic	W	The tape drive needs to be cleaned at the next opportunity. **Note:** This flag does not normally occur if you are using AME with SmartClean cartridges exclusively in your tape drive.
16h	Expired Cleaning Media	C	The cleaning cartridge that was inserted into the tape drive is used up. Use a new cleaning cartridge to clean the tape drive.
17h – 1Dh	Unassigned Cleaning Flag	—	Not used.
1Eh	Hardware A	C	The tape drive has a problem that is not read/write related. ▪ Reset the tape drive. ▪ Restart the operation. ▪ If the problem persists, contact Exabyte Technical Support.
1Fh	Hardware B	C	The tape drive has a problem that is not read/write related. ▪ Turn the tape drive off and then on again. ▪ Restart the operation. ▪ If the problem persists, contact Exabyte Technical Support.

Table 8-6 Parameters returned for the LOG SENSE TapeAlert page (continued)

Parameter	Flag name	Type[a]	Description
20h	Interface	W	There is a problem in the SCSI interface between the initiator and the tape drive. ▪ Check all of the SCSI cables and connections. ▪ Restart the operation.
21h	Eject Media	C	The current operation has failed. ▪ Eject the current data cartridge, then reload it. ▪ Restart the operation.
22h	Download Fail	W	The last attempt to download new firmware has failed. Obtain the correct firmware and try again.
23h – 27h	Unassigned Hardware Failure		Not used.
28h – 31h	Library Error		Not used.
32h – 40h	Unassigned		Not used.

[a] I = Informational suggestion to user.
W = Warning. Remedial action is advised. Performance of data may be at risk.
C = Critical. Immediate remedial action is required.

8.3.5 TAPE HISTORY LOG PAGE (PAGE CODE 35h)

The values of the counters on this page are statistics from the life of the tape currently loaded in the tape drive. When a tape is loaded, these values are refreshed from the values found in the tape's Tape History Log (THL) entries. These numbers apply to the whole tape and are not specific to the current partition. If the cartridge is write protected, then the THL values on the tape and on this page will not be updated.

The values of these counters will not roll. If a counter reaches its maximum count, it remains at this value. Thus, a 1-byte counter stops counting at FFh and will never roll back to zero. A counter is not likely to reach its maximum count before the tape exceeds its useful life.

Notes:

- The Tape History Log page is not supported by the LOG SELECT command. You cannot set thresholds for the parameters on this page or clear them.
- By default, the Tape History Log page is enabled in the EEPROM. Enabling the Tape History Log page requires updating the EEPROM firmware.
- If the Tape History Log option is disabled, the Previous and Lifetime counters on this page return 0. The Tape ID and Current counters will report normally.

Setting the Page Code in the CDB to 35h causes the tape drive to return the information about the parameters listed in Table 8-7.

Table 8-7 *Parameters returned on the Tape History Log page*

Parameter code	Parameter name	Parameter length (bytes)
01h	Tape ID	8
02h	Current Blocks Written	4
03h	Current Blocks Rewritten	4
04h	Current Blocks Read	4
05h	Current Blocks ECC'd	4
06h	Current Write Retries	2
07h	Current Read Retries	2
08h	Current Tracking Retries	2
09h	Current Data Underruns	2
0Ah	Current Data Overruns	2
0Bh	Current Rewinds	2
0Ch	Current Max Temperature	1
0Dh	Current Drive Serial Number	4
0Eh	Previous Blocks Written	4
0Fh	Previous Blocks Rewritten	4
10h	Previous Blocks Read	4
11h	Previous Blocks ECC'd	4
12h	Previous Write Retries	2
13h	Previous Read Retries	2
14h	Previous Tracking Retries	2
15h	Previous Data Underruns	2
16h	Previous Data Overruns	2
17h	Previous Rewinds	2
18h	Previous Max Temperature	1
19h	Previous Drive Serial Number	4
1Ah	Lifetime Blocks Written	5
1Bh	Lifetime Blocks Rewritten	5
1Ch	Lifetime Blocks Read	5
1Dh	Lifetime Blocks ECC'd	5

Table 8-7 *Parameters returned on the Tape History Log page (continued)*

Parameter code	Parameter name	Parameter length (bytes)
1Eh	Lifetime Write Retries	4
1Fh	Lifetime Read Retries	4
20h	Lifetime Tracking Retries	4
21h	Lifetime Data Underruns	4
22h	Lifetime Data Overruns	4
23h	Lifetime Rewinds	4
24h	Lifetime Max Temperature	1
25h	Lifetime Load Count	4
26h	Lifetime Maximum Tape Pass Count	4
27h	Lifetime SmartClean Cycles	4

Tape ID This field contains the unique identifier for the tape currently loaded in the tape drive. The Tape ID is created the first time a blank tape is written. It is unaffected by all normal read and write activity, including the SCSI ERASE command. Reformatting a previously written tape will create a new Tape ID if the new format is different from the previous format. The 8-byte ID is derived from the serial number and lifetime load count of the tape drive that first wrote to the tape.

In the following parameter descriptions, the same counters appear in three different forms: Current, Previous, and Lifetime. The parameter being accumulated in each counter is the same, regardless of whether it is Current, Previous, or Lifetime. The three forms of the counter are defined as follows:

- **Current** – Contains count values occurring since the current tape was loaded.
- **Previous** – Contains count values from the last use of this tape.
- **Lifetime** – Contains the count values accumulated over the entire lifetime of this tape, excluding the current load session.

Note: The Lifetime values for the Blocks Written, Blocks Rewritten, Blocks Read, and Blocks ECC'd counters are internally scaled. Therefore, the low order bits for values reported on this page may lose significance.

Blocks Written This field contains a count of the total number of physical blocks written to tape.

Blocks Rewritten This field contains a count of the total number of physical blocks rewritten to tape because of errors detected during the read-after-write operation.

Blocks Read This field contains a count of the number of physical blocks the tape drive has read from tape. This number may exceed the number of blocks transferred to the host due to read-ahead mechanisms used in read and search modes.

Blocks ECC'd This field contains a count of the number of physical blocks read from tape which required error correction by the tape drive.

Write Retries This field is a counter that increments whenever a write operation is unsuccessful and a recovery/retry operation is performed.

Read Retries This field is a counter that increments whenever a read operation is unsuccessful and a recovery/retry operation is performed.

Tracking Retries This field is a counter that increments when a tracking error occurs during tape motion start-up.

Data Underruns This field is a counter that increments whenever the tape drive repositions the tape after encountering an empty data buffer during a write operation. This indicates that the initiator is not transferring data fast enough to maintain streaming operation.

Data Overruns This field is a counter that increments whenever the tape drive repositions the tape after encountering a full data buffer during a read operation. This indicates that the initiator is not transferring data fast enough to maintain streaming operation.

Rewinds This field contains a count of the number of rewind operations performed by the tape drive.

Maximum Temperature This field indicates the highest temperature recorded by the tape drive's tape path temperature sensor. The value is reported in degrees Celsius.

Load Count This field contains a cumulative count of the number of times this data cartridge has been loaded during its lifetime.

Lifetime Maximum Tape Pass Count This field is a counter that increments for each tape pass over the lifetime of the tape. When the count reaches 20,000 (4E20h), the tape drive sets parameter code 07h on the TapeAlert Log page (see Table 8-6).

Lifetime SmartClean Cycles This field is a counter that increments for each time the tape drive executes an automatic cleaning cycle using an AME cartridge with SmartClean.

8.3.6 Data Compression Page (Page Code 39h)

Setting the Page Code in the CDB to 39h causes the tape drive to return information about the parameters listed in Table 8-8.

Table 8-8 *Parameters returned for LOG SENSE Data Compression page*

Parameter code	Parameter name	Parameter length (bytes)	Default cumulative value	Default threshold value
0005h	KB of Data Transferred to Data Compressor	6	0	all FFs
0007h	KB of Data Transferred to Tape	6	0	all FFs

KB of Data Transferred to Data Compressor Indicates the amount of data, in KB, that was compressed during a write operation.

KB of Data Transferred to Tape Indicates the amount of compressed data, in KB, that was written to tape.

8.3.7 Drive Usage Information Page (Page Code 3Ch)

Setting the Page Code in the CDB to 3Ch causes the tape drive to return information about the parameters listed in Table 8-9. These parameters provide lifetime statistics for the tape drive. If a counter reaches its maximum value, it will remain at that value and not roll back to zero.

Note: The Drive Usage Information page is not supported by the LOG SELECT command. You cannot set thresholds for the parameters on this page or clear them.

Table 8-9 *Parameters returned on the Drive Usage Information page*

Parameter code	Parameter name	Parameter Length (bytes)
0001h	Total Blocks Written	8
0002h	Total Blocks Rewritten	8
0003h	Total Blocks Read	8
0004h	Total ECC Corrections	8
0005h	Total Blocks Reread	8
0006h	Total Load Count	3
0007h	Minutes Since Last Clean	3
0008h	Minutes of Powered Time	3
0009h	Minutes of Tensioned Time	3
000Ah	Cleaning Count	2

Table 8-9 *Parameters returned on the Drive Usage Information page (continued)*

Parameter code	Parameter name	Parameter Length (bytes)
000Bh	Vendor Unique	2
000Ch	Vendor Unique	2
000Dh	Vendor Unique	2
000Eh	Vendor Unique	2
000Fh	Vendor Unique	2
0010h	Vendor Unique	2
0011h	Time to Clean	1
0012h	Vendor Unique	1
0013h	reserved	3
0014h	reserved	3

Total Blocks Written This parameter indicates the total number of physical blocks the tape drive has written to tape during its lifetime.

Total Blocks Rewritten This parameter indicates the total number of physical blocks the tape drive has rewritten during its lifetime.

Total Blocks Read This parameter indicates the total number of physical blocks the tape drive has read from tape during its lifetime.

Total ECC Corrections This parameter indicates the total number of physical blocks the tape drive has read from tape that required ECC correction during its lifetime.

Total Blocks Reread This parameter indicates the total number of physical blocks the tape drive has reread during its lifetime.

Total Load Count This parameter indicates the total number of load cycles the tape drive's cartridge loader has performed during its lifetime.

Minutes Since Last Clean This parameter indicates the number of tape motion minutes since the tape drive was last cleaned.

Minutes of Powered Time This parameter indicates the total number of minutes the tape drive has been powered on during its lifetime.

Minutes of Tensioned Time This parameter indicates the total number of minutes a tape has been tensioned in the tape path during the tape drive's lifetime.

Cleaning Count This parameter indicates the total number of cleaning cycles the tape drive has undergone during its lifetime. Count includes cleaning operations using AME with SmartClean cartridges and standard AME cleaning cartridges.

Time to Clean This parameter indicates whether the tape drive needs cleaning. Bit 1 of this byte is always set to 1, indicating that the tape drive dynamically updates bit 0 of this parameter. If bit 0 is set to 1, the tape drive needs to be cleaned.

8.3.8 DRIVE TEMPERATURE PAGE (PAGE CODE 3Eh)

Setting the Page Code in the CDB to 3Eh causes the tape drive to return information about the parameters listed in Table 8-10.

Note: The Drive Temperature page is not supported by the LOG SELECT command. You cannot set thresholds for the Drive Temperature sensor or clear it.

Table 8-10 *Parameters returned for LOG SENSE Drive Temperature page*

Parameter code	Parameter name	Parameter length (bytes)
0001h	Drive Temperature	1

Drive Temperature This parameter indicates the most recent temperature reading taken by the tape drive's internal sensor in degrees Celsius.

8.4 Exceptions and Error Conditions

Table 8-11 lists the exceptions and error conditions that cause the tape drive to return Check Condition status for the LOG SELECT command. See Appendix A for additional information about these errors.

Table 8-11 *REQUEST SENSE data for LOG SENSE command errors and exceptions*

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Explanation
24h	00h	5h	**Illegal Request.** Invalid field in CDB. This error is a result of any of the following: ▪ The PPC bit is not 0. ▪ The SP bit is set to 1. ▪ The Page Code field does not contain a valid value (see Table 8-2). ▪ The value for the Parameter Pointer is greater than the value for Parameter Code for any of the parameters.
3Ah	00h	2h	**Not Ready.** Tape drive is not ready. Command requires a tape, and no tape is present.
5Bh	01h	6h	**Unit Attention.** Log threshold met (a cumulative counter reached its maximum value of all FFs).

9

MODE SELECT (15h, 55h)

6-Byte MODE SELECT (15h)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	0	1	0	1
01	Logical Unit Number			PF	Reserved			SP
02	Reserved							
03								
04	Parameter List Length							
05	Vendor Unique		Reserved				0	0

10-Byte MODE SELECT (55h)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	1	0	1	0	1	0	1
01	Logical Unit Number			PF	Reserved			SP
02 ⋮ 06	Reserved							
07	(MSB) Parameter List Length							
08								(LSB)
09	Vendor Unique		Reserved				0	0

9.1 About This Command

The MODE SELECT command allows the initiator to specify medium, logical unit, and device parameters. These parameters apply to all initiators in a multi-initiator environment.

The tape drive supports both the 6-byte and the 10-byte format of the MODE SELECT CDB (command descriptor block). The 6-byte and 10-byte CDBs for the MODE SELECT command have different operation codes (Op codes), as shown in Table 9-1. The tape drive determines which version of the command is being used based on the Op code in the CDB.

Figure 9-1 *Operation Codes for MODE SELECT and MODE SENSE*

	6-byte CDB Op code	10-byte CDB Op code
MODE SELECT	15h	55h

The MODE SELECT parameters can be structured in either of two formats: *non-page format* or *page format*.

Non-Page Format

In non-page format, the parameters after the Block Descriptor are vendor unique (SCSI-1 format). The parameters are transferred in the following order:

- Parameter List Header
- Block Descriptor (optional)
- One to five bytes of vendor-unique parameters

Page Format

In page format, the parameters after the Block Descriptor are structured as pages of related parameters (SCSI-2 format). The parameters are transferred in the following order:

- Parameter List Header
- Block Descriptor (optional)
- One or more available pages of related parameters

9.2 CDB FIELD DEFINITIONS

Byte 01, Bit 4 – PF (Page Format)

This field indicates which format is used for the MODE SELECT parameters, as follows:

0 – Parameters after the Block Descriptor are vendor specific (non-page format)

1 – Parameters after the Block Descriptor are structured as pages of related parameters (page format)

Byte 01, Bit 0 – SP (Saved Page)

The tape drive does not support the saved page function. The valid value for this bit is 0.

Byte 04 (6-Byte CDB) or Bytes 07 and 08 (10-Byte CDB) – Parameter List Length

This field indicates the total number of bytes to be transferred from the initiator to the tape drive, as follows:

- For non-page format (PF=0), the Parameter List Length can contain values ranging from 00h to 11h (for the 6-byte CDB) or from 00h to 15h (for the 10-byte CDB).

- For page format (PF=1), all parameters after the Block Descriptor are transferred as pages of parameters. To determine the Parameter List Length, total the number of bytes contained in the Parameter List Header, the Block Descriptor (if you are sending it), and all of the parameter pages you are sending. The maximum value you can specify is FFh (for the 6-byte CDB) or FFFFh (for the 10-byte CDB).

Note: When the value for the Parameter List Length is 0, no data is transferred from the initiator. A value of 0 is not an error.

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for these bits. The valid value for these bits is 0.

9.3 Mode Parameter Data

With each MODE SELECT CDB, you send a parameter list for each page on which you are changing values. Each parameter list begins with a Parameter List Header that identifies the parameter page being sent and indicates the number of bytes that follow the header as mode parameters. Immediately following the Parameter List Header is an optional Block Descriptor, followed by the list of values for each parameter on the page that you want to change.

Note: The total number of bytes in the parameter list equals the Page Length of the parameter page, plus four bytes for the Parameter List Header. The sum of the bytes in all the parameter lists must equal the value specified for the Parameter List Length in the CDB.

Restrictions for sending MODE SELECT parameters:

- For non-page format, valid transfer lengths for the vendor-unique parameters are 0, 1, 2, 3, 4, and 5 bytes. All transfers of the vendor-unique parameters start with byte 0.
- For data transfers greater than 0 bytes, the entire Parameter List Header must be transferred before the Block Descriptor or any parameter page or vendor-unique parameters.
- The Block Descriptor and any parameter pages must be transferred in their entirety; partial transfers of these data segments are not allowed.

  Note: Any value for the Parameter List Length that causes the Parameter List Header, Block Descriptor, or one of the parameter pages to be truncated will terminate the command with Check Condition status. The sense key will be set to Illegal Request and the Additional Sense Code will be set to Parameter List Length Error.

9.3.1 Parameter List Header

The format of the Parameter List Header depends on which version of the MODE SELECT command you are using (6-byte or 10-byte CDB).

Parameter List Header, 6-Byte CDB

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved							
01								
02	RSVD	Buffered Mode			Speed			
03	Block Descriptor Length							

Parameter List Header, 10-Byte CDB

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved							
01								
02								
03	RSVD	Buffered Mode			Speed			
04	Reserved							
05								
06	(MSB) Block Descriptor Length							
07								(LSB)

Byte 02, Bits 6 through 4 (6-Byte CDB) or Byte 03, Bits 6 through 4 (10-Byte CDB) – Buffered Mode

This field specifies the data transfer mode to be used by the tape drive. The tape drive supports two data transfer modes:

000b – Unbuffered mode
001b – Buffered mode (power-on default)

In buffered mode, data from a WRITE command and filemarks or setmarks from a WRITE FILEMARKS command are held in the tape drive's buffer until one of the following events causes the data, filemarks, or setmarks to be written to the tape:

- The motion threshold is reached (see page 2-7).
- The tape drive receives one of the following commands:
  - REWIND (01h)
  - WRITE FILEMARKS (10h) non-immediate
  - SPACE (11h) in either direction
  - ERASE (19h)
  - LOAD/UNLOAD (1Bh)
  - LOCATE (2Bh)
- The operator presses the unload button.
- The time specified for the Write Delay Time field in the Device Configuration Page elapses (note, however, if the Write Delay Time field is 0, a partially full buffer is not flushed to tape). See page 9-21 for more information about the Write Delay Time field.
- The tape drive receives a Bus Device Reset message or a SCSI bus reset occurs.

In buffered mode, status is returned when the last block of data has been transferred to the tape drive's buffer. In unbuffered mode, status is returned only after the data has actually been written to the tape.

Byte 02, Bits 3 through 0 (6-Byte CDB) or
Byte 03, Bits 3 through 0 (10-Byte CDB) – Speed

The tape drive does not support any operations at different speeds. All operations have a defined speed that cannot be modified by this command. The valid value for this field is 0.

Byte 03 (6-Byte CDB) or Bytes 06 and 07 (10-Byte CDB) – Block Descriptor Length

This field specifies the length of the Block Descriptor in bytes. The tape drive does not support multiple block descriptions. The valid value for this field is 00h (for no Block Descriptor) or 08h (for the entire Block Descriptor).

9.3.2 BLOCK DESCRIPTOR

The optional Block Descriptor defines the data format and other format characteristics to be used by the tape drive when it writes data.

Bit / Byte	7	6	5	4	3	2	1	0
00	Density Code							
01	(MSB)							
02	Number of Blocks							
03								(LSB)
04	Reserved							
05	(MSB)							
06	Block Length							
07								(LSB)

Byte 00 – Density Code

This field specifies the format the tape drive will use to read or write data.

Because the M2 tape drive writes data in Mammoth-2 format only, you do not need to change the Density Code to write data. When reading data, the tape drive automatically detects the format of the data on the tape and sets the Density Code accordingly. Therefore, you also do not need to change the Density Code to read data.

If you choose to send a Density Code to the tape drive, refer to Table 9-1 for the values you can use and their results.

Table 9-1 *Values for the Density Code field in the MODE SELECT command*

Density code	Data format used	Notes
00h	Default format	You can use this Density Code at LBOT if you want to write or read in the default format (Mammoth-2 format). If the tape is not at LBOT, the tape drive ignores this Density Code.
7Fh	No change in format	You can use this Density Code if you do not want to change the tape format. The format will remain the same as it was before the MODE SELECT command was sent to the tape drive. If the tape is not at LBOT, you must use either 7Fh or the Density Code reported by the MODE SENSE command.
27h	Mammoth-1 format	You can use this Density Code to read Mammoth-1 format.
28h	Mammoth-2 format	You can use this Density Code (or 00h) if you want to write or read Mammoth-2 format.

Bytes 01 through 03 – Number of Blocks

This field indicates the total capacity of the tape in approximately 33-KB physical units (LBOT to LEOT). The tape drive ignores this field in the MODE SELECT data.

Bytes 05 through 07 – Block Length

This field indicates the length of each logical block, in bytes, when the Fixed bit is set for the READ, VERIFY, and WRITE commands. When the Block Length is non-zero, fixed-length block operations are allowed. When the Block Length is 0, only variable-length block operations are allowed.

Note: If the Block Length is 0, the SILI bit in the READ command suppresses illegal length indications for both underlength and overlength reads. If the Block Length is non-zero, the SILI bit of the READ command suppresses illegal length indications only for blocks shorter than requested. See page 12-2 for more information.

The power-on default value for the block length is 400h (1,024) bytes. The limit on the block length is the maximum block length specified by the Read Block Limits data (see Chapter 13).

9.3.3 Vendor-Unique Parameters (Non-Page Format)

Bit / Byte	7	6	5	4	3	2	1	0
00	CT	RSVD	ND	RSVD	NBE	EBD	PE	NAL
01	Reserved							112m
02	Motion Threshold							
03	Reconnect Threshold							
04	Gap Threshold							

Byte 00, Bit 7 – CT (Cartridge Type)

This bit is ignored by the tape drive.

Byte 00, Bit 5 – ND (No Disconnect During Data Transfer)

This field indicates whether the tape drive can disconnect from the initiator during the data transfer phase, as follows:

0 – The tape drive can disconnect during the data transfer phase (power-on default).

1 – The tape drive will not disconnect until the data transfer phase has completed or the entire command has completed, as determined by the DTDC field in the Disconnect-Reconnect Page (see page 9-14).

Byte 00, Bit 3 – NBE (No Busy Enable)

This bit is ignored by the tape drive.

Byte 00, Bit 2 – EBD (Even Byte Disconnect)

The tape drive ignores this bit in the MODE SELECT command because the tape drive always disconnects at 4-byte boundaries between data phases.

Note: Even-byte disconnect applies only when more data is to be transferred for the current command. If no more data is to be transferred, a disconnect may occur on an odd-byte boundary.

Byte 00, Bit 1 – PE (Parity Enable)

This field indicates whether parity checking on the SCSI bus is enabled, as follows:

0 – Parity checking disabled.
1 – Parity checking enabled. (Power-on default)

When PE=1, every byte received by the tape drive is checked for parity.

Byte 00, Bit 0 – NAL (No Auto Load)

This field indicates whether the automatic loading of the tape into the tape path is disabled when a data cartridge is inserted into the tape drive:

0 – Auto loading enabled. (Power-on default)
1 – Auto loading disabled.

Byte 01, Bit 0 – 112m

This bit is ignored by the tape drive.

Byte 02 – Motion Threshold

This field indicates the amount of data that must be in the buffer before tape motion is started for a buffered write or read operation. The value represents a percentage of the buffer space. Each 1h equals 0.39% of the buffer. The power-on default value is 80h, which represents one half of the buffer. The tape drive automatically adjusts this value (auto-thresholding) based on the data transfer rate of the host. See page 2-7 for more information about auto-thresholding and the Motion Threshold.

Note: The tape drive returns 00h for this field if auto-thresholding is enabled.

Byte 03 – Reconnect Threshold

This field indicates the amount of data that must be in the buffer before the tape drive reconnects to the initiator for a buffered write or read operation. The value represents a percentage of the buffer space. Each 1h equals 0.39% of the buffer. The power-on default value is 80h, which represents one half of the buffer. By default, the tape drive automatically adjusts this value (auto-thresholding) based on the data transfer rate of the host. See page 2-7 for more information about auto-thresholding and the Reconnect Threshold.

Note: The tape drive returns 00h for this field if auto-thresholding is enabled.

Byte 04 – Gap Threshold

This field specifies the maximum number of consecutive gap blocks that the tape drive will write on the current track while determining whether an empty buffer exists during a write operation. A gap block is a 33-KB block of undefined data that cannot be accessed by any SCSI command.

Valid values for the Gap Threshold byte are 00h to FFh. The default value is 00h. Any value greater than 07h is treated as 07h.

After writing the number of gap blocks specified by this byte, the tape drive will either continue the write operation (if there is new data in the buffer) or begin the process to stop tape motion (if the buffer is still empty). Before actually stopping tape motion, the tape drive writes additional gap blocks to complete the current track and then writes one or two complete gap tracks.

The Gap Threshold byte should be changed only when the host's average data transfer rate is slow and is impacting the capacity of the tape by forcing excessive start/stop activity. The Gap Threshold byte should be used in combination with the motion and reconnect thresholds described in this section.

9.3.4 Read-Write Error Recovery Page (Page Code 01h)

The Read-Write Error Recovery page specifies error recovery parameters used during read-write operations.

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code					
01	Page Length							
02	Reserved		TB	RSVD	EER	PER	DTE	DCR
03	Read Retry Count							
04 ⋮ 07	Reserved							
08	Write Retry Count							
09 ⋮ 11	Reserved							

Byte 00, Bits 5 through 0 – Page Code

The value for this field is 01h, identifying the current page as the Read-Write Error Recovery page.

Byte 01 – Page Length

This field indicates the number of bytes in the Read-Write Error Recovery page that follow this byte. The valid value is 0Ah.

Byte 02, Bit 5 – TB (Transfer Block)

The TB bit is not supported by the tape drive. The valid value is 0.

Byte 02, Bit 3 – EER (Enable Early Recovery)

The EER bit is not supported by the tape drive. The valid value is 0.

Byte 02, Bit 2 – PER (Post Error)

The PER bit is not supported by the tape drive. The valid value is 0.

Byte 02, Bit 1 – DTE (Disable Transfer on Error)

The DTE bit is not supported by the tape drive. The valid value is 0.

Byte 02, Bit 0 – DCR (Disable Correction)

The DCR bit is not supported by the tape drive. The valid value is 0.

Byte 03 – Read Retry Count

This field specifies how many times the tape drive attempts its read recovery algorithms before an unrecoverable read error is reported. If the tape drive fails to reread the block after this number of attempts, it reports an unrecoverable error. You can set the Read Retry Count to any value between 00h and FFh. The default is 0Bh. Any value greater than 0Bh is automatically set to 0Bh.

The value you specify for the Read Retry Count determines what operation the tape drive performs when it encounters an unreadable data block, as follows:

- If you specify 00h for this byte, the tape drive does not attempt any rereads before reporting an unrecoverable read error and continuing with the read operation.

- If you specify 01h to 0Bh for this byte, the tape drive attempts its read recovery algorithm for either the default number of times or the number specified by this byte, whichever is smaller, before reporting an unrecoverable read error and continuing with the read operation.

Note: If you are reading a tape that may have been written without retries (see "Write Retry Count"), issue a MODE SENSE command and check the value returned for the WWR (Write Without Retries) bit in the Vendor Unique Parameters Page 2. If the WWR bit is set to 1, specify 0 for this field; otherwise, specify a non-zero value.

Byte 08 – Write Retry Count

This field specifies how many times the tape drive should rewrite a physical block before a recovery is attempted. The value for this field can only be changed when the tape is positioned at LBOT. You can set the Write Retry Count to any value between 00h and FFh. The default value is 0Bh. Specify any other nonzero value to set the Write Retry Count to 0Bh.

9.3.5 Disconnect-Reconnect Page (Page Code 02h)

The Disconnect-Reconnect page specifies parameters that control how the tape drive disconnects and reconnects during data transfers.

<table>
<tr><th>Bit
Byte</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>00</td><td colspan="2">Reserved</td><td colspan="6">Page Code</td></tr>
<tr><td>01</td><td colspan="8">Page Length</td></tr>
<tr><td>02</td><td colspan="8">Buffer Full Ratio</td></tr>
<tr><td>03</td><td colspan="8">Buffer Empty Ratio</td></tr>
<tr><td>04</td><td colspan="8" rowspan="2">(MSB)
Bus Inactivity Limit
(LSB)</td></tr>
<tr><td>05</td></tr>
<tr><td>06</td><td colspan="8" rowspan="2">(MSB)
Disconnect Time Limit
(LSB)</td></tr>
<tr><td>07</td></tr>
<tr><td>08</td><td colspan="8" rowspan="2">(MSB)
Connect Time Limit
(LSB)</td></tr>
<tr><td>09</td></tr>
<tr><td>10</td><td colspan="8" rowspan="2">(MSB)
Maximum Burst Size
(LSB)</td></tr>
<tr><td>11</td></tr>
<tr><td>12</td><td colspan="4">Reserved</td><td>DImm</td><td>RSVD</td><td colspan="2">DTDC</td></tr>
<tr><td>13</td><td colspan="8" rowspan="3">Reserved</td></tr>
<tr><td>14</td></tr>
<tr><td>15</td></tr>
</table>

Byte 00, Bits 5 through 0 – Page Code

The value for this field is 02h, identifying the current page as the Disconnect-Reconnect page.

Byte 01 – Page Length

This field indicates the number of bytes in the Disconnect-Reconnect page that follow this byte. The valid value is 0Eh.

Byte 02 – Buffer Full Ratio

This field indicates the amount of data that must be present in the buffer during a buffered read operation before the tape drive will attempt to reconnect to the initiator. The value represents a percentage of the buffer space. Each 1h equals 0.39% of the buffer. The power-on default value is 80h, which represents one half of the buffer. By default, the tape drive automatically adjusts this value (auto-thresholding) based on the data transfer rate of the host.

The Buffer Full Ratio must equal the Buffer Empty Ratio. If these values are not equal, the tape drive returns Check Condition status with the sense key set to Illegal Request (5h).

Byte 03 – Buffer Empty Ratio

This field indicates how empty the buffer must be during a buffered write operation before the tape drive will attempt to reconnect to the initiator. The value represents a percentage of the buffer space. Each 1h equals 0.39% of the buffer. The power-on default value is 80h, which represents one half of the buffer. By default, the tape drive automatically adjusts this value (auto-thresholding) based on the data transfer rate of the host.

The Buffer Empty Ratio must equal the Buffer Full Ratio. If these values are not equal, the tape drive returns Check Condition status with the sense key set to Illegal Request (5h).

Note: The Buffer Full Ratio and the Buffer Empty Ratio are equivalent to the Reconnect Threshold byte in the vendor-unique parameters (non-page format). See page 2-7 for information about auto-thresholding and the Reconnect Threshold.

Bytes 04 and 05 – Bus Inactivity Limit

This field indicates the maximum amount of time in 100-microsecond increments that the tape drive can assert a BSY signal without a REQ/ACK handshake. When this time is exceeded, the tape drive can disconnect if not restricted by the DTDC field. The only supported value is 00h, which means that there is no time limit and the tape drive will disconnect as soon as it can.

Bytes 06 and 07 – Disconnect Time Limit

This field indicates the minimum amount of time in 100-microsecond increments that the tape drive must wait after going bus free before attempting reselection. A value of 00h means that there is no time limit and the tape drive can reselect immediately upon bus free. The power-on default is 00h.

Bytes 08 and 09 – Connect Time Limit

This field indicates the maximum amount of time that the tape drive can use the SCSI bus before it must disconnect. This value must be 00h, meaning that there is no time limit.

Bytes 10 and 11 – Maximum Burst Size

This field specifies the amount of data, in 512-byte increments, that the tape drive can transfer before it must disconnect. The tape drive supports all values for this field. The default is 0, which means that there is no limit.

Byte 12, Bit 3 – DImm (Disconnect Immediate)

This field indicates whether the tape drive will attempt to disconnect immediately after every Command phase, as follows:

0 – The tape drive may attempt to disconnect after a Command phase, based on the setting of the DiscPriv bit in the Identify message and the settings of the other parameters on this page.

1 – The tape drive will attempt to disconnect after a Command phase if allowed and if internal processing would result in extended bus idle time. (Power-on default)

Byte 12, Bits 1 and 0 – DTDC (Data Transfer Disconnect Control)

This field indicates how the tape drive performs a disconnect when the ND bit is set to 1 (see page 9-30). Table 9-2 lists the valid values for this field.

Table 9-2 *Valid values for the MODE SELECT DTDC field*

DTDC Value	Description
00b	Disconnects are not controlled by the DTDC field. Disconnects are controlled by the other fields on this page. (Power-on default)
01b	Once the data transfer of a command has started, the tape drive should not disconnect until all of the data has been transferred. The Maximum Burst Size (bytes 10 and 11) must be set to 0.
10b	Not valid.
11b	Once the data transfer of a command has started, the tape drive should not disconnect until the command is complete. The Maximum Burst Size (bytes 10 and 11) must be set to 0.

Note: The settings of the DTDC and ND fields are linked. If you change the setting of one, the other will be set accordingly.

9.3.6 Control Mode Page (Page Code 0Ah)

The Control Mode page specifies whether the tape drive returns Check Condition status when one of its write and read error counters reaches a specified threshold. For information about using the LOG SELECT command to set threshold values for the tape drive's write and read error counters, refer to Chapter 7.

<table>
<tr><th>Bit
Byte</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>00</td><td colspan="2">RSVD</td><td colspan="6">Page Code</td></tr>
<tr><td>01</td><td colspan="8">Page Length</td></tr>
<tr><td>02</td><td colspan="7">RSVD</td><td>RLEC</td></tr>
<tr><td>03</td><td colspan="4">Queue Algorithm Modifier</td><td colspan="2">Reserved</td><td>QErr</td><td>DQue</td></tr>
<tr><td>04</td><td>EECA</td><td colspan="4">Reserved</td><td>RAENP</td><td>UAAENP</td><td>EAENP</td></tr>
<tr><td>05</td><td colspan="8">Reserved</td></tr>
<tr><td>06</td><td colspan="8" rowspan="2">(MSB)
Ready AEN Holdoff Period
(LSB)</td></tr>
<tr><td>07</td></tr>
</table>

Byte 00, Bits 5 through 1 – Page Code

The value for this field is 0Ah, identifying the current page as the Control Mode page.

Byte 01 – Page Length

This field indicates the number of bytes in the Control Mode page that follow this byte. The valid value is 06h.

Byte 02, Bit 0 – RLEC (Report Log Exception Condition)

This field indicates whether the tape drive returns Check Condition status with the sense key set to Unit Attention (6h) when one of its write and read error counters reaches a specified threshold, as follows:

0 – Do not return Unit Attention when a threshold condition is met.
1 – Return Unit Attention when a threshold condition is met.

Byte 03, Bits 7 through 4 – Queue Algorithm Modifier

The tape drive does not support the Simple Queue Tag message. The valid value for this field is 0.

Byte 03, Bit 1 – QErr (Queue Error)

The tape drive does not support the Simple Queue Tag message. The valid value for this field is 0.

