EXABYTE®

Eliant™ 820 8mm Tape Drive

SCSI Reference

316869

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Revision History

Revision	Date	Description
000	April 1996	Preliminary release
001	August 1996	Beta release
002	January 1997	Initial release

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316869-002

Patents

TheExabyte® Eliant™820 8mm Tape Drive and related Exabyte products are covered by one or more of the following patents (other patents pending):

4,835,628	4,843,495	4,845,577	4,845,713	4,845,714
4,972,277	4,984,106	5,025,333	5,034,833	5,050,018
5,059,772	5,065,261	5,068,757	5,103,986	5,111,463
5,142,422	5,173,817	5,177,417	5,191,491	5,237,467
5,243,473	5,287,233	5,287,478	5,309,300	

Product Warranty Caution

The Exabyte® Eliant™820 8mm Tape Drive is warranted to be free from defects in materials, parts, and workmanship and will conform to the current product specification upon delivery. **For the specific details of your warranty, refer to your sales contract or contact the company from which the tape drive was purchased.**

The warranty for the tape drive shall not apply to failures caused by:

- Physical abuse or use not consistent with the operating instructions or product specification provided by Exabyte's personnel or agent for the applicable equipment.
- Use of any type of cleaning material other than an Exabyte 8mm Cleaning Cartridge (or an Exabyte-approved cleaning cartridge).
- Modifications by other than Exabyte's personnel or agent in any way other than those approved by Exabyte, provided the warranty shall not be voided by the repair or replacement of parts or the attachment of items in the manner described in maintenance or installation instructions provided by Exabyte.
- Repair by other than Exabyte's personnel or agent in a manner contrary to the maintenance instructions provided by Exabyte.
- Removal of the Exabyte serial number tag.
- Physical abuse due to improper packaging of returns.

CAUTION

Returning the tape drive in unauthorized packaging may damage the unit and void the warranty.

If you are returning the tape drive for repair, package it in its original packaging (or in replacement packaging obtained from your vendor).

If problems with the tape drive occur, contact your maintenance organization; do not void the product warranty by allowing untrained or unauthorized personnel to attempt repairs.

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About This Manual

This manual provides reference information for developing software to support applications for the Exabyte® Eliant™820 8mm Tape Drive. It also includes information about modifying an application that supports the Exabyte EXB-8205, EXB-8205XL, EXB-8505, EXB-8505XL, or EXB-8700 8mm tape drives to provide support for the Eliant 820.

Contents of This Manual

This manual contains the following information:

- **Chapter 1** describes the data formats supported by the Eliant 820 and the differences between the Eliant 820, EXB-8700, EXB-8700LT, EXB-8505, and EXB-8505XL.
- **Chapter 2** provides an overview of how the tape drive implements the Small Computer System Interface (SCSI).
- **Chapter 3** provides background information and instructions for implementing common tape drive operations in your application.
- **Chapters 4 through 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** describes the physical structure of data recorded on tape.
- **Appendix B** describes how the tape drive autosizes tapes and lists the track and physical block counts for the different sizes of data cartridges supported by the tape drive.
- **Appendix C** describes message processing and error handling.
- **Appendix D** 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. It also lists the Fault Symptom Codes that may be returned by the REQUEST SENSE command and recommends recovery procedures for each Fault Symptom Code.
- **Appendix E** provides instructions for using a microcode update tape to update the firmware in the tape drive.

Conventions Used in This Manual

This manual uses the following conventions to highlight important information in this manual:

Note: *Notes* provide hints or suggestions about the topic or procedure being discussed.

➤ **Important** Text under the heading “Important” provides information that will help you successfully complete a procedure or avoid additional steps in a procedure.

CAUTION

Boxed text under the heading “CAUTION” provides information you must know to avoid damaging the tape drive.

Related Publications

Eliant 820 8mm Tape Drive

- *Exabyte Eliant 820 8mm Tape Drive Installation and Operation*, 317209
- *Exabyte Eliant 820 8mm Tape Drive Product Specification*, 316593

Standards

- ANSI *Small Computer System Interface (SCSI)*, X3.131 – 1989
- ANSI *Small Computer System Interface-2 (SCSI-2)*, X3.131 – 1994
- ANSI/ISO/IEC 11319-1992 and ECMA-145, *Information Technology—8mm Wide Magnetic Tape Cartridge for Information Interchange*, July 1992
- ISO/IEC 12246 and ECMA-169, *Information Technology—8mm Wide Magnetic Tape Cartridge Dual Azimuth Format for Information Interchange, Helical Scan Recording*

1 Tape Drive Overview

This chapter is an overview of the Exabyte® Eliant™820 8mm Tape Drive and compares the Eliant 820 with other Exabyte half-high 8mm tape drives. It also provides guidelines for converting an existing driver for an EXB-8700, EXB-8205, EXB-8205XL, EXB-8505, or EXB-8505XL 8mm tape drive to support the Eliant 820.

1.1 Features and Performance

The Eliant 820 8mm Tape Drive is an enhanced 8mm digital helical-scan tape drive. It is similar in many ways to Exabyte's EXB-8505XL 8mm tape drive. It offers the same reliability and data capacity as the EXB-8505XL. However, the Eliant 820 records data to tape at 2.0 MB/second compressed—twice the speed of the EXB-8505XL.

The tape drive is available in either the industry-standard 5.25-inch half-high form factor (the internal tape drive) or in a self-contained enclosure (the tabletop tape drive). The internal tape drive can be easily integrated into many platforms. The tabletop model is a standalone, desktop storage solution with its own power supply, fan, and SCSI connectors.

Assuming an average compression ratio of 2:1, the tape drive can store approximately 14 gigabytes (GB) on a single EXATAPE™160m XL 8mm Data Cartridge. Featuring an integral Small Computer System Interface (SCSI) controller (single-ended or differential), the Eliant 820 is an ideal solution for archiving, data interchange, software distribution, imaging, data acquisition, and backup/restore applications.

Both the internal tape drive (shown in Figure 1-1) and tabletop tape drive (shown in Figure 1-2) include the following:

- Unload button, used to eject the data cartridge from the tape drive
- LEDs, used to indicate the operating status of the tape drive

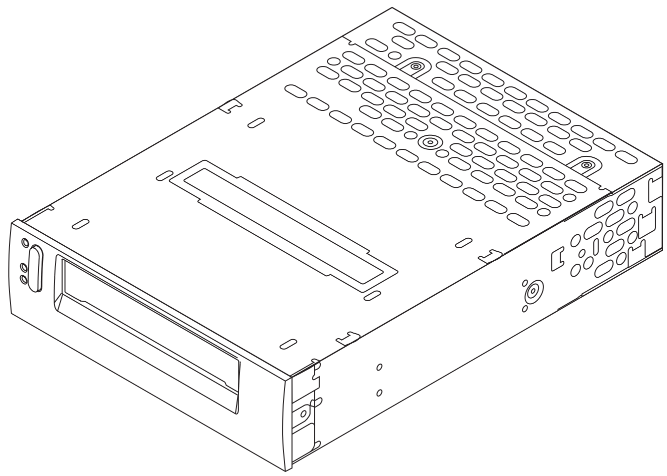


Figure 1-1 Internal Eliant 820 8mm Tape Drive

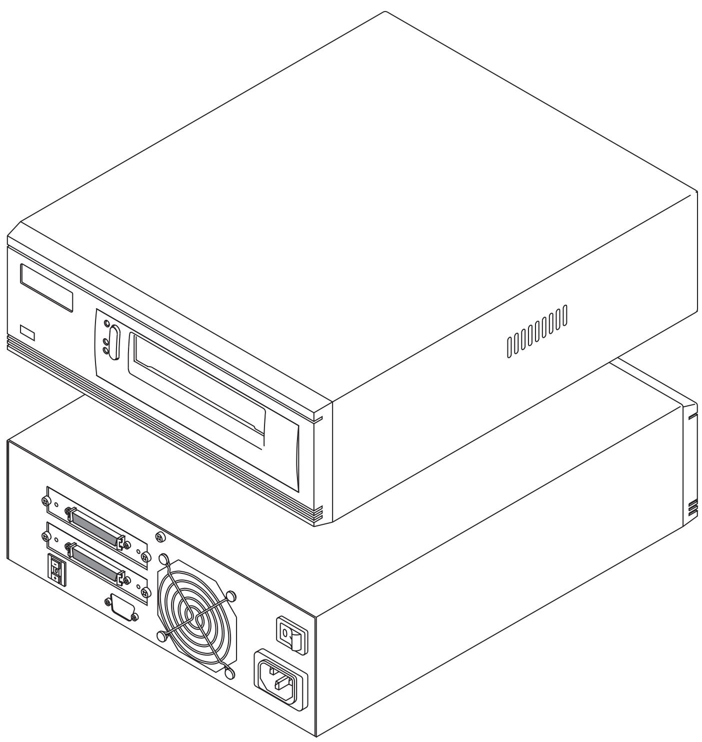


Figure 1-2 Tabletop Eliant 820 8mm Tape Drive

Table 1-1 compares the Eliant 820 to the EXB-8700 and the EXB-8505XL.

Note: Refer to the *Exabyte Eliant 820 Product Specification* for detailed information about the tape drive's features and performance.

Table 1-1 Comparison of tape drive features and performance

	Eliant 820	EXB-8700	EXB-8505XL
Form factor	5.25 inches (half-high)	Out of form (enclosure)	5.25 inches (half-high)
Synchronous data transfer	yes		
Time-to-clean LED	yes		
Data compression	yes		
Buffer size	1.0 MB		
Data transfer rate[a]	2.0 MB per second	1.0 MB per second	
Data formats supported	8500c, 8500, 8200[b]		8500c, 8500, 8200c, 8200
Forward search and rewind speed	30 MB per second (8500 format) 60 MB per second (8500c format) 5.3 MB per second (8200 format)	20 MB per second (8500 format) 40 MB per second (8500c format) 2.6 MB per second (8200 format)	37.5 MB per second (8500 format) 75 MB per second (8500c format) 2.5 MB per second (8200 format) 5.0 MB per second (8200c format)
Backward search speed	30 MB per second (8500 format) 60 MB per second (8500c format) 3.98 MB per second (8200 format)	20 MB per second (8500 format) 40 MB per second (8500c format) 1.95 MB per second (8200 format)	37.5 MB per second (8500 format) 75 MB per second (8500c format) 1.9 MB per second (8200 format) 3.75 MB per second (8200c format)
Tape tension release time	5 seconds after last tape motion command (if at LBOT) 15 seconds after last tape motion command (from anywhere but LBOT)	15 seconds after last tape motion command	5 seconds after last tape motion command (if at LBOT) 15 seconds after last tape motion command (from anywhere but LBOT)

Table 1-1 Comparison of tape drive features and performance *(continued)*

	Eliant 820	EXB-8700	EXB-8505XL
Drum motion suspension time	120 seconds after releasing tape tension if no tape motion command received		75 seconds after releasing tape tension if no tape motion command received
Typical time to resume tape motion	1.5 seconds (if tape tension released) 7 seconds (if drum motion suspended)		

[a] These figures represent the maximum sustained data transfer rate, assuming a 2:1 data compression ratio.

[b] The Eliant 820 and EXB-8700 can read but not write 8200 format.

1.2 Read/Write Compatibility

The Eliant 820 supports three data formats:

- 8500c
- 8500
- 8200 (read only)

8200 format The tape drive can read, but not write, 8200 format tapes. An 8200 format data cartridge must be write-protected before the tape drive will read it. When you insert a write-enabled 8200 format cartridge, the tape drive automatically ejects the cartridge and returns Check Condition status with a sense key of Medium Error (3h) and an FSC of 47h.

8200c format The tape drive cannot read or write 8200c format tapes. When you attempt to read an 8200c format tape, the tape drive returns Check Condition Status with a sense key of Medium Error (3h) and an FSC of 1Ch.

Table 1-2 shows the read and write compatibility of the four data formats with Exabyte half-high 8mm tape drives. Table 1-3 compares these data formats.

Table 1-2 Read and write compatibility of Exabyte half-high 8mm tape drives

A tape in this format...	Can be read and written by the...			
	Eliant 820	**EXB-8700**	**EXB-8205**[a]	**EXB-8505**[a]
8200	✔ (read only)	✔ (read only)	✔	✔
8200c	Not supported	Not supported	✔	✔
8500	✔	✔		✔
8500c	✔	✔		✔

[a] Includes the standard and eXtended-Length models of these tape drives.

Table 1-3 Data format features

	8200 format (read only)	**8500 format**	**8500c format**[a]
Maximum sustained data transfer rate	500 KB/sec	1 MB/sec	2.0 MB/sec
Maximum capacity on 112m tape	2.5 GB	5.0 GB	10 GB
Maximum capacity on 160m XL tape	3.5 GB	7.0 GB	14.0 GB
Track structure	Helical scan: One write head reads a single data track with a –10° azimuth.	Helical scan: Two write heads write two overlapping data tracks. Track 1 = + 20° azimuth. Track 2 = –10° azimuth.	
Supports partitions	no		yes
Supports setmarks	no		yes
Long filemarks	270 tracks (2,160 KB)	6 tracks (48 KB)	
Short filemarks	23 tracks (184 KB)	one 1-KB physical block	
Setmarks	no		yes – 6 tracks (48 KB)
EOD mark	no	yes – 602 tracks	
Search fields	no	yes	
Logical block packing	no	yes	

[a] Assumes an average 2:1 data compression ratio.

1.3 Controls and Indicators

Figure 1-3 shows the unload button and LEDs on the front panel of the Eliant 820.

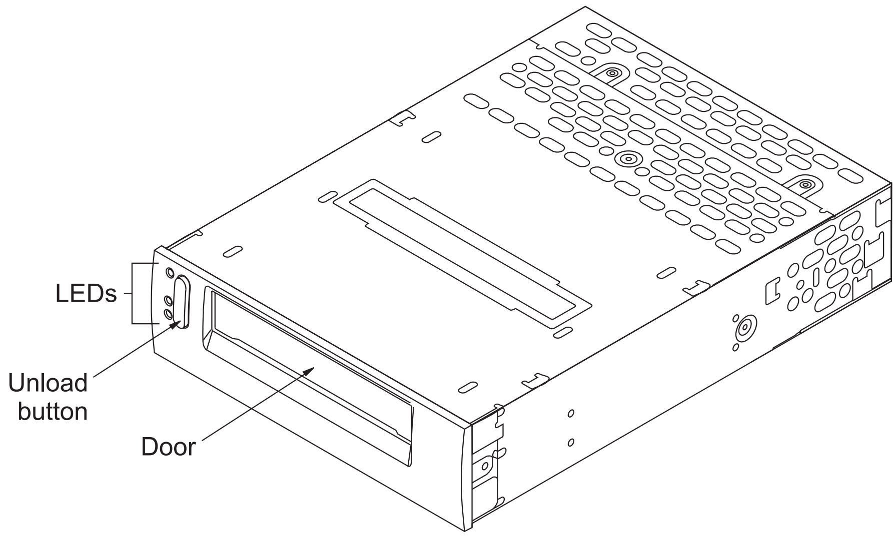


Figure 1-3 Front panel of the Eliant 820

Unload Button

The unload button is the only operator control on the tape drive. It is used to unload the tape from the tape drive. It can also be used to clear servo and other errors. If a hardware or servo error occurs, press the unload button to reset the tape drive. Then, if necessary, wait a few seconds and press the button again to eject the tape.

LEDs

As shown in Figure 1-3, the tape drive uses three light emitting diodes (LEDs) to indicate its various operating states. The LEDs indicate the following general conditions:

- **When the top (amber) LED is flashing**, the tape drive has an error or needs to be cleaned.
- **When the middle (green) LED is flashing**, SCSI bus activity is occurring.

- **When the bottom (green) LED is on**, a data cartridge is loaded in the tape drive. When this LED is flashing, tape motion is occurring. A fast flash indicates high-speed tape motion or that the tape drive needs cleaning.

Table 1-4 shows specific combinations of LEDs that may occur during operation.

Note: You may occasionally observe LED combinations and sequences not described in Table 1-4. These other combinations represent special or unusual conditions that are beyond the scope of this table. (For example, a fairly complex LED sequence occurs when you load new microcode from tape.)

Table 1-4 Tape drive states indicated by the LEDs

	POST	Failed POST	Ready no tape loaded	Ready tape loaded	Normal tape motion	High-speed tape motion	SCSI bus reset	Error	Time to clean	Cleaning tape loaded
Top LED (errors)	●	❊ fast	❍	❍	❍	❍	●	❊ slow	❊ fast	❍
Middle LED	●	❊ irreg	❊ irreg	❊ irreg	❊ irreg	❊ irreg	❊ irreg	n/a	n/a	❊ irreg
Bottom LED (motion)	●	❍	❍	●	❊ slow	❊ fast	●	❍	❊ fast	❊ slow

Key for Table 1-4

●	❍	❊	n/a
The LED is on.	The LED is off.	The LED is flashing: ❊ **slow** = 1 flash/second (0.94 Hz) ❊ **fast** = 4 flashes/second (3.76 Hz) ❊ **irregular** = Rate of flash varies with SCSI bus activity. If the tape drive is not connected to the bus the LED will be off.	Not applicable. Could be any state

1.4 Converting an Existing Half-High Driver

If you have been supporting any of the Exabyte half-high tape drives (for example, the EXB-8205, EXB-8505, or EXB-8700) and want to convert an existing driver to provide support for the Eliant 820, you need to consider the issues listed in Table 1-5.