Byte 03, Bit 0 – DQue (Disable Queuing)

The tape drive does not support the Simple Queue Tag message. The valid value for this field is 1.

Byte 04, Bit 7 – EECA (Enable Extended Contingent Allegiance)

The tape drive does not support extended contingent allegiance. The valid value for this bit is 0.

Byte 04, Bit 2 – RAENP (Ready AEN Permission)

The tape drive does not support asynchronous event notification (AEN). The valid value for this bit is 0.

Byte 04, Bit 1 – UAAENP (Unit Attention AEN Permission)

The tape drive does not support asynchronous event notification. The valid value for this bit is 0.

Byte 04, Bit 0 – EAENP (Enable AEN Permission)

The tape drive does not support asynchronous event notification (AEN). The valid value for this bit is 0.

Bytes 06 and 07 – Ready AEN Holdoff Period

The tape drive does not support asynchronous event notification. The valid value for this field is 0.

9.3.7 Data Compression Page (Page Code 0Fh)

The Data Compression page enables you to turn data compression on or off at any position on the tape.

When M2 writes data to tape, it automatically compresses the data. You can use this page to turn data compression off for various data files if, for some reason, you do not want to compress them.

To turn compression off, send this page with the DCE bit set to 0. To turn compression back on, send this page with the DCE bit set to 1.

<table>
<tr><th>Bit
Byte</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>00</td><td colspan="2">RSVD</td><td colspan="6">Page Code</td></tr>
<tr><td>01</td><td colspan="8">Page Length</td></tr>
<tr><td>02</td><td>DCE</td><td>DCC</td><td colspan="6">Reserved</td></tr>
<tr><td>03</td><td>DDE</td><td colspan="2">RED</td><td colspan="5">Reserved</td></tr>
<tr><td>04
⋮
07</td><td colspan="8">(MSB)
Compression Algorithm
(LSB)</td></tr>
<tr><td>08
⋮
11</td><td colspan="8">(MSB)
Decompression Algorithm
(LSB)</td></tr>
<tr><td>12
⋮
15</td><td colspan="8">Reserved</td></tr>
</table>

Byte 00, Bits 5 through 0 – Page Code

The value for this field is 0Fh, identifying the current page as the Data Compression page.

Byte 01 – Page Length

This field indicates the number of bytes in the Data Compression page that follow this byte. The valid value is 0Eh.

Byte 02, Bit 7 – DCE (Data Compression Enable)

This field enables or disables data compression, as follows:

0 – Data compression is disabled.
1 – Data compression is enabled.

Note: You can also use the Select Data Compression Algorithm field (byte 14 of the Device Configuration page) to control data compression (see page 9-23). The value received last by the tape drive takes precedence.

The setting of the DCE bit remains in effect across all operations (rewinds, loads, and so forth) until you change it or you change the Select Data Compression Algorithm field.

Byte 02, Bit 6 – DCC (Data Compression Capable)

This field indicates that the tape drive supports data compression. The tape drive ignores this field in the MODE SELECT data.

Byte 03, Bit 7 – DDE (Data Decompression Enable)

This field indicates whether data decompression is enabled. Because the tape drive automatically decompresses compressed data before sending to the initiator, the valid value for this bit is 1 (enable data decompression).

Note: This bit is set to 1 regardless of the tape format, compressed or not.

Byte 03, Bits 6 and 5 – RED (Report Exception on Decompression)

The tape drive does not report exceptions on decompression (boundaries between compressed and uncompressed data). The valid value for this field is 0.

Bytes 04 through 07 – Compression Algorithm

This field indicates which compression algorithm the tape drive will use to compress data from the initiator. The valid value for this field is 04h (compress data using the ALDC data compression algorithm). This is the only compression algorithm currently supported by the tape drive. The tape drive ignores this field in the MODE SELECT data.

Bytes 08 through 11 – Decompression Algorithm

This field indicates which decompression algorithm the tape drive will use when decompressing data from the tape. The tape drive ignores this field in the MODE SELECT data.

9.3.8 Device Configuration Page (Page Code 10h)

The Device Configuration page allows you to set the configurable options for the tape drive and move the tape from one partition to the logical beginning of another partition (LBOP).

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code					
01	Page Length							
02	RSVD	CAP	CAF	Active Format				
03	Active Partition							
04	Write Buffer Full Ratio							
05	Read Buffer Empty Ratio							
06	(MSB) Write Delay Time							
07								(LSB)
08	DBR	BIS	RSmk	AVC	SOCF		RBO	REW
09	Gap Size							
10	EOD Defined			EEG	SEW	Reserved		
11	(MSB)							
12	Buffer Size at Early Warning							
13								(LSB)
14	Select Data Compression Algorithm							
15	Reserved							

Byte 00, Bits 5 through 0 – Page Code

The value for this field is 10h, identifying the current page as the Device Configuration page.

Byte 01 – Page Length

This field indicates the number of bytes in the Device Configuration page that follow this byte. The valid value is 0Eh.

Byte 02, Bit 6 – CAP (Change Active Partition)

If the loaded tape is partitioned, this bit indicates that you want to move the tape from the current partition to a new partition specified by the Active Partition byte (byte 03), as follows:

0 – Do not move the tape from the current partition.
1 – Move the tape to the partition specified by the Active Partition byte.

If this bit is set to 1, the tape drive positions the tape to the logical beginning of the new partition (LBOP) after receiving a tape motion command. If the partition specified by the Active Partition field is the same as the currently active partition, the tape drive rewinds to the beginning of the current partition.

Note: If the currently loaded tape does not contain partitions, the value for this bit must be 0.

Byte 02, Bit 5 – CAF (Change Active Format)

This field indicates that the active format is to be changed as specified by the values in the Active Format field, as follows:

0 – Do not change active format.
1 – Change active format.

Byte 02, Bits 4 through 0 – Active Format

This field contains data that modifies the media format parameters. The bit definitions for the Active Format field are as follows:

4	3	2	1	0
Reserved		Gap Threshold		

Byte 02, Bits 2 through 0 – Gap Threshold This field has the same function as the Gap Threshold in the Vendor Unique Parameters for non-page format and in Vendor Unique Parameters Page 1 for page format. See page 9-9 for a description of this field. The value received last by the tape drive takes precedence.

Valid values for the Gap Threshold byte are 00h to FFh. The default value is 00h. Any value greater than 07h is treated as 07h.

Byte 03 – Active Partition

This field indicates the number of the new partition to which the tape is to be moved (if you set the CAP bit to 1 to change the active partition), as follows:

n – Position the tape at partition *n*, where *n* is a value from 0 through 63. Note that partitions are numbered consecutively from the *end* of the tape. Partition 0 is always the last partition on the tape.

Notes:

- If the tape is not partitioned, the value in the Active Partition field must be 0.
- If the CAP bit is 0, the tape drive ignores the Active Partition byte.
- If you specify a partition that does not exist, the tape drive returns Check Condition status with the sense key set to Illegal Request.

Byte 04 – Write Buffer Full Ratio

This field indicates the amount of data that must be present in the buffer during a buffered write operation before that data is written to the tape. The value represents a percentage of the buffer space. Each 1h equals 0.39% of the buffer. The power-on default value is 80h, which represents one half of the buffer. By default, the tape drive automatically adjusts this value (auto-thresholding) based on the data transfer rate of the host.

The Write Buffer Full Ratio must equal the Read Buffer Empty Ratio (see the following field). If these values are not equal, the tape drive returns Check Condition status with the sense key set to Illegal Request.

Note: The default value for this field depends on whether auto-thresholding is enabled.

Byte 05 – Read Buffer Empty Ratio

This field indicates how empty the buffer must be during a buffered read operation before additional data will be read from the tape. The value represents a percentage of the buffer space. Each 1h equals 0.39% of the buffer. The power-on default value is 80h, which represents one half of the buffer. By default, the tape drive automatically adjusts this value (auto-thresholding) based on the data transfer rate of the host.

Note: The default value for this field depends on whether auto-thresholding is enabled.

The Read Buffer Empty Ratio must equal the Write Buffer Full Ratio (see the previous field). If these values are not equal, the tape drive returns Check Condition status with the sense key set to Illegal Request.

Note: The Write Buffer Full Ratio and the Read Buffer Empty Ratio have the same function as the Motion Threshold in the Vendor Unique Parameters Page 1. If both the Device Configuration Page and the Vendor Unique Parameters Page 1 are sent, the value that is received last by the tape drive takes precedence. See page 2-7 for more information about auto-thresholding and the Motion Threshold.

Bytes 06 and 07 – Write Delay Time

If a WRITE command completes without transferring enough data to exceed the value specified for the Write Buffer Full Ratio, the value specified by this field determines the maximum amount of time, in units of 100 msec, that the data will remain in the buffer. When the time specified by Write Delay Time elapses, the data in the buffer is written to tape.

A value of 0 for this field indicates that a partially full buffer will not be flushed to tape until the tape drive receives a command that would otherwise flush the buffer (for example, REWIND, UNLOAD, SPACE, LOCATE, and so on).

Valid values for this field are 0000h to FFFFh (approximately 1.8 hours maximum). The default value for this byte is 0000h.

Byte 08, Bit 7 – DBR (Data Buffer Recovery)

The tape drive does not support the DBR bit. The valid value is 0.

Byte 08, Bit 6 – BIS (Block Identifier Supported)

This field indicates that block IDs are written on the tape relative to each partition. This bit is set to 1 in the MODE SENSE data and is ignored by the tape drive in the MODE SELECT command.

Byte 08, Bit 5 – RSmk (Report Setmarks)

This field specifies whether the tape drive returns Check Condition status when it encounters a setmark on the tape during read, verify, space block, or space filemark operations, as follows:

0 – Do not report setmarks (setmarks are ignored).
1 – Report setmarks (default setting).

If the RSmk bit is 1 and the tape drive encounters a setmark, it returns Check Condition status with the sense key set to No Sense (0h). The ASC and ASQ fields are set to 00h and 03h.

Byte 08, Bit 4 – AVC (Automatic Velocity Control)

The tape drive does not support the AVC bit. The valid value is 0.

Byte 08, Bits 3 and 2 – SOCF (Stop on Consecutive Filemarks)

The tape drive does not support the SOCF field. The valid value is 0.

Byte 08, Bit 1 – RBO (Recover Buffer Order)

The tape drive does not support the RBO bit. The valid value is 0.

Byte 08, Bit 0 – REW (Report Early Warning)

This field indicates whether reporting of the early-warning condition (LEOT) during a read operation is enabled or disabled, as follows:

0 – Do not report early-warning condition for read operations (default setting).

1 – Report early-warning condition for read operations after completing the current READ command.

The tape drive reports an early-warning condition as a Check Condition status with the sense key set to No Sense. The EOM bit is set to 1 and the LBOT bit is set to 0 in the extended sense data.

Byte 09 – Gap Size

The tape drive does not support the Gap Size field. The valid value is 0.

Byte 10, Bits 7 through 5 – EOD Defined

The tape drive does not support the EOD field. The valid value is 0.

Byte 10, Bit 4 – EEG (Enable EOD Generation)

Indicates that the tape drive will generate an EOD mark. The tape drive ignores this bit in the MODE SELECT command.

Byte 10, Bit 3 – SEW (Synchronize at Early Warning)

Indicates that the tape drive will cause any buffered data to be written to the tape when the early-warning condition (LEOT) is detected during a write operation.The tape drive ignores this bit in the MODE SELECT command.

Bytes 11 through 13 – Buffer Size at Early Warning

The tape drive does not support the Buffer Size at Early Warning field. The valid value is 0.

Byte 14 – Select Data Compression Algorithm

This field indicates whether data compression is enabled or disabled, as follows:

0 – Data compression is disabled.
1 – Data compression is enabled.

Note: You can also use the DCE bit (byte 02, bit 7 of the Data Compression Page) to control data compression (see page 9-17). The value received last by the tape drive takes precedence.

The setting of the Select Data Compression Algorithm field remains in effect across all operations (rewinds, loads, and so forth) until you change it or you change the DCE bit.

9.3.9 Medium Partition Page (Page Code 11h)

The Medium Partition page allows you to format a tape to contain up to 64 partitions. Partitions are numbered consecutively from the end of the tape with partition 0 always being the last partition on the tape.

Before formatting new partitions, you must position the tape at LBOT or at the logical beginning of an existing partition.

Bit / Byte	7	6	5	4	3	2	1	0
00	PS	RSVD	Page Code					
01	Page Length							
02	Maximum Additional Partitions							
03	Additional Partitions Defined							
04	FDP	SDP	IDP	PSUM		Reserved		
05	Medium Format Recognition							
06	Reserved							
07	Reserved							
08	(MSB) Partition Size (partition 0)							
09								(LSB)
10	(MSB) Partition Size (partition 1)							
11								(LSB)
12 ⋮ 133	Partition Size (partitions 2 through 62)							
134	(MSB) Partition Size (partition 63)							
135								(LSB)

Byte 00, Bit 7 – PS (Parameters Savable)

The tape drive does not support saving the parameter data contained in this page. The valid value is 0.

Byte 00, Bits 5 through 0 – Page Code

The value for this field is 11h, identifying the current page as the Medium Partition page.

Byte 01 – Page Length

This field indicates the number of bytes in the Medium Partition page that follow this byte. The valid value is 86h.

Byte 02 – Maximum Additional Partitions

This field indicates how many partitions in addition to the original partition (the entire tape) may be defined. This field is ignored by the tape drive in the MODE SELECT command.

Byte 03 – Additional Partitions Defined

In the MODE SELECT data, this field indicates the number of partitions being defined in addition to the original partition (the entire tape). Valid values are from 00h through 3Fh (63). If this byte is set to 00h, the tape drive ignores the sizes for partitions 0 through 63 in the Partition Size fields (bytes 08 through 135).

Byte 04, Bit 7 – FDP (Fixed Data Partitions)

This field specifies whether the tape drive should use its "fixed" definition of partitions to format the tape. The fixed definition is a single partition encompassing the entire tape.

0 – Do not format the tape.
1 – Format the tape with one partition.

Byte 04, Bit 6 – SDP (Select Data Partitions)

This field specifies whether the tape drive should format the tape based on a predefined partition size. This size is "hard coded" in the tape drive as 250 MB and cannot be changed.

0 – Do not format the tape.

1 – Format the tape with $n+1$ partitions, where n is the number of partitions specified by the Additional Partitions Defined field. The tape drive ignores the partition sizes specified in the Partition Size fields. The size of each partition (other than partition 0) is automatically set to 250 MB.

Byte 04, Bit 5 – IDP (Initiator Defined Partitions)

This field specifies whether the tape drive should format the tape based on the partition sizes provided in the Partition Size fields, as follows:

0 – Do not format the tape.

1– Format the tape with $n+1$ partitions, where n is the number of partitions specified by the Additional Partitions Defined field. The size of each partition is specified in the Partition Size fields (bytes 10 through 135). Partition 0 is the remainder of the tape.

Table 9-3 summarizes the results of all possible combinations of the FDP, SDP, and IDP bits.

Note: The FDP, SDP, and IDP bits are mutually exclusive. When one of these bits is set to 1, the others must be 0.

Table 9-3 *Results of combinations of the FDP, SDP, and IDP bits in the Medium Partition page*

For these combinations...			These results occur...	
FDP	**SDP**	**IDP**	**When you specify no additional partitions (Additional Partitions Defined = 00h)...**	**When you specify additional partitions (Additional Partitions Defined = 01h through 3Fh)...**
0	0	0	The tape drive does not format the tape.	
0	0	1	The tape drive formats the tape with one partition (the entire tape).	The tape drive formats the tape with *n*+1 partitions, where *n* is the number of partitions specified by the Additional Partitions Defined field. The sizes of Partitions 1 through *n* are specified in the Partition Size fields. Partition 0 is the remainder of the tape.
0	1	0	The tape drive formats the tape with one partition (the entire tape).	The tape drive formats a tape with *n*+1 partitions, where *n* is the number of partitions specified by the Additional Partitions Defined field. The size of partitions 1 through *n* is set to 250 MB. Partition 0 is the remainder of the tape.
0	1	1	Not supported.	
1	0	0	The tape drive formats the tape with one partition (the entire tape).	
1	0	1	Not supported.	
1	1	0		
1	1	1		

Byte 04, Bits 4 and 3 – PSUM (Partition Size Unit of Measure)

This field indicates the units used to specify partition sizes. If you set IDP (Initiator Defined Partitions) to 1 and are defining additional partitions (Additional Partitions Defined = 01h through 3Fh), use the PSUM field to indicate the units you are using to specify the sizes of the additional partitions. The valid values for PSUM are:

00b – The partition size is specified in bytes.
01b – The partition size is specified in KB.
10b – The partition size is specified in MB.

Notes:

- If you specify the partition size in bytes, the tape drive automatically sets the value to 1 MB. If you specify the partition size in KB, the tape drive rounds the value down to the nearest MB. (If the result is 0, the value is automatically set to 1 MB.)

- If you are defining no additional partitions (Additional Partitions Defined = 00h), the tape drive ignores the PSUM field.

- If you are not using the Partition Size field to specify the partition size (that is, FDP=1 or SDP=1), the tape drive ignores the PSUM field.

Byte 05 – Medium Format Recognition

This field is ignored by the tape drive in the MODE SELECT command.

Bytes 08 and 09, 10 and 11, 12 through 133, 134 and 135 – Partition Size (Partition *n*)

These fields indicate the size of the partitions. When IDP=1, these fields specify the approximate amount of uncompressed data space that is available between the logical beginning of each partition (LBOP) and the logical end of each partition (LEOP) on the tape.

In the MODE SELECT data, the tape drive ignores the partition size for partition 0 because partition 0 is always the remainder of the tape after all other partitions have been formatted.

Use the Partition Size fields for partitions 1 through *n* to specify the sizes of all other partitions you are creating. Specify the units for the Partition Size field in the PSUM field (byte 04, bits 4 and 3).

9.3.10 TapeAlert Page (Page Code 1Ch)

The TapeAlert page allows you to configure how the tape drive uses the TapeAlert function.

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code					
01	Page Length							
02	Perf	Reserved			DExcpt	Test	RSVD	LogErr
03	Reserved				MRIE			
04 ⋮ 07	Interval Timer							
08 ⋮ 11	Report Count							

Byte 00, Bits 5 through 0 – Page Code

The value for this field is 1Ch, which identifies the current page as the TapeAlert page.

Byte 01 – Page Length

This field indicates the number of bytes in the TapeAlert page that follow this byte. The valid value is 0Ah.

Byte 02, Bit 7 – Perf (Performance)

This field indicates whether informational exception operations that can cause delays are acceptable. The valid value for this bit is 0 (delays are acceptable).

Byte 02, Bit 3 – DExcpt (Disable Exception Reporting)

This field determines how the tape drive handles the reporting of informational exception operations, as follows:

0 – The tape drive reports informational exceptions using the method specified by the MRIE field.

1 – The tape drive disables all informational exception operations. The MRIE field is ignored (default setting).

Byte 02, Bit 4 – Test

This field determines whether the tape drive generates false informational exception conditions. The tape drive does not support the Test bit. The valid value for this field is 0.

Byte 02, Bit 0 – LogErr

This field indicates whether the tape drive logs informational exception conditions. The tape drive does not support the LogErr bit. The valid value for this field is 0.

Byte 03, Bits 3 through 0 – MRIE

This field indicates the method used by the tape drive to report informational exception conditions, as follows:

3 – The tape drive conditionally generates a Recovered Error. Whenever one or more TapeAlert flags are set, the tape drive returns Check Condition status with sense key set to Recovered Error (1h). The ASC and ASCQ fields are set to 5Dh and 00h; the FSC is set to F1h. A pending Recovered Error will be returned on the first successful SCSI command after the TapeAlert flag is set. The TapeAlert log page should be read immediately after the Recovered Error message is received.

Note: The command which receives the Recovered Error message will have executed correctly and should not be reissued by the initiator.

Bytes 04 through 07 – Interval Timer

This field indicates the number of times the tape drive reports the informational exception condition. The tape drive only reports the condition one time. The valid value for this field is 0.

Bytes 08 through 11 – Report Count

The tape drive does not support this field. The valid value is 0.

9.3.11 Vendor Unique Parameters Page 1 (Page Code 20h)

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code					
01	Page Length							
02	CT	RSVD	ND	RSVD	NBE	EBD	PE	NAL
03	RTF			WTF			RSVD	112m
04	Motion Threshold							
05	Gap Threshold							

Byte 00, Bits 5 through 0 – Page Code

The value for this field is 20h, identifying the current page as the Vendor Unique Parameters Page 1 page.

Byte 01 – Page Length

This field indicates the number of bytes in the Vendor Unique Parameters Page 1 page that follow this byte. The valid value is 04h.

Byte 02, Bit 7 – CT (Cartridge Type)

This bit is ignored by the tape drive.

Byte 02, Bit 5 – ND

This field indicates whether the tape drive can disconnect from the initiator during the data transfer phase, as follows:

0 – The tape drive can disconnect during the data transfer phase. (Power-on default)

1 – The tape drive will not disconnect until either the data transfer phase has completed or the command has completed, as determined by the DTDC field in the Disconnect-Reconnect Page (see page 9-14).

Note: The settings of the ND and DTDC fields are linked. If you change the setting of one, the other will be set accordingly.

Byte 02, Bit 3 – NBE (No Busy Enable)

The tape drive ignores this bit in the MODE SELECT command.

Byte 02, Bit 2 – EBD (Even Byte Disconnect)

This bit enables or disables disconnects on even (4-byte) boundaries. The tape drive ignores this bit because it always disconnects on 4-byte boundaries between data phases. The valid value is 1.

Note: Even-byte disconnect applies only when more data is to be transferred for the current command. If no more data is to be transferred, a disconnect may occur on an odd-byte boundary.

Byte 02, Bit 1 – PE (Parity Enable)

This field indicates whether parity checking on the SCSI bus is enabled, as follows:

0 – Parity checking disabled.
1 – Parity checking enabled. The tape drive checks every byte it receives for parity. (Power-on default)

Byte 02, Bit 0 – NAL (No Auto Load)

This field indicates whether the tape drive automatically loads the tape into the tape path when a data cartridge is inserted into the tape drive, as follows:

0 – Auto loading enabled. (Power-on default)
1 – Auto loading disabled.

Byte 03, Bits 7 through 5 – RTF (Read Tape Format)

This field indicates the data format on the currently loaded data cartridge. The tape drive ignores this field in the MODE SELECT command.

Byte 03, Bits 4 through 2 – WTF (Write Tape Format)

This field indicates the format the tape drive uses to write data to tape. The tape drive ignores this field in the MODE SELECT command.

Byte 03, Bit 0 – 112m

This bit is ignored by the tape drive.

Byte 04 – Motion Threshold

This field indicates the amount of data that must be in the buffer before tape motion for a buffered write or read operation starts. The value represents a percentage of the buffer. Each 1h equals 0.39% of the buffer. The power-on default value is 80h, which represents one half of the buffer. By default, the tape drive automatically adjusts this value (auto-thresholding) based on the transfer rate of the host. See page 2-7 for more information about auto-thresholding and the Motion Threshold.

Notes:

- The default value for this field depends on whether auto-thresholding is enabled.
- The Motion Threshold has the same function as the Write Buffer Full Ratio and the Read Buffer Empty Ratio fields in the Device Configuration Page. If you send both the Vendor Unique Parameters Page 1 page and the Device Configuration page, the value that the tape drive receives last takes precedence.

Byte 05 – Gap Threshold

This field has the same function as the Gap Threshold in the non-page format of the Vendor Unique Parameters page and in the page format of the Device Configuration page. See page 9-9 for a description of this field. The value received last by the tape drive takes precedence. Valid values for the Gap Threshold byte are 00h to FFh. The default value is 00h. Any value greater than 07h is treated as 07h.

9.3.12 Vendor Unique Parameters Page 2 (Page Code 21h)

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code					
01	Page Length							
02	Reserved							
03	RSVD	LPART						WWR
04	Reserved							
05								

Byte 00, Bits 5 through 0 – Page Code

The value for this field is 21h, identifying the current page as the Vendor Unique Parameters Page 2 page.

Byte 01 – Page Length

This field indicates the number of bytes in the Vendor Unique Parameters Page 2 page that follow this byte. The valid value is 04h.

Byte 03, Bits 6 through 1 – LPART (Load Partition)

This field indicates to which partition the tape drive positions the tape the next time it loads a tape or after it formats partitions on the current tape. Valid values for this field are from 0 to 63. The power-on default is 0. Partitions are numbered sequentially from the end of the tape with partition 0 always being the last partition on the tape.

Note: If the requested partition does not exist on the tape, the tape drive loads to the highest numbered partition on the tape (the partition closest to LBOT).

Byte 03, Bit 0 – WWR (Write without Retries)

This field indicates whether the tape was written with retries. The tape drive ignores this bit in the MODE SELECT command.

0 – The tape was written with retries.
1 – The tape was written with no retries.

Note: The tape drive writes a tape without retries when you issue a MODE SELECT command at LBOT and set the Write Retry Count field (Read-Write Error Recovery page) to 00h. If the tape was written without retries, it should be read without retries. For this reason, if the WWR bit is set to 1, issue a MODE SELECT command to set the Read Retry Count field (Read-Write Error Recovery page) to 00h.

9.4 EXCEPTIONS AND ERROR CONDITIONS

The following exceptions and error conditions can occur with the MODE SELECT command.

Table 9-4 lists the exceptions and error conditions that cause the tape drive to return Check Condition status for the MODE SELECT command. See Appendix A for additional information about these errors.

Note: If the Medium Partition page is sent, causing the current tape to be formatted, motion and write errors may occur. See the WRITE command (Chapter 25) for error conditions that may arise in this situation.

Table 9-4 *REQUEST SENSE data for MODE SELECT command errors and exceptions*

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Description
00h	03h	0h	**No Sense.** The RSmk bit is set to 1 and the tape drive encountered a setmark.
1Ah	00h	5h	**Illegal Request.** Illegal transfer length in CDB.
24h	00h	5h	**Illegal Request.** Invalid field in the CDB.
25h	00h	5h	**Illegal Request.** The logical unit specified in the CDB is not supported.

Table 9-4 REQUEST SENSE data for MODE SELECT command errors and exceptions (continued)

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Description
26h	00h	5h	**Illegal Request.** Invalid value in parameter list. This error is a result of any of the following: ▪ The Buffered Mode field in the Parameter List Header is not set to either 000b (unbuffered) or 001b (buffered). ▪ The Block Descriptor Length field in the Parameter List Header is not set to either 00h (no descriptor) or 08h (the size of the Block Descriptor). ▪ The Block Length field in the Block Descriptor is set to a value greater than 3C000h (240 KB). ▪ The Block Length field in the Block Descriptor is set to a non-zero value (fixed-length blocks) and the specified value is not evenly divisible by 4. ▪ The Page Length field for the specified page does not match the actual length of the field. ▪ The TB, EER, PER, DTE, or DCR bit in the Read-Write Recovery page are set to 1. ▪ The Buffer Full Ratio does not equal Buffer Empty Ratio. ▪ Bus Inactivity Limit, Disconnect Time Limit, or Connect Time Limit field in the Disconnect-Reconnect page is not set to 0. ▪ The QErr, EECA, RAENP, UAAENP, EAENP, Ready AEN Holdoff Period bit in the Control Mode page is set to 1. ▪ The DQue field in the Control Mode page is set to 0. ▪ The Queue Algorithm Modifier or Ready AEN Holdoff Period field in the Control Mode page is not set to 0. ▪ The RED field in the Data Compression page is set to 1. ▪ The DBR, AVC, SOCF, RBO, Gap Size, EOD, or Buffer Size at Early Warning field in the Device Configuration page is set to 1. ▪ The Additional Partitions Defined field in the Medium Partition page is set to a value greater than 3Fh (63 partitions). ▪ More than one of the FDP, SDP, and IDP bits in the Medium Partition page are set to 1. ▪ The PSUM field in the Medium Partition page is set to 11b.
2Ah	01h	6h	**Unit Attention.** MODE SELECT parameters have been changed.The tape drive sends status to all other initiators on the SCSI bus.
30h	02h	5h	**Illegal Request.** The tape format is incompatible with the command. This error is a result of any of the following: ▪ The Density Code field in the Block Descriptor is set to a value other than 00h (default format), 7Fh (no change), 27h (Mammoth-1 format), or 28h (Mammoth-2 format). ▪ The IDP field on the Medium Partition page is set to 1 and the sum of the partition size fields is greater than the size of the tape.
31h	00h	3h	**Medium Error.** A switch partition operation failed.
31h	01h	3h	**Medium Error.** The format partition operation failed.

Table 9-4 *REQUEST SENSE data for MODE SELECT command errors and exceptions (continued)*

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Description
47h	00h	Bh	**Aborted Command.** SCSI parity error. The command was aborted because of a SCSI bus parity error.
5Dh	00h	1h	**Recovered Error.** One or more TapeAlert flags are set.
84h	00h	5h	**Illegal Request.** Could not change the MODE SELECT parameters since the tape was not at LBOT (or LBOP).

Notes

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MODE SENSE (1Ah, 5Ah)

6-Byte MODE SENSE (1Ah)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	1	0	1	0
01	Logical Unit Number			RSVD	DBD	Reserved		
02	PC		Page Code					
03	Reserved							
04	Allocation Length							
05	Vendor Unique		Reserved				0	0

10-Byte MODE SENSE (5Ah)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	1	0	1	1	0	1	0
01	Logical Unit Number			RSVD	DBD	Reserved		
02	PC		Page Code					
03 ⋮ 06	Reserved							
07	(MSB) Allocation Length							
08	(LSB)							
09	Vendor Unique		Reserved				0	0

10.1 About This Command

The MODE SENSE command allows the tape drive to report its medium, logical unit, and device parameters to the initiator. These parameters apply to all initiators in a multi-initiator environment.

The tape drive supports both the 6-byte and the 10-byte format of the MODE SENSE CDB (command descriptor block). When requesting all parameter pages, use the 10-byte version of the MODE SENSE command, if possible, to accommodate the future addition of pages.

The 6-byte and 10-byte CDBs for the MODE SENSE command have different operation codes (Op codes), as shown in Table 10-1. The tape drive determines which version of the command is being used based on the Op code in the CDB.

Table 10-1 *Operation Codes for MODE SELECT and MODE SENSE*

	6-byte CDB Op code	10-byte CDB Op code
MODE SENSE	1Ah	5Ah

The MODE SENSE parameters can be structured in either of two formats: *non-page format* or *page format*.

Non-Page Format

In non-page format, the parameters after the Block Descriptor are vendor unique (SCSI-1 format). The parameters are transferred in the following order:

- Parameter List Header
- Block Descriptor (optional)
- One to five bytes of vendor-unique parameters

Page Format

In page format, the parameters after the Block Descriptor are structured as pages of related parameters (SCSI-2 format). The parameters are transferred in the following order:

- Parameter List Header
- Block Descriptor (optional)
- One or more available pages of related parameters

10.2 CDB FIELD DEFINITIONS

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 01, Bit 3 – DBD (Disable Block Descriptor)

This field indicates whether the tape drive returns the Block Descriptor as part of the MODE SENSE parameter data, as follows:

0 – Send the Block Descriptor
1 – Do not send the Block Descriptor

Note: The DBD bit must be 0 if the Page Code is 0 (non-page format). Otherwise the tape drive returns Check Condition status with a sense key of Illegal Request (5h). When the Page Code is 0, use the Allocation Length field in the CDB to specify whether the Block Descriptor is returned.

Byte 02, Bits 7 and 6 – PC (Page Control)

This field specifies the type of parameter values to be returned in the MODE SENSE data. Table 10-2 lists the valid values for this field.

Note: This field is used only when returning parameters in the page format; it must be set to 00h when using the non-page format.

Table 10-2 *Valid values for the PC field in the MODE SENSE command*

PC Setting	Description
00b	Return the values set by the last successful MODE SELECT command or if a MODE SELECT command has not been executed since the last tape drive reset, return the power-on default values.
01b	Return all values that are changeable. The changeable values are indicated by a 1 in each bit of each changeable field.
10b	Return the default values. (Values set in the EEPROM.)
11b	Return saved parameters. The tape drive des not support saving parameters.

Byte 02, Bits 5 through 0 – Page Code

This field specifies which MODE SENSE parameter page or pages the initiator is requesting. A value of 0 indicates that the parameters will be returned in non-page format.

Table 10-3 lists the valid values for the Page Code field.

Table 10-3 *Values for the Page Code field in the MODE SENSE command*

To return the parameters in...	Specify this Page Code...	This information will be returned...	Length
Non-page format	00h[a]	1 to 5 bytes of vendor-unique parameters	5 bytes
Page format	01h	Read-Write Error Recovery page	12 bytes
	02h	Disconnect/Reconnect page	16 bytes
	0Ah	Control Mode page	8 bytes
	0Fh	Data Compression page	16 bytes
	10h	Device Configuration page	16 bytes
	11h	Medium Partition page	136 bytes
	1Ch	TapeAlert page	12 bytes
	20h	Vendor Unique Parameters Page 1 page	6 bytes
	21h	Vendor Unique Parameters Page 2 page	6 bytes
	3Fh	All available pages (in ascending page code order)	228 bytes

[a] If you specify 0 for the Page Code field, ensure that the DBD bit is also set to 0. Otherwise, the tape drive returns Check Condition status with the sense key set to Illegal Request (5h).

Byte 04 (6-Byte CDB) or Bytes 07 and 08 (10-Byte CDB) – Allocation Length

The Allocation Length indicates the amount of memory in bytes that the initiator has allocated for the return of MODE SENSE parameters. The Allocation Length can contain values ranging from 0 to FFh (for the 6-byte CDB) or from 0 to FFFFh (for the 10-byte CDB).

When the Page Code field is 00h, the tape drive returns up to 17 bytes in response to the 6-byte CDB and up to 21 bytes in response to the 10-byte CDB. When the Page Code field is a non-zero value, the tape drive returns either one or all pages of related parameters plus the Parameter List Header and the Block Descriptor (if requested).

To determine the Allocation Length, total the number of bytes in the Parameter List Header (4 bytes), Block Descriptor (8 bytes, if you are requesting it), and all parameter pages you are requesting. Table 10-3 lists the page lengths of all the supported mode pages. Or, to receive all available data, specify FFh (for the 6-byte CDB) or FFFFh (for the 10-byte CDB).

Note: If the future addition of MODE SENSE pages results in more than FFh bytes of available data, using the 6-byte CDB may result in Check Condition status with the sense key set to Illegal Request when all pages are requested. For this reason, it is recommended that you use the 10-byte CDB.

If the Allocation Length is smaller than the amount of data available from the tape drive, the returned data is truncated. If the Allocation Length is greater than the amount of data to be returned, only the number of bytes available are transferred; no additional data is transferred.

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for these bits. The value for these bits must be 0.

10.3 What the Tape Drive Returns

This section describes the log page format and the log pages that the tape drive supports. The MODE SENSE command returns the single log page specified in the Page Code field of the CDB.

Each log page begins with a four-byte Parameter List Header (bytes 00 through 03). Immediately following the Parameter List Header is an optional Block Descriptor, followed by zero or more variable-length log parameters defined for that page.

10.3.1 Parameter List Header

The Parameter List Header specifies the page code for the log parameter data being returned and indicates the total length of the data to follow. The format of the Parameter List Header depends on which version of the MODE SENSE command you are using (6-byte CDB or 10-byte CDB), as shown below.

Parameter List Header, 6-Byte MODE SENSE

Bit Byte	7	6	5	4	3	2	1	0
00	Mode Data Length							
01	Medium Type							
02	WP	Buffered Mode			Speed			
03	Block Descriptor Length							

Parameter List Header, 10-Byte MODE SENSE

Bit / Byte	7	6	5	4	3	2	1	0
00	(MSB) Mode Data Length							
01								(LSB)
02	Medium Type							
03	WP	Buffered Mode			Speed			
04	Reserved							
05								
06	(MSB) Block Descriptor Length							
07								(LSB)

Byte 00 (6-Byte CDB) or
Byte 00 and Byte 01 (10-Byte CDB) – Mode Data Length

This field indicates the number of bytes of MODE SENSE data that are available for transfer, excluding this field. The value returned for this field is the remaining number of bytes in the Parameter List Header plus the number of bytes of data to be returned based on the field settings in the CDB.

Notes:

- For the 6-byte CDB, the Mode Data Length cannot exceed FFh. If the future addition of MODE SENSE pages results in more than FFh bytes of available data, using the 6-byte CDB may result in Check Condition status with the sense key set to Illegal Request when all pages are requested. For this reason, it is recommended that you use the 10-byte CDB.

- The value returned for the Mode Data Length does not reflect the value you specified for the Allocation Length in the CDB.

Byte 01 (6-Byte CDB) or Byte 02 (10-Byte CDB) – Medium Type

This field indicates the length of tape currently loaded in the tape drive. The values that can be returned are shown in Table 10-4.

Note: If the tape drive has not yet determined the tape length, it reports the shortest of the possible supported lengths.

Table 10-4 *Values returned for Medium Type field in MODE SENSE data*

Value returned	Length of tape loaded
00h	No cartridge loaded, cleaning cartridge loaded, or tape is unknown, broken, or unreadable
D1h	22 meters (Exabyte AME 22m)[a]
D2h	170 meters (Exabyte AME 170m)[a]
D3h	125 meters (Exabyte AME 125m)[a]
D4h	45 meters (Exabyte AME 45m)[a]
D5h	225 meters (Exabyte AME with SmartClean 225m)
D6h	150 meters (Exabyte AME with SmartClean 150m)
D7h	75 meters (Exabyte AME with SmartClean 75m)

[a] Not recommended for use with M2. M2 can read data recorded on these tapes using the original Mammoth format. It cannot write data using the original Mammoth format.

Byte 02, Bit 7 (6-Byte CDB) or Byte 03, Bit 7 (10-Byte CDB) – WP (Write Protect)

This field indicates whether the data cartridge loaded in the tape drive is write protected, as follows:

0 – The data cartridge is not write protected.
1 – The data cartridge is write protected.

Byte 02, Bits 6 through 4 (6-Byte CDB) or Byte 03, Bits 6 through 4 (10-Byte CDB) – Buffered Mode

This field indicates the data transfer mode to be used by the tape drive during a write operation (see page 2-7 for information about buffered mode), as follows:

000b – Unbuffered mode.
001b – Buffered mode. (Power-on default)

Byte 02, Bits 3 through 0 (6-Byte CDB) or Byte 03, Bits 3 through 0 (10-Byte CDB) – Speed

The tape drive does not support any operations at different speeds. All operations have a defined speed that cannot be modified. The valid value for this field is 0.

Byte 03 (6-Byte CDB) or Bytes 06 and 07 (10-Byte CDB) – Block Descriptor Length

This field specifies the length of the Block Descriptor in bytes. The tape drive does not support multiple block descriptions. The valid value for this field is 00h (for no Block Descriptor) or 08h (for the entire Block Descriptor).

Note: The tape drive does not support multiple block descriptors.

10.3.2 Block Descriptor

The optional Block Descriptor reports the data format and other format characteristics used by the tape drive when it writes data.

Bit / Byte	7	6	5	4	3	2	1	0
00	Density Code							
01	(MSB)							
02	Number of Blocks							
03								(LSB)
04	Reserved							
05	(MSB)							
06	Block Length							
07								(LSB)

Byte 00 – Density Code

The Density Code indicates the format the tape drive is using to read or write data. As shown in Table 10-5, the value returned by the MODE SENSE command depends on the most recent activity.

Table 10-5 Relationship between the most recent tape drive activity and the Density Code reported by MODE SENSE

If the most recent activity was...	The value reported for the Density Code is the...		
	Format of the data on tape	Power-on default, format of previous tape, or format set with last MODE SELECT	Power-on default
Power on (tape not loaded)		✔	
Load tape (tape written in recognizable format)	✔		
Load tape (blank tape or tape written in unrecognizable format)			✔
Position tape at any location other than LBOP	✔		
READ, SPACE, LOCATE, or VERIFY at LBOP	✔		
WRITE		✔	

Bytes 01 through 03 – Number of Blocks

This field indicates the total capacity of the tape in approximately 33-KB physical units (LBOT to LEOT).

Note: Use the Medium Partition page (Page Code 11h) to determine the capacity in MB of each of the partitions on the tape.

Bytes 05 through 07 – Block Length

This field indicates the length of each logical block, in bytes, when the Fixed bit is set for the READ, VERIFY, and WRITE commands.

- When the Block Length is non-zero, fixed-length block operations are allowed. For fixed-length blocks, only block sizes that are evenly divisible by four (that is, they end on a 4-byte boundary) are valid. A block length of 0 is invalid for fixed-length blocks.
- When the Block Length is 0, only variable-length block operations are allowed.

The power-on default value for the block length is 400h (1,024) bytes. The limit on the block length is the maximum block length specified by the Read Block Limits data (see Chapter 13).

Note: If the Block Length is 0, the SILI bit in the READ command suppresses illegal length indications for both underlength and overlength reads. If the Block Length is non-zero, the SILI bit of the READ command suppresses illegal length indications only for blocks shorter than requested. See page 12-2 for more information.

10.3.3 Vendor-Unique Parameters (Non-Page Format)

Bit / Byte	7	6	5	4	3	2	1	0
00	CT	RSVD	ND	RSVD	NBE	EBD	PE	NAL
01	Reserved							112m
02	Motion Threshold							
03	Reconnect Threshold							
04	Gap Threshold							

Byte 00, Bit 7 – CT (Cartridge Type)

This bit is ignored by the tape drive.

Byte 00, Bit 5 – ND (No Disconnect During Data Transfer)

This field indicates whether the tape drive can disconnect from the initiator during the data transfer phase, as follows:

0 – The tape drive can disconnect during the data transfer phase. (Power-on default)

1 – The tape drive will not disconnect until the data transfer phase has completed or the entire command has completed, as determined by the DTDC field in the Disconnect-Reconnect page (see page 10-16).

Byte 00, Bit 3 – NBE (No Busy Enable)

This bit is ignored by the tape drive.

Byte 00, Bit 2 – EBD (Even Byte Disconnect)

This bit indicates whether the tape drive disconnects on even (4-byte) boundaries. Because the tape drive always disconnects at 4-byte boundaries between data phases, the value returned is always 1.

Note: Even-byte disconnect applies only when more data is to be transferred for the current command. If no more data is to be transferred, a disconnect may occur on an odd-byte boundary.

Byte 00, Bit 1 – PE (Parity Enable)

This field indicates whether parity checking on the SCSI bus is enabled, as follows:

0 – Parity checking disabled.
1 – Parity checking enabled. (Power-on default)

When PE=1, every byte received by the tape drive is checked for parity.

Byte 00, Bit 0 – NAL (No Auto Load)

This field indicates whether the automatic loading of the tape into the tape path is disabled when a data cartridge is inserted into the tape drive:

0 – Auto loading enabled. (Power-on default)
1 – Auto loading disabled.

Byte 01, Bit 0 – 112m

This bit is ignored by the tape drive.

Byte 02 – Motion Threshold

This field indicates the amount of data that must be in the buffer before tape motion is started for a buffered write or read operation. The value represents a percentage of the buffer space. Each 1h equals 0.39% of the buffer. The power-on default value is 80h, which represents one half of the buffer. The tape drive automatically adjusts this value (auto-thresholding) based on the data transfer rate of the host. See page 2-7 for more information about auto-thresholding and the Motion Threshold.

Note: The tape drive returns 00h for this field if auto-thresholding is enabled.

Byte 03 – Reconnect Threshold

This field indicates the amount of data that must be in the buffer before the tape drive reconnects to the initiator for a buffered write or read operation. The value represents a percentage of the buffer space. Each 1h equals 0.39% of the buffer. The power-on default value is 80h, which represents one half of the buffer. By default, the tape drive automatically adjusts this value (auto-thresholding) based on the data transfer rate of the host. See page 2-7 for more information about auto-thresholding and the Reconnect Threshold.

Note: The tape drive returns 00h for this field if auto-thresholding is enabled.

Byte 04 – Gap Threshold

This field indicates the maximum number of consecutive gap blocks that the tape drive will write on the current track while determining whether an empty buffer exists during a write operation. A gap block is a 33-KB block of undefined data that cannot be accessed by any SCSI command.

Valid values for the Gap Threshold byte are 00h to FFh. The default value is 00h. Any value greater than 07h is treated as 07h.

After writing the number of gap blocks specified by this byte, the tape drive will either continue the write operation (if there is new data in the buffer) or begin the process to stop tape motion (if the buffer is still empty). Before actually stopping tape motion, the tape drive writes additional gap blocks to complete the current track and then writes one or two complete gap tracks.

The Gap Threshold byte should be changed only when the average data transfer rate is slow and is impacting the capacity of the tape by forcing excessive start/stop activity. The Gap Threshold byte should be used in combination with the motion and reconnect thresholds described in this section.

10.3.4 Read-Write Error Recovery Page (Page Code 01h)

The Read-Write Error Recovery page reports the error recovery parameters used during read-write operations.

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code					
01	Page Length							
02	Reserved		TB	RSVD	EER	PER	DTE	DCR
03	Read Retry Count							
04 ⋮ 07	Reserved							
08	Write Retry Count							
09 ⋮ 11	Reserved							

Byte 00, Bits 5 through 0 – Page Code

The value for this field is 01h, identifying the current page as the Read-Write Error Recovery page.

Byte 01 – Page Length

This field indicates the number of bytes in the Read-Write Error Recovery page that follow this byte. The valid value is 0Ah.

Byte 02, Bit 5 – TB (Transfer Block)

The TB bit is not supported by the tape drive. The valid value is 0.

Byte 02, Bit 3 – EER (Enable Early Recovery)

The EER bit is not supported by the tape drive. The valid value is 0.

Byte 02, Bit 2 – PER (Post Error)

The PER bit is not supported by the tape drive. The valid value is 0.

Byte 02, Bit 1 – DTE (Disable Transfer on Error)

The DTE bit is not supported by the tape drive. The valid value is 0.

Byte 02, Bit 0 – DCR (Disable Correction)

The DCR bit is not supported by the tape drive. The valid value is 0.

Byte 03 – Read Retry Count

This field indicates how many times the tape drive attempts its read recovery algorithms before an unrecoverable read error is reported, as follows:

00h – The tape drive does not attempt any rereads before reporting an unrecoverable read error and continuing with the read operation.

01h to 0Bh – The tape drive attempts its read recovery algorithm for either the default number of times or the number specified by this byte, whichever is smaller, before reporting an unrecoverable read error and continuing with the read operation.

Note: If you are reading a tape that may have been written without retries (see "Write Retry Count"), issue a MODE SENSE command and check the value returned for the WWR (Write Without Retries) bit in the Vendor Unique Parameters Page 2. If the WWR bit is set to 1, issue a MODE SELECT command and specify 0 for this field; otherwise specify a non-zero value.

Byte 08 – Write Retry Count

This field indicates how many times the tape drive rewrites a physical block before a recovery is attempted, as follows:

00h – The tape drive will not rewrite any physical blocks during a write operation and will continue to write additional data. The tape drive may not be able to recover the data written on the tape since its write integrity cannot be guaranteed. The tape drive does not stop the write operation. Instead it writes Gap Blocks when no data blocks are present.

01h to 0Bh – The tape drive rewrites a physical block for either the default number of times or the number specified by this byte, whichever is smaller, before attempting a recovery.

Note: If this field was set to 00h when the tape was written, you should issue a MODE SELECT command and set the Read Retry Count byte to 0 when reading the tape.

10.3.5 Disconnect-Reconnect Page (Page Code 02h)

The Disconnect-Reconnect page reports parameters that control how the tape drive disconnects and reconnects during data transfers.

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code					
01	Page Length							
02	Buffer Full Ratio							
03	Buffer Empty Ratio							
04	(MSB) Bus Inactivity Limit							
05								(LSB)
06	(MSB) Disconnect Time Limit							
07								(LSB)
08	(MSB) Connect Time Limit							
09								(LSB)
10	(MSB) Maximum Burst Size							
11								(LSB)
12	Reserved				DImm	RSVD	DTDC	
13	Reserved							
14								
15								

Byte 00, Bits 5 through 0 – Page Code

The value for this field is 02h, identifying the current page as the Disconnect-Reconnect page.

Byte 01 – Page Length

This field indicates the number of bytes in the Disconnect-Reconnect page that follow this byte. The valid value is 0Eh.

Byte 02 – Buffer Full Ratio

This field indicates the amount of data that must be present in the buffer during a buffered read operation before the tape drive will attempt to reconnect to the initiator. The value represents a percentage of the buffer space. Each 1h equals 0.39% of the buffer. The power-on default value is 80h, which represents one half of the buffer. By default, the tape drive automatically adjusts this value (auto-thresholding) based on the data transfer rate of the host. See page 2-7 for more information about auto-thresholding.

Byte 03 – Buffer Empty Ratio

This field indicates how empty the buffer must be during a buffered write operation before the tape drive will attempt to reconnect to the initiator. The value represents a percentage of the buffer space. Each 1h equals 0.39% of the buffer. The power-on default value is 80h, which represents one half of the buffer. By default, the tape drive automatically adjusts this value (auto-thresholding) based on the data transfer rate of the host. See page 2-7 for more information about auto-thresholding.

Bytes 04 and 05 – Bus Inactivity Limit

This field indicates the maximum amount of time in 100-microsecond increments that the tape drive can assert a BSY signal without a REQ/ACK handshake. When this time is exceeded, the tape drive can disconnect if not restricted by the DTDC field. The only supported value is 00h, which means that there is no time limit and the tape drive will disconnect as soon as it can.

Bytes 06 and 07 – Disconnect Time Limit

This field indicates the minimum amount of time in 100-microsecond increments that the tape drive must wait after going bus free before attempting reselection. A value of 00h means that there is no time limit and the tape drive can reselect immediately upon bus free. The power-on default is 00h.

Bytes 08 and 09 – Connect Time Limit

This field indicates the maximum amount of time that the tape drive can use the SCSI bus before it must disconnect. This value must be 00h, meaning that there is no time limit.

Bytes 10 and 11 – Maximum Burst Size

This field specifies the amount of data, in 512-byte increments, that the tape drive can transfer before it must disconnect. The tape drive supports all values for this field. The default is 0, which means that there is no limit.

Byte 12, Bit 3 – DImm (Disconnect Immediate)

This field indicates whether the tape drive will attempt to disconnect immediately after every Command phase, as follows:

0 – The tape drive may attempt to disconnect after a Command phase, based on the setting of the DiscPriv bit in the Identify message and the settings of the other parameters on this page.

1 – The tape drive will attempt to disconnect after a Command phase if allowed and if internal processing would result in extended bus idle time. (Power-on default)

Byte 12, Bits 1 and 0 – DTDC (Data Transfer Disconnect Control)

This field indicates how the tape drive performs a disconnect when the ND bit is set to 1 (see page 10-28). Table 10-6 lists the valid values for this field.

Table 10-6 *Values returned in the MODE SENSE DTDC field*

DTDC Value	Description
00b	Disconnects are not controlled by the DTDC field. Disconnects are controlled by the other fields on the MODE SELECT Disconnect-Reconnect page. (Power-on default)
01b	Once the data transfer of a command has started, the tape drive does not disconnect until all of the data has been transferred. The Maximum Burst Size (bytes 10 and 11) must be set to 0.
10b	Not valid.
11b	Once the data transfer of a command has started, the tape drive does not disconnect until the command is complete. The Maximum Burst Size (bytes 10 and 11) must be set to 0.

10.3.6 Control Mode Page (Page Code 0Ah)

The Control Mode page reports whether the tape drive returns Check Condition status when one of its write and read error counters reaches a specified threshold. For information about using the LOG SELECT command to set threshold values for the tape drive's write and read error counters, refer to Chapter 7.

Bit / Byte	7	6	5	4	3	2	1	0
00	RSVD		Page Code					
01	Page Length							
02	RSVD							RLEC
03	Queue Algorithm Modifier				Reserved		QErr	DQue
04	EECA	Reserved				RAENP	UAAENP	EAENP
05	Reserved							
06	(MSB) Ready AEN Holdoff Period							
07								(LSB)

Byte 00, Bits 5 through 1 – Page Code

The value for this field is 0Ah, identifying the current page as the Control Mode page.

Byte 01 – Page Length

This field indicates the number of bytes in the Control Mode page that follow this byte. The valid value is 06h.

Byte 02, Bit 0 – RLEC (Report Log Exception Condition)

This field indicates whether the tape drive returns Check Condition status with the sense key set to Unit Attention (6h) when one of its write and read error counters reaches a specified threshold, as follows:

0 – Do not return Unit Attention when a threshold condition is met.
1 – Return Unit Attention when a threshold condition is met.

Byte 03, Bits 7 through 4 – Queue Algorithm Modifier

The tape drive does not support the Simple Queue Tag message. The valid value for this field is 0.

Byte 03, Bit 1 – QErr (Queue Error)

The tape drive does not support the Simple Queue Tag message. The valid value for this field is 0.

Byte 03, Bit 0 – DQue (Disable Queuing)

The tape drive does not support the Simple Queue Tag message. The valid value for this field is 1.

Byte 04, Bit 7 – EECA (Enable Extended Contingent Allegiance)

The tape drive does not support extended contingent allegiance. The valid value for this bit is 0.

Byte 04, Bit 2 – RAENP (Ready AEN Permission)

The tape drive does not support asynchronous event notification (AEN). The valid value for this bit is 0.

Byte 04, Bit 1 – UAAENP (Unit Attention AEN Permission)

The tape drive does not support asynchronous event notification. The valid value for this bit is 0.

Byte 04, Bit 0 – EAENP (Enable AEN Permission)

The tape drive does not support asynchronous event notification (AEN). The valid value for this bit is 0.

Bytes 06 and 07 – Ready AEN Holdoff Period

The tape drive does not support asynchronous event notification. The valid value for this field is 0.

10.3.7 Data Compression Page (Page Code 0Fh)

The Data Compression page reports whether data compression is on or off at any position on the tape.

<table>
<tr><th>Bit
Byte</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>00</td><td colspan="2">RSVD</td><td colspan="6">Page Code</td></tr>
<tr><td>01</td><td colspan="8">Page Length</td></tr>
<tr><td>02</td><td>DCE</td><td>DCC</td><td colspan="6">Reserved</td></tr>
<tr><td>03</td><td>DDE</td><td colspan="2">RED</td><td colspan="5">Reserved</td></tr>
<tr><td>04
⋮
07</td><td colspan="8">(MSB)
Compression Algorithm
(LSB)</td></tr>
<tr><td>08
⋮
11</td><td colspan="8">(MSB)
Decompression Algorithm
(LSB)</td></tr>
<tr><td>12
⋮
15</td><td colspan="8">Reserved</td></tr>
</table>

Byte 00, Bits 5 through 0 – Page Code

The value for this field is 0Fh, identifying the current page as the Data Compression page.

Byte 01 – Page Length

This field indicates the number of bytes in the Data Compression page that follow this byte. The valid value is 0Eh.

Byte 02, Bit 7 – DCE (Data Compression Enable)

This field indicates whether data compression is enabled or disabled, as follows:

0 – Data compression is disabled.
1 – Data compression is enabled.

Note: The Select Data Compression Algorithm field (byte 14 of the Device Configuration page) can also be used to control data compression (see page 10-23). The value received last by the tape drive takes precedence.

Byte 02, Bit 6 – DCC (Data Compression Capable)

This field indicates whether the tape drive supports data compression. The valid value for this bit is 1.

Byte 03, Bit 7 – DDE (Data Decompression Enable)

This field indicates whether data decompression is enabled. Because the tape drive automatically decompresses compressed data before sending to the initiator. The valid value for this bit is 1 (enable data decompression).

Note: This bit is set to 1 regardless of the tape format, compressed or not.

Byte 03, Bits 6 and 5 – RED (Report Exception on Decompression)

The tape drive does not report exceptions on decompression (boundaries between compressed and uncompressed data). The valid value for this field is 0.

Bytes 04 through 07 – Compression Algorithm

This field indicates which compression algorithm the tape drive will use to compress data from the initiator. The only currently supported for this field is 00000004h (compress data using the ALDC data compression algorithm).

Bytes 08 through 11 – Decompression Algorithm

Indicates which decompression algorithm the tape drive will use when decompressing data from the tape. The value of this field depends on the format of the data on the tape currently in the tape drive. For Mammoth-1 format, the value is 00000010h (IDRC); for Mammoth-2 format, the value is 00000004h (ALDC).

10.3.8 Device Configuration Page (Page Code 10h)

The Device Configuration page reports the current settings for the tape drive's configurable options.

<table>
<tr><th>Bit
Byte</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>00</td><td colspan="2">Reserved</td><td colspan="6">Page Code</td></tr>
<tr><td>01</td><td colspan="8">Page Length</td></tr>
<tr><td>02</td><td>RSVD</td><td>CAP</td><td>CAF</td><td colspan="5">Active Format</td></tr>
<tr><td>03</td><td colspan="8">Active Partition</td></tr>
<tr><td>04</td><td colspan="8">Write Buffer Full Ratio</td></tr>
<tr><td>05</td><td colspan="8">Read Buffer Empty Ratio</td></tr>
<tr><td>06</td><td colspan="8" rowspan="2">(MSB)
Write Delay Time
(LSB)</td></tr>
<tr><td>07</td></tr>
<tr><td>08</td><td>DBR</td><td>BIS</td><td>RSmk</td><td>AVC</td><td colspan="2">SOCF</td><td>RBO</td><td>REW</td></tr>
<tr><td>09</td><td colspan="8">Gap Size</td></tr>
<tr><td>10</td><td colspan="3">EOD Defined</td><td>EEG</td><td>SEW</td><td colspan="3">Reserved</td></tr>
<tr><td>11</td><td colspan="8" rowspan="3">(MSB)
Buffer Size at Early Warning
(LSB)</td></tr>
<tr><td>12</td></tr>
<tr><td>13</td></tr>
<tr><td>14</td><td colspan="8">Select Data Compression Algorithm</td></tr>
<tr><td>15</td><td colspan="8">Reserved</td></tr>
</table>

Byte 00, Bits 5 through 0 – Page Code

The value for this field is 10h, identifying the current page as the Device Configuration page.

Byte 01 – Page Length

This field indicates the number of bytes in the Device Configuration page that follow this byte. The valid value is 0Eh.

Byte 02, Bit 6 – CAP (Change Active Partition)

The valid value for this bit is 0.

Byte 02, Bit 5 – CAF (Change Active Format)

The valid value for this bit is 0.

Byte 02, Bits 4 through 0 – Active Format

This field indicates the current media format parameters. The bit definitions for the Active Format field are as follows:

4	3	2	1	0
Reserved		Gap Threshold		

Byte 02, Bits 2 through 0 – Gap Threshold This field has the same function as the Gap Threshold in the Vendor Unique Parameters for non-page format and in Vendor Unique Parameters Page 1 for page format. See page 10-11 for a description of this field. The value received last by the tape drive takes precedence. Valid values for the Gap Threshold byte are 00h to FFh. The default value is 00h. Any value greater than 07h is treated as 07h.

Byte 03 – Active Partition

This field indicates the number of the partition in which the tape is currently positioned, as follows:

n – The tape is positioned at partition *n*, where *n* is a value from 0 through 63. Note that partitions are numbered consecutively from the *end* of the tape. Partition 0 is always the last partition on the tape.

Notes:

- If the tape is not partitioned, the value in the Active Partition field is 0.
- If the CAP bit is 0, the tape drive ignores the Active Partition byte.
- If you specify a partition that does not exist, the tape drive returns Check Condition status with the sense key set to Illegal Request.
- If the tape drive is not ready, the value of the Active Partition field returned in the MODE SENSE data may be invalid.

Byte 04 – Write Buffer Full Ratio

This field indicates the amount of data that must be present in the buffer during a buffered write operation before that data is written to the tape. The value represents a percentage of the buffer space. Each 1h equals 0.39% of the buffer. The power-on default value is 80h, which represents one half of the buffer. By default, the tape drive automatically adjusts this value (auto-thresholding) based on the data transfer rate of the host. See page 2-7 for more information about auto-thresholding.

Byte 05 – Read Buffer Empty Ratio

This field indicates how empty the buffer must be during a buffered read operation before additional data will be read from the tape. The value represents a percentage of the buffer space. Each 1h equals 0.39% of the buffer. The power-on default value is 80h, which represents one half of the buffer. By default, the tape drive automatically adjusts this value (auto-thresholding) based on the data transfer rate of the host. See page 2-7 for more information about auto-thresholding.

Bytes 06 and 07 – Write Delay Time

If a WRITE command completes without transferring enough data to exceed the value specified for the Write Buffer Full Ratio, this field indicates the maximum amount of time, in units of 100 msec, that the data will remain in the buffer. When the time specified by Write Delay Time elapses, the data in the buffer is written to tape.

A value of 0 for this field indicates that a partially full buffer will not be flushed to tape until the tape drive receives a command that would otherwise flush the buffer (for example, REWIND, UNLOAD, SPACE, LOCATE, and so on).

Valid values for this field are 0000h to FFFFh (approximately 1.8 hours maximum). The default value for this byte is 0000h.

Byte 08, Bit 7 – DBR (Data Buffer Recovery)

The tape drive does not support the DBR bit. The valid value is 0.

Byte 08, Bit 6 – BIS (Block Identifier Supported)

The valid value for this bit is 1, indicating that block IDs are written on the tape relative to each partition.

Byte 08, Bit 5 – RSmk (Report Setmarks)

This field indicates whether the tape drive returns Check Condition status when it encounters a setmark on the tape during read, verify, space block, or space filemark operations, as follows:

0 – Do not report setmarks (setmarks are ignored).
1 – Report setmarks (default setting).

Byte 08, Bit 4 – AVC (Automatic Velocity Control)

The tape drive does not support the AVC bit. The valid value is 0.

Byte 08, Bits 3 and 2 – SOCF (Stop on Consecutive Filemarks)

The tape drive does not support the SOCF field. The valid value is 0.

Byte 08, Bit 1 – RBO (Recover Buffer Order)

The tape drive does not support the RBO bit. The valid value is 0.

Byte 08, Bit 0 – REW (Report Early Warning)

This field indicates whether reporting of the early-warning condition (LEOT) during a read operation is enabled or disabled, as follows:

0 – Do not report early-warning condition for read operations (default setting).

1 – Report early-warning condition for read operations after completing the current READ command.

The tape drive reports an early-warning condition as a Check Condition status with the sense key set to No Sense. The EOM bit is set to 1 and the LBOT bit is set to 0 in the extended sense data.

Byte 09 – Gap Size

The tape drive does not support the Gap Size field. The valid value is 0.

Byte 10, Bits 7 through 5 – EOD Defined

The tape drive does not support the EOD field. The valid value is 0.

Byte 10, Bit 4 – EEG (Enable EOD Generation)

The valid value for this bit is 1, indicating that the tape drive generates an EOD mark.

Byte 10, Bit 3 – SEW (Synchronize at Early Warning)

The valid value for this bit is 1, indicating that the tape drive writes any buffered data to the tape when the early-warning condition (LEOT) is detected during a write operation.

Bytes 11 through 13 – Buffer Size at Early Warning

The tape drive does not support the Buffer Size at Early Warning field. The valid value for this field is 0.

Byte 14 – Select Data Compression Algorithm

This field indicates whether data compression is enabled or disabled, as follows:

0 – Data compression is disabled.
1 – Data compression is enabled.

10.3.9 Medium Partition Page (Page Code 11h)

The Medium Partition page reports how many partitions the currently loaded tape contains. A tape can contain up to contain up to 64 partitions. Partitions are numbered consecutively from the end of the tape with partition 0 always being the last partition on the tape.

<table>
<tr><th>Bit
Byte</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>00</td><td>PS</td><td>RSVD</td><td colspan="6">Page Code</td></tr>
<tr><td>01</td><td colspan="8">Page Length</td></tr>
<tr><td>02</td><td colspan="8">Maximum Additional Partitions</td></tr>
<tr><td>03</td><td colspan="8">Additional Partitions Defined</td></tr>
<tr><td>04</td><td>FDP</td><td>SDP</td><td>IDP</td><td colspan="2">PSUM</td><td colspan="3">Reserved</td></tr>
<tr><td>05</td><td colspan="8">Medium Format Recognition</td></tr>
<tr><td>06</td><td colspan="8">Reserved</td></tr>
<tr><td>07</td><td colspan="8">Reserved</td></tr>
<tr><td>08</td><td colspan="8" rowspan="2">(MSB)
Partition Size (partition 0)
(LSB)</td></tr>
<tr><td>09</td></tr>
<tr><td>10</td><td colspan="8" rowspan="2">(MSB)
Partition Size (partition 1)
(LSB)</td></tr>
<tr><td>11</td></tr>
<tr><td>12
⋮
133</td><td colspan="8">Partition Size (partitions 2 through 62)</td></tr>
<tr><td>134</td><td colspan="8" rowspan="2">(MSB)
Partition Size (partition 63)
(LSB)</td></tr>
<tr><td>135</td></tr>
</table>

Byte 00, Bit 7 – PS (Parameters Savable)

The tape drive does not support saving the parameter data contained on the Medium Partition page. The valid value is 0.

Byte 00, Bits 5 through 0 – Page Code

The value for this field is 11h, identifying the current page as the Medium Partition page.

Byte 01 – Page Length

This field indicates the number of bytes in the Medium Partition page that follow this byte. The valid value is 86h.

Byte 02 – Maximum Additional Partitions

This field indicates the maximum number of partitions, in addition to the original partition (the entire tape), that can be defined on a single tape. The tape drive supports up to 64 partitions, so the value returned for this byte is 3Fh (63).

Byte 03 – Additional Partitions Defined

The value returned for this field is one less than the number of partitions currently on the tape. For example, a value of 00h indicates the tape contains one partition (the entire tape).

Byte 04, Bit 7 – FDP (Fixed Data Partitions)

The valid value for this bit is 0.

Byte 04, Bit 6 – SDP (Select Data Partitions)

The valid value for this bit is 0.

Byte 04, Bit 5 – IDP (Initiator Defined Partitions)

The valid value for this bit is 0.

Byte 04, Bits 4 and 3 – PSUM (Partition Size Unit of Measure)

This field indicates the units used to specify partition sizes. The valid value for this field is 10b, indicating that the partition size is specified in MB.

Byte 05 – Medium Format Recognition

The value returned for this field is 03h, indicating that the tape drive can recognize both medium format and partition information.

Bytes 08 and 09, 10 and 11, 12 through 133, 134 and 135 – Partition Size (Partition *n*)

These fields indicate the size of the defined partitions. When IDP=1, these fields specify the approximate amount of uncompressed data space that is available between the logical beginning of each partition (LBOP) and the logical end of each partition (LEOP) on the tape. If the tape contains just a single partition, the Partition Size (partition 0) field returns the approximate uncompressed capacity of the entire tape.

10.3.10 TapeAlert Page (Page Code 1Ch)

The TapeAlert page reports how the tape drive uses the TapeAlert function.

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code					
01	Page Length							
02	Perf	Reserved			DExcpt	Test	RSVD	LogErr
03	Reserved				MRIE			
04 ⋮ 07	Interval Timer							
08 ⋮ 11	Report Count							

Byte 00, Bits 5 through 0 – Page Code

The value for this field is 1Ch, which identifies the current page as the TapeAlert page.

Byte 01 – Page Length

This field indicates the number of bytes in the TapeAlert page that follow this byte. The valid value is 0Ah.

Byte 02, Bit 7 – Perf

This field indicates whether informational exception operations that can cause delays are acceptable. The valid value for this bit is 0 (delays are acceptable).

Byte 02, Bit 3 – DExcpt (Disable Exception Reporting)

This field indicates how the tape drive handles the reporting informational exception operations, as follows:

0 – The tape drive reports informational exceptions using the method specified by the MRIE field.

1 – The tape drive disables all informational exception operations. The MRIE field is ignored (default setting).

Byte 02, Bit 4 – Test

This field indicates whether the tape drive generates false informational exception conditions, as follows:

0 – The tape drive does not generate any false informational exception conditions.

1 – The tape drive generates a false informational exception condition based on the MRIE and Interval Timer settings.

Byte 02, Bit 0 – LogErr

The tape drive does not support the LogErr bit. The valid value is 0.

Byte 03, Bits 3 through 0 – MRIE

This field indicates the method used by the tape drive to report informational exception conditions, as follows:

3 – The tape drive conditionally generates a Recovered Error. Whenever one or more TapeAlert flags are set, the tape drive returns Check Condition status with sense key set to Recovered Error (1h). The ASC and ASCQ fields are set to 5Dh and 00h; the FSC is set to F1h. A pending Recovered Error will be returned on the first successful SCSI command after the TapeAlert flag is set. The TapeAlert log page should be read immediately after the Recovered Error message is received.

Note: The command which receives the Recovered Error message will have executed correctly and should not be reissued by the initiator.

Bytes 04 through 07 – Interval Timer

The valid value for this field is 0, indicating that the tape drive only reports the condition one time.

Bytes 08 through 11 – Report Count

The tape drive does not support this field. The valid value is 0.

10.3.11 Vendor Unique Parameters Page 1 (Page Code 20h)

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code					
01	Page Length							
02	CT	RSVD	ND	RSVD	NBE	EBD	PE	NAL
03	RTF			WTF			RSVD	112m
04	Motion Threshold							
05	Gap Threshold							

Byte 00, Bits 5 through 0 – Page Code

The value for this field is 20h, identifying the current page as the Vendor Unique Parameters Page 1 page.