Note: If you implemented support for custom EEPROM options in your half-high driver, contact your Exabyte account manager for assistance.

Table 1-5 Converting an existing half-high 8mm tape drive device driver to an Eliant 820 device driver

If you are converting from a driver that supports either the EXB-8205, EXB-8505, or EXB-8700...	Look here for more information...
Allow for longer forward and backward file-search times.	Table 1-1 and the *Exabyte Eliant 820 8mm Tape Drive Product Specification*
Check the product identification value returned by the Eliant 820 in the Inquiry data. The value returned is the same as for the EXB-8505.	Chapter 5 (INQUIRY)
Include support for 160m XL tape.[a]	Chapter 6 (LOAD/UNLOAD)
Be aware that the LOG SELECT command has been modified to support resetting the current cumulative values for the Data Compression page to 0. Threshold values for this page cannot be set using LOG SELECT.	Chapter 8 (LOG SELECT)
Be aware that the LOG SENSE command has been modified to support the Data Compression page and the Drive Usage Information page.	Chapter 9 (LOG SENSE)
Be aware that the Eliant 820's default write format is 8500c. Check for illegal density code values. The Eliant 820 will read, but not write, 8200 format tapes. It will not read or write 8200c format tapes.	Chapter 10 (MODE SELECT/ MODE SENSE)
Be aware that the SEND DIAGNOSTICS and RECEIVE DIAGNOSTIC RESULTS commands have been modified to return only a complete processor memory listing.	Chapters 16 and 21 (RECEIVE DIAGNOSTIC RESULTS and SEND DIAGNOSTIC)
Be aware that the WRITE BUFFER command has been modified to allow using this command to prepare microcode update tapes in addition to transferring new microcode to the tape drive over the SCSI bus.	Chapter 26 (WRITE BUFFER)

[a] Drivers for the EXB-8205XL, EXB-8505XL, and EXB-8700 should already include support for 160m XL tape.

2 SCSI Communication

This chapter provides an overview of how the Small Computer System Interface (SCSI) is implemented for the Eliant 820. It discusses the following topics:

- SCSI commands supported by the tape drive
- Required format of SCSI commands
- Command statuses supported by the tape drive
- SCSI bus messages supported by the tape drive

Note: The ANSI *Small Computer System Interface-2 (SCSI-2) Specification* provides detailed information about SCSI physical characteristics. As described in that specification, SCSI devices can be daisy-chained together using a common cable. Both ends of the cable must be terminated. All signals are common between all bus devices.

2.1 Overview of SCSI Communication

Table 2-1 shows the commands, status information, and messages supported by the tape drive during SCSI bus phases.

Table 2-1 Overview of SCSI communication

SCSI Bus Phase	Explanation	
Bus Free	BSY and SEL are false. The SCSI bus is idle and available for arbitration.	
Arbitration	BSY and SCSI ID assertion (highest ID wins).	
Selection	Winning ID asserts SEL. The initiator releases I/O and BSY. The tape drive sets BSY. The initiator releases SEL and asserts ATN.	
Message Out	The initiator sends the Identify message and indicates whether disconnects are permitted. Other messages supported during the Message Out phase, but in a different bus sequence include: Extended Message (Synchronous Data Transfer Request) Initiator Detected Error Abort Message Reject No Operation Message Parity Error Bus Device Reset	
Command	The tape drive switches to Command Phase. The Initiator sends the command CDB. Commands supported by the tape drive include: ERASE INQUIRY LOAD/UNLOAD LOCATE LOG SELECT LOG SENSE MODE SELECT MODE SENSE PREVENT/ALLOW MEDIUM REMOVAL READ READ BLOCK LIMITS READ BUFFER READ POSITION	 RECEIVE DIAGNOSTIC RESULTS RELEASE UNIT REQUEST SENSE RESERVE UNIT REWIND SEND DIAGNOSTIC SPACE TEST UNIT READY VERIFY WRITE WRITE BUFFER WRITE FILEMARKS
Data In/Out	The tape drive drives the bus to one of the Data phases and sends or receives data.	

Table 2-1 Overview of SCSI communication *(continued)*

SCSI Bus Phase	Explanation
Status	The tape drive returns one byte of status information, as follows: Good — Busy Check Condition — Reservation Conflict
Message In	The tape drive returns one byte of message information, as follows: Command Complete Other messages supported during the Message In phase, but in a different sequence of bus activity, include: Extended Message (Synchronous Data Transfer Request) Save Data Pointers Restore Pointers Disconnect Message Reject Identify

2.2 Supported SCSI Commands

The Eliant 820 supports the SCSI commands shown in Table 2-2.

Table 2-2 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 4
INQUIRY	12h	Provides the initiator with information about the tape drive's device parameters, including product and vendor identification.	Chapter 5
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 6
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 7

Table 2-2 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. The initiator can set threshold and cumulative values for the counters or reset the counters.	Chapter 8
LOG SENSE	4Dh	Returns the values of the counters managed by the LOG SELECT command. These values provide the initiator with statistical information about the read and write error recovery operations that the tape drive has performed.	Chapter 9
MODE SELECT	15h	Changes the tape drive's internal medium, logical unit, or device parameters to values specified by the initiator.	Chapter 10
MODE SENSE	1Ah	Provides the initiator with information about the tape drive's internal medium, logical unit, and device parameters.	
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	Copies the tape drive's microcode to the initiator. (This command is used in conjunction with the WRITE BUFFER command to copy one tape drive's microcode to another tape drive.)	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 or a complete processor memory listing to the initiator.	Chapter 16
RELEASE UNIT	17h	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

Table 2-2 Supported SCSI commands *(continued)*

Command	Operation code (hex)	What the tape drive does in response to this command	Described in
RESERVE UNIT	16h	Reserves the tape drive for exclusive use by the initiator that issued the command.	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
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 (8500c format only). For tapes written in all formats except 8200, the tape drive can also space to the end of data (EOD).	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. (This command is used in conjunction with the READ BUFFER command to copy one tape drive's microcode to another tape drive.) WRITE BUFFER can also be used to create a microcode update tape by transferring new microcode from the initiator into the tape drive's RAM buffer and then writing the code to tape. The microcode update tape can then be used to update the microcode for other Exabyte Eliant 820 tape drives.	Chapter 26
WRITE FILEMARKS	10h	Writes a specified type and number of filemarks or setmarks (8500c format only) to the tape.	Chapter 27

2.3 SCSI Command Format

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

The word *Reserved* or *RSVD* as used in field definitions for SCSI commands has one of the following meanings:

- Fields defined as reserved by the *ANSI Small Computer System Interface 2 (SCSI-2)* standard. These fields are checked for a value of 0. If zeros are not present, Check Condition status is returned with the sense key set to Illegal Request (5h).

- Exabyte undefined fields. These fields are reserved for future enhancements and are not currently checked for illegal values.

CDBs 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							

CDBs 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

2.4 Field Definitions for the Command Descriptor Block

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

Field Definitions for Six-Byte CDBs

The following are the definitions of the fields shown for the six-byte CDB.

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 Vendor Unique portion of the Control byte is defined for each specific command, if used. The tape drive does not support linked commands or recognize the Flag bit. The following are the field definitions for the Control byte:

Bits 7 and 6 – Vendor Unique Command unique.

Bits 5 through 2 – Reserved These bits are reserved.

Bit 1 – Flag Not used, must be 0.

Bit 0 – Link Not used, must be 0.

Field Definitions for Ten-Byte CDBs

The following are the definitions of the fields shown for the ten-byte CDB.

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 bytes are used as defined in the specific commands.

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 Vendor Unique portion of the Control byte is defined for each specific command, if used. The tape drive does not support linked commands or recognize the Flag bit. The following are the field definitions for the Control byte:

Bits 7 and 6 – Vendor Unique These bits are command unique.

Bit 1 – Flag This bit is not supported and must be 0.

Bit 0 – Link This bit is not supported and must be 0.

2.5 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 in the CDB is not 0.
- The bytes or bits in a Reserved field (as defined by the ANSI SCSI-2 standard) are not 0.
- The Link or Flag fields of the Control byte (bits 1 and 0) are not 0, or the Vendor Unique fields (bits 7 and 6) are not valid definitions for the specific command.

For all command format errors, the command is terminated and Check Condition status is returned 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.

2.6 Command Status

One status byte is sent from the tape drive to the initiator at the completion of a command. The format of the status byte is shown below.

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

The meaning of the Status Byte Code is shown in Table 2-3. Note that the value of bit 0 is always 0.

Table 2-3 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.

The following are definitions of the status bytes supported by the tape drive.

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.

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. 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 definitions that return Check Condition status, refer to the command descriptions in Chapters 4 through 27.

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

- When there is a bus parity error or format check error in a CDB.

- When 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).

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.

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.