Byte 01 – Page Length

This field indicates the number of bytes in the Vendor Unique Parameters Page 1 page that follow this byte. The valid value is 04h.

Byte 02, Bit 7 – CT (Cartridge Type)

This bit is ignored by the tape drive.

Byte 02, Bit 5 – ND

This field indicates whether the tape drive can disconnect from the initiator during the data transfer phase, as follows:

0 – The tape drive can disconnect during the data transfer phase. (Power-on default)

1 – The tape drive will not disconnect until either the data transfer phase has completed or the command has completed, as determined by the DTDC field in the Disconnect-Reconnect page (see page 10-16).

Byte 02, Bit 3 – NBE (No Busy Enable)

The valid value for this bit is 1.

Byte 02, Bit 2 – EBD (Even Byte Disconnect)

The valid value for this bit is 1, indicating that the tape drive always disconnects on 4-byte boundaries between data phases.

Note: Even-byte disconnect applies only when more data is to be transferred for the current command. If no more data is to be transferred, a disconnect may occur on an odd-byte boundary.

Byte 02, Bit 1 – PE (Parity Enable)

This field indicates whether parity checking on the SCSI bus is enabled, as follows:

0 – Parity checking disabled.
1 – Parity checking enabled. The tape drive checks every byte it receives for parity. (Power-on default)

Byte 02, Bit 0 – NAL (No Auto Load)

This field indicates whether the tape drive automatically loads the tape into the tape path when a data cartridge is inserted into the tape drive, as follows:

0 – Auto loading enabled. (Power-on default)
1 – Auto loading disabled.

Byte 03, Bits 7 through 5 – RTF (Read Tape Format)

This field indicates the data format on the currently loaded data cartridge, as follows:

100b – Mammoth-1 format
101b – Mammoth-2 format

Note: If the tape is blank or written in an unrecognized format, or if the tape drive is not ready, the tape drive returns 101b (Mammoth-2 format).

Byte 03, Bits 4 through 2 – WTF (Write Tape Format)

This field indicates the format the tape drive uses to write data to tape. The valid value for this field is 101b (Mammoth-2 format).

Byte 03, Bit 0 – 112m

This bit is ignored by the tape drive.

Byte 04 – Motion Threshold

This field indicates the amount of data that must be in the buffer before tape motion for a buffered write or read operation starts. The value represents a percentage of the buffer. Each 1h equals 0.39% of the buffer. The power-on default value is 80h, which represents one half of the buffer. By default, the tape drive automatically adjusts this value (auto-thresholding) based on the transfer rate of the host. See page 2-7 for more information about auto-thresholding and the Motion Threshold.

Byte 05 – Gap Threshold

This field has the same function as the Gap Threshold in the non-page format of the Vendor Unique Parameters page and in the page format of the Device Configuration page. See page 10-11 for a description of this field. The value received last by the tape drive takes precedence. Valid values for the Gap Threshold byte are 00h to FFh. The default value is 00h. Any value greater than 07h is treated as 07h.

10.3.12 Vendor Unique Parameters Page 2 (Page Code 21h)

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code					
01	Page Length							
02	Reserved							
03	RSVD	LPART						WWR
04	Reserved							
05								

Byte 00, Bits 5 through 0 – Page Code

The value for this field is 21h, identifying the current page as the Vendor Unique Parameters Page 2 page.

Byte 01 – Page Length

This field indicates the number of bytes in the Vendor Unique Parameters Page 2 page that follow this byte. The valid value is 04h.

Byte 03, Bits 6 through 1 – LPART (Load Partition)

This field indicates to which partition the tape drive will position the tape the next time it loads a tape or after it formats partitions on the current tape. Valid values for this field are from 0 to 63. Partitions are numbered sequentially from the end of the tape with partition 0 always being the last partition on the tape.

The power-on default for LPART is 0.

Byte 03, Bit 0 – WWR (Write without Retries)

This field indicates whether the tape was written with retries, as follows

0 – The tape was written with retries.
1 – The tape was written with no retries.

Note: The tape drive writes a tape without retries when you issue a MODE SELECT command at LBOT and set the Write Retry Count field (Read-Write Error Recovery page) to 00h. If the tape was written without retries, it should be read without retries. For this reason, if the WWR bit is set to 1, issue a MODE SELECT command to set the Read Retry Count field (Read-Write Error Recovery page) to 00h.

10.4 EXCEPTIONS AND ERROR CONDITIONS

Table 10-7 lists the exceptions and error conditions that cause the tape drive to return Check Condition status for the MODE SENSE command. See Appendix A for additional information about these errors.

Table 10-7 *REQUEST SENSE data for MODE SENSE command errors and exceptions*

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Description
24h	00h	5h	**Illegal Request.** Invalid field in the CDB.The Page Code is invalid.
39h	00h	5h	**Illegal Request.** The Page Control field is set to 11b (return saved parameters). The tape drive does not support saving parameters.

Notes

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PREVENT/ALLOW MEDIUM REMOVAL (1Eh)

<table>
<tr><th>Bit
Byte</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>00</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>01</td><td colspan="3">Logical Unit Number</td><td colspan="5">Reserved</td></tr>
<tr><td>02</td><td colspan="8" rowspan="2">Reserved</td></tr>
<tr><td>03</td></tr>
<tr><td>04</td><td colspan="7"></td><td>Prevent</td></tr>
<tr><td>05</td><td colspan="2">Vendor Unique</td><td colspan="4">Reserved</td><td>0</td><td>0</td></tr>
</table>

11.1 About This Command

You can use the PREVENT/ALLOW MEDIUM REMOVAL command to allow or disallow the removal of the data cartridge from the tape drive.

The PREVENT/ALLOW MEDIUM REMOVAL command is reservation independent. The tape drive will execute a PREVENT/ALLOW MEDIUM REMOVAL command issued by any initiator even if the tape drive is reserved by another initiator.

If an initiator has issued a PREVENT MEDIUM REMOVAL (1Eh) command to prevent the removal of the data cartridge, the data cartridge will not be ejected until that initiator sends an ALLOW MEDIUM REMOVAL command to allow the data cartridge to be removed.

If more than one initiator has issued PREVENT MEDIUM REMOVAL commands to the tape drive to prevent the removal of the data cartridge, the cartridge will not be ejected until each of those initiators sends an ALLOW MEDIUM REMOVAL command to release the condition.

Effect on the Unload Button

When removal of the data cartridge is prevented by the PREVENT/ALLOW MEDIUM REMOVAL command, the tape drive's unload button is disabled; pressing this button does not cause the tape to be rewound or ejected.

Effect on the LOAD/UNLOAD (1Bh) Command

When removal of the data cartridge is prevented by the PREVENT/ALLOW MEDIUM REMOVAL command, issuing an LOAD/UNLOAD (1Bh) command causes the tape to be unloaded from the tape path but not ejected from the tape drive. Any data in the buffer is written to tape before the tape is rewound and unloaded from the tape path.

11.2 CDB Field Definitions

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 04, Bit 0 – Prevent

This field specifies whether the tape drive prevents or allows the removal of a data cartridge from the tape drive, as follows:

0 – Allow the data cartridge to be removed.
1 – Prevent the data cartridge from being removed.

The prevent-data-cartridge-removal condition terminates when any of the following conditions occur:

- A PREVENT/ALLOW MEDIUM REMOVAL command with the Prevent bit set to 0 is received from all initiators that set the prevent condition.

- The tape drive is reset by a Bus Device Reset message, SCSI bus reset, or power-on reset.

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for these bits. The value of this field must be 0.

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READ (08h)

<table>
<tr><th>Byte \ Bit</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>00</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>01</td><td colspan="3">Logical Unit Number</td><td colspan="3">Reserved</td><td>SILI</td><td>Fixed</td></tr>
<tr><td>02</td><td colspan="8" rowspan="3">(MSB)
Transfer Length
(LSB)</td></tr>
<tr><td>03</td></tr>
<tr><td>04</td></tr>
<tr><td>05</td><td colspan="2">Vendor Unique</td><td colspan="4">Reserved</td><td>0</td><td>0</td></tr>
</table>

12.1 About This Command

The READ command transfers one or more bytes or blocks of data from the tape drive to the initiator, beginning with the next logical block. The tape drive reads tapes written in Mammoth-1 and Mammoth-2 formats, and automatically determines the format of the data on the tape.

Notes:

- The tape drive can read tapes that have a combination of fixed-length and variable-length data blocks.
- The tape drive will report the early-warning condition (LEOP reached) if the REW bit is set with the MODE SELECT command (byte 8, bit 0 in the Device Configuration Page).

12.2 CDB Field Definitions

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 01, Bit 1 – SILI (Suppress Illegal Length Indication)

The SILI bit is used to suppress an illegal length Check Condition status for read operations that read logical blocks that do not contain the defined number of bytes. This bit is valid only when the read operation is for variable-length logical blocks (that is, when the Fixed bit is set to 0).

0 – Do not suppress illegal length indication Check Condition status.
1 – Suppress illegal length indication Check Condition status.

Notes:

- If the Fixed bit is 1 (fixed-length logical blocks) and the SILI bit is 1, the tape drive returns Check Condition status with the sense key set to Illegal Request (5h). The ASC and ASCQ fields are set to 24h and 00h.

- If the Fixed bit is 0 and the SILI bit is 1, Check Condition status is suppressed for all cases in which the length of the logical block to be read is less than the length specified by the Transfer Length field. If the length of the logical block is greater than the length specified by the Transfer Length field, Check Condition status is suppressed only if the Block Length field of the MODE SELECT Block Descriptor is 0.

- The tape drive never transfers more data than requested, regardless of the setting of the SILI bit.

Byte 01, Bit 0 – Fixed

The Fixed bit defines the type of read operation to be performed, as follows:

0 – Read a single logical block. The length of this block is specified in the Transfer Length field.

1 – Read one or more fixed-length logical blocks. The number of blocks is specified in the Transfer Length field.

Note: The tape drive returns Check Condition status with the sense key set to Illegal Request (5h) if the Fixed field in the READ command is 1 (fixed-length logical blocks) and the Block Length field in the current MODE SELECT data is 0 (variable-length logical block). The ASC and ASCQ bits are set to 81h and 00h (fixed/variable mismatch).

Bytes 02 through 04 – Transfer Length

The Transfer Length field specifies the amount of data to be read, as follows:

- When the Fixed bit is set to 0 (read variable-length blocks), this field contains the length of the logical block in bytes. The logical block can be any size from 4 bytes to 240 KB (1 KB = 1,024 bytes). The valid value for this field is from 000004h to 03C000h.

- When the Fixed bit is set to 1 (read fixed-length blocks), this field contains the number of logical blocks to be read. The length of each block is either the power-on default block length or the length specified with the currently active MODE SELECT command (see page 9-7). The allowable fixed block sizes are defined by the READ BLOCK LIMITS (05h) command (see page 13-2).

The data is read from the next logical block on the tape and is transferred to the initiator.

Note: When the value for the Transfer Length field is 0, no data is transferred and the current position of the tape is not changed. A value of 0 for these bytes is not an error.

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for these bits. The value for this field must be 0.

12.3 Exceptions and Error Conditions

The following sections describe exceptions and error conditions that cause the tape drive to return Check Condition status for the READ command.

12.3.1 Transfer Length Incorrect

If the actual transfer length does not match the requested transfer length, the information reported depends on the setting of the Fixed bit.

Variable Length Mode (Fixed = 0) If the Fixed bit is 0 and the actual length of the block on the tape does not match the transfer length requested, the tape drive transfers the number of bytes available up to the transfer length requested. Then, it terminates the READ command and returns Check Condition status. (The Check Condition status may be suppressed if the SILI bit is set to 1.)

The REQUEST SENSE data is set as follows:

Valid	1
ILI	1
Sense Key	No Sense (0h)
Information bytes	Indicate the difference between the actual length and the requested length: ▪ If the requested length is greater than the actual length, the Information bytes are positive. ▪ If the requested length is less than the actual length, the Information bytes are negative (2s complement notation).
ASC	00h
ASCQ	00h
FSC	0Ah

Note: 2's complement is the method of representing a negative number as a binary number that when added to a positive number of the same magnitude equals zero.

When the READ command terminates in variable mode, the tape is positioned after the block with the incorrect length (at the start of the next logical block).

Fixed Length Mode (Fixed = 1) If the Fixed bit is 1 and the actual length of any one block does not match the requested block length, the tape drive transfers the number of blocks requested until it encounters the block with the incorrect length. Then, it terminates the READ command and returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	1
ILI	1
Sense Key	No Sense (0h)
Information bytes	Indicate the number of blocks not transferred to the initiator, including the block with the incorrect length.
ASC	00h
ASCQ	00h
FSC	0Ah

When the READ command terminates in fixed mode, the tape is positioned after the block with the incorrect length (at the start of the next logical block).

12.3.2 FILEMARK DETECTED

If the tape drive detects a filemark before completing the read operation, it returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	1
Filemark	1
Sense Key	No Sense (0h)
Information bytes	Depend on the setting of the Fixed bit, as follows: ▪ If the Fixed bit is 0, equal the requested transfer length. ▪ If the Fixed bit is 1, equal the difference between the requested transfer length and the actual number of logical blocks read.
ASC	00h
ASCQ	01h
FSC	0Dh

When the READ command terminates, the logical position is at the EOT side of the filemark encountered.

12.3.3 Setmark Detected

If the RSmk bit in the MODE SELECT Device Configuration page (Page Code 10h) is set to 1 and the tape drive detects a setmark before completing the read operation, it returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	1
Filemark	1
Sense Key	No Sense (0h)
Information bytes	Depend on the setting of the Fixed bit, as follows: ▪ If the Fixed bit is 0, equal the requested transfer length. ▪ If the Fixed bit is 1, equal the difference between the requested transfer length and the actual number of logical blocks read.
ASC	00h
ASCQ	03h
FSC	1Dh

When the READ command terminates, the logical position is at the EOT side of the setmark encountered.

12.3.4 PEOT or PEOP Encountered

During a read operation, if the tape drive encounters the physical end of tape (PEOT) or the physical end of partition (PEOP), it returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	0 or 1
EOM	1
Sense Key	Medium Error (3h)
Information bytes	If Valid=1, depend on the setting of the Fixed bit, as follows: ▪ If the Fixed bit is 0, equal the requested transfer length. ▪ If the Fixed bit is 1, equal the difference between the requested transfer length and the actual number of logical blocks read.
ASC	3Bh
ASCQ	02h
PEOT	1
FSC	14h

When the READ command terminates, the logical position is undefined.

12.3.5 EOD Detected

If the tape drive detects the EOD mark during the read operation, it returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	1
Sense Key	Blank Check (8h)
Information bytes	Depend on the setting of the Fixed bit, as follows: ▪ If the Fixed bit is 0, equal the requested transfer length. ▪ If the Fixed bit is 1, equal the difference between the requested transfer length and the actual number of logical blocks read.
ASC	00h
ASCQ	05h
FSC	0Ch

When the READ command terminates, the logical position is after the last recorded data block, filemark, or setmark.

12.3.6 Unrecoverable Read Error

If an unrecoverable media or hardware error occurs during the read operation, the tape drive terminates the READ command and returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	0 or 1
Sense Key	Medium Error (3h) or Hardware Error (4h)
Information bytes	If Valid=1, depend on the setting of the Fixed bit, as follows: ▪ If the Fixed bit is 0, equal the requested transfer length. ▪ If the Fixed bit is 1, equal the difference between the requested transfer length and the actual number of logical blocks read. The actual number does not include the unrecovered block.
Other bits and bytes	Depend on the error condition

When the READ command is terminated, the tape drive is positioned after the unrecovered block for a Medium Error or in an undefined position for a Hardware Error.

Note: In both fixed and variable block modes, the tape drive may have entered the Data Phase before reporting this error.

12.3.7 Additional Errors

Table 12-1 lists additional exceptions and error conditions that cause the tape drive to return Check Condition status for the READ command. See Appendix A for additional information about these errors.

Table 12-1 *REQUEST SENSE data for READ command errors and exceptions*

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Description
00h	05h	5h	**Illegal Request.** Invalid field in the CDB. The tape is in an invalid position for the tape drive to perform a read operation (a READ command was issued after a WRITE or WRITE FILEMARKS command).
04h	01h	2h	**Not Ready.** Tape drive is not ready, but is in process of becoming ready (rewinding or loading tape).
11h	00h	3h	**Medium Error.** An uncorrectable block was encountered during a read operation.
11h	00h	4h	**Hardware Error.** The compression circuit was unable to decompress previously compressed data during a read operation. Use the following steps to recover from this error: **1.** Reissue the failed command or command sequence. **2.** Power the tape drive off and back on again. or Send a SCSI bus reset (“hard” reset). **3.** If the error persists, the tape may be bad or the tape drive may require service.
11h	02h	4h	**Hardware Error.** The read decompression CRC failed during a read operation. Use the following steps to recover from this error: **1.** Reissue the failed command or command sequence. **2.** Power the tape drive off and back on again. or Send a SCSI bus reset (“hard” reset). **3.** If the error persists, the tape may be bad or the tape drive may require service.
11h	03h	3h	**Medium Error.** Too many permanent read errors. Cannot sync.
14h	00h	3h	**Medium Error.** The tape drive detected a medium error during a read operation.
15h	01h	4h	**Hardware Error.** The tape drive cannot position the media correctly.
1Ah	00h	5h	**Illegal Request.** Invalid transfer length in the CDB. The Transfer Length exceeds 3C000h (240 KB) for a variable-block read.
24h	00h	5h	**Illegal Request.** Invalid field in the CDB. Both the Fixed and SILI bits are set to 1.
30h	00h	6h	**Unit Attention.** Incompatible media was rejected after the cartridge was inserted.

Table 12-1 REQUEST SENSE data for READ command errors and exceptions (continued)

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Description
30h	01h	3h	**Medium Error.** Incompatible format. The format of the currently loaded tape is not compatible with the tape drive.
30h	02h	5h	**Illegal Request.** The tape format is incompatible with the command.
3Ah	00h	2h	**Not Ready.** Tape drive is not ready. Command requires a tape, and no tape is present.
81h	00h	5h	**Illegal Request.** Fixed/variable mismatch. The Fixed bit is set to 1 (write fixed-length logical blocks) and the value in the Block Length field in the current MODE SELECT data is 0 (variable-length logical block).

Notes

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READ BLOCK LIMITS (05h)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	0	0	1	0	1
01	Logical Unit Number			Reserved				
02	Reserved							
03								
04								
05	Vendor Unique		Reserved				0	0

13.1 About This Command

The READ BLOCK LIMITS command requests that the tape drive return data identifying the maximum and minimum logical block lengths supported. The data returned by the READ BLOCK LIMITS command applies to both the variable and fixed block lengths for the READ and WRITE commands.

13.2 CDB Field Definitions

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for this command. The value of this field must be 0.

13.3 What the Tape Drive Returns

The tape drive returns Read Block Limits data to the initiator to indicate the maximum and minimum block lengths it supports, formatted as follows:

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved							
01	(MSB)							
02	Maximum Block Length							
03								(LSB)
04	(MSB)							
05	Minimum Block Length							(LSB)

Bytes 01 through 03 – Maximum Block Length

The tape drive returns 3C000h (240 KB) for the Maximum Block Length.

Note: 1 KB = 1,024 bytes.

Bytes 04 and 05 – Minimum Block Length

The tape drive returns 0004h (4 bytes) for the Minimum Block Length.

14

READ BUFFER (3Ch)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	1	1	1	1	0	0
01	Logical Unit Number			Reserved		Mode		
02	Buffer ID							
03	(MSB)							
04	Buffer Offset							
05								(LSB)
06	(MSB)							
07	Allocation Length							
08								(LSB)
09	Vendor Unique		Reserved				0	0

14.1 About This Command

The READ BUFFER command is used to create a diagnostic listing of tape drive data for later analysis. You can obtain data about the tape drive's state or actual read or write data from the tape drive's buffer.

14.2 CDB Field Definitions

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 01, Bits 2 through 0 – Mode

The Mode field specifies the type of data to be returned to the initiator, as follows:

010b – Buffer data
011b – Buffer descriptor information (described on page 13-2)

Byte 02 – Buffer ID

The Buffer ID field specifies the buffer for which the initiator is requesting data. Table 14-1 lists valid values for this field.

Table 14-1 *Valid values for the READ BUFFER Buffer ID field*

Buffer ID	Description
0000b	Read and write data buffer (image of tape data)
0001b	Diagnostic data buffer
0011b	Buffer Descriptor

Note: All other buffer ID values are reserved for use by Exabyte.

If you set the Mode field to 010b and the Buffer ID field to 01h, diagnostic information is returned. This data can be used by Exabyte to diagnose tape drive problems.

Bytes 03 through 05 – Buffer Offset

The Buffer Offset field indicates the byte offset within the buffer specified by the Buffer ID. The value must be less than the Buffer Capacity minus the total number of bytes to be transferred, and must be a multiple of:

$$2^{\mathit{Offset\ Boundary}}$$

The Buffer Capacity and Offset Boundary values are returned in the Buffer Descriptor (see page 14-3).

Bytes 06 through 08 – Allocation Length

The Allocation Length field specifies the amount of space, in bytes, that the initiator has allocated for buffer data returned from the tape drive. The amount of data returned is the Allocation Length or the total amount of data in the buffer, whichever is less.

Note: If you are requesting the Buffer Descriptor information (Mode = 0011b), set the Allocation Length to at least 4 bytes.

Byte 09, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for these bits. The value of this field must be 0.

14.3 WHAT THE TAPE DRIVE RETURNS

If you set the Mode field to 011b, the tape drive returns a Buffer Descriptor for the buffer specified by the Buffer ID field.

Bit / Byte	7	6	5	4	3	2	1	0
00	Offset Boundary							
01	(MSB)							
02	Buffer Capacity							
03								(LSB)

Byte 00 – Offset Boundary

This field indicates the boundary alignment within the selected buffer, as described in Table 14-2. For subsequent WRITE BUFFER or READ BUFFER commands, use this value as a power of two in the Buffer Offset field.

Table 14-2 *Offset Boundary values*

Offset Boundary value	Buffer offset	$2^{\text{Offset Boundary}}$ (use for Buffer Offset)
00h	Byte boundaries	$2^0 = 1$
01h	Even-byte boundaries	$2^1 = 2$
02h	Four-byte boundaries	$2^2 = 4$
03h	Eight-byte boundaries	$2^3 = 8$
04h	16-byte boundaries	$2^4 = 16$
⋮	⋮	⋮
FFh	0 is the only supported buffer offset	not applicable

Bytes 01 through 03 – Buffer Capacity

This field indicates the size of the buffer in bytes. Currently, the size of buffer 00 (read and write data buffer) is approximately 8 MB. The size of the diagnostic data buffer (Buffer ID 0001b) is approximately 1 MB. These values may change with new releases of tape drive microcode.

14.4 Exceptions and Error Conditions

Table 14-3 lists the exceptions and error conditions that cause the tape drive to return Check Condition status for the READ BUFFER command. See Appendix A for additional information about these errors.

Table 14-3 *REQUEST SENSE data for READ BUFFER command errors and exceptions*

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Description
11h	02h	4h	**Hardware Error.** Error too long to correct. A CRC error was detected by the decompression hardware. Use the following steps to recover from this error: **1.** Reissue the failed command or command sequence. **2.** Power the tape drive off and back on again. or Send a SCSI bus reset (“hard” reset). **3.** If the error persists, the tape may be bad or the tape drive may require service.
24h	00h	5h	**Illegal Request.** Invalid field in the CDB. ▪ The Mode field contains a value other than 010b or 011b. ▪ The value in the Buffer Offset field is greater than the value in the Buffer Capacity field of the Buffer Descriptor. ▪ The sum of the values in the Allocation Length plus the Buffer Offset field is greater than the value returned in the Buffer Capacity field of the Buffer Descriptor.

15

READ POSITION (34h)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	1	1	0	1	0	0
01	Logical Unit Number			Reserved				BT
02 ⋮ 08	Reserved							
09	Vendor Unique		Reserved				0	0

15.1 About This Command

The READ POSITION command reports the tape drive's current logical position but does not cause tape motion to occur. As described in Chapter 6, the READ POSITION command is used with the LOCATE (2Bh) command to position the tape at a specified logical block address.

15.2 CDB Field Definitions

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 01, Bit 0 – BT (Block Type)

This bit determines the type of block number to be returned to the initiator, as follows:

0 – Return the SCSI logical block ID, numbered sequentially from the beginning of the tape or from the beginning of each partition. The number includes setmarks and filemarks.

1 – Return the logical block number, not including setmarks or filemarks. (This setting is not recommended for normal use.)

Byte 09, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for these bits. The value of this field must be 0.

15.3 What the Tape Drive Returns

When it completes the READ POSITION command, the tape drive returns 20 bytes of Read Position data to the initiator, formatted as follows:

Bit / Byte	7	6	5	4	3	2	1	0
00	BOP	EOP	Reserved			BPU	Reserved	
01	Partition Number							
02	Reserved							
03								
04	(MSB)							
⋮	First Block Location							
07								(LSB)
08	(MSB)							
⋮	Last Block Location							
11								(LSB)
12	Reserved							
13	(MSB)							
⋮	Number of Blocks in Buffer							
15								(LSB)
16	(MSB)							
⋮	Number of Bytes in Buffer							
19								(LSB)

Byte 00, Bit 7 – BOP (Beginning of Partition)

This field indicates whether the tape is positioned at the beginning of a partition, as follows:

0 – The tape is not positioned at the beginning of a partition.

1 – For a partitioned tape, the tape is positioned at the logical beginning of the currently active partition (LBOP). For a non-partitioned tape, the tape is positioned at LBOT.

Byte 00, Bit 6 – EOP (End of Partition)

This field indicates whether the tape is positioned at the end of a partition, as follows:

0 – The tape is not positioned at the end of a partition.

1 – For a partitioned tape, the tape is positioned between the logical end of partition (LEOP) and the physical end of partition (PEOP) of the currently active partition. For a non-partition tape, the tape is positioned between LEOT and PEOT.

Byte 00, Bit 2 – BPU (Block Position Unknown)

This field indicates whether the block position is known, as follows:

0 – The block position is known and the remainder of the READ POSITION data is valid.

1 – The block position is not known and cannot be obtained without tape motion. The remainder of the READ POSITION data is not valid.

Byte 01 – Partition Number

This field indicates the number of the partition in which the tape is currently located. The valid value for this field is 0 through *n*, where *n* is the total number of partitions on the tape, excluding partition 0. The tape drive supports up to 63 additional partitions. Note that partitions are numbered consecutively from the *end* of the tape. Partition 0 is always the last partition on the tape.

Note: If the tape is not partitioned, the tape drive returns a value of 0.

Bytes 04 through 07 – First Block Location

This field indicates the block address associated with the current logical block position (that is, the block address of the next data block to be transferred between the initiator and the tape drive if a READ or WRITE command is issued). When using a LOCATE command to search for this position, specify the value returned for this field as the Block Address in byte 03 through 06 of the LOCATE CDB.

Note: If a READ POSITION command follows a command that requires immediate action, the returned position will be the expected position after the immediate command is completed.

Bytes 08 through 11 – Last Block Location

The Last Block Location field is not supported by the tape drive. The value returned for this field is 0.

Bytes 13 through 15 – Number of Blocks in Buffer

The Number of Blocks in Buffer field is not supported by the tape drive. The value returned for this field is 0.

Bytes 16 through 19 – Number of Bytes in Buffer

The Number of Bytes in Buffer field is not supported by the tape drive. The value returned for this field is 0.

15.4 Exceptions and Error Conditions

Table 15-1 lists exceptions and error conditions that cause the tape drive to return Check Condition status for the READ POSITION command. See Appendix A for additional information about these errors.

Table 15-1 *REQUEST SENSE data for READ POSITION command errors and exceptions*

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Explanation
00h	00h	8h	**Blank Check.** The media does not contain any data.
04h	01h	2h	**Not Ready.** Tape drive is not ready, but is in process of becoming ready (rewinding or loading tape).
11h	00h	3h	**Medium Error.** An uncorrectable block was encountered during a read operation.
24h	00h	5h	**Illegal Request.** Invalid field in the CDB. The BT bit is set to 1.
30h	00h	6h	**Unit Attention.** Incompatible media was rejected after the cartridge was inserted.
30h	02h	5h	**Illegal Request.** The tape format is incompatible with the command.
3Ah	00h	2h	**Not Ready.** Tape drive is not ready. Command requires a tape, and no tape is present.

16

RECEIVE DIAGNOSTIC RESULTS (1Ch)

Bit Byte	7	6	5	4	3	2	1	0
00	0	0	0	3-1	1	1	0	0
01	Logical Unit Number			Reserved				
02	Reserved							
03	(MSB) Allocation Length							
04								(LSB)
05	Vendor Unique		Reserved				0	0

16.1 About This Command

You can use the RECEIVE DIAGNOSTIC RESULTS command to obtain the results of tests requested by a previous SEND DIAGNOSTIC (1Dh) command. See Chapter 21 for descriptions of these tests.

Note: To ensure that the diagnostic results are up-to-date and accurate, be sure that the RECEIVE DIAGNOSTIC RESULTS command immediately follows the SEND DIAGNOSTIC command and that the tape drive is reserved for the initiator's exclusive use.

16.2 CDB Field Definitions

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Bytes 03 and 04 – Allocation Length

This field specifies the number of bytes that the initiator has allocated for the return of RECEIVE DIAGNOSTIC RESULTS data.

To receive all available diagnostic information, specify a value for the Allocation Length field that equals the Page Length for the diagnostic page requested plus 4 bytes. A value of 0 for the Allocation Length field indicates that no diagnostic data will be returned and is not an error.

The tape drive terminates the Data In phase when the number of bytes specified in the Allocation Length field has been transferred or when all available data has been transferred to the initiator, whichever is less.

Byte 05, Bits 6 and 7 – Vendor Unique

There are no vendor unique definitions for these bits. The value for this field must be 0.

16.3 What the Tape Drive Returns

When the tape drive receives a RECEIVE DIAGNOSTIC RESULTS command, it returns the results of the previous SEND DIAGNOSTIC command, formatted as follows:

Bit / Byte	7	6	5	4	3	2	1	0
00	Page Code							
01	Reserved							
02	(MSB) Page Length							
03	Page Length (LSB)							
04	Diagnostic Parameter							

Byte 00 – Page Code

The value returned for the Page Code depends on the valid combination of the SelfTest, DevOffL, and UnitOffL bits in the SEND DIAGNOSTIC CDB, as shown in Table 16-1. See page 21-3 for a description of the tests performed by the tape drive.

Table 16-1 *RECEIVE DIAGNOSTIC RESULTS page codes returned for valid SEND DIAGNOSTIC parameter combinations*

SelfTest	DevOffL	UnitOffL	Type of test	Page code returned
1	0	0	Code check	90h
		1	Code check	91h
	1	0	Buffer check	90h
		1	Tape operation check	91h

Bytes 02 and 03 – Page Length

This field indicates the number of Diagnostic Parameter bytes that follow this field. The tape drive returns a Page Length of 0001h (1 byte).

Byte 04 – Diagnostic Parameter

This field indicates the result of the diagnostic test, as follows:

00h – The tape drive passed the test.
01h to FFh – The tape drive failed the test.

Note: If the tape drive failed the test, the value returned corresponds to a Fault Symptom Code. These codes are described in Appendix A.

Notes

17

RELEASE UNIT (17h OR 57h)

6-BYTE RELEASE UNIT (17h)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	0	1	1	1
01	Logical Unit Number			3rdPty	Third Party Device ID			RSVD
02	Reserved							
03								
04								
05	Vendor Unique		Reserved				0	0

10-BYTE RELEASE UNIT (57h)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	1	0	1	0	1	1	1
01	Logical Unit Number			3rdPty	Reserved		0	RSVD
02	Reserved							
03	Third Party Device ID							
04 ⋮ 08	Reserved							
09	Vendor Unique		Reserved				0	0

17.1 About This Command

The RELEASE UNIT command releases a tape drive from an initiator's exclusive use or, if third-party reservations are in effect, from another SCSI device's use. To have effect, the command must be issued by the initiator that reserved the tape drive with a RESERVE UNIT command.

It is not an error to attempt to release a tape drive that is not currently reserved by the current initiator, but if the tape drive is reserved by another initiator, then that reservation remains in effect.

The tape drive supports both the 6-byte and the 10-byte format of the RELEASE UNIT CDB. The tape drive determines which version of the command is being used based on the operation code in the CDB. You can use either version of the command.

17.2 CDB Field Definitions

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 01, Bit 4 – 3rdPty

This field indicates whether the tape drive is to release a third-party reservation, as follows:

0 – Do not release the third-party reservation.
1 – Release the third-party reservation.

Byte 01, Bits 3 through 1 (6-byte CDB) or Byte 03 (10-byte CDB) – Third Party Device ID

This field indicates the SCSI ID of the initiator that reserved the tape drive. The tape drive ignores this field if the initiator is not requesting a third-party reservation release.

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for these bits. The value for this field must be 0.

18

REQUEST SENSE (03h)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	0	0	0	1	1
01	Logical Unit Number			Reserved				
02	Reserved							
03								
04	Allocation Length							
05	CLRCNT	VU	Reserved				0	0

18.1 About This Command

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

The sense data is valid for the Check Condition status just presented to the initiator. The tape drive preserves the sense data for the initiator receiving the Check Condition status until it is cleared by that initiator. Sense data is cleared when the tape drive receives any subsequent command other than INQUIRY (12h) from the initiator that received the Check Condition status.

18.2 CDB Field Definitions

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 04 – Allocation Length

This field specifies the number of bytes that the initiator should allocate for the returned sense data. The parallel SCSI bus version of the tape drive provides a total of 32 (20h) bytes of sense data.

Byte 05, Bit 7 – CLRCNT (Clear Counter)

This field indicates whether to reset the Tracking Retry counter, the Read/Write Retry counter, and the Underrun/Overrun counter, as follows:

0 – Do not reset counters.
1 – Reset counters.

If the CLRCNT bit is set to 1, the counters are reset when the REQUEST SENSE command completes. The initiator must allocate at least 29 (1Dh) bytes for sense data to be read in order to reset the counters.

Note: Values for the Tracking Retry, Read/Write Retry, and Underrun/Overrun counters are returned in the REQUEST SENSE sense data.

Byte 05, Bit 6 – VU (Vendor Unique)

There is no vendor unique definition for this bit. The value for this bit must be 0.

18.3 What the Tape Drive Returns

This section describes the Extended Sense data returned by the tape drive in response to the REQUEST SENSE command. The definitions of bytes 08 through 11 and bytes 18 through 31 apply to sense data returned for any SCSI command except the EXTENDED COPY command used by the Fibre Channel version of the tape drive. See the *Exabyte Mammoth-2 Fibre Channel Supplement* for changes to these fields when the tape drive is using a Fibre Channel communication interface.