2.7 Message System

The message system allows communication between the initiator and the tape drive for physical path management. Table 2-4 lists the messages supported by the tape drive. Refer to Appendix C for information about the specific actions the tape drive takes in response to messages from the initiator.

Table 2-4 Supported SCSI messages

Hex Value	Message	Direction	
		In (Tape drive to initiator)	Out (Initiator to tape drive)
00h	Command Complete	✔	
01h	Extended Message (Synchronous Data Transfer Request)	✔	✔
02h	Save Data Pointer	✔	
03h	Restore Pointers	✔	
04h	Disconnect	✔	
05h	Initiator Detected Error		✔
06h	Abort		✔
07h	Message Reject	✔	✔
08h	No Operation		✔
09h	Message Parity Error		✔
0Ch	Bus Device Reset		✔
80h or C0h	Identify	✔	✔

Command Complete (00h)

The tape drive sends the Command Complete message to the initiator to indicate that the execution of a command has terminated and that valid status has been sent to the initiator. After successfully sending this message, the tape drive goes to the Bus Free phase.

Extended Message (01h)

The tape drive supports only one Extended message, the Synchronous Data Transfer Request message.

Synchronous Data Transfer Request (01h)

The Synchronous Data Transfer Request message is used to negotiate synchronous data transfer agreements. If the initiator wants to transfer data synchronously, it must negotiate a synchronous data transfer agreement before transferring data.

Note: The tape drive will not originate a synchronous data transfer request. Instead, it sends a Synchronous Data Transfer Request message in response to the initiator's request.

A synchronous data transfer negotiation is accomplished as follows:

1. The initiator sends a Synchronous Data Transfer Request message to the tape drive. This message specifies a transfer period and a REQ / ACK offset.

2. The tape drive returns a Synchronous Data Transfer Request message. The transfer period returned by the tape drive will be equal to or greater than the initiator's value, and the REQ /ACK offset will be less than or equal to the initiator's value.

The agreement can be terminated immediately after the negotiation if the initiator asserts the Attention signal and then sends a Message Reject message.

Once negotiated, the synchronous transfer agreement stays in effect with the initiator until renegotiated or until a reset condition (SCSI bus reset, Bus Device Reset message, or power-on reset) occurs.

The format of the Synchronous Data Transfer Request message is as follows:

Byte \ Bit	7	6	5	4	3	2	1	0
00	0	0	0	0	0	0	0	1
01	Extended Message Length							
02	Extended Message Code							
03	Transfer Period							
04	REQ/ACK Offset							

Byte 00 – Extended Message The valid value for the Extended Message field is 01h, indicating that this is an extended message that contains multiple bytes.

Byte 01 – Extended Message Length The valid value for the Extended Message Length field is 03h, indicating that there are three additional message bytes to be transferred, not including this byte.

Byte 02 – Extended Message Code The Extended Message Code byte identifies the specific extended message being sent. The valid value for this byte is 01h, indicating that the Extended message is a Synchronous Data Transfer Request.

Byte 03 – Transfer Period This byte identifies the minimum time allowed between leading edges of successive REQ pulses and ACK pulses for successful reception of data. The value represents the number of 4-nanosecond increments allowed for the synchronous transfer period. The tape drive supports a minimum of 50 increments or 200 nanoseconds for the minimum synchronous transfer period.

Byte 04 – REQ/ ACK Offset This byte identifies the maximum number of REQ pulses that can be outstanding before the leading edge of the corresponding ACK is received by the tape drive. The tape drive allows up to 15 outstanding REQ pulses.

Save Data Pointer (02h)

The tape drive sends the Save Data Pointer message to direct the initiator to save a copy of its present active data pointer for the tape drive.

Restore Pointers (03h)

The tape drive sends the Restore Pointers message to direct the initiator to restore the most recently saved data pointers for the currently attached LUN to the active state. Pointers to the Command, Data, and Status locations for the LUN are restored to the active pointers. Command and Status pointers are restored at the beginning of the present command and status areas. The data pointer is restored to the value at the beginning of the data area or the most recent Save Data Pointer value.

Disconnect (04h)

The tape drive sends the Disconnect message to inform the initiator that the present physical path will be broken (the tape drive will disconnect by releasing the BSY signal) and that a later reconnect is required to complete the current operation. If the disconnect privilege has been granted by the initiator, the tape drive can send this message at any time after receiving the CDB (except as restricted by the ND bit of the MODE SELECT command).

If the tape drive does not send either the Disconnect message or the Command Complete message before going to the Bus Free phase (other than as a result of the reset condition), one of the following situations has occurred:

- A catastrophic error condition has occurred for the current command.
- The initiator aborted the command.

Note: The Disconnect message should not cause the initiator to save the data pointer.

Initiator Detected Error (05h)

The initiator sends the Initiator Detected Error message to inform the tape drive that an error has occurred that does not preclude the tape drive from retrying the operation. Generally, the initiator sends this message when it has detected a parity error in a non-message phase, such as Status In or Data In. The present pointer integrity is not ensured.

Abort (06h)

The initiator sends the Abort message to the tape drive to clear the present operation. All pending data and status for the issuing initiator is cleared and the tape drive goes to the Bus Free phase. No status or ending message is sent for the operation.

If a process is aborted, the tape drive generates sense data that indicates how the process terminated (either aborted or an error condition).

Message Reject (07h)

Either the tape drive or the initiator can send the Message Reject message to indicate that the last message received was inappropriate or has not been implemented.

Note: If the initiator sends a Message Reject message after a non-message phase, the tape drive treats this as an error by the initiator and aborts any processes owned by the initiator.

To indicate its intention of sending this message, the initiator must assert the Attention signal before releasing ACK for the REQ /ACK handshake of the message that will be rejected. When the tape drive sends this message, it changes to the Message In phase and sends this message before requesting additional message bytes from the initiator. This provides an interlock so that the initiator can determine which message is rejected.

No Operation (08h)

The initiator sends the No Operation message in response to the tape drive's request for a message when the initiator does not currently have any other valid message to send.

Message Parity Error (09h)

The initiator sends the Message Parity Error message to the tape drive to indicate that the last message it received had a parity error. The tape drive responds by re-sending the previous message.

Note: If the tape drive receives a Message Parity Error message when the last phase was not Message In, it sends a Message Reject message to the initiator.

To indicate its intention of sending this message, the initiator must assert the Attention signal before releasing ACK for the REQ/ACK handshake of the message that has the parity error. This provides an interlock so that the tape drive can determine which message has the parity error.

Bus Device Reset (0Ch)

The initiator sends the Bus Device Reset message to direct the tape drive to reset all current I/O operations. This message forces the tape drive to an initial state with no operations pending for any initiator. Upon recognizing this message, the tape drive goes to the Bus Free phase.

Note: Refer to Section 3.9 for more information about the effect of the Bus Device Reset message.

Identify (80h or C0h)

Either the initiator or the tape drive can send the Identify message. The message is used to establish the physical path connection between an initiator and the tape drive.

When the tape drive sends the Identify message to the initiator during reconnection, an implied Restore Pointers message must be implemented by the initiator before completion of this message.

Identify Message

Bit / Byte	7	6	5	4	3	2	1	0
00	Identify	DiscPriv	LUNTAR	Reserved		LUNTRN		

Bit 7 – Identify The Identify bit is set to 1 to distinguish the Identify message from all other messages.

Bit 6 – DiscPriv The initiator sets the DiscPriv (disconnect privilege) bit to grant the tape drive disconnect privileges.

0–Disconnect is not allowed
1–Disconnect is allowed

Bit 5 – LUNTAR The tape drive does not support this field; the only valid value for this field is 0.

Bits 2 through 0 – LUNTRN The tape drive is a single device target and does not support multiple devices; therefore, the LUN must be 0.

Message Sequence

When the tape drive connects to the SCSI bus, the following sequence of events occurs:

1. The initiator indicates its ability to accommodate more than the Command Complete message by asserting the Attention signal in the Selection phase before the Select signal is driven true and the Busy signal is driven false.

2. To indicate its ability to accommodate more than the Command Complete message, the tape drive responds to the Attention signal by transitioning to the Message Out phase immediately after completing the Selection phase.

3. If the initiator supports messages other than Command Complete, the first message sent by the initiator after the Selection phase is the Identify message. This allows the physical path to be established for the LUN specified by the initiator. The tape drive supports an LUN of 0 only.

4. If the DiscPriv bit (bit 6) in the Identify message is set, the tape drive may send the Disconnect message to the initiator to indicate that the physical path will be broken temporarily.

   or

   If the DiscPriv bit is not set, the tape drive will not send the Disconnect message and will not temporarily suspend the physical path.

5. If the physical path has been broken temporarily, the tape drive will re-establish the communication path with the initiator by entering the Reselection phase. After completing the reselection, the tape drive will send an Identify message to the initiator to re-establish the physical path.