Bit / Byte	7	6	5	4	3	2	1	0
00	Valid	Error Code						
01	Reserved							
02	FMK	EOM	ILI	RSVD	Sense Key			
03 ⋮ 06	(MSB) Information (LSB)							
07	Additional Sense Length							
08	Log Parameter Page Code							
09	Log Parameter Code							
10	Reserved							
11	Underrun/Overrun Counter							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Reserved							
15	SKSV	Sense Key Specific Data						
16	Sense Key Specific Data							
17								
18	Reserved							
19	PF	BPE	FPE	ME	ECO	TME	TNP	LBOT
20	RSVD	TMD	WP	FMKE	URE	WE1	SSE	FE
21	CWF	UCLN	RRR	CLND	CLN	PEOT	WSEB	WSEO
22	Reserved							
23	(MSB) Remaining Tape							
24								
25	(LSB)							
26	Tracking Retry Counter							
27	Read/Write Retry Counter							
28	Fault Symptom Code							
29	Cleaning Reason							
30	Reserved							
31								

Byte 00, Bit 7 – Valid

This field indicates whether the sense data in the Information field (bytes 03 through 06) is valid, as follows:

0 – The data in the Information field is undefined.

1 – The data in the Information field is valid for the command receiving the Check Condition status.

Byte 00, Bits 6 through 0 – Error Code

This field indicates with what command the reported sense data is associated, as follows:

70h – The sense data is associated with the command that received the Check Condition status.

71h – The sense data is for a deferred error condition and is associated with an earlier command.

Byte 02, Bit 7 – FMK (Filemark)

This bit indicates whether the current command detected a filemark, as follows:

0 – No filemarks were detected.
1 – The current command detected a filemark.

Byte 02, Bit 6 – EOM (End of Medium)

When set to 1, this bit indicates either of the following conditions:

- The tape is at LBOP (logical beginning of partition).
- The tape is at or past the early warning (logical end of tape).

Byte 02, Bit 5 – ILI (Illegal Length Indicator)

When set to 1, this bit indicates that the logical block length requested did not match the actual logical block length of the data recorded on the tape.

Byte 02, Bits 3 through 0 – Sense Key

This field contains the sense key associated with the current sense data. Table 18-1 lists the sense key values supported by the tape drive. See Appendix A for the ASC, ASCQ, and FSC values associated with each sense key.

Table 18-1 Sense Key values and definitions

Sense Key	Meaning	Explanation
0h	No Sense	Indicates that there is no specific sense key information to be reported for the designated logical unit. This occurs when a command completes successfully or returns Check Condition status with the FMK, EOM, or ILI bits set to 1.
1h	Recovered Error	Indicates that the last command completed successfully with some recovery action performed by the tape drive.
2h	Not Ready	Indicates that the tape drive does not contain a data cartridge or that the data cartridge is not loaded. Operator intervention may be required to correct this condition.
3h	Medium Error	Indicates that the command terminated with a non-recoverable error condition that may have been caused by a flaw in the tape.
4h	Hardware Error	Indicates that the tape drive detected a non-recoverable hardware failure while performing the command or during a self-test.
5h	Illegal Request	Indicates that there was an illegal parameter in the CDB or in the additional parameters supplied as data for a command or that the tape drive is in the wrong mode to execute the command.
6h	Unit Attention	Indicates one of the following: ▪ The tape drive has been reset (by a power-on reset, a Bus Device Reset message, or a SCSI bus reset). ▪ An initiator changed the MODE SELECT parameters since the last command was issued to the tape drive. ▪ The unload button was pressed and the data cartridge was ejected. ▪ A data cartridge was inserted and automatically loaded. ▪ The internal microcode (firmware) was changed. ▪ A log parameter (counter) reached a specified threshold value (assuming that RLEC bit on the MODE SELECT Control Mode page is set to 1). This sense key is reported the first time any command is issued by each initiator after the condition is detected, and the requested command is not performed. This sense key is cleared when the next command other than INQUIRY or REQUEST SENSE is received by the tape drive.
7h	Data Protect	Indicates that a command that writes to tape was attempted on a write-protected data cartridge. The write operation is not performed.
8h	Blank Check	Indicates that EOD (blank tape) was encountered during a read, space, or locate operation.
9h	Exabyte	This is a vendor unique sense key used by Exabyte to indicate that a positioning error has occurred. The actual position of the tape drive is undetermined and is not the expected position.

Table 18-1 Sense Key values and definitions

Sense Key	Meaning	Explanation
Bh	Aborted Command	Indicates that the tape drive aborted the command. This condition occurs when an Initiator Detected Error (05h) message is received during command execution or when a Message Reject (07h) or SCSI bus parity error is detected by the tape drive during Command or Data Out phase. The initiator may be able to recover by trying the command again.
Dh	Volume Overflow	Indicates that the last WRITE or WRITE FILEMARKS command reached the physical end of tape (PEOT) and that data may remain in the buffer.

Bytes 03 through 06 – Information

For the parallel SCSI bus version of the tape drive, the value in this field represents the number of unprocessed blocks or bytes of data resulting from a Check Condition status for the LOCATE, READ, SPACE, VERIFY, WRITE, or WRITE FILEMARKS commands.

This field is valid only when the Valid bit (byte 00, bit 7) is set to 1. When the Valid bit is set to 0, any data in this field is invalid.

Byte 07 – Additional Sense Length

This byte indicates the length, in bytes, of any additional sense data provided by the tape drive, excluding this byte. For the parallel SCSI bus version of the tape drive, the value is 24 (18h) bytes.

Byte 08 – Log Parameter Page Code

When a log parameter (write or read error counter) meets the threshold criteria specified with the TMC bit in the LOG SELECT command, the tape drive sets this byte to the Page Code for the parameter. For more information about the LOG SELECT command, refer to Chapter 7.

Byte 09 – Log Parameter Code

When a log parameter (write or read error counter) meets the threshold criteria specified with the TMC bit in the LOG SELECT command, the tape drive sets this byte to the Parameter Code for the parameter. For more information about the LOG SELECT command, refer to Chapter 7.

Byte 11 – Underrun/Overrun Counter

The Underrun/Overrun Counter is a dual-function counter for logging write underruns and read overruns. This counter is used to determine the number of times the initiator failed to maintain the tape drive in streaming mode. It is incremented any time the tape drive repositions the tape after encountering an empty data buffer during a write operation or a full data buffer during a read operation.

When the counter reaches its maximum of FFh, it does not roll over to 00h, but remains at FFh until it is reset. The counter is reset to 00h after any of the following occurrences:

- A REQUEST SENSE command is issued with the CLRCNT bit (byte 05, bit 7) set to 1.

  Note: For the reset to be performed, at least 29 (1Dh) bytes of sense data must be read by the REQUEST SENSE command.

- The tape is loaded or rewound.
- The mode changes from write to read or from read to write.
- The tape drive is reset.

Byte 12 – Additional Sense Code (ASC)

This field contains the Additional Sense Code (ASC) data. The ASC, in conjunction with the Additional Sense Code Qualifier (byte 13), provides additional information about the error indicated by the sense key. Table A-1 on page A-2 provides detailed information about the valid combinations of ASC and ASCQ and their meanings. Where applicable, the “Exceptions and Error Conditions” section at the end of each command chapter provides detailed, command-specific information.

Byte 13 – Additional Sense Code Qualifier (ASCQ)

This field contains the Additional Sense Code Qualifier (ASCQ) data. The ASCQ, in conjunction with the Additional Sense Code (byte 12), provides additional information about the error indicated by the sense key. Table A-1 on page A-2 provides detailed information about the valid combinations of ASC and ASCQ and their meanings. Where applicable, the “Exceptions and Error Conditions” section at the end of each command chapter provides detailed, command-specific information.

Byte 15, Bit 7 – SKSV (Sense Key Specific Valid)

This field indicates whether the data in the Sense Key Specific Data field (bytes 15 through 17) is valid, as follows:

0 – The Sense Key Specific Data is not valid.
1 – The Sense Key Specific Data is valid. The Sense Key Specific Data is valid only when the sense key is Illegal Request (5h).

Bytes 15 through 17 – Sense Key Specific Data

When the sense key indicates Illegal Request (5h) and the SKSV is 1, the Sense Key Specific Data returns additional information about the illegal request, formatted as follows:

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

- **Byte 15, Bit 6 – C/D (Command/Data)** – This field indicates the location of the illegal parameter, as follows:

  0 – The illegal parameter is in the parameters sent by the initiator.
  1 – The illegal parameter is in the command descriptor block.

- **Byte 15, Bit 3 – BPV (Bit Pointer Valid)** – This field indicates whether the bit pointer for the illegal parameter is valid, as follows:

  0 – The Bit Pointer information is not valid.
  1 – The Bit Pointer information is valid.

- **Byte 15, Bits 2 through 0 – Bit Pointer** – This field indicates which bit of the byte indicated by the Field Pointer is in error. If a multiple bit field is in error, the Bit Pointer indicates the most significant (left-most) bit of the field.

- **Bytes 16 and 17 – Field Pointer** – This field indicates which byte of the command descriptor block or parameter data was in error. If a multiple-byte field is in error, the Field Pointer indicates the most significant (left-most) byte of the field.

Bytes 19 through 21 – Unit Sense

For each status bit defined in the Unit Sense field, the normal or Good status is 0. When one of these fields is set to 1, the condition indicated by that bit exists, as follows.

Note: All Reserved bits have an effective value of 0.

Byte 19, Bit 7 – PF (Power Fail) The tape drive has been reset since the last status, or the tape drive has performed an internal reset due to power-up.

Byte 19, Bit 6 – BPE (SCSI Bus Parity Error) The tape drive detected a SCSI bus parity error.

Byte 19, Bit 5 – FPE (Formatted Buffer Parity Error) The tape drive detected an internal data buffer parity error.

Byte 19, Bit 4 – ME (Media Error) In write mode, this bit indicates a permanent write error. In read mode, this bit indicates an uncorrectable read error.

Byte 19, Bit 3 – ECO (Error Counter Overflow) The Read/Write Retry Counter (byte 27) overflowed to 0.

Byte 19, Bit 2 – TME (Tape Motion Error) The tape drive detected an error while attempting to acquire tracking.

Byte 19, Bit 1 – TNP (Tape Not Present) The tape drive does not have a data cartridge inserted.

Byte 19, Bit 0 – LBOT (Logical Beginning of Tape) The data cartridge is positioned at the logical beginning of tape.

Byte 20, Bit 6 – TMD (Tape Mark Detect Error) The tape drive does not use this bit.

Byte 20, Bits 5 – WP (Write Protect) The data cartridge is write protected.

Byte 20, Bit 4 – FMKE (Filemark Error) A write error occurred when the tape drive was attempting to write a filemark.

Byte 20, Bit 3 – URE (Under Run Error) A hardware data formatter underrun error occurred. (Byte 20, bit 0, is also set to 1.)

Byte 20, Bit 2 – WE1 (Write Error 1) The maximum number of rewrites was attempted. This is a Media Error (3h).

Byte 20, Bit 1 – SSE (Servo System Error) A catastrophic hardware error occurred. The servo system detected an error.

Byte 20, Bit 0 – FE (Formatter Error) A catastrophic hardware error occurred. The data formatter detected an error.

Byte 21, Bit 7 – CWF (Cleaning Wheel Fail) Indicates the results of the cleaning wheel test, as follows:

0 – Cleaning wheel passed the test.
1 – Cleaning wheel failed the test.

The cleaning wheel test is performed once during Power On Self-Test. The tape drive does not treat this condition as a hard failure.

Byte 21, Bit 6 – UCLN (Unsuccessful Clean) A cleaning cartridge was loaded but the cleaning tape was used up, so a successful cleaning was not performed. This bit is reset to 0 after a successful cleaning is performed or the tape drive is reset.

Byte 21, Bit 5 – RRR (Reverse Retries Required) The tape drive was forced to invoke retries in order to move the tape properly. This bit is reset to 0 when a new tape is loaded.

Byte 21, Bit 4 – CLND (Cleaned) The tape drive has been cleaned. This bit is reset to 0 when the next REQUEST SENSE command is received.

Byte 21, Bit 3 – CLN (Clean) The tape drive needs to be cleaned. This bit is reset to 0 when a successful cleaning cycle is performed. The tape drive's cleaning requirements depend on the number of tape motion hours and the type of tape being used.

Byte 21, Bit 2 – PEOT (Physical End of Tape) The data cartridge is positioned at PEOT.

Byte 21, Bit 1 – WSEB (Write Splice Error) A write splice error occurred. The tape drive encountered blank tape when it was attempting a write splice operation. This is a Hardware Error (4h).

Byte 21, Bit 0 – WSEO (Write Splice Error) A write splice error occurred. The tape drive passed the splice position when it was attempting a write splice operation. This is a Hardware Error (4h).

Bytes 23 through 25 – Remaining Tape

This field indicates the amount of tape remaining, in approximately 33-KB physical units. This value equals the logical end of tape (LEOT) position minus the current physical position. If the current position is beyond LEOT, the value for this field is negative. If there is no data cartridge loaded, the value is 0.

Byte 26 – Tracking Retry Counter

This counter increments when a tracking error occurs during tape motion start-up. It is reset to 0 after any of the following:

- A REQUEST SENSE command is issued with the CLRCNT bit (byte 05, bit 7) set to 1.

  Note: For the reset to be performed, at least 29 (1Dh) bytes of sense data must be read by the REQUEST SENSE command.

- The tape is loaded or rewound.
- The mode changes from write to read or from read to write.
- The tape drive is reset.

Byte 27 – Read/Write Retry Counter

This counter increments when a read or write operation is unsuccessful and a recovery/retry action is performed. It is reset to 0 after any of the following:

- A REQUEST SENSE command is issued with the CLRCNT bit (byte 05, bit 7) set to 1.

  Note: For the reset to be performed, at least 29 (1Dh) bytes of sense data must be read by the REQUEST SENSE command.

- The tape is loaded or rewound.
- The mode changes from write to read or from read to write.
- The tape drive is reset.

The counter does not roll over from FFh to 0 but remains at FFh until it is reset.

Byte 28 – Fault Symptom Code

The Fault Symptom Code (FSC) field is an Exabyte-unique byte used to indicate the specific nature of hardware and software errors or other events. Table A-1 lists the errors indicated by the Fault Symptom Code byte.

Byte 29 – Cleaning Reason

This field indicates the reason that the drive is currently requesting or requiring cleaning, as follows:

00h – Cleaning not required
01h – Reserved
02h – Currently loaded tape exhibits poor error statistics
04h – Tape drive experienced an unrecoverable read or write error
08h – Greater than 100 hours of AME tape motion

If the tape drive requests cleaning for multiple reasons, the sum of the associated values is reported. For example, if the tape drive needs cleaning due to poor error statistics and >100 hours of AME usage, the reported value is 0Ah (02h + 08h).

18.4 Sense Byte Pending Status

When the tape drive reports Check Condition status in response to a command from an initiator, the tape drive retains the sense byte pending status, including error information and Check Condition status, for the initiator until one of the following occurs:

- Error information is reset by the next command other than INQUIRY from the same initiator.
- Error information is reset by a power-on reset, a Bus Device Reset message, or a SCSI bus reset condition.

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RESERVE UNIT (16h or 56h)

6-Byte RESERVE UNIT (16h)

Bit Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	0	1	1	0
01	Logical Unit No			3rdPty	Third Party Device ID			RSVD
02	Reserved							
03								
04								
05	Vendor Unique		Reserved				0	0

10-Byte RESERVE UNIT (56h)

Bit Byte	7	6	5	4	3	2	1	0
00	0	1	0	1	0	1	1	0
01	Logical Unit No			3rdPty	Reserved		0	RSVD
02	Reserved							
03	Third Party Device ID							
04 ⋮ **08**	Reserved							
09	Vendor Unique		Reserved				0	0

19.1 ABOUT THIS COMMAND

The RESERVE UNIT command reserves the tape drive for an initiator's exclusive use or, if third-party reservations are in effect, for another SCSI device's use. The reservation remains in effect until a RELEASE UNIT command is received from the same initiator or until the tape drive is reset by a SCSI bus reset, a Bus Device Reset message, or a power-on reset.

It is not an error for the initiator that made the last reservation to send another valid RESERVE UNIT command.

If the tape drive is reserved and it receives any command (other than an INQUIRY (12h), PREVENT/ALLOW MEDIUM REMOVAL (1Eh), or REQUEST SENSE (03h) command) from another initiator, it does not honor the command. Instead, it returns Reservation Conflict (18h) status to the initiator that sent the command.

The tape drive supports both the 6-byte and the 10-byte format of the RESERVE UNIT CDB. The tape drive determines which version of the command is being used based on the operation code in the CDB. You can use either version of the command.

19.2 CDB FIELD DEFINITIONS

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 01, Bit 4 – 3rdPty

This bit indicates whether a third-party reservation is requested, as follows:

0 – A third-party reservation is not requested.
1 – A third-party reservation is requested.

Byte 01, Bits 3 through 1 (6-byte CDB) or Byte 03 (10-byte CDB) – Third Party Device ID

This field indicates the SCSI ID of the device for which the initiator is making the third-party reservation. The tape drive ignores this field if the initiator is not requesting a third-party reservation.

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for these bits. The value for this field must be 0.

20

REWIND (01h)

<table>
<tr><th>Bit
Byte</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>00</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>01</td><td colspan="3">Logical Unit Number</td><td colspan="4">Reserved</td><td>Immed</td></tr>
<tr><td>02</td><td colspan="8" rowspan="3">Reserved</td></tr>
<tr><td>03</td></tr>
<tr><td>04</td></tr>
<tr><td>05</td><td colspan="2">Vendor Unique</td><td colspan="4">Reserved</td><td>0</td><td>0</td></tr>
</table>

20.1 About This Command

The REWIND command causes the tape drive to rewind the tape to the logical beginning of tape (LBOT) or, if the tape is partitioned, to the logical beginning of the partition (LBOP) in which the tape is currently positioned.

Notes:

- If the disconnect option is enabled, the tape drive disconnects from the initiator while the REWIND command is executing.
- If the tape is already at LBOT (or LBOP for a partitioned tape) and there is no data in the buffer, no tape motion results.
- If a command is received by the tape drive while the tape is rewinding, the tape drive executes the command after it reaches LBOT or LBOP.
- If the REWIND command is received after a WRITE (0Ah) or WRITE FILEMARKS (10h) command, buffered data, filemarks, or setmarks and an end of data (EOD) mark are written to the tape before it is rewound.
- If an error occurs while writing the data in the buffer to tape, the tape drive returns Check Condition status. The rewind operation is not performed. Issue a REQUEST SENSE (03h) command to determine the cause of the error.
- If there is data in the buffer because an earlier WRITE (0Ah) command was terminated with Check Condition status, that data is discarded before the tape is rewound.

20.2 CDB Field Definitions

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 01, Bit 0 – Immed

The value in this field determines when command status is returned to the initiator, as follows:

0 – Status is reported when the REWIND command is completed.

1 – Status is reported when the REWIND command is initiated by the tape drive.

If the tape drive's buffer contains data from a previous WRITE command, the tape drive disconnects from the initiator (if disconnect is enabled) and writes the data in the buffer to the tape.

- **If the Immed bit is set to 1**, the tape drive reconnects to the initiator when the write operation has completed successfully. It then returns Good status and performs the rewind operation.

  Note: Completing the write operation includes emptying the buffer to tape and writing the EOD mark.

- **If the Immed bit is set to 0**, the tape drive reconnects and returns status when the rewind operation is complete.

Byte 05, Bit 7 and 6 – Vendor Unique

There are no vendor unique definitions for these bits. The value for this field must be 0.

20.3 EXCEPTIONS AND ERROR CONDITIONS

Table 20-1 lists exceptions and error conditions that cause the tape drive to return Check Condition status for the REWIND command. See Appendix A for additional information about these errors.

***Table 20-1** REQUEST SENSE data for REWIND command errors and exceptions*

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Explanation
04h	01h	2h	**Not Ready.** Tape drive is not ready, it is in process of becoming ready (rewinding or loading tape).
15h	01h	4h	**Hardware Error.** The tape drive cannot position the media correctly.
30h	01h	3h	**Medium Error.** Incompatible format. The format of the currently loaded tape is not compatible with the tape drive.
30h	00h	6h	**Unit Attention.** Incompatible media was rejected after the cartridge was inserted.
3Ah	00h	2h	**Not Ready.** Tape drive is not ready. Command requires a tape, and no tape is present.

Notes

21

SEND DIAGNOSTIC (1Dh)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	1	1	0	1
01	Logical Unit Number			PF	RSVD	SelfTest	DevOffL	UnitOffL
02	Reserved							
03	(MSB) Parameter List Length							
04								(LSB)
05	Vendor Unique		Reserved				0	0

21.1 About This Command

The SEND DIAGNOSTIC command causes the tape drive to perform certain diagnostic tests. If a test is successful, the tape drive returns Good status; otherwise, it returns Check Condition status. When this command is followed by a RECEIVE DIAGNOSTIC RESULTS (1Ch) command or a REQUEST SENSE (03h) command, detailed results of these diagnostic tests are reported to the initiator.

Notes:

- To ensure that the diagnostic data returned is valid, the SEND DIAGNOSTIC command must be immediately followed by the RECEIVE DIAGNOSTIC RESULTS command.
- To ensure that the results of the diagnostic test are not destroyed by a command sent by another initiator, the tape drive should be reserved for the initiator's exclusive use.
- The initiator must support the disconnect option if you plan to use the SEND DIAGNOSTIC command because the tape drive will disconnect from the initiator while the command is executing.

- If the requested test involves a tape, either of the following conditions causes the SEND DIAGNOSTIC command to return Check Condition status with the sense key set to Illegal Request (5h) and the ASC and ASCQ fields set to 53h and 02h.
  - The Prevent bit in the PREVENT/ALLOW MEDIUM REMOVAL (1Eh) command is set to 1 (prevent media removal).
  - The NAL bit in MODE SELECT (15h) is set to 0 (autoloading disabled).

21.2 CDB Field Definitions

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 01, Bit 4 – PF (Page Format)

This bit specifies the format of the parameter list for the SEND DIAGNOSTIC command. The tape drive does not support page format, so the only valid value for this bit is 0, indicating that the parameter list is in non-page format.

Byte 01, Bit 2 – SelfTest

The value for this field must be 1. The tape drive performs its default self-diagnostic tests only.

Byte 01, Bit 1 – DevOffL

This field specifies whether the tape drive is allowed to perform diagnostic tests that might affect unit reservations, log parameters, or sense data, as follows:

0 – The tape drive may not perform such diagnostic tests.
1 – The tape drive may perform such diagnostic tests.

Byte 01, Bit 0 – UnitOffL

This field specifies whether the tape drive is allowed to perform diagnostic tests that might affect the tape, such as writing data or repositioning the tape, as follows:

0 – The tape drive may not perform diagnostic tests that affect the tape.
1 – The tape drive may perform diagnostic tests that affect the tape.

See Table 21-1 for a description of the valid combinations of the SelfTest, DevOfl, and UntOfl bits.

Bytes 03 and 04 – Parameter List Length

The value for this field must be 0. The tape drive does not support returning parameter list information to the initiator.

Byte 05, Bits 7 and 6 – Vendor Unique

There is no vendor unique definition for this bit. The value for this bit must be 0.

21.3 DIAGNOSTIC TESTS

Table 21-1 lists the valid combinations of the SelfTest, DevOffL, and UnitOffL bits and the resulting actions performed by the tape drive. All other combinations of settings for these fields are undefined and will result in Check Condition status with the sense key set to Illegal Request.

Table 21-1 *Valid combinations of SEND DIAGNOSTIC fields*

SelfTest	DevOfL	UntOfL	Type of test	Page Code returned
1	0	0	Code check	90h
		1	Code check	91h
	1	0	Buffer check	90h
		1	Tape operation check	91h

21.3.1 CODE CHECK

The tape drive checks to see if its code image is still valid. This test does not affect tape operations, and no changes to the log parameters are permitted. Any data in the write buffer is written to tape before the test is performed.

21.3.2 BUFFER CHECK

The tape drive checks its main data buffer for proper operation. This test does not affect tape operations. Various parameters, such as mode parameters, may be altered.

21.3.3 TAPE OPERATION CHECK

The tape drive first performs the buffer check described above. Then, if an Exabyte AME tape is loaded and the tape is not write protected, the tape drive performs the following steps to test tape operations:

1. Rewinds the tape.
2. Writes approximately 130 MB of data to the tape.
3. Rewinds the tape.
4. Executes a high-speed search to EOD.
5. Rewinds the tape.
6. Repeats steps 2 through 5 one time.

21.4 Exceptions and Error Conditions

Table 21-2 lists exceptions and error conditions that cause the tape drive to return Check Condition status for the SEND DIAGNOSTIC command. See Appendix A for additional information about these errors.

Table 21-2 *REQUEST SENSE data for SEND DIAGNOSTIC command errors and exceptions*

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Explanation
3Ah	00h	02h	**Not Ready.** Tape drive is not ready. Command requires a tape, and no tape is present.
53h	02h	05h	**Illegal Request.** Invalid value in parameter list. If the requested test involves a tape, this error is a result of any of the following: ▪ The Prevent bit in the PREVENT/ALLOW MEDIUM REMOVAL (1Eh) command is set to 1 (prevent media removal). ▪ The NAL bit in MODE SELECT (15h) is set to 0 (autoloading disabled). ▪ The SelfTest, DevOffL, or UnitOffL bit is set to a value other than 0 or 1.

22

SPACE (11h)

<table>
<tr><th>Bit
Byte</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>00</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>01</td><td colspan="3">Logical Unit Number</td><td colspan="2">Reserved</td><td colspan="3">Code</td></tr>
<tr><td>02</td><td colspan="8" rowspan="3">(MSB)
Count
(LSB)</td></tr>
<tr><td>03</td></tr>
<tr><td>04</td></tr>
<tr><td>05</td><td colspan="2">Vendor Unique</td><td colspan="4">Reserved</td><td>0</td><td>0</td></tr>
</table>

22.1 About This Command

The SPACE command enables the tape drive to perform forward or backward high-speed searches. You can use this command to space directly to the end of data (EOD) or to space over a specified number of logical blocks, filemarks, or setmarks.

Notes:

- The tape drive can space over both fixed- and variable-length logical blocks; it determines the type of spacing to use according to the type of block found on the tape.
- If the disconnect option is enabled, the tape drive can disconnect from the initiator while the SPACE command is executing.
- If you attempt to space backward immediately after writing data, filemarks, or setmarks, the tape drive will complete the write operation before performing the space operation. Completing the write operation includes writing any buffered data to tape and writing an end of data (EOD) mark.
- If an error occurs when the data in the buffer is being written, the tape drive returns Check Condition status and the space operation is not performed. You can issue a REQUEST SENSE (03h) command to determine the cause of the error.

- On a partitioned tape, spacing is limited to locations within the current partition. If you want to space to a location outside of the current partition, you must move to the new partition using the LOCATE or MODE SELECT command.

22.2 CDB Field Definitions

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 01, Bits 2 through 0 – Code

The Code field specifies the type of space operation the tape drive is to perform. Table 22-1 lists the valid values for the Code field and indicates the type of operation each specifies.

Table 22-1 *Values of Code field for the SPACE (11h) command*

Value of Code field	Type of operation	Notes
000b	Space over *n* fixed or variable-length blocks	See page 22-3 for information about the errors and exceptions that can occur for these settings.
001b	Space over *n* filemarks	
011b	Space to end of data	When you set the Code field to 011b, the tape drive ignores the setting of the Count field. Instead, it spaces forward until it encounters EOD. The tape is positioned so that a subsequent WRITE command can append data after the last block, filemark, or setmark written before the end of data.
100b	Space over *n* setmarks	When you set the Code field to 100b, the tape drive ignores the setting of the RSmk bit on the MODE SELECT Device Configuration page (Page Code 10h). In addition, filemarks are ignored if you are spacing over setmarks.
010b	Reserved	If you set the Code field to one of these values, the tape drive returns Check Condition status with the sense key set to Illegal Request (5h).
101b		
110b		
111b		

Bytes 02 through 04 – Count

The count value, *n*, in this field represents the number of blocks, filemarks, or setmarks to be spaced over. The value of *n* determines the direction of spacing, as follows:

- A positive value of *n* in the Count field causes the tape drive to space forward *n* blocks, filemarks, or setmarks. When the space operation is complete, the tape is logically positioned on the EOT side of the *n*th block, filemark, or setmark.

- A negative value of *n* (in 2's complement notation) in the Count field causes the tape drive to space backward over *n* blocks, filemarks, or setmarks. When the operation is complete, the tape is logically positioned on the BOT side of the *n*th block, filemark, or setmark.

- A value of 0 in the Count field causes no change in the tape position and is not an error.

Note: The tape drive ignores the Count field when spacing to end of data.

Byte 05, Bits 7 and 6 – Vendor Unique

There is no vendor unique definition for this bit. The value must be 0.

22.3 EXCEPTIONS AND ERROR CONDITIONS

The following exceptions and error conditions can occur with the SPACE command.

22.3.1 FILEMARK DETECTED

If the Code field has a value of 000b (space over *n* logical blocks) and a filemark is detected, the tape drive returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	1
Filemark	1
Sense Key	No Sense (0h)
Information bytes	Indicate the difference between the requested number of blocks and the actual number of blocks spaced over. This value is always positive.
ASC	00h
ASCQ	01h
FSC	32h

If the filemark was detected during a forward search, the tape is logically positioned on the EOT side of the filemark. If the filemark was detected during a backward search, the tape is logically positioned on the BOT side of the filemark.

Note: Filemarks are ignored if you have set the Code field to space over setmarks (100b).

22.3.2 PEOT or PEOP Encountered

If the physical end of tape (PEOT) or physical end of partition (PEOP) is encountered during a space operation (regardless of the value of the Code field), the tape drive returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	0 or 1
EOM	1
Sense Key	Medium Error (3h)
Information bytes	If Valid=1, indicate the difference between the requested number of blocks, filemarks, or setmarks and the actual number of blocks, filemarks, or setmarks spaced over. This value is always positive. **Note:** If the Code field is 011b, the Information bytes are invalid.
ASC	00h
ASCQ	02h
PEOT	1
FSC	34h

22.3.3 Setmark Detected

If the Code field has a value of 000b (space over *n* logical blocks) or 001b (space over *n* filemarks) and a setmark is detected, the tape drive looks at the setting of the RSmk bit on the MODE SELECT Device Configuration page (Page Code=10h):

- If the bit is 0 (do not report setmarks), the tape drive continues to space over blocks or filemarks.

- If the bit is 1 (report setmarks), the tape drive returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	1
Filemark	1
Sense Key	No Sense (0h)
Information bytes	Indicate the difference between the requested number of blocks or filemarks and the actual number of blocks or filemarks spaced over. This value is always positive.
ASC	00h
ASCQ	03h
FSC	31h

If the setmark was detected during a forward search, the tape is logically positioned on the EOT side of the setmark. If the setmark was detected during a backward search, the tape is logically positioned on the BOT side of the setmark.

22.3.4 PBOT OR PBOP ENCOUNTERED

If the Code field has a value of 000b, 001b, or 100b (space over logical blocks, filemarks, or setmarks) and the physical beginning of tape (PBOT) or physical beginning of partition (PBOP) is encountered, the tape drive returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	1
EOM	1
Sense Key	No Sense (0h)
Information bytes	Indicate the difference between the requested number of blocks, filemarks, or setmarks and the actual number of blocks, filemarks, or setmarks spaced over. This value is always positive.
ASC	00h
ASCQ	04h
LBOT	1
FSC	35h

After PBOT (or PBOP) is encountered, the tape is positioned at LBOT (or LBOP).

22.3.5 EOD Detected

If the Code field has a value of 000b (space over *n* logical blocks), 001b (space over *n* filemarks), or 100b (space over *n* setmarks), and the EOD mark is detected, the tape drive returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	1
Sense Key	Blank Check (8h)
Information bytes	Indicate the difference between the requested number of blocks, filemarks, or setmarks and the actual number of blocks, filemarks, or setmarks spaced over. This value is always positive.
ASC	00h
ASCQ	05h
FSC	33h

The tape is positioned so that a subsequent WRITE command can append data after the last information written before EOD.

22.3.6 Unrecoverable Error

If an unrecoverable media or hardware error occurs during the space operation, the tape drive terminates the SPACE command and returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	0 or 1
Sense Key	Medium Error (3h) or Hardware Error (4h)
Information bytes	If Valid=1, indicate the difference between the requested number of blocks, filemarks, or setmarks and the actual number of blocks, filemarks, or setmarks spaced over. The actual length does not include the unrecovered block. This value is always positive.
Other bits and bytes	Depend on the error condition

When the SPACE command is terminated, the position of the tape drive depends on whether a forward or backward space was attempted:

- If the error occurred during a forward space, the tape drive is positioned after the unrecovered block.
- If the error occurred during a backward space, the tape drive is positioned before the unrecovered block.

22.3.7 ADDITIONAL ERRORS

Table 22-2 lists additional exceptions and error conditions that cause the tape drive to return Check Condition status for the SPACE command. See Appendix A for additional information about these errors.

Table 22-2 *REQUEST SENSE data for SPACE command errors and exceptions*

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Description
00h	01h	0h	**No Sense.** A filemark was encountered during a space operation. The tape is positioned at the EOT-side of the filemark.
00h	05h	5h	**Illegal Request.** Invalid field in the CDB. The tape is in an invalid position for the tape drive to perform a read operation (a SPACE command was issued after a WRITE or WRITE FILEMARKS command).
04h	01h	2h	**Not Ready.** Tape drive is not ready, but is in process of becoming ready (rewinding or loading tape).
11h	00h	3h	**Medium Error.** An uncorrectable block was encountered during a space operation.
14h	00h	3h	**Medium Error.** The tape drive detected a medium error during the space operation.
15h	00h	3h	**Medium Error.** The tape drive cannot perform the space operation because there is no information at this position.
15h	01h	4h	**Hardware Error.** The tape drive cannot position the media correctly.
26h	00h	5h	**Illegal Request.** The Code field is set to an invalid value.
30h	02h	5h	**Illegal Request.** The Code field is set to 100b and the tape is not in a format that supports setmarks.
31h	00h	3h	**Medium Error.** A tape format error was encountered during a space operation.
3Ah	00h	2h	**Not Ready.** Tape drive is not ready. Command requires a tape, and no tape is present.

Notes

23

TEST UNIT READY (00h)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	0	0	0	0	0
01	Logical Unit Number			Reserved				
02	Reserved							
03								
04								
05	Vendor Unique		Reserved				0	0

23.1 About This Command

The TEST UNIT READY command provides a means for determining if the tape drive is ready to accept an appropriate medium access command.