3 Implementing Tape Drive Operations

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

- Using data cartridges
- Controlling the format of data on the tape
- Using data compression
- Setting the size of data blocks
- Using filemarks and setmarks
- Using streaming and start/stop modes
- Formatting and using partitioned tapes
- Handling Unit Attention conditions
- Resetting the tape drive

3.1 Using Data Cartridges

To ensure optimum data reliability and minimize wear on the tape drive's recording heads, Exabyte strongly recommends the use of EXATAPE™8mm Data Cartridges in all Exabyte 8mm tape drives. Metal particle EXATAPE 8mm Data Cartridges are available in the following lengths: 15m, 54m, 112m, 160m XL. The Eliant 820 supports all four sizes of EXATAPE. The Eliant 820 does not support any data cartridge using advanced metal evaporated (AME) tape.

➤ **Important** The EXATAPE™160m XL tape includes a Recognition System (RS) stripe on the tape leader to enable the tape drive to recognize the tape as data-quality metal-particle media. An RS logo appears on the tape and its packaging. When you purchase 160m tapes, make sure they have this logo.

If you load a 160m tape that does not have the Recognition System stripe, the tape drive treats it as a 112m tape. This will result in a lower-than expected tape capacity.

Recognition System

CAUTION

Do not attempt to use the 160m XL data cartridge in the following Exabyte tape drives: EXB-8200, EXB-8200SX, EXB-8500, and EXB-8500c. Although these tape drives will accept the 160m XL cartridge, these cartridges are not supported by these drives and should not be used.

Table 3-1 summarizes the compatibility of EXATAPE 8mm Data Cartridges and Exabyte 8mm tape drives.

Table 3-1 Compatibility of EXATAPE 8mm Data Cartridges and Exabyte 8mm tape drives

<table>
<tr><th rowspan="2">Tape Drive</th><th colspan="3">EXATAPE 8mm Data Cartridge</th></tr>
<tr><th>15m, 54m, and 112m</th><th>160m XL</th><th>22m and 170m AME</th></tr>
<tr><td>EXB-8700</td><td>✔</td><td>✔</td><td rowspan="7">Not supported (automatically ejected)</td></tr>
<tr><td>EXB-8700LT</td><td>✔</td><td>✔</td></tr>
<tr><td>EXB-8205 and EXB-8505</td><td>✔</td><td>Not supported (automatically ejected)</td></tr>
<tr><td>EXB-8205XL and EXB-8505XL</td><td>✔</td><td>✔</td></tr>
<tr><td>EXB-8200 and EXB-8200SX</td><td>✔</td><td>Not supported</td></tr>
<tr><td>EXB-8500 and EXB-8500c</td><td>✔</td><td>Not supported</td></tr>
<tr><td>Eliant 820</td><td>✔</td><td>✔</td></tr>
<tr><td>Exabyte Mammoth</td><td>✔
(read only)</td><td>✔
(read only)</td><td>✔</td></tr>
</table>

Loading Data Cartridges

When you insert a data cartridge into the tape drive, the tape is automatically loaded into the tape path and positioned at the logical beginning of tape (LBOT). During the load operation, the tape drive determines the tape format and the length (see Appendix B for an explanation of the autosizing process). The tape drive goes to the ready state (bottom LED on solid) after it has finished loading the tape.

If you want to prevent automatic loading, you can disable it using the MODE SELECT command (see the NAL bit on page 10-48). If you have prevented autoloading, you must issue a LOAD (1Bh) command to load the tape.

Unloading Data Cartridges

When you press the unload button on the tape drive, the following steps occur (assuming that a data cartridge is loaded and that the tape drive is ready).

Note: If you have prevented media removal with a PREVENT/ ALLOW MEDIUM REMOVAL command, the tape drive performs no action when you press the unload button.

1. Any command or operation currently in progress is completed.
2. Any buffered information is written to tape, and an EOD mark is written to indicate the end of data.
3. The tape is rewound to the physical beginning of tape (PBOT).
4. The tape is unloaded from the tape path.
5. The tape is ejected.

Status Reported for Unload Procedure

If a command is issued to the tape drive during the unload procedure, the tape drive returns Check Condition status with the sense key set to Unit Attention (6h). Once the Unit Attention condition is reported, all subsequent commands (except INQUIRY and REQUEST SENSE) receive Check Condition with the sense key set to Not Ready (2h). (For information about clearing a Unit Attention condition, see Section 3.8.)

Error During Unload Procedure

If an error exists before or during the unload procedure, the unload sequence will be suspended and the top (amber) LED will flash. If the unload button is pressed again, the unload sequence will be reattempted; however, unwritten data in the buffer will not be written to tape. The buffer and errors will be cleared.

3.2 Controlling the Format of Data on the Tape

As described in Chapter 1, the Eliant 820 writes tapes in two formats: 8500c and 8500. You control the format of the tape by issuing a MODE SELECT (15h) command when the tape is positioned at the logical beginning of tape (LBOT). Keep the following three rules in mind whenever you write, append to, or read a tape. These rules are described in more detail in the examples in Section 10.18.

Note: The tape drive can read tapes written in three formats: 8500c, 8500, and 8200. The tape drive cannot read or write 8200c formatted tapes. If you are reading a previously written tape, the tape drive automatically determines the tape's format.

Rule 1: The tape drive allows only one format on any one tape. To write compressed data, you must write the tape entirely in 8500c format.

> **Note:** If you are writing in 8500c format, you can turn data compression on and off at any point on the tape using the MODE SELECT command.

Rule 2: When writing to a new tape, you must use the MODE SELECT command to specify the tape's format at the logical beginning of tape (LBOT). This is because the LBOT blocks define the format for the tape. If you do not specify a format, the tape drive writes in its power-on default format (8500c format).

> **Note:** To rewrite a tape in a different format, you must overwrite the previously written LBOT pattern by issuing a WRITE (0Ah) or WRITE FILEMARKS (10h) command at LBOT.

Rule 3: If you are appending to a previously written tape at a location other than LBOT, the tape drive automatically writes in the format of the data already on the tape. Refer to Table 25-1 on page 25-3 for the valid locations for appending data in the two data formats.

3.3 Using Data Compression

When writing in 8500c format, the tape drive uses the Improved Data Recording Capability (IDRC) compression algorithm licensed from IBM. During compression, the tape drive uses the Exabyte Compression Integrity Check feature to ensure that data is accurately compressed and decompressed into the original form sent by the initiator.

When the tape drive writes data to tape in compressed format, it compresses the data at an average ratio of 2:1. However, the actual compression ratio may be higher or lower depending on the type of data.

Logical Block CRC

To ensure that user data is compressed and decompressed accurately, the tape drive adds two bytes of cyclic redundancy check (CRC) data to every logical block written in compressed format.

Note: These *logical block CRC* bytes are in addition to the two bytes of *physical block CRC* data that the tape drive adds to every physical block on tape.

Adding CRC bytes to each logical block reduces the data capacity of the tape by two bytes for every logical block. For example, if you are writing 1,024-byte logical blocks, the data capacity of the tape will be reduced by 0.2% (that is, $2 \div 1{,}024 \times 100\%$).

Writing Compressed Data

In addition to the rules described on page 3-5, keep the following rules in mind when writing compressed data.:

- You can use the MODE SELECT command to specify data compression parameters. The parameters that you can specify depend on whether your SCSI driver uses non-page format or page format for the MODE SELECT command. If your SCSI driver does not support MODE SELECT pages, the only compression-related information you can specify is the Density Code, which is located in the Block Descriptor (see Section 10.6). If your SCSI driver supports MODE SELECT pages, you can specify compression-related information with both the Density Code and the Data Compression Page (Page Code= 0Fh).

- If you are writing in 8500c format and your SCSI driver supports MODE SELECT pages, you can turn data compression on and off at any point on the tape using the DCE (Data Compression Enable) bit of the Data Compression Page. If your SCSI driver does not support MODE SELECT pages, you cannot turn data compression on and off.

3.4 Setting the Size of Data Blocks

You may want to adjust the block size of the data being transferred from the host to the tape drive to use the maximum capacity of the data cartridge. In general, you can improve tape drive performance by using logical block sizes of 16 KB or larger. (See page A-6 for a description of physical and logical blocks.)

Logical Block Packing

The maximum amount of data that can be placed in a physical block to be written to tape in all data formats is 1,024 bytes. A physical block of data can contain one or more logical blocks of data from the host. For example, if a logical block from the host is 512 bytes, the tape drive places two of the 512-byte blocks in the physical block it writes to tape.

A logical block can start in one physical block and end in another physical block. For example, if a logical block from the host is 3,000 bytes, the tape drive places 1,024 bytes in the first physical block, 1,024 bytes in the second physical block, and 952 bytes in the third physical block. The next 3,000-byte logical block from the host starts immediately following the 952 bytes in the third physical block. Because no *gap bytes* (undefined data values used to fill otherwise incomplete physical blocks) are added during a write operation, tape capacity is not significantly affected by the size of data block sent by the host.