The TEST UNIT READY command returns Good status after the tape is loaded if the tape drive is ready to accept a medium access command without returning Check Condition status. If the tape drive is not ready to accept a medium access command, the tape drive returns Check Condition status with the sense key set to Not Ready (2h).

Note: The TEST UNIT READY command is not a request for a unit self-test.

23.2 CDB Field Definitions

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for this command. The value for this field must be 0.

23.3 Exceptions and Error Conditions

Table 23-1 lists exceptions and error conditions that cause the tape drive to return Check Condition status for the INQUIRY command. See Appendix A for additional information about these errors.

Table 23-1 REQUEST SENSE data for TEST UNIT READY command errors and exceptions

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Description
04h	01h	2h	**Not Ready.** Tape drive is not ready, but is in process of becoming ready (rewinding or loading tape).
25h	00h	5h	**Illegal Request.** The logical unit specified in the CDB is not supported.
3Ah	00h	2h	**Not Ready.** Tape drive is not ready. Command requires a tape, and no tape is present.

24

VERIFY (13h)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	0	0	1	1
01	Logical Unit Number			Reserved		Immed	BytCmp	Fixed
02	(MSB) Verification Length							
03								
04								(LSB)
05	Vendor Unique		Reserved				0	0

24.1 About This Command

The VERIFY command enables the tape drive to verify one or more logical blocks of data on the tape, beginning with the next logical block. When the VERIFY command is completed, the tape is positioned on the EOT side of the last block of data verified.

24.2 CDB Field Definitions

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 01, Bit 2 – Immed

The value in this field determines when command status is returned to the initiator, as follows:

0 – Status is returned when the verify operation is complete.

1 – Status is returned when the VERIFY command is initiated by the tape drive.

Byte 01, Bit 1 – BytCmp

The tape drive does not support byte comparison operations. The valid value for this bit is 0.

Byte 01, Bit 0 – Fixed

This field specifies the type of verify operation to be performed, as follows:

0 – Verify a single variable-length logical block. The length of this block is specified in the Verification Length field.

1 – Verify one or more fixed-length logical blocks. The number of blocks is specified in the Verification Length field.

> **Note:** The tape drive returns Check Condition status with the sense key set to Illegal Request (5h) if the Fixed field in the VERIFY command is 1 (fixed-length logical blocks) and the Block Length field in the current MODE SELECT data is 0 (variable-length logical block). The ASC and ASCQ bits are set to 81h and 00h (fixed/variable mismatch).

Bytes 02 through 04 – Verification Length

This field specifies the amount of data to be verified, as follows:

- When the Fixed bit is set to 0 (use variable-length blocks), this field contains the length of the logical block in bytes. The logical block can be any size from 4 bytes to 240 KB (1 KB = 1,024 bytes). The valid value for this field is from 000004h to 03C000h.

- When the Fixed bit is set to 1 (use fixed-length blocks), this field contains the number of logical blocks to be verified. The length of each block is either the power-on default block length or the length specified with the currently active MODE SELECT command (see page 9-7). The allowable fixed block sizes are defined by the READ BLOCK LIMITS (05h) command (see page 13-2).

Note: When the value for the Verification Length field is 0, no data is verified and the current position of the tape is not changed.

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for these bits. The value for this field must be 0.

24.3 EXCEPTIONS AND ERROR CONDITIONS

The following exceptions and error conditions can occur with the VERIFY command.

24.3.1 VERIFICATION LENGTH INCORRECT

If the actual verification length does not match the requested verification length, the information reported depends on the setting of the Fixed bit.

Variable Length Mode (Fixed = 0)

If the Fixed bit is 0 and the actual length of the block on the tape does not match the verification length requested, the tape drive verifies the number of bytes available up to the verification length requested. Then, it terminates the VERIFY command and returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	1
ILI	1
Sense Key	No Sense (0h)
Information bytes	Indicate the difference between the actual length and the requested length: ▪ If the requested length is greater than the actual length, the Information bytes are positive. ▪ If the requested length is less than the actual length, the Information bytes are negative (2s complement notation)
ASC	00h
ASCQ	00h
FSC	0Ah

When the VERIFY command terminates in variable mode, the tape is positioned after the block with the incorrect length (at the start of the next logical block).

Fixed Length Mode (Fixed = 1)

If the Fixed bit is 1 and the actual length of any one block does not match the requested block length, the tape drive verifies the number of blocks requested until it encounters the block with the incorrect length. Then, it terminates the VERIFY command and returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	1
ILI	1
Sense Key	No Sense (0h)
Information bytes	Indicate the number of blocks not verified, including the block with the incorrect length.
ASC	00h
ASCQ	00h
FSC	0Ah

When the VERIFY command terminates in fixed mode, the tape is positioned after the block with the incorrect length (at the start of the next logical block).

24.3.2 Filemark Detected

If a filemark is detected before the verify operation is completed, the tape drive returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	1
Filemark	1
Sense Key	No Sense (0h)
Information bytes	Depend on the setting of the Fixed bit, as follows: ▪ If the Fixed bit is 0, equal the requested verification length. ▪ If the Fixed bit is 1, equal the difference between the requested verification length and the actual number of logical blocks verified.
ASC	00h
ASCQ	01h
FSC	0Dh

When the VERIFY command terminates, the logical position is at the EOT side of the filemark.

24.3.3 SETMARK DETECTED

If the RSmk bit in the MODE SELECT Device Configuration page (Page Code=10h) is set to 1 and the tape drive detects a setmark before completing the verify operation, the tape drive returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	1
Filemark	1
Sense Key	No Sense (0h)
Information bytes	Depend on the setting of the Fixed bit, as follows: ▪ If the Fixed bit is 0, equal the requested verification length. ▪ If the Fixed bit is 1, equal the difference between the requested verification length and the actual number of logical blocks verified.
ASC	00h
ASCQ	03h
FSC	1Dh

When the VERIFY command terminates, the logical position is at the EOT side of the setmark encountered.

24.3.4 EOD DETECTED

If the tape drive detects EOD during the verify operation, it returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	1
Sense Key	Blank Check (8h)
Information bytes	Depend on the setting of the Fixed bit, as follows: ▪ If the Fixed bit is 0, equal the requested verification length. ▪ If the Fixed bit is 1, equal the difference between the requested verification length and the actual number of logical blocks verified.
ASC	00h
ASCQ	05h
FSC	0Ch

When the VERIFY command terminates, the logical position is after the last recorded data block, filemark, or setmark.

24.3.5 PEOT or PEOP Encountered

If the tape drive encounters the physical end of tape (PEOT) or the physical end of partition (PEOP) during a verify operation, it returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	0 or 1
EOM	1
Sense Key	Medium Error (3h)
Information bytes	If Valid=1, depend on the setting of the Fixed bit, as follows: ▪ If the Fixed bit is 0, equal the requested verification length. ▪ If the Fixed bit is 1, equal the difference between the requested verification length and the actual number of logical blocks verified.
ASC	3Bh
ASCQ	02h
PEOT	1
FSC	14h

When the VERIFY command terminates, the logical position is undefined.

24.3.6 Unrecoverable Error

If an unrecoverable media or hardware error occurs during the verify operation, the tape drive terminates the VERIFY command and returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	0 or 1
Sense Key	Medium Error (3h) or Hardware Error (4h)
Information bytes	If Valid=1, depend on the setting of the Fixed bit, as follows: ▪ If the Fixed bit is 0, equal the requested verification length. ▪ If the Fixed bit is 1, equal the difference between the requested verification length and the actual number of logical blocks verified. The actual number does not include the unrecovered block.
Other bits and bytes	Depend on the error condition

When the VERIFY command is terminated, the tape is positioned after the unrecovered block for a Medium Error or in an undefined position for a Hardware Error.

24.3.7 Additional Errors

Table 24-1 lists additional exceptions and error conditions that cause the tape drive to return Check Condition status for the VERIFY command. See Appendix A for additional information about these errors.

Table 24-1 *REQUEST SENSE data for VERIFY command errors and exceptions*

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Description
00h	05h	5h	**Illegal Request.** Invalid field in the CDB. The tape is in an invalid position for the tape drive to perform a read operation (a VERIFY command was issued after a WRITE or WRITE FILEMARKS command).
04h	01h	2h	**Not Ready.** Tape drive is not ready, but is in process of becoming ready (rewinding or loading tape).
11h	00h	3h	**Hardware Error.** An uncorrectable block was encountered during a read operation.
11h	00h	4h	**Hardware Error.** The compression circuit was unable to decompress previously compressed data during a read operation. Use the following steps to recover from this error: **1.** Reissue the failed command or command sequence. **2.** Power the tape drive off and back on again. or Send a SCSI bus reset (“hard” reset). **3.** If the error persists, the tape may be bad or the tape drive may require service.
11h	02h	4h	**Hardware Error.** The read decompression CRC failed during a read operation. Use the following steps to recover from this error: **1.** Reissue the failed command or command sequence. **2.** Power the tape drive off and back on again. or Send a SCSI bus reset (“hard” reset). **3.** If the error persists, the tape may be bad or the tape drive may require service.
11h	03h	3h	**Medium Error.** Too many permanent read errors. Cannot sync.
14h	00h	3h	**Medium Error.** The tape drive detected a medium error during a read operation.
15h	01h	4h	**Hardware Error.** The tape drive cannot position the media correctly.
1Ah	00h	5h	**Illegal Request.** Invalid transfer length in the CDB. The Transfer Length exceeds 3C000h (240 KB) for a variable-block read.
24h	00h	5h	**Illegal Request.** Invalid field in the CDB. The Fixed bit is set to 0 and the requested block length is greater than 240 KB.
30h	00h	6h	**Unit Attention.** Incompatible media was rejected after the cartridge was inserted.

Table 24-1 *REQUEST SENSE data for VERIFY command errors and exceptions (continued)*

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Description
30h	01h	3h	**Medium Error.** Incompatible format. The format of the currently loaded tape is not compatible with the tape drive.
30h	02h	5h	**Illegal Request.** The tape format is incompatible with the command.
3Ah	00h	2h	**Not Ready.** Tape drive is not ready. Command requires a tape, and no tape is present.
81h	00h	5h	**Illegal Request.** Fixed/variable mismatch. The Fixed bit is set to 1 (write fixed-length logical blocks) and the value in the Block Length field in the current MODE SELECT data is 0 (variable-length logical block).

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WRITE (0Ah)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	0	1	0	1	0
01	Logical Unit Number			Reserved				Fixed
02	(MSB)							
03	Transfer Length							
04								(LSB)
05	Vendor Unique		Reserved				0	0

25.1 About This Command

The WRITE command transfers one or more bytes or blocks of data from the initiator to the tape drive. The M2 tape drive writes data to the tape in Mammoth-2 format only. The data is compressed or uncompressed according to the setting of the DCE (data compression enable) bit in the MODE SELECT command (see page 9-17).

After writing data, the tape drive writes an end of data (EOD) mark to indicate the location of the last data on tape. The EOD mark is overwritten when additional data is appended to the last data on the tape.

25.1.1 Tape Positioning

This section describes the legal tape positions for a write operation.

Tape Positioned at LBOT or LBOP

When you issue a WRITE command to a tape positioned at LBOT or LBOP, the tape drive automatically writes a new LBOT (logical beginning of tape) or LBOP (logical beginning of partition) pattern before writing the data. The first track containing data blocks is recorded directly after the last track containing the LBOT information. You cannot alter or access the data contained in the LBOT or LBOP blocks.

Note: If a read-after-write check indicates an error while the tape drive is writing LBOT, the blocks are not rewritten. Errors in writing the LBOT blocks are not reported to the initiator. If excessive read-after-write checks occur, the tape is rewound and the process is repeated. If the retry fails, a Medium Error is reported.

Appending Data

When writing to tape, the tape drive can append new data to existing data at certain locations only. If the tape is not positioned at a legal location, the tape drive returns Check Condition status with the sense key set to Illegal Request (5h). The legal locations for appending data are:

- EOD mark (the EOD mark is overwritten as new data is appended)
- Beginning or end of a long filemark
- Beginning or end of a setmark

Note: If data is appended at the beginning of a long filemark or setmark, the filemark or setmark is overwritten.

25.1.2 Data Buffering

The tape drive provides two modes of operation for the WRITE command: unbuffered and buffered. The mode of operation is set with the MODE SELECT command (byte 02, bits 6 through 4, in the Parameter List Header).

Unbuffered Write Operation

When the tape drive is set for an unbuffered write operation, it returns Good status as soon as all data blocks are written to tape.

Buffered Write Operation

When the tape drive is set for a buffered write operation, it returns Good status as soon as all data blocks are successfully transferred to the buffer. The data in the buffer is written to tape when one of the following conditions occurs:

- The motion threshold is reached during a WRITE command (see Section 2.5).

- The tape drive receives one of the following commands:
  - REWIND (01h)
  - WRITE FILEMARKS (10h) non-immediate
  - SPACE (11h) in either direction
  - ERASE (19h)
  - LOAD/UNLOAD (1Bh)
  - LOCATE (2Bh)
- The operator presses the unload button.

The time specified for the Write Delay Time field in the MODE SELECT command elapses (note, however, if the Write Delay Time field is 0, a partially full buffer is not flushed to tape). See page 9-21 for more information about Write Delay Time.

25.2 CDB Field Definitions

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 01, Bit 0 – Fixed

This field specifies the type of write operation the tape drive is to perform, as follows:

0 – Write a single variable-length logical block. The length of this block is specified in the Transfer Length field.

1 – Write one or more fixed-length logical blocks. The number of blocks is specified in the Transfer Length field.

Bytes 02 through 04 – Transfer Length

This field specifies the amount of data the tape drive is to write, as follows:

- When the Fixed bit is set to 0 (write variable-length blocks), this field contains the length of the logical block in bytes. The logical block can be any size from 4 bytes to 240 KB (1 KB = 1,024 bytes). The valid value for this field is from 000004h to 03C000h.

- When the Fixed bit is set to 1 (write fixed-length blocks), this field contains the number of logical blocks to be written. The length of each block is either the power-on default block length or the length specified with the currently active MODE SELECT command (see page 9-7). The allowable fixed block sizes are defined by the READ BLOCK LIMITS (05h) command (see page 13-2).

Note: When the value for the Transfer Length field is 0, no data is transferred and the current position of the tape is not changed.

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for this command. The value for this field must be 0.

25.3 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the WRITE command.

LEOT or LEOP Encountered

If the logical end of tape (LEOT) or logical end of partition (LEOP) is encountered during a WRITE command, the action of the tape drive depends on the setting of the Fixed bit in the current CDB. The REQUEST SENSE data is set as follows:

Valid	1
EOM	1
Sense Key	No Sense (0h)
Information bytes	The value depends on the setting of the Fixed bit as follows: ▪ If the Fixed bit is 0, the Information bytes are always 0. ▪ If the Fixed bit is 1, the Information bytes are 0 if all the data was written to tape. If all the data was not written, the Information bytes equal the difference between the requested transfer length and the actual number of logical blocks written.
ASC	00h
ASCQ	02h (LEOT or LEOP Detected)
FSC	04h, 06h, 09h, 28h
LBOT	0

25.3.1 WRITE Command Issued after LEOT or LEOP Encountered (EOT or EOP Detected)

Issuing a WRITE command after LEOT or LEOP is encountered causes the tape drive to go into unbuffered mode and to return Check Condition status after writing as much data as possible. The REQUEST SENSE data is set as follows:

Valid	1
EOM	1
Sense Key	Dh (Volume Overflow)
Information bytes	The value depends on the setting of the Fixed bit as follows: ▪ If the Fixed bit is 0, the Information bytes are always 0. ▪ If the Fixed bit is 1, the Information bytes are 0 if all the data was written to tape. If all the data was not written, the Information bytes equal the difference between the requested transfer length and the actual number of logical blocks written.
ASC	00h
ASCQ	02h (EOT or EOP Detected)
FSC	72h, 93h, AFh, B6h
LBOT	0

Note: If the data transfer stops before it is completed, it terminates on a logical block boundary.

25.3.2 PEOT or PEOP Encountered

If the physical end of tape (PEOT) or physical end of partition (PEOP) is encountered, the tape drive terminates the WRITE command and returns Check Condition status. Data that remains in the buffer is not written to tape. The REQUEST SENSE data is set as follows:

Valid	0 or 1
EOM	1
Sense Key	Medium Error (3h)
Information Bytes	If Valid=1, depend on the setting of the Fixed bit, as follows: ▪ If the Fixed bit is 0, the Information bytes equal the requested transfer length. ▪ If the Fixed bit is 1, the Information bytes equal the difference between the requested transfer length and the actual number of logical blocks written.
ASC	00h
ASCQ	02h (PEOT or PEOP detected)
FSC	14h, 34h
PEOT	1

25.3.3 Unrecoverable Error

If an unrecoverable media or hardware error occurs during the write operation, the tape drive terminates the WRITE command and returns Check Condition status. Data that remains in the buffer is not written to tape. The REQUEST SENSE data is set as follows:

Valid	0 or 1
Sense Key	Medium Error (3h) or Hardware Error (4h)
Information bytes	If Valid=1, depend on the setting of the Fixed bit, as follows: ▪ If the Fixed bit is 0, equal the requested transfer length. ▪ If the Fixed bit is 1, equal the difference between the requested transfer length and the actual number of logical blocks written.
Other bits and bytes	Depend on the error condition

Note: If another WRITE command is issued after an unrecoverable error occurs, the tape drive returns Check Condition status with the sense key set to Medium Error or Hardware Error and the command is not executed.

25.3.4 ADDITIONAL ERRORS

Table 25-1 lists additional exceptions and error conditions that cause the tape drive to return Check Condition status for the WRITE command. See Appendix A for additional information about these errors.

Table 25-1 *REQUEST SENSE data for WRITE command errors and exceptions*

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Description
04h	01h	2h	**Not Ready.** Tape drive is not ready, but is in process of becoming ready (rewinding or loading tape).
15h	01h	4h	**Hardware Error.** The tape drive cannot position the media correctly.
24h	00h	5h	**Illegal Request.** Invalid field in CDB. The Fixed bit is set to 0 and the requested block length exceeds 03C000h (245,760 bytes).
27h	00h	7h	**Data Protect.** A write operation was attempted on a data cartridge that is write protected.
30h	00h	6h	**Unit Attention.** Incompatible media was rejected after the cartridge was inserted.
30h	01h	3h	**Medium Error.** Incompatible format. The format of the currently loaded tape is not compatible with the tape drive.
30h	02h	5h	**Illegal Request.** The tape format is incompatible with the command. You have attempted to write in a non-Mammoth-2 format.
30h	05h	5h	**Illegal Request.** Cannot write to tape. The currently loaded tape is not AME or density is not supported for a write operation.
3Ah	00h	2h	**Not Ready.** Tape drive is not ready. Command requires a tape, and no tape is present.
47h	00h	Bh	**Aborted Command.** A SCSI parity error occurred during data transfer.
50h	01h	3h	**Medium Error.** Write failure after retry limit (specified in MODE SELECT) was exceeded.
50h	01h	5h	**Illegal Request.** A WRITE command was issued at an invalid tape position.
81h	00h	5h	**Illegal Request.** Fixed/variable mismatch. The Fixed bit is set to 1 (write fixed-length logical blocks) and the value in the Block Length field in the current MODE SELECT data is 0 (variable-length logical block).

Notes

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WRITE BUFFER (3Bh)

<table>
<tr><th>Bit
Byte</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>00</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>01</td><td colspan="3">Logical Unit Number</td><td colspan="2">Reserved</td><td colspan="3">Mode</td></tr>
<tr><td>02</td><td colspan="8">Buffer ID</td></tr>
<tr><td>03</td><td colspan="8" rowspan="3">(MSB)
Buffer Offset
(LSB)</td></tr>
<tr><td>04</td></tr>
<tr><td>05</td></tr>
<tr><td>06</td><td colspan="8" rowspan="3">(MSB)
Parameter List Length
(LSB)</td></tr>
<tr><td>07</td></tr>
<tr><td>08</td></tr>
<tr><td>09</td><td>WBF</td><td>0</td><td colspan="4">Reserved</td><td>0</td><td>0</td></tr>
</table>

26.1 About This Command

The WRITE BUFFER command allows you to load new microcode from a file into the tape drive's control memories across the SCSI bus. You can obtain microcode update files on diskettes from Exabyte Technical Support, or you can download microcode files from the Exabyte web site (www.exabyte.com).

Note: You can also obtain microcode updates on 8mm tape. When using an 8mm microcode codeload tape, you do not need to use the WRITE BUFFER command. See Appendix B for instructions for using a microcode codeload tape.

26.1.1 Cautions for Using the WRITE BUFFER Command

Caution

Be sure to heed these precautions when issuing the WRITE BUFFER command:

- The WRITE BUFFER command allows you to load new microcode from the SCSI bus into the tape drive. It is not intended to be used for testing tape drive functionality (that is, do not issue this command unless you are actually loading new microcode).
- Be sure that the tape drive is reserved for the initiator's exclusive use while WRITE BUFFER commands are executing.
- Do not power off the tape drive while WRITE BUFFER commands are executing.

If a hardware failure or power failure occurs during the execution of this command, the tape drive may not be able to operate. If this occurs, you can use the M2 Monitor program to reload microcode (from a *.i file) through a serial cable attached to the tape drive's Monitor port. (See the documentation for the M2 Monitor program for complete instructions.)

26.1.2 How the Tape Drive Performs the Write Buffer Operation

When the tape drive receives a WRITE BUFFER command, it enters a write buffer mode that prevents the execution of all SCSI commands except WRITE BUFFER, REQUEST SENSE, and INQUIRY. All other commands result in Check Condition status with the sense key set to Aborted Command (Bh) and an FSC of EBh. The write buffer operation is terminated and partially received microcode is discarded. To prevent termination of the write buffer operation, reserve the tape drive for the initiator's exclusive use before issuing WRITE BUFFER commands.

After the WRITE BUFFER command or command sequence is executed, the microcode is transferred from the SCSI bus to the tape drive's RAM buffer. Then, the image in the buffer is validated. During validation, the microcode is checked for the correct header and internal format, the proper number of files, and whether the tape drive's hardware and boot code support the new microcode. If the new microcode passes these tests, it is loaded into the tape drive's control memories. The machine state (including MODE SELECT parameters) is set to the new power-on defaults, and the tape drive performs its power-on self-test.

After the new code has been loaded successfully, the tape drive terminates the write buffer mode and returns Good status to the initiator that issued the WRITE BUFFER command or command sequence. The tape drive returns Check Condition status with the sense key set to Unit Attention (6h) to commands sent by other initiators. The ASC and ASCQ fields will be set to 3Fh and 01h, and the Fault Symptom Code will be C3h (new microcode loaded).

26.1.3 Using One or More WRITE BUFFER Commands

You have the option of issuing one WRITE BUFFER command or a sequence of WRITE BUFFER commands to load microcode into your tape drive. If you use just one WRITE BUFFER command, you specify the exact length of the microcode file on your host system with the command. If you use multiple WRITE BUFFER commands, you specify partial lengths of the microcode file with each command. The total of the lengths you specify in a sequence of WRITE BUFFER commands must add up to the total length of the microcode file on your host system.

Note: The M2 microcode file size is approximately 1 MB. However, the size of the microcode file you will be loading into your tape drive may be different once it is on your host system. The size of the file on your host system is the size you use when issuing the WRITE BUFFER command or command sequence.

26.1.4 Tape Present During WRITE BUFFER Execution

If a tape is loaded when the tape drive receives a WRITE BUFFER command, the tape drive flushes any buffered write data to the tape. When all of the WRITE BUFFER commands have been received, the tape drive unloads the tape but does not eject it. After the code load has completed successfully, the tape is reloaded. If the code load fails, the tape is reloaded and positioned at the original location.

26.1.5 Aborting a Write Buffer Operation

If necessary, you can abort a write buffer operation by sending an Abort message to the tape drive or resetting the tape drive. Then, you can reissue the WRITE BUFFER command or the entire sequence of WRITE BUFFER commands.

! Important After all of the microcode has been transferred and the tape drive has started loading it into memory, SCSI bus reset and selection are disabled for the tape drive until the operation is complete.

26.2 CDB Field Definitions

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 01, Bits 2 through 0 – Mode

This field specifies the mode used to write data to the buffer. Table 26-1 lists the valid values for this field.

Table 26-1 *Valid Mode settings for the WRITE BUFFER (3Bh) command*

Mode Setting	Description
101b	Use the vendor-unique WFB bit to specify whether one or more WRITE BUFFER commands will be used to transfer the microcode file. Instructions for using Mode 101b begin on page 26-5.
111b	Use the Buffer Offset and Parameter List Length to control whether one or more WRITE BUFFER commands are required to transfer the microcode files. Instructions for using Mode 111b begin on page 26-7.

Byte 02 – Buffer ID

The value for this field must be 0.

Bytes 03 through 05 – Buffer Offset

The value you specify for the Buffer Offset field depends on whether you are issuing one WRITE BUFFER command or several WRITE BUFFER commands, as follows:

- If you are using one WRITE BUFFER command, set this field to 0.
- If you are using more than one WRITE BUFFER command, set this field to the sum of the Buffer Offset and Parameter List Length from the previous WRITE BUFFER command. This sum must not exceed the length of the microcode file.

Bytes 06 through 08 – Parameter List Length

This field specifies the number of bytes to be transferred by the current WRITE BUFFER command. The value you specify for this field depends on whether you are issuing one WRITE BUFFER command or several WRITE BUFFER commands, as follows:

- If you using only one WRITE BUFFER command, specify the exact length of the microcode file on your host system in bytes. (Note that M2 microcode files may differ in length from one release to the next.)

- If you are using more than one WRITE BUFFER command, specify a multiple of 100h for each Parameter List Length (must be greater than 0). Then, for the last WRITE BUFFER command in the sequence, set the Parameter List Length to the remaining length.

Note: The Parameter List Length must not exceed the size of the code load file minus the Buffer Offset. If the Parameter List Length is greater than the maximum allowed by the tape drive, a Check Condition status results with a sense key of Illegal Request.

Byte 09, Bit 7 – WBF (WRITE BUFFERs Follow)

If you are using Mode 101b, this vendor-unique bit specifies whether the new microcode is being sent using one or more WRITE BUFFER commands, as follows:

0 – This is the only WRITE BUFFER command, or this is the last WRITE BUFFER command in a sequence.

1 – This is one of several (but not the last) WRITE BUFFER commands in a sequence.

Note: If you are using Mode 111b, set the WBF bit to 0 for all WRITE BUFFER commands. The microcode file has a delimiter that the tape drive looks for in this mode to determine the end of the file.

26.3 Loading Microcode Using Mode 101b

Mode 101b uses the vendor-unique WFB bit to specify whether one or more WRITE BUFFER commands will be used to transfer the microcode file. To load microcode using Mode 101b, use the following steps:

1. Send the WRITE BUFFER command with the following settings:

Mode:	101b
Buffer ID:	00h
Buffer Offset:	000000h
Parameter List Length:	Number of bytes to be sent (must be greater than 0 and must be a multiple of 100h).
WBF:	0 –Transfer requires one WRITE BUFFER command. 1 –Transfer requires additional WRITE BUFFER commands.

2. Transfer the number of bytes specified by the Parameter List Length. If you are using multiple WRITE BUFFER commands, the Buffer Offset for the first WRITE BUFFER command must be 000000h. The Parameter List Length value you specify with each WRITE BUFFER command must indicate only the amount of data you are transferring with the current command, not the total length of the microcode file.

3. Wait for the status and the Command Complete message. If the status is not Good, issue a REQUEST SENSE command. If the write buffer mode requires termination, issue a TEST UNIT READY command.

4. If there is more microcode to be transferred, continue to step 5. If not, then skip to step 9.

5. Send the next WRITE BUFFER command with the following settings:

Mode:	101b
Buffer ID:	00h
Buffer Offset:	The current Buffer Offset equals the sum of the previous Buffer Offset plus previous Parameter List Length. (This sum must not exceed the total length of the microcode file.)
Parameter List Length:	Number of bytes to be sent. (This value must be greater than 0 and, unless this is the last transfer, must be a multiple of 100h. If this is the last transfer, set this value to the remaining length.) The sum of the Parameter List Lengths from all the WRITE BUFFER commands you issue must add up to the total length of the microcode file you are transferring.
WBF:	0 –This is the last WRITE BUFFER command. 1 –Additional WRITE BUFFER commands follow.

6. Transfer the number of bytes specified by the Parameter List Length. Use the Buffer Offset field to specify the starting point within the file for the block of data to be transferred. The Parameter List Length value you specify with each WRITE BUFFER command must indicate only the amount of data you are transferring with the current command, not the total length of the microcode file.

7. Wait for the status and the Command Complete message as before.

8. If more microcode remains, repeat steps 5 through 7 until all of the microcode has been transferred.

9. After the last block of microcode has been transferred, the tape drive disconnects from the SCSI bus and validates the microcode data in the buffer. When validation is complete, the tape drive reconnects to the SCSI bus and returns status and the Command Complete message.

   During validation, the microcode data is checked for the correct header and internal format, the proper number of files, and whether the tape drive's hardware and boot code support the new microcode.

26.4 LOADING MICROCODE USING MODE 111b

Mode 111b ignores the vendor-unique WFB bit. Instead it uses the Buffer Offset and Parameter List Length to control whether one or more WRITE BUFFER commands are required to transfer the microcode files. To load microcode using Mode 111b, follow the steps outlined below.

1. Send the WRITE BUFFER command with the following settings:

Mode:	111b
Buffer ID:	00h
Buffer Offset:	000000h
Parameter List Length:	Number of bytes to be sent (must be greater than 0 and must be a multiple of 100h)
WBF:	0

2. Transfer the number of bytes specified by the Parameter List Length. If you are using multiple WRITE BUFFER commands, the Buffer Offset for the first WRITE BUFFER command must be 000000h. The Parameter List Length value you specify with each WRITE BUFFER command must indicate only the amount of data you are transferring with the current command, not the total length of the microcode file.

3. Wait for the status and the Command Complete message. If the status is not Good, issue a REQUEST SENSE command. If the write buffer mode requires termination, issue a TEST UNIT READY command.

4. If there is more microcode to be transferred, proceed with step 5. If not, then skip to step 9.

5. Send the next WRITE BUFFER command with the following settings:

Mode:	111b
Buffer ID:	00h
Buffer Offset:	The current Buffer Offset equals the sum of the previous Buffer Offset plus previous Parameter List Length. (This sum must not exceed the total length of the microcode file.)
Parameter List Length:	Number of bytes to be sent. (This value must be greater than 0 and, unless this is the last transfer, must be a multiple of 100h. If this is the last transfer, set this value to the remaining length.) The sum of the Parameter List Lengths from all the WRITE BUFFER commands you issue must add up to the total length of the microcode file you are transferring.
WBF:	0

6. Transfer the number of bytes specified by the Parameter List Length. Use the Buffer Offset field to specify the starting point within the file for the block of data to be transferred. The Parameter List Length value you specify with each WRITE BUFFER command must indicate only the amount of data you are transferring with the current command, not the total length of the microcode file.

7. Wait for the status and the Command Complete message as before.

8. If more microcode remains, repeat steps 5 through 7 until all of the microcode has been transferred.

9. After the last block of microcode has been transferred, the tape drive disconnects from the SCSI bus and validates the microcode data in the buffer. When validation is complete, the tape drive reconnects to the SCSI bus and returns status and the Command Complete message.

   During validation, the microcode data is checked for the correct header and internal format, the proper number of files, and whether the tape drive's hardware and boot code support the new microcode.

26.5 Exceptions and Error Conditions

The following exceptions and errors can occur with the WRITE BUFFER command.

26.5.1 Illegal WRITE BUFFER Data

If data transferred by the WRITE BUFFER command is invalid, the tape drive terminates the write buffer mode and returns a sense key of Aborted Command (0Bh) with an ASC of 26h and an ASCQ of 00h. Table 26-1 lists the possible Fault Symptom Codes.

Figure 26-1 *Fault Symptom Codes for illegal WRITE BUFFER data*

FSC	Description
61h	The file header or format is invalid.
63h	The image for the FE section is invalid.
65h	The image for the EE section is invalid.
69h	The file CRC is incorrect.

26.5.2 Fatal Load Error

Once the load process is started, it is irreversible. If a hardware error or power failure occurs during the load operation, the tape drive may not be able to operate. In this event, you can use the M2 Monitor program to reload the microcode through the Monitor port (refer to the documentation for M2 Monitor program for instructions). The M2 Monitor program is included on the M2 CD that accompanies the tape drive, or you can download it from Exabyte's web site at www.exabyte.com.

26.5.3 Additional Errors

Table 26-2 lists the exceptions and error conditions that cause the tape drive to return Check Condition status for the WRITE BUFFER command. See Appendix A for additional information about these errors.

Table 26-2 *REQUEST SENSE data for WRITE BUFFER command errors and exceptions*

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Description
00h	00h	Bh	**Aborted Command.** A command other than WRITE BUFFER, INQUIRY, or REQUEST SENSE was issued to the tape drive during a WRITE BUFFER command sequence. The tape drive terminates the WRITE BUFFER sequence. The Fault Symptom Code is set to EBh. If another initiator issues any SCSI command to the tape drive during the write buffer operation, the tape drive returns Check Condition status with a sense key of Bh and an FSC of EBh, but does not abort the write buffer operation.
24h	00h	5h	**Illegal Request.** Invalid field in the CDB. This error is a result of any of the following: ▪ The Mode field contains a value other than 101b or 111b. ▪ The Buffer ID field is not set to 0. ▪ The value in the Buffer Offset field is greater than the value in the Buffer Capacity field of the READ BUFFER Buffer Descriptor. ▪ The sum of the values in the Parameter List Length plus the Buffer Offset field is greater than the value returned in the Buffer Capacity field of the READ BUFFER Buffer Descriptor. If the tape drive is already in the write buffer mode, it remains in this mode. If the tape drive is not in write buffer mode, it does not enter this mode.
26h	01h	5h	**Illegal Request.** The tape drive's boot PROM is not compatible with the new microcode. The boot PROM must be updated to accommodate the new microcode level.
3Fh	01h	6h	**Unit Attention.** The tape drive firmware (microcode) has been changed.
47h	00h	Bh	**Aborted Command.** A SCSI parity error occurred during data transfer.

Notes

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WRITE FILEMARKS (10h)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	0	0	0	0
01	Logical Unit Number			Reserved			WSmk	Immed
02	(MSB)							
03	Number of Filemarks							
04								(LSB)
05	Short	VU	Reserved				0	0

27.1 About This Command

The WRITE FILEMARKS command causes the tape drive to write any data remaining in the buffer to tape and then to write one or more filemarks or setmarks to tape.

Note: Filemarks and setmarks can be buffered. Each buffered filemark or setmark uses 1 KB of the tape drive's buffer.

A write filemarks operation can be performed at the following logical tape positions:

- **Tape Positioned at LBOT or LBOP.** When writing to a tape positioned at the logical beginning of tape (LBOT) or at the logical beginning of partition (LBOP), the tape drive automatically writes a new LBOT pattern and then writes the requested number of filemarks (or setmarks).

- **Appending Data.** The tape drive can append filemarks (or setmarks) to existing data as long as the tape is positioned at one of the following locations:

  - End of data (EOD) mark
  - Beginning or end of a long filemark
  - Beginning or end of a setmark

If the tape is not positioned at one of these locations, the tape drive returns Check Condition status with the sense key set to Illegal Request (5h).

27.2 CDB Field Definitions

Logical Unit Number (LUN) – Byte 01, Bits 7 through 5

The tape drive only supports LUN 0. The value for this field must be 0.

Byte 01, Bit 1 – WSmk (Write Setmark)

This field specifies whether you want the tape drive to write setmarks or filemarks at the current position, as follows:

0 – Write filemarks at the current position.
1 – Write setmarks at the current position.

Byte 01, Bit 0 – Immed

The value for this field determines when command status is returned to the initiator and whether buffered filemarks and setmarks will remain in the buffer, as follows:

0 – Status is reported to the initiator when the WRITE FILEMARKS command is completed. All buffered data, filemarks, and setmarks are written to the tape before the command is completed.

1 – Status is reported to the initiator when the WRITE FILEMARKS command is initiated by the tape drive. This mode is valid only if the tape drive is operating in buffered mode (the Buffered Mode field is set to 001b in the MODE SENSE parameter header, see page 10-7).

Bytes 02 through 04 – Number of Filemarks

This field specifies the number of filemarks (or setmarks) to be written to tape. A value of 0 is not an error and results in either of the following:

- If the Immed bit is 0, no filemarks (or setmarks) are transferred and the data in the buffer is written to the tape.
- If the Immed bit is 1, no operation is performed and Good status is returned.

Byte 05, Bit 7 – Short

The value for this field determines the size of the filemark written to tape, as follows:

0 – Write a long filemark.
1 – Write a short filemark.

Note: If WSmk bit is 1 (write setmarks), the Short bit is ignored.

Byte 05, Bit 6 – VU (Vendor Unique)

There is no vendor unique definition for this bit. The value for this bit must be 0.

27.3 EXCEPTIONS AND ERROR CONDITIONS

The following exceptions and error conditions can occur with the WRITE FILEMARKS command.

27.3.1 LEOT OR LEOP ENCOUNTERED

If the logical end of tape (LEOT) or logical end of partition (LEOP) is encountered, the tape drive attempts to write all of the filemarks (or setmarks) requested and then returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	1
EOM	1
Sense Key	No Sense (0h)
Information bytes	Contain the difference between the requested number of filemarks (or setmarks) and the actual number of filemarks (or setmarks) written. A value of 0 indicates that all filemarks (or setmarks) were written to tape.
ASC	00h
ASCQ	02h
LBOT	0
PEOT	0
FSC	28h

If you issue a WRITE FILEMARKS command after LEOT or LEOP is encountered, the tape drive returns Check Condition status after the command is completed. The REQUEST SENSE data is set as shown above.

27.3.2 PEOT or PEOP Encountered

If the physical end of tape (PEOT) or physical end of partition (PEOP) is encountered, the tape drive terminates the WRITE FILEMARKS command and returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	0 or 1
EOM	1
Information bytes	If Valid=1, contain the difference between the requested number of filemarks (or setmarks) and the actual number of filemarks (or setmarks) written.
Sense Key	Volume Overflow (Dh)
ASC	00h
ASCQ	02h
PEOT	1
FSC	AFh

27.3.3 Unrecoverable Error

If an unrecoverable media or hardware error occurs during the write filemarks operation, the tape drive terminates the WRITE FILEMARKS command and returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	0 or 1
Sense Key	Medium Error (3h) or Hardware Error (4h)
Information bytes	If Valid=1, contain the difference between the requested number of filemarks (or setmarks) and the actual number of filemarks (or setmarks) written.
Other bits and bytes	Depend on the error condition

Note: If another WRITE FILEMARKS command is issued after an unrecoverable error occurs, the tape drive returns Check Condition status with the sense key set to Medium Error or Hardware Error and the command is not executed.

27.3.4 ADDITIONAL ERRORS

Table 27-1 lists additional exceptions and error conditions that cause the tape drive to return Check Condition status for the WRITE FILEMARKS command. See Appendix A for additional information about these errors.

Table 27-1 *REQUEST SENSE data for WRITE FILEMARKS command errors and exceptions*

ASC (Byte 12)	ASCQ (Byte 13)	Sense Key	Description
04h	01h	2h	**Not Ready.** Tape drive is not ready, but is in process of becoming ready (rewinding or loading tape).
15h	01h	4h	**Hardware Error.** The tape drive cannot position the media correctly.
24h	00h	5h	**Illegal Request.** Invalid field in CDB. The Fixed bit is set to 0 and the requested block length exceeds 03C000h (245,760 bytes).
27h	00h	7h	**Data Protect.** A write operation was attempted on a data cartridge that is write protected.
30h	00h	6h	**Unit Attention.** Incompatible media was rejected after the cartridge was inserted.
30h	01h	3h	**Medium Error.** Incompatible format. The format of the currently loaded tape is not compatible with the tape drive.
30h	02h	5h	**Illegal Request.** The tape format is incompatible with the command. You have attempted to write in a non-Mammoth-2 format.
30h	05h	5h	**Illegal Request.** Cannot write to tape. The currently loaded tape is not AME or density is not supported for a write operation.
3Ah	00h	2h	**Not Ready.** Tape drive is not ready. Command requires a tape, and no tape is present.
47h	00h	Bh	**Aborted Command.** A SCSI parity error occurred during data transfer.
50h	01h	3h	**Medium Error.** Write failure after retry limit (specified in MODE SELECT) was exceeded.
50h	01h	5h	**Illegal Request.** A WRITE command was issued at an invalid tape position.

Notes

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ERROR CODES

This appendix describes the error codes the tape drive reports over the SCSI bus in response to a REQUEST SENSE command (see Chapter 18). These error codes include the following error information:

- The sense key (SK), Additional Sense Codes (ASCs), and Additional Sense Code Qualifiers (ASCQs) associated with the error. The ASC and ASCQ codes provide additional information for each sense key. See Table 18-1 on page 18-5 for definitions of the sense keys.

- The Exabyte-unique Fault Symptom Codes (FSCs). These codes can be used to determine the nature of hardware and software errors and other events. Each FSC code description also provides recommended error recovery procedures (ERPs).

A.1 REQUEST SENSE INFORMATION

This section lists the possible combinations of values for the Additional Sense Code (ASC) and the Additional Sense Code Qualifier (ASCQ) fields in the Extended Sense data returned by the REQUEST SENSE (03h) command. Each ASC and ASCQ combination is associated with one or more Sense Key values, and one or more Fault Symptom Codes (FSCs). The FSC is an Exabyte-unique byte that specifies the reason for the most recent Check Condition status. It is returned in byte 18 in the Extended Sense data.

! Important The Fault Symptom Codes may change as new revisions of the tape drive firmware become available. For this reason, be sure to check the documentation provided with new firmware releases for the most current list of codes.

Notes:

- For more information about the suggested actions for each ERP code, refer to “Error Recovery Procedures” on page A-27. When multiple ERP codes are associated with an FSC, consider the ERPs in the order listed.

- FSCs associated with a hardware error (SK 4h), may supersede medium errors (SK 3h).

For ease of reference, all of the possible ASC, ASCQ, Sense Key, and FSC values returned by the tape drive are presented in three identical tables, each sorted as follows:

- Table A-1 lists all of the possible ASC, ASCQ, Sense Key, and FSC values returned by the tape drive, sorted in ascending ASC/ASCQ/FSC order.
- Table A-2 lists all of the possible ASC, ASCQ, Sense Key, and FSC values, sorted in ascending FSC/ASC/ASCQ order.
- Table A-3 lists all of the possible ASC, ASCQ, Sense Key, and FSC values, sorted in ascending Sense Key/ASC/ASCQ order.

In all of the tables, each combination of values is accompanied by one or more cause codes and one or more error recovery procedure codes (ERPs). The ERPs are described in Section A.2 on page A-27.

Note: When two or more ERP codes are listed for a Fault Symptom Code, perform the recovery procedures in the order listed.

Cause Key:

A =	Application software	**O =**	Operator
B =	Bus (SCSI)	**S =**	System
D =	Drive	**T =**	Tape
I =	Information message		

Table A-1 *REQUEST SENSE error data, sorted by ASC/ASCQ/FSC*

ASC	ASCQ	FSC	SK	ERP	Cause	Explanation
00h	00h	05h	Bh	11	O, A	**Aborted Command.** The write operation was aborted as requested.
00h	00h	0Ah	0h	14, 11, 12	T, A, D	**No Sense.** The actual block size read did not match the requested block size during a read operation.
00h	00h	10h	Bh	11	O, A	**Aborted Command.** The read operation was aborted as requested.
00h	00h	3Bh	Bh	11	O, A	**Aborted Command.** The SPACE or LOCATE command was aborted as requested.
00h	00h	4Eh	Bh	11	O, A	**Aborted Command.** The ERASE command was aborted as requested.
00h	00h	58h	4h	9, 6,12	T, D	**Hardware Error.** An error occurred during the send diagnostics operation.
00h	00h	67h	4h	3, 11, 12	D	**Hardware Error.** One of the memories could not be programmed.

Table A-1 *REQUEST SENSE error data, sorted by ASC/ASCQ/FSC (continued)*

ASC	ASCQ	FSC	SK	ERP	Cause	Explanation
00h	00h	6Dh	4h	3, 11, 12	D	**Hardware Error.** The READ BUFFER command failed.
00h	00h	75h	Bh	11	O, A	**Aborted Command.** The format partition operation was aborted.
00h	00h	7Ah	Bh	11	O, A	**Aborted Command.** The switch partitions operation was aborted.
00h	00h	DFh	8h	11	I, A	**Blank Check.** There is a host error in message system.
00h	00h	E7h	Bh	11	O, A	**Aborted Command.** The initiator sent an Abort or Initiator Detected Error message during a read operation and the command was aborted.
00h	00h	E9h	0h	10	I	**No Sense.** Cleaning occurred.
00h	00h	EBh	Bh	11	O, A	**Aborted Command.** The requested operation is illegal during a WRITE BUFFER command sequence. The WRITE BUFFER sequence was aborted.
00h	00h	FAh	4h	15	D	**Hardware Error.** The tape drive's serial number is invalid or blank.
00h	00h	FCh	4h	15	D	**Hardware Error.** The Head Sync value in the EEPROM is out of range.
00h	00h	FDh	4h	15	D	**Hardware Error.** The EEPROM contains meaningless information.
00h	01h	0Dh	0h	10	I	**No Sense.** A filemark was encountered during a read or verify operation. The tape is positioned at the EOT-side of the filemark.
00h	01h	32h	0h	10	I	**No Sense.** A filemark was encountered during a space operation. The tape is positioned at the EOT-side of the filemark.
00h	02h	04h	0h	10	I	**No Sense.** LEOT or LEOP was encountered during the current write operation (the command may have terminated early).
00h	02h	06h	0h	10	I	**No Sense.** LEOT or LEOP was encountered during the last write operation (the command completed successfully).
00h	02h	09h	0h	10	I	**No Sense.** LEOT or LEOP was encountered during a read operation.
00h	02h	14h	3h	9, 14, 12	T, D	**Medium Error.** PEOT or PEOP was encountered during a read or verify operation.

Table A-1 REQUEST SENSE error data, sorted by ASC/ASCQ/FSC (continued)

ASC	ASCQ	FSC	SK	ERP	Cause	Explanation
00h	02h	28h	0h	10	I	**No Sense.** LEOT or LEOP was encountered during or before the write filemarks operation. The filemark was written.
00h	02h	34h	3h	9, 14, 12	T, D	**Medium Error.** PEOT or PEOP was encountered during a space or locate operation.
00h	02h	72h	Dh	11	A	**Blank Check.** The specified partition size is too big for tape.
00h	02h	AFh	Dh	6, 9, 11, 12	T, D	**Blank Check.** PEOT or PEOP encountered during a tape motion command.
00h	02h	B6h	Dh	6, 9, 12	T, D	**Blank Check.** EOT or PEOP encountered during a buffer flush.
00h	03h	1Dh	0h	10	I	**No Sense.** A setmark was encountered during a read or verify operation. The tape is positioned at the EOT-side of the setmark.
00h	03h	31h	0h	10	I	**No Sense.** A setmark was encountered during a space operation. The tape is positioned at the EOT-side of the setmark.
00h	04h	35h	0h	11	I	**No Sense.** PBOT or PBOP was encountered during a space or locate operation.
00h	05h	0Ch	8h	9, 14, 12	T, D	**Blank Check.** End of data encountered during a read operation.
00h	05h	0Eh	5h	11	A, I	**Illegal Request.** The tape was in write mode and a READ or VERIFY command was issued.
00h	05h	0Fh	8h	14, 11, 12	T, A, D	**Blank Check.** Already at blank tape. It is an error to attempt to perform a read operation.
00h	05h	33h	8h	9, 14, 12	T, D	**Blank Check.** End of data encountered during a space or locate operation.
00h	17h	E8h	1h	11, 9, 12	I, T, D	**Recovered Error.** Cleaning requested by tape drive.
03h	02h	94h	3h	9, 6, 12	T, D	**Medium Error.** Write setmark failure after internal retry limit exceeded.[a]
03h	02h	96h	3h	9, 6, 12	T, D	**Medium Error.** Write filemark failure after internal retry limit exceeded.[a]
03h	02h	97h	3h	9, 6, 12	T, D	**Medium Error.** Write EOD failure after internal retry limit exceeded.[a]
03h	02h	9Ah	3h	9, 6, 12	T, D	**Medium Error.** Permanent write error. Too many recoveries at one location. Possible Tape edge damage. Media may be unusable.

Table A-1 REQUEST SENSE error data, sorted by ASC/ASCQ/FSC (continued)

ASC	ASCQ	FSC	SK	ERP	Cause	Explanation
03h	02h	9Dh	3h	9, 6, 12	T, D	**Medium Error.** Permanent write error. Write recovery failure during Defect Skip.[b]
03h	02h	9Eh	3h	9, 6, 12	T, D	**Medium Error.** Permanent write error. Rewrite threshold exceeded.[b]
03h	02h	B3h	3h	9, 6, 12	T, D	**Medium Error.** LBOT or LBOP write failure. Read-back-check criteria not met after retry limit exceeded.[a]
04h	00h	C6h	2h	8, 7, 12	I, D	**Not Ready.** Logical unit not ready. Cause not known, or cartridge may be inserted but tape not loaded in tape path.
04h	00h	C8h	2h	8, 3	I	**Not Ready.** Logical unit not ready. A tape motion command is required to move the tape from its current position.
04h	00h	DDh	2h	11	I	**Not Ready.** Logical unit not ready. A head sync tape is in the tape drive.
04h	01h	C7h	2h	10	I	**Not Ready.** Logical unit not ready, but is in process of becoming ready (rewinding or loading tape).
08h	02h	A3h	Bh	13, 12	D	**Aborted Command.** IPORT write parity error. Logical port write buffer CRC error.
08h	02h	A4h	4h	8, 12	D	**Hardware Error.** Logical unit communication parity error. Physical port write buffer CRC error.
08h	02h	A5h	4h	8, 12	D	**Hardware Error.** Buffer positioning lost during write abort process.
08h	02h	A6h	Bh	13, 12	D	**Aborted Command.** IPORT read parity error. Logical port read buffer CRC error.
08h	02h	A7h	4h	8, 12	D	**Hardware Error.** Logical unit communication parity error. Physical port read buffer CRC error.
08h	02h	A8h	4h	8, 12	D	**Hardware Error.** Logical unit communication parity error. PPORT parity error.
09h	00h	AEh	3h	9, 6, 12	T, D	**Medium Error.** Tracking error. Unable to achieve or maintain tracking.
09h	00h	B0h	3h	9, 6, 12	T, D	**Medium Error.** Tracking error. Tape damaged. Unable to achieve or maintain tracking.
0Ah	00h	EDh	0h	11	T, I	**No Sense.** The tape history log indicates a worn tape.

Table A-1 REQUEST SENSE error data, sorted by ASC/ASCQ/FSC (continued)

ASC	ASCQ	FSC	SK	ERP	Cause	Explanation
0Ch	00h	9Bh	3h	9, 6, 12	T, D	**Medium Error**. Permanent write error. The operating performance for one or more tracks falls below the set threshold value.
0Ch	00h	9Ch	4h	9, 6, 12	T, D	**Hardware Error**. Permanent write error. The tape drive scanner requires maintenance.
0Ch	00h	B4h	3h	9, 6, 12	T, D	**Medium Error.** LBOT failure.
10h	00h	08h	Bh	12, 11	I,D	**Aborted Command.** Compression Integrity Check failed.
11h	00h	17h	4h	8, 9, 14, 12	T, D	**Hardware Error.** A hardware error was detected during a read operation.
11h	00h	18h	4h	8, 9, 14, 12	T, D	**Hardware Error.** The compression circuit was unable to decompress previously compressed data during a read operation.
11h	00h	37h	3h	9, 14, 12	T, D	**Medium Error.** An uncorrectable block was encountered during a locate or space operation.
11h	00h	B5h	3h	9, 14, 12	T, D	**Medium Error.** The Physical Read Manager could not read LBOT or LBOP.
11h	01h	0Bh	3h	9, 14, 12	T, D	**Medium Error.** An uncorrectable block was encountered during a read operation.
11h	02h	19h	4h	8, 9, 14, 12	T, D	**Hardware Error.** The read decompression CRC failed during a read operation.
11h	03h	11h	3h	9, 14, 12	T, D	**Medium Error.** Too many permanent read errors. Cannot sync.
14h	00h	16h	3h	9, 14, 12	T, D	**Medium Error.** The tape drive detected a medium error during a read operation.
14h	00h	38h	3h	9, 14, 12	T, D	**Medium Error.** The tape drive detected a medium error during a locate or space operation.
15h	00h	3Dh	3h	9, 14, 12	T, D	**Medium Error.** The tape drive cannot perform the space operation because there is no information at this position on the tape.
15h	01h	ADh	4h	8, 9, 6, 12	T, D	**Hardware Error.** The tape drive cannot position the media correctly. Servo hardware failure.
1Ah	00h	CCh	5h	4	A, O	**Illegal Request.** Parameter List Length error in the MODE SELECT CDB.
1Ah	00h	D4h	5h	4	A, O	**Illegal Request.** Illegal transfer length in the CDB.

Table A-1 REQUEST SENSE error data, sorted by ASC/ASCQ/FSC (continued)

ASC	ASCQ	FSC	SK	ERP	Cause	Explanation
20h	00h	CDh	5h	4	A, O	**Illegal Request.** Illegal operation code.
24h	00h	CEh	5h	4	A, O	**Illegal Request.** Invalid field or reserved bits set in the CDB.
25h	00h	CFh	5h	4	A, O	**Illegal Request.** The logical unit specified in the CDB is not supported.
25h	00h	D1h	5h	4	A, O	**Illegal Request.** The logical unit specified in the Identify message is illegal (not zero).
26h	00h	D0h	5h	4	A, O	**Illegal Request.** Invalid field in MODE SELECT parameter list.
26h	00h	EAh	5h	4	A, O	**Illegal Request.** Conflict between Density Code and Data Compression Page in MODE SELECT.
26h	01h	66h	5h	3, 11, 12	D, I	**Illegal Request.** The tape drive's boot PROM is not compatible with the new microcode being loaded.
26h	02h	61h	5h	3, 15, 11, 12	D, I	**Illegal Request.** The code header was not valid when loading firmware.
26h	02h	63h	5h	3, 15, 11, 12	D, I	**Illegal Request.** The control load image was not valid when loading firmware.
26h	02h	65h	5h	3, 15, 11, 12	D, I	**Illegal Request.** The EEPROM image was not valid when loading firmware.
26h	02h	69h	3h	3, 15, 11, 12	D, I	**Medium Error.** The CRC for the code image in the buffer was incorrect.
27h	00h	03h	7h	5	O	**Data Protect.** A WRITE command was received and the data cartridge is write protected.
27h	00h	27h	7h	5	O	**Data Protect.** A WRITE FILEMARKS command was received and the data cartridge is write protected.
27h	00h	4Ch	7h	5	O	**Data Protect.** The data cartridge is write protected and cannot be erased.
28h	00h	C1h	6h	10, 11	I	**Unit Attention.** A new tape load has occurred, and the data cartridge may have been changed.
29h	00h	C0h	6h	10, 11	I	**Unit Attention.** Power-on reset, SCSI bus reset, or device reset has occurred.
2Ah	01h	C2h	6h	10, 11	I	**Unit Attention.** MODE SELECT parameters have been changed.
2Ah	02h	CBh	6h	10, 11	I	**Unit Attention.** Log parameter changed.

Table A-1 REQUEST SENSE error data, sorted by ASC/ASCQ/FSC (continued)

ASC	ASCQ	FSC	SK	ERP	Cause	Explanation
30h	00h	47h	3h	6, 11	T, I	**Medium Error.** Incompatible media was ejected after a LOAD command was issued.
30h	00h	C5h	6h	6, 11	T, I	**Unit Attention.** Incompatible media was rejected after the cartridge was inserted.
30h	01h	1Ch	3h	14, 11	T, I	**Medium Error.** Incompatible format. The format of the currently loaded tape is not compatible with the tape drive.
30h	02h	D7h	5h	14, 11	T, I	**Illegal Request.** The tape format is incompatible with the command.
30h	05h	DBh	5h	6, 11	T, I	**Illegal Request.** Cannot write to tape. Media is not AME.
30h	05h	DEh	5h	11	A, I	**Illegal Request.** Cannot write to tape. Specified density is not supported for write operations.
31h	00h	36h	3h	14, 11, 12	T, D, I	**Medium Error.** A tape format error was encountered during a space or locate operation.
31h	00h	79h	3h	9, 14, 11, 12	T, D, I	**Medium Error.** A switch partition operation failed.
31h	01h	74h	3h	9, 6, 11, 12	T, A, D, I	**Medium Error.** The format partition operation failed.
37h	00h	DCh	1h	10	A, I	**Recovered Error.** A parameter was out of range in the last LOG SELECT or MODE SELECT command. The parameter was rounded to a valid value and the operation was completed.
3Ah	00h	C9h	2h	7	O, I	**Not Ready.** Logical unit not ready. Command requires a tape, and no tape is present.
3Dh	00h	DAh	5h	4	A, I	**Illegal Request.** Illegal bit set in Identify message.
3Fh	01h	C3h	6h	10, 11	I	**Unit Attention.** The tape drive firmware (microcode) has been changed.
40h	80h	8Dh	4h	8, 9, 6, 12	T, D	**Hardware Error.** Controller hardware failure.
43h	00h	E0h	Bh	8, 9, 11, 12	B, D	**Aborted Command.** The command was aborted in the CDB phase (parity or other error), or a reconnect attempt failed after the allowed number of retries.
43h	00h	E1h	Bh	8, 9, 11, 12	B, D	**Aborted Command.** The command was aborted before the Data phase; received bad message. Bad Identify message.

Table A-1 REQUEST SENSE error data, sorted by ASC/ASCQ/FSC (continued)

ASC	ASCQ	FSC	SK	ERP	Cause	Explanation
43h	00h	E3h	Bh	8, 9, 11, 12	B, D	**Aborted Command.** The command was aborted in the Data phase. Received bad message out.
43h	00h	E4h	Bh	8, 9, 11, 12	B, D	**Aborted Command.** The command was aborted after the Data phase. Received bad message out.
43h	00h	E5h	Bh	8, 9, 11, 12	B, D	**Aborted Command.** The command was aborted after the Data phase. Other error.
44h	00h	8Ch	4h	8, 9, 6, 12	T, D	**Hardware Error.** Controller firmware logic error.
44h	00h	ACh	4h	8, 9, 6, 12	T, D	**Hardware Error.** Servo software error.
47h	00h	E6h	Bh	8, 9, 11, 12	B, D	**Aborted Command.** The WRITE command was aborted because of a SCSI bus parity error.
48h	00h	E2h	Bh	8, 9, 11, 12	B, D	**Aborted Command.** The command was aborted in the Data phase because of an Initiator Detected Error message.
4Eh	00h	D8h	5h	3	A, I	**Illegal Request.** Overlapped commands attempted. Bad initiator-target-LUN (ITL) nexus.
50h	01h	02h	5h	11	A,I	**Illegal Request.** A WRITE command was received when the tape was not at a legal position to write.
50h	01h	26h	5h	11	A, I	**Illegal Request.** A WRITE FILEMARKS command was received when the tape was not at a legal position to write.
50h	01h	4Bh	5h	11	A, I	**Illegal Request.** The tape is at an illegal position to perform an erase operation.
50h	01h	74h	5h	11	A, I	**Illegal Request.** The tape is at an illegal position to perform a format partitions operation.
50h	01h	95h	3h	9, 6, 12	T, D	**Medium Error.** Write failure after retry limit (specified with MODE SELECT) exceeded.
53h	02h	D2h	5h	11	I	**Illegal Request.** Media removal prevented.
5Ah	01h	C4h	6h	10, 11	O	**Unit Attention.** Operator requested media removal.

Table A-1 REQUEST SENSE error data, sorted by ASC/ASCQ/FSC (continued)

ASC	ASCQ	FSC	SK	ERP	Cause	Explanation
5Bh	01h	CAh	6h	11	I	**Unit Attention.** Log threshold met. (For additional information about this error, look at the Log Parameter Page Code and Log Parameter Code bytes in the REQUEST SENSE data.)
5Bh	02h	ECh	1h	10, 11	I	**Recovered Error.** Log parameter overflow (a cumulative counter reached its maximum value of all FFs).
5Dh	00h	EEh	0h	12	D	**No Sense.** A tape drive component has exceeded its expected operational lifetime.
5Dh	00h	F1h	1h	11	T, D	**Recovered Error.** TapeAlert asynchronous notification.
5Dh	FFh	F0h	6h	11	T, D	**Unit Attention.** TapeAlert asynchronous notification test.
81h	00h	D3h	5h	4	A, I	**Illegal Request.** Fixed/variable mismatch. The Fixed bit is set to 1 (write fixed-length logical blocks) and the value in the Block Length field in the current MODE SELECT data is 0 (variable-length logical block).
84h	00h	D6h	5h	1, 11	A, I	**Illegal Request.** Could not change the MODE SELECT parameters since the tape was not at LBOT (or LBOP).

[a] If the read-back-check criteria are not met for an LBOT or LBOP, filemark, setmark, or EOD block written to tape, the tape drive moves the tape backward and retries the operation the number of times specified by the Write Retry Count (byte 08 of the MODE SENSE data). If the read-back-check criteria are still not met, the tape drive returns Check Condition status and these FSCs apply.

[b] If the read-back-check criteria are not met for a data or short filemark block (that is, if the block is not perfect), the block is rewritten. If rewrite activity is excessive, the tape drive moves the tape backward, reads the tape to verify that blocks are written, then moves the tape backward again. It then performs a write splice operation and rewrites the blocks. If the rewrite threshold is exceeded for any block, the tape drive returns Check Condition status with the sense key set to 3h (Medium Error) and the FSC set to 9E. If the recovery splice operation cannot be completed, the FSC is 9Dh.

Table A-2 REQUEST SENSE error data, sorted by FSC/ASC/ASCQ

FSC	ASC	ASCQ	SK	ERP	Cause	Explanation
02h	50h	01h	5h	11	A,I	**Illegal Request.** A WRITE command was received when the tape was not at a legal position to write.
03h	27h	00h	7h	5	O	**Data Protect.** A WRITE command was received and the data cartridge is write protected.
04h	00h	02h	0h	10	I	**No Sense.** LEOT or LEOP was encountered during the current write operation (the command may have terminated early).
05h	00h	00h	Bh	11	O, A	**Aborted Command.** The write operation was aborted as requested.
06h	00h	02h	0h	10	I	**No Sense.** LEOT or LEOP was encountered during the last write operation (the command completed successfully).
08h	10h	00h	Bh	12, 11	I,D	**Aborted Command.** Compression Integrity Check failed.
09h	00h	02h	0h	10	I	**No Sense.** LEOT or LEOP was encountered during a read operation.
0Ah	00h	00h	0h	14, 11, 12	T, A, D	**No Sense.** The actual block size read did not match the requested block size during a read operation.
0Bh	11h	01h	3h	9, 14, 12	T, D	**Medium Error.** An uncorrectable block was encountered during a read operation.
0Ch	00h	05h	8h	9, 14, 12	T, D	**Blank Check.** End of data encountered during a read operation.
0Dh	00h	01h	0h	10	I	**No Sense.** A filemark was encountered during a read or verify operation. The tape is positioned at the EOT-side of the filemark.
0Eh	00h	05h	5h	11	A, I	**Illegal Request.** The tape was in write mode and a READ or VERIFY command was issued.
0Fh	00h	05h	8h	14, 11, 12	T, A, D	**Blank Check.** Already at blank tape. It is an error to attempt to perform a read operation.
10h	00h	00h	Bh	11	O, A	**Aborted Command.** The read operation was aborted as requested.
11h	11h	03h	3h	9, 14, 12	T, D	**Medium Error.** Too many permanent read errors. Cannot sync.
14h	00h	02h	3h	9, 14, 12	T, D	**Medium Error.** PEOT or PEOP was encountered during a read or verify operation.
16h	14h	00h	3h	9, 14, 12	T, D	**Medium Error.** The tape drive detected a medium error during a read operation.

Table A-2 REQUEST SENSE error data, sorted by FSC/ASC/ASCQ (continued)

FSC	ASC	ASCQ	SK	ERP	Cause	Explanation
17h	11h	00h	4h	8, 9, 14, 12	T, D	**Hardware Error.** A hardware error was detected during a read operation.
18h	11h	00h	4h	8, 9, 14, 12	T, D	**Hardware Error.** The compression circuit was unable to decompress previously compressed data during a read operation.
19h	11h	02h	4h	8, 9, 14, 12	T, D	**Hardware Error.** The read decompression CRC failed during a read operation.
1Ch	30h	01h	3h	14, 11	T, I	**Medium Error.** Incompatible format. The format of the currently loaded tape is not compatible with the tape drive.
1Dh	00h	03h	0h	10	I	**No Sense.** A setmark was encountered during a read or verify operation. The tape is positioned at the EOT-side of the setmark.
26h	50h	01h	5h	11	A, I	**Illegal Request.** A WRITE FILEMARKS command was received when the tape was not at a legal position to write.
27h	27h	00h	7h	5	O	**Data Protect.** A WRITE FILEMARKS command was received and the data cartridge is write protected.
28h	00h	02h	0h	10	I	**No Sense.** LEOT or LEOP was encountered during or before the write filemarks operation. The filemark was written.
31h	00h	03h	0h	10	I	**No Sense.** A setmark was encountered during a space operation. The tape is positioned at the EOT-side of the setmark.
32h	00h	01h	0h	10	I	**No Sense.** A filemark was encountered during a space operation. The tape is positioned at the EOT-side of the filemark.
33h	00h	05h	8h	9, 14, 12	T, D	**Blank Check.** End of data encountered during a space or locate operation.
34h	00h	02h	3h	9, 14, 12	T, D	**Medium Error.** PEOT or PEOP was encountered during a space or locate operation.
35h	00h	04h	0h	11	I	**No Sense.** PBOT or PBOP was encountered during a space or locate operation.
36h	31h	00h	3h	14, 11, 12	T, D, I	**Medium Error.** A tape format error was encountered during a space or locate operation.
37h	11h	00h	3h	9, 14, 12	T, D	**Medium Error.** An uncorrectable block was encountered during a locate or space operation.

Table A-2 REQUEST SENSE error data, sorted by FSC/ASC/ASCQ (continued)

FSC	ASC	ASCQ	SK	ERP	Cause	Explanation
38h	14h	00h	3h	9, 14, 12	T, D	**Medium Error.** The tape drive detected a medium error during a locate or space operation.
3Bh	00h	00h	Bh	11	O, A	**Aborted Command.** The SPACE or LOCATE command was aborted as requested.
3Dh	15h	00h	3h	9, 14, 12	T, D	**Medium Error.** The tape drive cannot perform the space operation because there is no information at this position on the tape.
47h	30h	00h	3h	6, 11	T, I	**Medium Error.** Incompatible media was ejected after a LOAD command was issued.
4Bh	50h	01h	5h	11	A, I	**Illegal Request.** The tape is at an illegal position to perform an erase operation.
4Ch	27h	00h	7h	5	O	**Data Protect.** The data cartridge is write protected and cannot be erased.
4Eh	00h	00h	Bh	11	O, A	**Aborted Command.** The ERASE command was aborted as requested.
58h	00h	00h	4h	9, 6,12	T, D	**Hardware Error.** An error occurred during the send diagnostics operation.
61h	26h	02h	5h	3, 15, 11, 12	D, I	**Illegal Request.** The code header was not valid when loading firmware.
63h	26h	02h	5h	3, 15, 11, 12	D, I	**Illegal Request.** The control load image was not valid when loading firmware.
65h	26h	02h	5h	3, 15, 11, 12	D, I	**Illegal Request.** The EEPROM image was not valid when loading firmware.
66h	26h	01h	5h	3, 11, 12	D, I	**Illegal Request.** The tape drive's boot PROM is not compatible with the new microcode being loaded.
67h	00h	00h	4h	3, 11, 12	D	**Hardware Error.** One of the memories could not be programmed.
69h	26h	02h	3h	3, 15, 11, 12	D, I	**Medium Error.** The CRC for the code image in the buffer was incorrect.
6Dh	00h	00h	4h	3, 11, 12	D	**Hardware Error.** The READ BUFFER command failed.
72h	00h	02h	Dh	11	A	**Blank Check.** The specified partition size is too big for tape.
74h	31h	01h	3h	9, 6, 11, 12	T, A, D, I	**Medium Error.** The format partition operation failed.
74h	50h	01h	5h	11	A, I	**Illegal Request.** The tape is at an illegal position to perform a format partitions operation.