Although logical block packing prevents the loss of significant tape capacity, slight capacity may be lost when small block sizes are used. When packing more than two logical blocks in a single physical block, the tape drive adds a two-byte header to each logical block after the second block.

Example

In an extreme case, suppose that the host is sending a series of one-byte logical blocks to the tape drive. Tape capacity is used as follows:

1. The tape drive places the first two one-byte data blocks in the physical block. If the data is compressed, it appends two bytes of logical-block-CRC to each data block. This uses six bytes of the total 1,024 bytes available in the physical block. No header information is added to the first two blocks.

2. The tape drive then places the next 203 one-byte logical blocks into the physical block, adding two bytes of header information and two bytes of CRC to each of the logical blocks. Therefore, these 203 one-byte data blocks consume 1,015 bytes of space in the physical block.

3. The tape drive places the next one-byte block and two bytes of header into the last three bytes of the physical block. The two bytes of CRC for this logical block go into the next physical block.

Because of the extremely small logical block size, tape capacity is reduced by approximately four-fifths (206 bytes of user data stored in each physical block out of 1,024 bytes available).

3.5 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 (8500c format only) 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 30 times the normal tape speed. Setmarks (8500c format only) provide an additional way to indicate data boundaries on the tape; in a sense, they can be thought of as a “hierarchically superior” filemark.

Filemarks

The tape drive supports both short and long filemarks. The size of the filemarks depends on the format of the tape and on the setting of the Short bit in the WRITE FILEMARKS (10h) command (see Chapter 27).

Long Filemarks

The long filemark in 8500c and 8500 formats is 48 KB long and consists of six tracks of information:

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

Note: A *gap block* is a complete block (1,024 bytes) of undefined data used to fill out an otherwise incomplete track during a write operation. Gap blocks are ignored during read operations.

Short Filemarks

The short filemark in 8500 and 8500c formats consists of a single 1-KB physical block.

Setmarks (8500c Format Only)

When you write in 8500c format, you can issue a WRITE FILEMARKS command to write one or more setmarks to tape.

Setmarks function similarly to the long filemark in 8500c format. 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. Like the 8500c long filemark, each setmark occupies six tracks of information:

- Two tracks of gap blocks at the beginning
- Two tracks of setmark physical blocks
- Two tracks of gap blocks at the end

For additional information about using setmarks, refer to Chapter 27.

3.6 Using Streaming and Start/Stop Modes

The tape drive includes a 1-MB data buffer that enables it to operate as either a *streaming* tape device or as a *start/stop* tape device, depending on the rate of data transfer to and from the host system. 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.

Streaming Mode

When the tape drive is operating in streaming mode, it transfers data continuously between the buffer and tape without stopping tape motion. 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 to tape until the buffer has emptied to a certain level (the *reconnect threshold*). Then the tape drive reconnects to the SCSI bus to accept more data.

Similarly, 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 the buffer is refilled to the reconnect threshold while continuing to read data into the buffer. Then the tape drive reconnects to the SCSI bus to transfer more data.

Start/Stop Mode

When the tape drive is operating in start/stop mode, it must stop and restart tape motion during read and write operations to accommodate the slower data transfer rate of the host.

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.

Start/stop activity increases the amount of wear on the tape and the tape drive's recording heads. It also decreases the amount of data that can be stored on the tape because gap blocks and gap tracks are written to the tape whenever tape motion has to be stopped.

Note: A *gap track* is an entire physical track (eight physical blocks) of gap blocks written when completing a write operation. At the end of a write operation, before tape motion stops, the tape drive adds gap blocks to complete the last track and then writes at least one gap track after the last track containing user data blocks. This ending gap track ensures reliable write splicing during a subsequent write operation. Gap tracks are ignored during read operations.

Matching Host and Tape Drive Data Transfer Rates

Table 3-2 shows the data transfer rates that must be achieved to enable the tape drive to operate in streaming mode. If the host is capable, try to match or slightly exceed these data transfer rates.

Table 3-2 Host data transfer rates required for streaming data

Using this data format	Streaming data transfers are possible if the host can maintain or exceed this data transfer rate
8500c	2 MB per second (assuming a 2:1 compression ratio)
8500	1 MB per second
8200[a]	500 KB per second

[a] Read only.

As described in the following section, the motion threshold can be used to fine-tune the starting and stopping of tape motion in start/stop mode. The reconnect threshold can be used to fine-tune disconnects and reconnects between the tape drive and the initiator in streaming mode.

Using the Motion and Reconnect Thresholds

This section explains how to increase the efficiency of data transfers to and from the tape drive's buffer by adjusting the *motion threshold* and *reconnect threshold*. Although start/stop operations are not as efficient as streaming operations, you can maximize start/stop performance by adjusting the motion threshold. You can maximize streaming performance by adjusting the reconnect threshold.

Table 3-3 indicates where you can set the motion and reconnect thresholds using the MODE SELECT command. 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 3-3 Where to set the motion threshold and reconnect threshold

To set this threshold...	Use any of these fields in the MODE SELECT command...	
	Page	Field
Motion threshold	(Non-page format)	Motion Threshold—Byte 02 of the vendor-unique parameters
	Device Configuration Page (Page Code = 10h)	Write Buffer Full Ratio—Byte 04 and Read Buffer Empty Ratio—Byte 05 (these values must be equal)
	Vendor Unique Parameters Page 1 (Page Code = 20h)	Motion Threshold—Byte 04
Reconnect threshold	(Non-page format)	Reconnect Threshold—Byte 03 of the vendor-unique parameters
	Disconnect-Reconnect Page (Page Code = 02h)	Buffer Full Ratio—Byte 02 and Buffer Empty Ratio—Byte 03 (these values must be equal)

Motion Threshold

The motion threshold is used in start/stop mode to control data transfers between the buffer and the tape. The motion threshold is measured in 4-KB increments. The default is 80h (512 KB). This value represents half the capacity of the tape drive's buffer. You can change the motion threshold value with a MODE SELECT (15h) command.

Write Operations During a start/stop write operation, the motion threshold represents the minimum amount of data that must be in the tape drive's 1-MB buffer before tape motion will start and data will be written to tape. Note that if you are using 8500c format, this data will be compressed. Assuming an average compression ratio of 2:1, the motion threshold can actually represent twice that amount of user data.

When the motion threshold is exceeded, tape motion starts. The write-to-tape operation continues until the buffer is empty and the tape motion stops. Tape motion does not restart until the amount of data in the buffer once again exceeds the motion threshold or until the buffer is flushed for some other reason (such as a reverse tape motion command).

Read Operations During a start/stop read operation, the motion threshold represents the minimum amount of free space that must be in the tape drive's 1-MB buffer before tape motion will start and data will be read from the tape to the buffer. Note that if you are using 8500c format, the data being read from the tape is compressed. Assuming an average compression ratio of 2:1, the motion threshold can actually represent twice that amount of user data.

When the motion threshold is exceeded, tape motion starts. The read-from-tape operation continues until the buffer is full and the tape motion stops. Tape motion does not restart until the amount of free space in the buffer once again exceeds the motion threshold.

Reconnect Threshold

The reconnect threshold is used in streaming mode to control data transfers between the buffer and the initiator. To optimize tape drive performance, the reconnect threshold is measured differently for read and write operations.

The reconnect threshold is measured in 3-KB increments for a read operation and 4-KB increments for a write operation. The default value is 80h (384 KB for a read operation and 512KB for a write operation). You can change this value with a MODE SELECT (15h) command.

Write Operations During a streaming write operation, the tape drive disconnects from the initiator when the buffer becomes full but continues to write data to tape. The reconnect threshold represents the minimum amount of free space that must be in the tape drive's 1-MB buffer before the tape drive will reconnect to the initiator to accept additional data. When the reconnect threshold is exceeded, the tape drive reconnects to the initiator and data transfer continues again until the buffer is full.

Read Operations During a streaming read operation, the tape drive disconnects from the initiator when the buffer becomes empty but continues to read data from the tape. The reconnect threshold represents the minimum amount of data that must be in the tape drive's 1-MB buffer before the tape drive will reconnect to the initiator to transfer data from the buffer. When the reconnect threshold is exceeded, the tape drive reconnects to the initiator and data transfer resumes again until the buffer is empty.

Summary of Motion and Reconnect Thresholds

Table 3-4 provides summary information about the motion and reconnect thresholds.

Table 3-4 Motion threshold and reconnect threshold summary

Threshold	Default value	What it controls...	What it represents during a write operation...	What it represents during a read operation...
Motion Threshold	80h in 4-KB increments (512 KB)	During start/stop operations, the starting and stopping of tape motion (buffer/tape transfers)	Minimum amount of data that must be in the buffer before tape motion starts and data is written to the tape	Minimum amount of space that must be available in the buffer before tape motion starts and data is read from the tape
Reconnect Threshold	80h in 3-KB increments for read operations (384 KB) 80h in 4-KB increments for write operations (512 KB)	During streaming operations, the disconnects and reconnects between the tape drive and the initiator (initiator/buffer transfers)	Minimum amount of space that must be available in the buffer before the tape drive reconnects to the initiator and accepts more data	Minimum amount of data that must be in the buffer before the tape drive reconnects to the initiator and transfers more data

If you feel that data transfers between a particular host and tape drive need to be fine-tuned, use the following rule-of-thumb to adjust the motion or reconnect threshold:

- If the data transfer rate is fast, raise the reconnect threshold.
- If the data transfer rate is slow, raise the motion threshold.

3.7 Formatting and Using Partitions

In 8500c format, the tape drive can write and read tapes containing either one or two partitions. Partitioned tapes provide a highly efficient way to maintain a directory at the beginning of a tape. This directory can indicate where various data sets are located on the tape and can include the following types of information:

- **The names of the data sets on the tape.** You can use this information to determine quickly what data is on the tape. For example, if you want to know which of several tapes contain a particular data set, you can simply read the directory in the partition at the beginning of each tape.

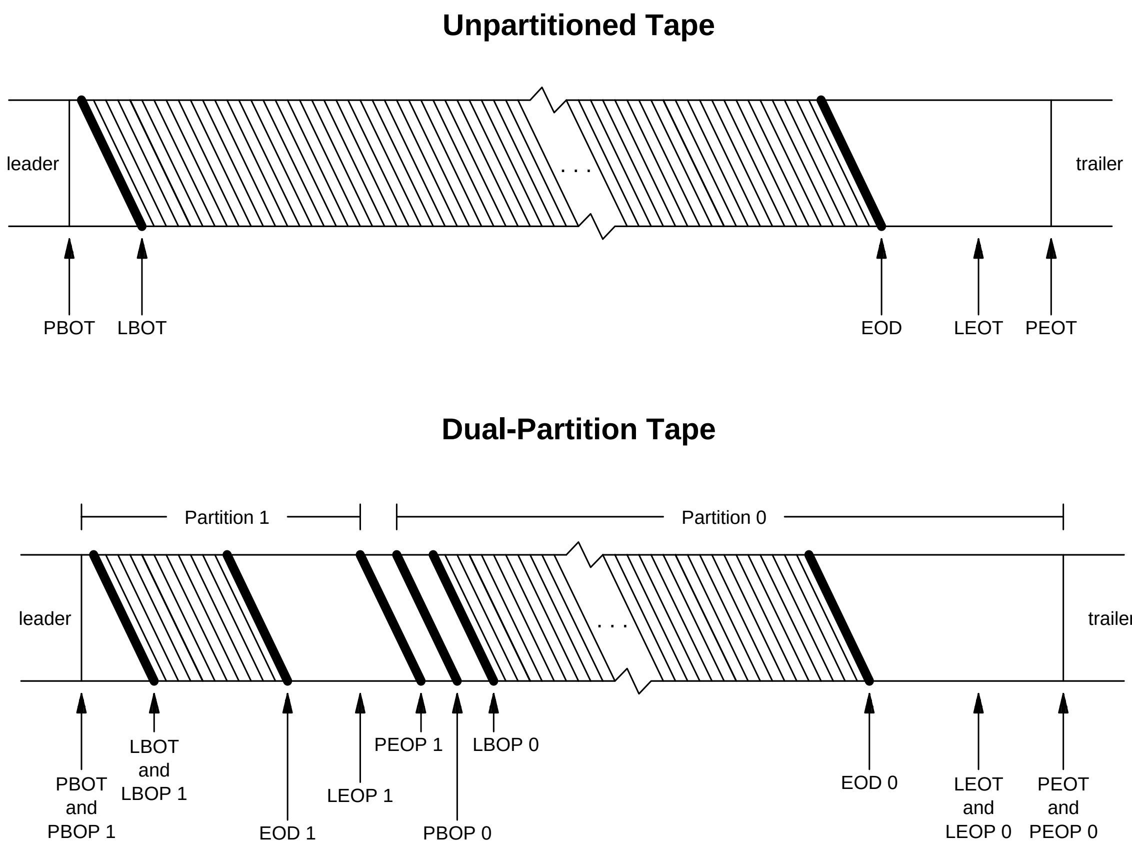
- **The locations of the data sets on the tape.** You can use this information to take advantage of the tape drive's high-speed search capability. Once you have determined a data set's location by reading the directory information in the first partition, you can issue a LOCATE (2Bh) command to move to the second partition and locate that data set at 30 times the normal tape speed.

➤ **Important** The tape drive supports partitions on tapes written in 8500c format only. Partitions are not supported for tapes written in 8500 format.

What Are Partitions?

The term *partition* refers to a self-contained writable and readable area on a tape. The tape drive supports either one or two partitions on a tape. A standard tape is considered a *single-partition* tape. That is, there are no divisions on the tape, and you can write to and read the entire tape as normal. A *dual-partition* tape is a tape that has been divided into two separate writable and readable areas (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 to be a completely self-contained recording area independent of the other partition 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. Figure 3-1 shows the correspondence between the various areas on an unpartitioned tape and on a tape with two partitions.



PBOT = Physical beginning of tape
LBOT = Logical beginning of tape
LEOT = Logical end of tape
PEOT = Physical end of tape
EOD = End of data

PBOP = Physical beginning of partition
LBOP = Logical beginning of partition
LEOP = Logical end of partition
PEOP = Physical end of partition

Figure 3-1 Corresponding areas on an unpartitioned tape and a dual-partition tape

As shown in Figure 3-1, the first partition on a dual-partition tape is Partition 1, and the second partition is Partition 0. For a dual-partition tape, the following areas correspond:

- The physical beginning of the tape (PBOT) is equivalent to the physical beginning of the first partition (PBOP 1).
- The logical beginning of the tape (LBOT) is equivalent to the logical beginning of the first partition (LBOP 1).
- The logical end of the second partition (LEOP 0) is equivalent to the logical end of the tape (LEOT).
- The physical end of the second partition (PEOP 0) is equivalent to the physical end of the tape (PEOT).

Because they are treated as separate entities by the tape drive, partitions provide a safe, effective way to maintain a directory on a tape. Typically, the first partition on the tape is used as the directory, and the second partition (the remainder of the tape) is used for the data. Because the partitions are independent of each other, there is never any risk of overwriting data in the second partition when you update the directory in the first partition.

How Do You Create Partitions?

To create a partitioned tape, you *format* the tape using the MODE SELECT (15h) command. The MODE SELECT command lets you specify how many partitions will be on the tape (one or two) and what size the first partition will be (the size of the second partition is always the remainder of the tape).

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 dual-partition tape back to a single-partition tape.

To create and use partitions, the tape drive must be set to read and write in 8500c format. You cannot write data in different formats in two separate partitions.

A summary of the steps you take to create a dual-partition tape from an unformatted (or single-partition) tape follows. (Refer to Chapter 10 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. Make sure that the tape drive is set to write in 8500c format. If necessary, issue a MODE SELECT command with the **Density Code** in the Block Descriptor set to 8Ch.

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

- For **Additional Partitions Defined**, specify 01h to indicate that you want one partition in addition to the original partition.

- 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 first partition on the tape to be determined. (Note that you can set only one of these fields.)

  If FDP= 1, the first partition will encompass the entire tape, resulting in a single-partition tape. If SDP= 1, the first partition will be a size that is predefined by the tape drive. If IDP= 1, the first partition will be a size you specify.

- If you have chosen to define the first partition's size yourself (you set IDP to 1), use **PSUM** (Partition Size Unit of Measure) to specify the units of measure you will use to specify the size (bytes, KB, or MB). Use **Partition Size** to specify the partition's size.

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

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

How Do You Use a Dual-Partition Tape?

The easiest way to understand how to use a dual-partition tape is to think of it as two separate tapes. Just as you would have to physically change tapes to access data on a second tape, you have to specifically request that the tape be moved to the other partition before you can perform actions in that partition. The following are descriptions of how to perform several typical actions on a dual-partition tape.

Loading a Partitioned Tape

You load a dual-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.

The partition that the tape drive positions to by default is the second partition on the tape. The second partition is typically used as the data area, while the first partition is used as the directory for the tape. Because the tape drive positions the tape to the second partition, you can easily append data in the data area, then move back to the first partition to update the directory.

If you want to override the default partition for the next tape load, you can use the MODE SELECT command as follows:

1. Before loading the tape, issue a MODE SELECT command and specify page format (PF= 1). (You can do this while the previous tape is loaded.) With the MODE SELECT command, send Vendor Unique Parameters Page 2 (Page Code= 21h).