Table A-2 REQUEST SENSE error data, sorted by FSC/ASC/ASCQ (continued)

FSC	ASC	ASCQ	SK	ERP	Cause	Explanation
75h	00h	00h	Bh	11	O, A	**Aborted Command.** The format partition operation was aborted.
79h	31h	00h	3h	9, 14, 11, 12	T, D, I	**Medium Error.** A switch partition operation failed.
7Ah	00h	00h	Bh	11	O, A	**Aborted Command.** The switch partitions operation was aborted.
8Ch	44h	00h	4h	8, 9, 6, 12	T, D	**Hardware Error.** Controller firmware logic error.
8Dh	40h	80h	4h	8, 9, 6, 12	T, D	**Hardware Error.** Controller hardware failure.
94h	03h	02h	3h	9, 6, 12	T, D	**Medium Error.** Write setmark failure after internal retry limit exceeded.[a]
95h	50h	01h	3h	9, 6, 12	T, D	**Medium Error.** Write failure after retry limit (specified with MODE SELECT) exceeded.
96h	03h	02h	3h	9, 6, 12	T, D	**Medium Error.** Write filemark failure after internal retry limit exceeded.[a]
97h	03h	02h	3h	9, 6, 12	T, D	**Medium Error.** Write EOD failure after internal retry limit exceeded.[a]
9Ah	03h	02h	3h	9, 6, 12	T, D	**Medium Error.** Permanent write error. Too many recoveries at one location. Possible Tape edge damage. Media may be unusable.
9Bh	0Ch	00h	3h	9, 6, 12	T, D	**Medium Error**. Permanent write error. The operating performance for one or more tracks falls below the set threshold value.
9Ch	0Ch	00h	4h	9, 6, 12	T, D	**Hardware Error**. Permanent write error. The tape drive scanner requires maintenance.
9Dh	03h	02h	3h	9, 6, 12	T, D	**Medium Error.** Permanent write error. Write recovery failure during Defect Skip.[b]
9Eh	03h	02h	3h	9, 6, 12	T, D	**Medium Error.** Permanent write error. Rewrite threshold exceeded.[b]
A3h	08h	02h	Bh	13, 12	D	**Aborted Command.** IPORT write parity error. Logical port write buffer CRC error.
A4h	08h	02h	4h	8, 12	D	**Hardware Error.** Logical unit communication parity error. Physical port write buffer CRC error.
A5h	08h	02h	4h	8, 12	D	**Hardware Error.** Buffer positioning lost during write abort process.
A6h	08h	02h	Bh	13, 12	D	**Aborted Command.** IPORT read parity error. Logical port read buffer CRC error.
A7h	08h	02h	4h	8, 12	D	**Hardware Error.** Logical unit communication parity error. Physical port read buffer CRC error.

Table A-2 *REQUEST SENSE error data, sorted by FSC/ASC/ASCQ (continued)*

FSC	ASC	ASCQ	SK	ERP	Cause	Explanation
A8h	08h	02h	4h	8, 12	D	**Hardware Error.** Logical unit communication parity error. PPORT parity error.
ACh	44h	00h	4h	8, 9, 6, 12	T, D	**Hardware Error.** Servo software error.
ADh	15h	01h	4h	8, 9, 6, 12	T, D	**Hardware Error.** The tape drive cannot position the media correctly. Servo hardware failure.
AEh	09h	00h	3h	9, 6, 12	T, D	**Medium Error.** Tracking error. Unable to achieve or maintain tracking.
AFh	00h	02h	Dh	6, 9, 11, 12	T, D	**Blank Check.** PEOT or PEOP encountered during a tape motion command.
B0h	09h	00h	3h	9, 6, 12	T, D	**Medium Error.** Tracking error. Tape damaged. Unable to achieve or maintain tracking.
B3h	03h	02h	3h	9, 6, 12	T, D	**Medium Error.** LBOT or LBOP write failure. Read-back-check criteria not met after retry limit exceeded.[a]
B4h	0Ch	00h	3h	9, 6, 12	T, D	**Medium Error.** LBOT failure.
B5h	11h	00h	3h	9, 14, 12	T, D	**Medium Error.** The Physical Read Manager could not read LBOT or LBOP.
B6h	00h	02h	Dh	6, 9, 12	T, D	**Blank Check.** EOT or PEOP encountered during a buffer flush.
C0h	29h	00h	6h	10, 11	I	**Unit Attention.** Power-on reset, SCSI bus reset, or device reset has occurred.
C1h	28h	00h	6h	10, 11	I	**Unit Attention.** A new tape load has occurred, and the data cartridge may have been changed.
C2h	2Ah	01h	6h	10, 11	I	**Unit Attention.** MODE SELECT parameters have been changed.
C3h	3Fh	01h	6h	10, 11	I	**Unit Attention.** The tape drive firmware (microcode) has been changed.
C4h	5Ah	01h	6h	10, 11	O	**Unit Attention.** Operator requested media removal.
C5h	30h	00h	6h	6, 11	T, I	**Unit Attention.** Incompatible media was rejected after the cartridge was inserted.
C6h	04h	00h	2h	8, 7, 12	I, D	**Not Ready.** Logical unit not ready. Cause not known, or cartridge may be inserted but tape not loaded in tape path.
C7h	04h	01h	2h	10	I	**Not Ready.** Logical unit not ready, but is in process of becoming ready (rewinding or loading tape).

Table A-2 REQUEST SENSE error data, sorted by FSC/ASC/ASCQ (continued)

FSC	ASC	ASCQ	SK	ERP	Cause	Explanation
C8h	04h	00h	2h	8, 3	I	**Not Ready.** Logical unit not ready. A tape motion command is required to move the tape from its current position.
C9h	3Ah	00h	2h	7	O, I	**Not Ready.** Logical unit not ready. Command requires a tape, and no tape is present.
CAh	5Bh	01h	6h	11	I	**Unit Attention.** Log threshold met. (For additional information about this error, look at the Log Parameter Page Code and Log Parameter Code bytes in the REQUEST SENSE data.)
CBh	2Ah	02h	6h	10, 11	I	**Unit Attention.** Log parameter changed.
CCh	1Ah	00h	5h	4	A, O	**Illegal Request.** Parameter List Length error in the MODE SELECT CDB.
CDh	20h	00h	5h	4	A, O	**Illegal Request.** Illegal operation code.
CEh	24h	00h	5h	4	A, O	**Illegal Request.** Invalid field or reserved bits set in the CDB.
CFh	25h	00h	5h	4	A, O	**Illegal Request.** The logical unit specified in the CDB is not supported.
D0h	26h	00h	5h	4	A, O	**Illegal Request.** Invalid field in MODE SELECT parameter list.
D1h	25h	00h	5h	4	A, O	**Illegal Request.** The logical unit specified in the Identify message is illegal (not zero).
D2h	53h	02h	5h	11	I	**Illegal Request.** Media removal prevented.
D3h	81h	00h	5h	4	A, I	**Illegal Request.** Fixed/variable mismatch. The Fixed bit is set to 1 (write fixed-length logical blocks) and the value in the Block Length field in the current MODE SELECT data is 0 (variable-length logical block).
D4h	1Ah	00h	5h	4	A, O	**Illegal Request.** Illegal transfer length in the CDB.
D6h	84h	00h	5h	1, 11	A, I	**Illegal Request.** Could not change the MODE SELECT parameters since the tape was not at LBOT (or LBOP).
D7h	30h	02h	5h	14, 11	T, I	**Illegal Request.** The tape format is incompatible with the command.
D8h	4Eh	00h	5h	3	A, I	**Illegal Request.** Overlapped commands attempted. Bad initiator-target-LUN (ITL) nexus.
DAh	3Dh	00h	5h	4	A, I	**Illegal Request.** Illegal bit set in Identify message.

Table A-2 REQUEST SENSE error data, sorted by FSC/ASC/ASCQ (continued)

FSC	ASC	ASCQ	SK	ERP	Cause	Explanation
DBh	30h	05h	5h	6, 11	T, I	**Illegal Request.** Cannot write to tape. Media is not AME.
DCh	37h	00h	1h	10	A, I	**Recovered Error.** A parameter was out of range in the last LOG SELECT or MODE SELECT command. The parameter was rounded to a valid value and the operation was completed.
DDh	04h	00h	2h	11	I	**Not Ready.** Logical unit not ready. A head sync tape is in the tape drive.
DEh	30h	05h	5h	11	A, I	**Illegal Request.** Cannot write to tape. Specified density is not supported for write operations.
DFh	00h	00h	8h	11	I, A	**Blank Check.** There is a host error in message system.
E0h	43h	00h	Bh	8, 9, 11, 12	B, D	**Aborted Command.** The command was aborted in the CDB phase (parity or other error), or a reconnect attempt failed after the allowed number of retries.
E1h	43h	00h	Bh	8, 9, 11, 12	B, D	**Aborted Command.** The command was aborted before the Data phase; received bad message. Bad Identify message.
E2h	48h	00h	Bh	8, 9, 11, 12	B, D	**Aborted Command.** The command was aborted in the Data phase because of an Initiator Detected Error message.
E3h	43h	00h	Bh	8, 9, 11, 12	B, D	**Aborted Command.** The command was aborted in the Data phase. Received bad message out.
E4h	43h	00h	Bh	8, 9, 11, 12	B, D	**Aborted Command.** The command was aborted after the Data phase. Received bad message out.
E5h	43h	00h	Bh	8, 9, 11, 12	B, D	**Aborted Command.** The command was aborted after the Data phase. Other error.
E6h	47h	00h	Bh	8, 9, 11, 12	B, D	**Aborted Command.** The WRITE command was aborted because of a SCSI bus parity error.
E7h	00h	00h	Bh	11	O, A	**Aborted Command.** The initiator sent an Abort or Initiator Detected Error message during a read operation and the command was aborted.
E8h	00h	17h	1h	11, 9, 12	I, T, D	**Recovered Error.** Cleaning requested by tape drive.
E9h	00h	00h	0h	10	I	**No Sense.** Cleaning occurred.
EAh	26h	00h	5h	4	A, O	**Illegal Request.** Conflict between Density Code and Data Compression Page in MODE SELECT.

Table A-2 REQUEST SENSE error data, sorted by FSC/ASC/ASCQ (continued)

FSC	ASC	ASCQ	SK	ERP	Cause	Explanation
EBh	00h	00h	Bh	11	O, A	**Aborted Command.** The requested operation is illegal during a WRITE BUFFER command sequence. The WRITE BUFFER sequence was aborted.
ECh	5Bh	02h	1h	10, 11	I	**Recovered Error.** Log parameter overflow (a cumulative counter reached its maximum value of all FFs).
EDh	0Ah	00h	0h	11	T, I	**No Sense.** The tape history log indicates a worn tape.
EEh	5Dh	00h	0h	12	D	**No Sense.** A tape drive component has exceeded its expected operational lifetime.
F0h	5Dh	FFh	6h	11	T, D	**Unit Attention.** TapeAlert asynchronous notification test.
F1h	5Dh	00h	1h	11	T, D	**Recovered Error.** TapeAlert asynchronous notification.
FAh	00h	00h	4h	15	D	**Hardware Error.** The tape drive's serial number is invalid or blank.
FCh	00h	00h	4h	15	D	**Hardware Error.** The Head Sync value in the EEPROM is out of range.
FDh	00h	00h	4h	15	D	**Hardware Error.** The EEPROM contains meaningless information.

[a] If the read-back-check criteria are not met for an LBOT or LBOP, filemark, setmark, or EOD block written to tape, the tape drive moves the tape backward and retries the operation the number of times specified by the Write Retry Count (byte 08 of the MODE SENSE data). If the read-back-check criteria are still not met, the tape drive returns Check Condition status and these FSCs apply.

[b] If the read-back-check criteria are not met for a data or short filemark block (that is, if the block is not perfect), the block is rewritten. If rewrite activity is excessive, the tape drive moves the tape backward, reads the tape to verify that blocks are written, then moves the tape backward again. It then performs a write splice operation and rewrites the blocks. If the rewrite threshold is exceeded for any block, the tape drive returns Check Condition status with the sense key set to 3h (Medium Error) and the FSC set to 9E. If the recovery splice operation cannot be completed, the FSC is 9Dh.

Table A-3 REQUEST SENSE error data, sorted by Sense Key/ASC/ASCQ

SK	ASC	ASCQ	FSC	ERP	Cause	Explanation
0h	00h	00h	0Ah	14, 11, 12	T, A, D	**No Sense.** The actual block size read did not match the requested block size during a read operation.
0h	00h	00h	E9h	10	I	**No Sense.** Cleaning occurred.
0h	00h	01h	0Dh	10	I	**No Sense.** A filemark was encountered during a read or verify operation. The tape is positioned at the EOT-side of the filemark.
0h	00h	01h	32h	10	I	**No Sense.** A filemark was encountered during a space operation. The tape is positioned at the EOT-side of the filemark.
0h	00h	02h	04h	10	I	**No Sense.** LEOT or LEOP was encountered during the current write operation (the command may have terminated early).
0h	00h	02h	06h	10	I	**No Sense.** LEOT or LEOP was encountered during the last write operation (the command completed successfully).
0h	00h	02h	09h	10	I	**No Sense.** LEOT or LEOP was encountered during a read operation.
0h	00h	02h	28h	10	I	**No Sense.** LEOT or LEOP was encountered during or before the write filemarks operation. The filemark was written.
0h	00h	03h	1Dh	10	I	**No Sense.** A setmark was encountered during a read or verify operation. The tape is positioned at the EOT-side of the setmark.
0h	00h	03h	31h	10	I	**No Sense.** A setmark was encountered during a space operation. The tape is positioned at the EOT-side of the setmark.
0h	00h	04h	35h	11	I	**No Sense.** PBOT or PBOP was encountered during a space or locate operation.
0h	0Ah	00h	EDh	11	T, I	**No Sense.** The tape history log indicates a worn tape.
0h	5Dh	00h	EEh	12	D	**No Sense.** A tape drive component has exceeded its expected operational lifetime.
1h	00h	17h	E8h	11, 9, 12	I, T, D	**Recovered Error.** Cleaning requested by tape drive.
1h	37h	00h	DCh	10	A, I	**Recovered Error.** A parameter was out of range in the last LOG SELECT or MODE SELECT command. The parameter was rounded to a valid value and the operation was completed.

Table A-3 REQUEST SENSE error data, sorted by Sense Key/ASC/ASCQ (continued)

SK	ASC	ASCQ	FSC	ERP	Cause	Explanation
1h	5Bh	02h	ECh	10, 11	I	**Recovered Error.** Log parameter overflow (a cumulative counter reached its maximum value of all FFs).
1h	5Dh	00h	F1h	11	T, D	**Recovered Error.** TapeAlert asynchronous notification.
2h	04h	00h	C6h	8, 7, 12	I, D	**Not Ready.** Logical unit not ready. Cause not known, or cartridge may be inserted but tape not loaded in tape path.
2h	04h	00h	C8h	8, 3	I	**Not Ready.** Logical unit not ready. A tape motion command is required to move the tape from its current position.
2h	04h	00h	DDh	11	I	**Not Ready.** Logical unit not ready. A head sync tape is in the tape drive.
2h	04h	01h	C7h	10	I	**Not Ready.** Logical unit not ready, but is in process of becoming ready (rewinding or loading tape).
2h	3Ah	00h	C9h	7	O, I	**Not Ready.** Logical unit not ready. Command requires a tape, and no tape is present.
3h	00h	02h	14h	9, 14, 12	T, D	**Medium Error.** PEOT or PEOP was encountered during a read or verify operation.
3h	00h	02h	34h	9, 14, 12	T, D	**Medium Error.** PEOT or PEOP was encountered during a space or locate operation.
3h	03h	02h	94h	9, 6, 12	T, D	**Medium Error.** Write setmark failure after internal retry limit exceeded.[a]
3h	03h	02h	96h	9, 6, 12	T, D	**Medium Error.** Write filemark failure after internal retry limit exceeded.[a]
3h	03h	02h	97h	9, 6, 12	T, D	**Medium Error.** Write EOD failure after internal retry limit exceeded.[a]
3h	03h	02h	9Ah	9, 6, 12	T, D	**Medium Error.** Permanent write error. Too many recoveries at one location. Possible Tape edge damage. Media may be unusable.
3h	03h	02h	9Dh	9, 6, 12	T, D	**Medium Error.** Permanent write error. Write recovery failure during Defect Skip.[b]
3h	03h	02h	9Eh	9, 6, 12	T, D	**Medium Error.** Permanent write error. Rewrite threshold exceeded.[b]
3h	03h	02h	B3h	9, 6, 12	T, D	**Medium Error.** LBOT or LBOP write failure. Read-back-check criteria not met after retry limit exceeded.[a]

Table A-3 REQUEST SENSE error data, sorted by Sense Key/ASC/ASCQ (continued)

SK	ASC	ASCQ	FSC	ERP	Cause	Explanation
3h	09h	00h	AEh	9, 6, 12	T, D	**Medium Error.** Tracking error. Unable to achieve or maintain tracking.
3h	09h	00h	B0h	9, 6, 12	T, D	**Medium Error.** Tracking error. Tape damaged. Unable to achieve or maintain tracking.
3h	0Ch	00h	9Bh	9, 6, 12	T, D	**Medium Error**. Permanent write error. The operating performance for one or more tracks falls below the set threshold value.
3h	0Ch	00h	B4h	9, 6, 12	T, D	**Medium Error.** LBOT failure.
3h	11h	00h	37h	9, 14, 12	T, D	**Medium Error.** An uncorrectable block was encountered during a locate or space operation.
3h	11h	00h	B5h	9, 14, 12	T, D	**Medium Error.** The Physical Read Manager could not read LBOT or LBOP.
3h	11h	01h	0Bh	9, 14, 12	T, D	**Medium Error.** An uncorrectable block was encountered during a read operation.
3h	11h	03h	11h	9, 14, 12	T, D	**Medium Error.** Too many permanent read errors. Cannot sync.
3h	14h	00h	16h	9, 14, 12	T, D	**Medium Error.** The tape drive detected a medium error during a read operation.
3h	14h	00h	38h	9, 14, 12	T, D	**Medium Error.** The tape drive detected a medium error during a locate or space operation.
3h	15h	00h	3Dh	9, 14, 12	T, D	**Medium Error.** The tape drive cannot perform the space operation because there is no information at this position on the tape.
3h	26h	02h	69h	3, 15, 11, 12	D, I	**Medium Error.** The CRC for the code image in the buffer was incorrect.
3h	30h	00h	47h	6, 11	T, I	**Medium Error.** Incompatible media was ejected after a LOAD command was issued.
3h	30h	01h	1Ch	14, 11	T, I	**Medium Error.** Incompatible format. The format of the currently loaded tape is not compatible with the tape drive.
3h	31h	00h	36h	14, 11, 12	T, D, I	**Medium Error.** A tape format error was encountered during a space or locate operation.
3h	31h	00h	79h	9, 14, 11, 12	T, D, I	**Medium Error.** A switch partition operation failed.
3h	31h	01h	74h	9, 6, 11, 12	T, A, D, I	**Medium Error.** The format partition operation failed.
3h	50h	01h	95h	9, 6, 12	T, D	**Medium Error.** Write failure after retry limit (specified with MODE SELECT) exceeded.

Table A-3 REQUEST SENSE error data, sorted by Sense Key/ASC/ASCQ (continued)

SK	ASC	ASCQ	FSC	ERP	Cause	Explanation
4h	00h	00h	58h	9, 6,12	T, D	**Hardware Error.** An error occurred during the send diagnostics operation.
4h	00h	00h	67h	3, 11, 12	D	**Hardware Error.** One of the memories could not be programmed.
4h	00h	00h	6Dh	3, 11, 12	D	**Hardware Error.** The READ BUFFER command failed.
4h	00h	00h	FAh	15	D	**Hardware Error.** The tape drive's serial number is invalid or blank.
4h	00h	00h	FCh	15	D	**Hardware Error.** The Head Sync value in the EEPROM is out of range.
4h	00h	00h	FDh	15	D	**Hardware Error.** The EEPROM contains meaningless information.
4h	08h	02h	A4h	8, 12	D	**Hardware Error.** Logical unit communication parity error. Physical port write buffer CRC error.
4h	08h	02h	A5h	8, 12	D	**Hardware Error.** Buffer positioning lost during write abort process.
4h	08h	02h	A7h	8, 12	D	**Hardware Error.** Logical unit communication parity error. Physical port read buffer CRC error.
4h	08h	02h	A8h	8, 12	D	**Hardware Error.** Logical unit communication parity error. PPORT parity error.
4h	0Ch	00h	9Ch	9, 6, 12	T, D	**Hardware Error**. Permanent write error. The tape drive scanner requires maintenance.
4h	11h	00h	17h	8, 9, 14, 12	T, D	**Hardware Error.** A hardware error was detected during a read operation.
4h	11h	00h	18h	8, 9, 14, 12	T, D	**Hardware Error.** The compression circuit was unable to decompress previously compressed data during a read operation.
4h	11h	02h	19h	8, 9, 14, 12	T, D	**Hardware Error.** The read decompression CRC failed during a read operation.
4h	15h	01h	ADh	8, 9, 6, 12	T, D	**Hardware Error.** The tape drive cannot position the media correctly. Servo hardware failure.
4h	40h	80h	8Dh	8, 9, 6, 12	T, D	**Hardware Error.** Controller hardware failure.
4h	44h	00h	8Ch	8, 9, 6, 12	T, D	**Hardware Error.** Controller firmware logic error.
4h	44h	00h	ACh	8, 9, 6, 12	T, D	**Hardware Error.** Servo software error.
5h	00h	05h	0Eh	11	A, I	**Illegal Request.** The tape was in write mode and a READ or VERIFY command was issued.
5h	1Ah	00h	CCh	4	A, O	**Illegal Request.** Parameter List Length error in the MODE SELECT CDB.

Table A-3 REQUEST SENSE error data, sorted by Sense Key/ASC/ASCQ (continued)

SK	ASC	ASCQ	FSC	ERP	Cause	Explanation
5h	1Ah	00h	D4h	4	A, O	**Illegal Request.** Illegal transfer length in the CDB.
5h	20h	00h	CDh	4	A, O	**Illegal Request.** Illegal operation code.
5h	24h	00h	CEh	4	A, O	**Illegal Request.** Invalid field or reserved bits set in the CDB.
5h	25h	00h	CFh	4	A, O	**Illegal Request.** The logical unit specified in the CDB is not supported.
5h	25h	00h	D1h	4	A, O	**Illegal Request.** The logical unit specified in the Identify message is illegal (not zero).
5h	26h	00h	D0h	4	A, O	**Illegal Request.** Invalid field in MODE SELECT parameter list.
5h	26h	00h	EAh	4	A, O	**Illegal Request.** Conflict between Density Code and Data Compression Page in MODE SELECT.
5h	26h	01h	66h	3, 11, 12	D, I	**Illegal Request.** The tape drive's boot PROM is not compatible with the new microcode being loaded.
5h	26h	02h	61h	3, 15, 11, 12	D, I	**Illegal Request.** The code header was not valid when loading firmware.
5h	26h	02h	63h	3, 15, 11, 12	D, I	**Illegal Request.** The control load image was not valid when loading firmware.
5h	26h	02h	65h	3, 15, 11, 12	D, I	**Illegal Request.** The EEPROM image was not valid when loading firmware.
5h	30h	02h	D7h	14, 11	T, I	**Illegal Request.** The tape format is incompatible with the command.
5h	30h	05h	DBh	6, 11	T, I	**Illegal Request.** Cannot write to tape. Media is not AME.
5h	30h	05h	DEh	11	A, I	**Illegal Request.** Cannot write to tape. Specified density is not supported for write operations.
5h	3Dh	00h	DAh	4	A, I	**Illegal Request.** Illegal bit set in Identify message.
5h	4Eh	00h	D8h	3	A, I	**Illegal Request.** Overlapped commands attempted. Bad initiator-target-LUN (ITL) nexus.
5h	50h	01h	02h	11	A,I	**Illegal Request.** A WRITE command was received when the tape was not at a legal position to write.
5h	50h	01h	26h	11	A, I	**Illegal Request.** A WRITE FILEMARKS command was received when the tape was not at a legal position to write.
5h	50h	01h	4Bh	11	A, I	**Illegal Request.** The tape is at an illegal position to perform an erase operation.

Table A-3 REQUEST SENSE error data, sorted by Sense Key/ASC/ASCQ (continued)

SK	ASC	ASCQ	FSC	ERP	Cause	Explanation
5h	50h	01h	74h	11	A, I	**Illegal Request.** The tape is at an illegal position to perform a format partitions operation.
5h	53h	02h	D2h	11	I	**Illegal Request.** Media removal prevented.
5h	81h	00h	D3h	4	A, I	**Illegal Request.** Fixed/variable mismatch. The Fixed bit is set to 1 (write fixed-length logical blocks) and the value in the Block Length field in the current MODE SELECT data is 0 (variable-length logical block).
5h	84h	00h	D6h	1, 11	A, I	**Illegal Request.** Could not change the MODE SELECT parameters since the tape was not at LBOT (or LBOP).
6h	28h	00h	C1h	10, 11	I	**Unit Attention.** A new tape load has occurred, and the data cartridge may have been changed.
6h	29h	00h	C0h	10, 11	I	**Unit Attention.** Power-on reset, SCSI bus reset, or device reset has occurred.
6h	2Ah	01h	C2h	10, 11	I	**Unit Attention.** MODE SELECT parameters have been changed.
6h	2Ah	02h	CBh	10, 11	I	**Unit Attention.** Log parameter changed.
6h	30h	00h	C5h	6, 11	T, I	**Unit Attention.** Incompatible media was rejected after the cartridge was inserted.
6h	3Fh	01h	C3h	10, 11	I	**Unit Attention.** The tape drive firmware (microcode) has been changed.
6h	5Ah	01h	C4h	10, 11	O	**Unit Attention.** Operator requested media removal.
6h	5Bh	01h	CAh	11	I	**Unit Attention.** Log threshold met. (For additional information about this error, look at the Log Parameter Page Code and Log Parameter Code bytes in the REQUEST SENSE data.)
6h	5Dh	FFh	F0h	11	T, D	**Unit Attention.** TapeAlert asynchronous notification test.
7h	27h	00h	03h	5	O	**Data Protect.** A WRITE command was received and the data cartridge is write protected.
7h	27h	00h	27h	5	O	**Data Protect.** A WRITE FILEMARKS command was received and the data cartridge is write protected.
7h	27h	00h	4Ch	5	O	**Data Protect.** The data cartridge is write protected and cannot be erased.
8h	00h	00h	DFh	11	I, A	**Blank Check.** There is a host error in message system.

Table A-3 REQUEST SENSE error data, sorted by Sense Key/ASC/ASCQ (continued)

SK	ASC	ASCQ	FSC	ERP	Cause	Explanation
8h	00h	05h	0Ch	9, 14, 12	T, D	**Blank Check.** End of data encountered during a read operation.
8h	00h	05h	0Fh	14, 11, 12	T, A, D	**Blank Check.** Already at blank tape. It is an error to attempt to perform a read operation.
8h	00h	05h	33h	9, 14, 12	T, D	**Blank Check.** End of data encountered during a space or locate operation.
Bh	00h	00h	05h	11	O, A	**Aborted Command.** The write operation was aborted as requested.
Bh	00h	00h	10h	11	O, A	**Aborted Command.** The read operation was aborted as requested.
Bh	00h	00h	3Bh	11	O, A	**Aborted Command.** The SPACE or LOCATE command was aborted as requested.
Bh	00h	00h	4Eh	11	O, A	**Aborted Command.** The ERASE command was aborted as requested.
Bh	00h	00h	75h	11	O, A	**Aborted Command.** The format partition operation was aborted.
Bh	00h	00h	7Ah	11	O, A	**Aborted Command.** The switch partitions operation was aborted.
Bh	00h	00h	E7h	11	O, A	**Aborted Command.** The initiator sent an Abort or Initiator Detected Error message during a read operation and the command was aborted.
Bh	00h	00h	EBh	11	O, A	**Aborted Command.** The requested operation is illegal during a WRITE BUFFER command sequence. The WRITE BUFFER sequence was aborted.
Bh	08h	02h	A3h	13, 12	D	**Aborted Command.** IPORT write parity error. Logical port write buffer CRC error.
Bh	08h	02h	A6h	13, 12	D	**Aborted Command.** IPORT read parity error. Logical port read buffer CRC error.
Bh	10h	00h	08h	12, 11	I,D	**Aborted Command.** Compression Integrity Check failed.
Bh	43h	00h	E0h	8, 9, 11, 12	B, D	**Aborted Command.** The command was aborted in the CDB phase (parity or other error), or a reconnect attempt failed after the allowed number of retries.
Bh	43h	00h	E1h	8, 9, 11, 12	B, D	**Aborted Command.** The command was aborted before the Data phase; received bad message. Bad Identify message.

Table A-3 REQUEST SENSE error data, sorted by Sense Key/ASC/ASCQ (continued)

SK	ASC	ASCQ	FSC	ERP	Cause	Explanation
Bh	43h	00h	E3h	8, 9, 11, 12	B, D	**Aborted Command.** The command was aborted in the Data phase. Received bad message out.
Bh	43h	00h	E4h	8, 9, 11, 12	B, D	**Aborted Command.** The command was aborted after the Data phase. Received bad message out.
Bh	43h	00h	E5h	8, 9, 11, 12	B, D	**Aborted Command.** The command was aborted after the Data phase. Other error.
Bh	47h	00h	E6h	8, 9, 11, 12	B, D	**Aborted Command.** The WRITE command was aborted because of a SCSI bus parity error.
Bh	48h	00h	E2h	8, 9, 11, 12	B, D	**Aborted Command.** The command was aborted in the Data phase because of an Initiator Detected Error message.
Dh	00h	02h	72h	11	A	**Blank Check.** The specified partition size is too big for tape.
Dh	00h	02h	AFh	6, 9, 11, 12	T, D	**Blank Check.** PEOT or PEOP encountered during a tape motion command.
Dh	00h	02h	B6h	6, 9, 12	T, D	**Blank Check.** EOT or PEOP encountered during a buffer flush.

[a] If the read-back-check criteria are not met for an LBOT or LBOP, filemark, setmark, or EOD block written to tape, the tape drive moves the tape backward and retries the operation the number of times specified by the Write Retry Count (byte 08 of the MODE SENSE data). If the read-back-check criteria are still not met, the tape drive returns Check Condition status and these FSCs apply.

[b] If the read-back-check criteria are not met for a data or short filemark block (that is, if the block is not perfect), the block is rewritten. If rewrite activity is excessive, the tape drive moves the tape backward, reads the tape to verify that blocks are written, then moves the tape backward again. It then performs a write splice operation and rewrites the blocks. If the rewrite threshold is exceeded for any block, the tape drive returns Check Condition status with the sense key set to 3h (Medium Error) and the FSC set to 9E. If the recovery splice operation cannot be completed, the FSC is 9Dh.

A.2 ERROR RECOVERY PROCEDURES

Table A-4 describes the error recovery procedures (ERPs) recommended for each Fault Symptom Code listed in Table A-1, Table A-2, and Table A-3.

Caution Some recovery procedures advise you to reset the tape drive. Before performing a reset, make sure there is no SCSI activity on the SCSI bus to which the drive is connected. Resetting a device on an active bus may disrupt communications.

Table A-4 *Recommended error recovery procedures*

ERP	Recommended error recovery procedure
1	Issue a REWIND command and retry the operation.
2	Issue a SPACE command to space backward over a block or a filemark.
3	Reissue the failed command or command sequence.
4	Correct the errors in the CDB bytes or parameter data.
5	Move the write protect switch on the data cartridge to write enable the tape.
6	Repeat the operation with a new data cartridge.
7	Insert a data cartridge into the tape drive.
8	Perform one of the following actions: ▪ Power the tape drive off and back on again. ▪ Send a SCSI bus reset ("hard" reset). ▪ Reset the tape drive by holding down the eject button for >10 seconds, and then releasing it.
9	Clean the tape drive and repeat the operation.
10	No action is necessary.
11	User should determine what recovery procedure to follow.
12	The tape drive requires maintenance.
13	**1.** Perform one of the following actions: ▪ Issue a REWIND, SPACE, LOAD/UNLOAD, or LOCATE command ▪ Press the eject button ▪ Power the tape drive off and back on again ▪ Send a SCSI bus reset ("hard" reset) **2.** Reissue the failed command or command sequence.
14	Repeat the operation with a different data cartridge; the tape drive cannot read the tape.
15	Reprogram the EEPROM.

Notes

B

UPGRADING THE MICROCODE

Exabyte periodically releases new levels of microcode for the tape drive. If you need to upgrade the M2 tape drive's microcode, contact Exabyte Technical Support (see "Contacting Exabyte" on page iii). A Technical Support Specialist can help determine what microcode version you need and what method of upgrading is best for your situation. You can obtain microcode updates from the Exabyte web site or from Exabyte Technical Support.

There are two methods for upgrading microcode:

- Using M2 Monitor for Windows
- Using a code load tape

Note: You can also use an application capable of issuing the WRITE BUFFER command to copy microcode from a microcode file on your computer to your tape drive across the SCSI bus. (See Chapter 26 for instructions.)

B.1 USING M2 MONITOR FOR WINDOWS

M2 Monitor is a PC-based tool for use with Windows 95, 98, 2000, or NT 4.0. You can use M2 Monitor to upgrade microcode over the SCSI bus or over the drive's Monitor (serial) port. In addition to upgrading the tape drive microcode, you can use M2 Monitor if you need to make copies or backups of existing FECODE or MODE SELECT options or to create your own microcode update tapes.

Note: The tabletop and Fibre Channel models of the tape drive do not have an external serial port. Contact Exabyte Technical Support for assistance.

The M2 Monitor program is included on the M2 CD or you can download it from the Exabyte web site (www.exabyte.com). Instructions for using the program are included on the CD and also in the downloadable executable file.

You can also order an M2 Monitor kit from Exabyte. The kit includes a custom serial cable that connects from the serial port on the back of the tape drive to a serial port on a PC.

B.2 USING A CODELOAD TAPE

When a new level of microcode is available, you can obtain the update files on 8mm tape from Exabyte Technical Support.

B.2.1 PERFORMING THE \MICROCODE UPDATE

The following instructions explain how to use the microcode codeload tape.

1. Make sure that a SCSI bus reset cannot occur during the microcode update process. To do this, make sure that there is no activity on the SCSI bus involving the host computer and any other devices on the bus.

Caution If a SCSI bus reset occurs during the microcode update process, the tape drive may not be operable. If this happens, use the M2 Monitor Software for Windows program to reload the microcode from the *.i file.

2. Apply power to the tape drive.
3. After the tape drive's power-on self-test completes (all three LEDs off), insert the microcode update tape. The tape drive automatically detects the presence of the update tape and upgrades the microcode. No operator intervention is needed. The update process takes two to three minutes. When the process is complete, the tape drive ejects the tape.

   Note: If possible, write the new microcode level on the tape drive's label.

4. Replace the tape drive's terminator if you removed it, and reconnect the tape drive to the SCSI bus if you disconnected it.

B.2.2 IF THE MICROCODE UPDATE FAILS

If the tape drive has not ejected the tape after several minutes, the microcode update has failed. Push the unload button to eject the tape and restore normal tape drive operation. Then, repeat the code update process. If it fails again, you can use M2 Monitor for Windows to load the code from diskettes over the tape drive's serial port.

! Important Make sure that you use the correct monitor software. The M2 Monitor Software for Windows program is designed specifically for use with the M2 tape drive.

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