   For **LPART** (Load Partition), indicate which partition you want the tape to be positioned to. Specify 1 for the first partition, 0 for the second.

2. Load the tape. The tape drive positions the tape to the beginning of either the first or second partition, depending on the setting of LPART.

   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 the other partition (LBOP), use the LOCATE command with the following parameters:

- Set **CP** (Change Partitions) to 1 to indicate you want to change partitions.
- For **Block Address**, specify the block you want the tape to be located to.
- Set **Partition** to 0 if you want the tape located in the second partition or 1 if you want the tape located in the first partition.

Another Way to Change Partitions An optional method for moving from one partition to the logical beginning of the other partition is to 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 the other partition.
- Set **Active Partition** to 1 if you want to move to the first partition, or 0 if you want to move to the second partition.

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 command to indicate that you want to change partitions. 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 the first 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 in the first partition while writing data, 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.

Data Format Restriction Although partitions are treated as separate entities by the tape drive, you cannot use different data formats in the two partitions. If you attempt to change data formats between partitions, you will destroy the partition information. You must create the partitions in 8500c format, and you cannot use the Density Code field in the MODE SELECT command to change formats anywhere on the tape. However, you can turn compression on and off in either partition.

Locating Data Blocks in Partitions

Use the READ POSITION (34h) command to identify the position of a specific data block on a dual-partition 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 dual-partition 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 the 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 the tape is positioned in the second partition, the tape drive rewinds the tape to the logical beginning of the second partition (LBOP).

If you want to rewind to LBOT and the tape is positioned in the second partition, 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 upon 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 both partitions 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 the other partition is erased.

Erasing the Entire Tape If you want to erase the entire tape, first erase one partition, use the MODE SELECT command to change to the other partition, then erase that partition. This preserves the partition information. Or, you can reformat the tape as a single-partition tape, then erase the entire tape.

➤ **Important** When you reformat a dual-partition tape to create a single-partition tape, all of the information defining the original two partitions is erased. However, the data on the tape is not erased. 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 an erase operation to erase the data.

Unloading a Partitioned Tape

The UNLOAD command works exactly as it would for a single-partition tape. You can issue the UNLOAD command from either the first or the second 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.

3.8 Handling Unit Attention Conditions

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

- The tape drive is reset (whether by a Bus Device Reset message, a SCSI bus reset, or a power-on reset).
- The MODE SELECT parameters are changed by an initiator other than the one attempting to communicate with the tape drive.
- The unload button is pressed and the data cartridge is ejected.
- A data cartridge is inserted and automatically loaded.
- A 8200 format data cartridge is inserted and ejected because it is not write-protected.
- The internal microcode (firmware) is changed.
- 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.

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) 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 will unload the tape. It then returns Check Condition status with the sense key set to Unit Attention (6h) to the first command it receives during the unload procedure. Finally, 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).

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 Occurs

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 received after a Unit Attention condition occurs 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 Reported

If the next command after the Unit Attention condition has been reported with Check Condition status is a REQUEST SENSE or an INQUIRY command, the tape drive executes the command and preserves the Unit Attention sense data. If, however, the next command after the Unit Attention condition has been reported with Check Condition status is any other command, then 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.

3.9 Resetting the Tape Drive

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

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

- Power the tape drive off and back on again (*power-on reset*).
- If a servo or hardware error has occurred, press the unload button to clear the error and reset the tape drive (*unload button reset*). If necessary, wait a few seconds and press the button again to eject the tape.
- 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.

Effect of Power-on Reset

Performing a power-on reset causes the tape drive to complete its power-on self-test as indicated by the LEDs (both on). In addition, a power-on reset 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.

Effect of SCSI Bus and Device Resets

SCSI bus and device resets have the following effects:

- If the tape drive is connected to the SCSI bus, the SCSI bus goes to the Bus Free phase.
- 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.

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.

Reset Processing

This section specifies how the tape drive processes power-on resets, SCSI bus resets, and device resets. 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, the tape is rewound, unloaded, and reloaded. When the reset is complete, the tape is positioned at LBOT and 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.

When the tape drive receives tape motion commands during a reset or load operation, it returns Check Condition status with the sense key set to Not Ready.

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.

4 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

4.1 About This Command

The ERASE command causes the tape drive to erase all tape from the current valid tape position to the physical end of tape (PEOT). If the tape is partitioned, the ERASE command causes the tape drive to erase all tape from the current valid tape position to the physical end of the current partition (PEOP).

When the erase operation is successfully completed, the tape is automatically rewound to the logical beginning of tape (LBOT). If the tape is partitioned, the tape is automatically rewound to the logical beginning of the current partition (LBOP).

The ERASE command performs the erase operation at the same speed as the READ and WRITE commands are performed; for example, starting at LBOT, a 112m EXATAPE data cartridge will take approximately one and a half hours to erase.

Notes:

- If the disconnect option is enabled, the tape drive disconnects from the initiator while executing the ERASE command. It does not reconnect until the ERASE command has completed.

- If the ERASE command is received after a WRITE (0Ah) or WRITE FILEMARKS (10h) command, buffered data, filemarks, and setmarks (8500c format only) are written to tape before the erase operation is performed.

  If an error occurs during the writing of the data in the buffer to the tape, the tape drive returns Check Condition status. The erase operation is not performed. The initiator should issue a REQUEST SENSE (03h) command to determine the cause of the error.

- To erase all of the data from a partitioned tape without eliminating the partitions, you must erase each partition separately.

- The erase operation cannot be interrupted once it has started.

4.2 Field Definitions

Byte 01, Bit 1 – Immed

The Immed bit is used to determine when command status is returned to the initiator, as follows:

0 – Status is reported to the initiator when the ERASE command is completed.

1 – Status is reported to the initiator when the ERASE 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 by the Identify message) 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.

  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 erase and rewind operations are complete.

Byte 01, Bit 0 – Long

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

0 – No data is erased. An end of data (EOD) mark is written at the current tape position, as long as that position is legal for writing data (see Table 4-1).

1 – All tape will be erased from the current position to PEOT or to PEOP for a partitioned tape.

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for this command.

4.3 Tape Positioning

Table 4-1 shows the legal tape positions for an erase operation in the data formats supported by the tape drive.

Note: If an EOD mark is not already present, one will be written before the erase operation is performed.

Table 4-1 Legal locations for performing an erase operation

When erasing a tape in this format...	You can erase from the following locations...				
	LBOT	LBOP	EOD mark	BOT or EOT side of long filemark	BOT or EOT side of setmark
8500c	✔	✔	✔	✔	✔
8500	✔		✔	✔	

4.4 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the ERASE command.

Write-Protected Data Cartridge

If you attempt to erase a data cartridge that is write-protected, the tape drive returns Check Condition status with the sense key set to Data Protect (7h).

Illegal Request

If the ERASE command is issued from an illegal position, the tape drive returns Check Condition status with the sense key set to Illegal Request (5h).

5 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

5.1 About This Command

The INQUIRY command requests that information about the tape drive's parameters be sent to the initiator. The tape drive executes the INQUIRY command whether a tape is loaded and whether it has been reserved by another initiator.

The tape drive will return inquiry data within 3 seconds of a power cycle or when a Unit Attention condition exists. Issuing an INQUIRY command does not clear a pending Unit Attention for the initiator.

5.2 Field Definitions

Byte 01, Bit 0 – EVPD

The Enable Vital Product Data bit indicates the type of inquiry data being requested by the initiator, as follows:

0 – Return the standard Inquiry Data Table

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

Byte 02 – Page Code

The Page Code field contains the page number of the Vital Product Data page to be returned to the initiator for this INQUIRY command. The tape drive supports the following values for the Page Code:

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

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

Byte 04 – Allocation Length

The Allocation Length specifies the number of bytes that the initiator has allocated for the return of inquiry data. A value of 0 indicates that no inquiry data is to be transferred 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 inquiry data has been transferred, whichever is less.

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for this command. Table 5-1 summarizes the values you should specify to return the different types of inquiry data.

Table 5-1 Values to specify for the return of 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 Table	0	00h	any value (from 0 to FFh)	0 to 106 bytes (0h to 6Ah)
Supported Vital Product Data Page	1	00h	06h	6 bytes (06h)
Unit Serial Number Page	1	80h	0Eh	14 bytes (0Eh)

5.3 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>AENC</td><td>TrmIOP</td><td colspan="2">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>WBus32</td><td>WBus16</td><td>Sync</td><td>Linked</td><td>RSVD</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
⋮
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, Bits 7 through 5 – Peripheral Qualifier

This field, in combination with the Peripheral Device Type field (byte 00, bits 4 through 0), identifies the device currently connected to the logical unit. The value returned for this field is 0, which indicates that the specified device is currently connected to the selected logical unit. If the LUN in the CDB or in the Identify message is not 0, the value returned for these fields is 7Fh, which indicates that the LUN is invalid.

Byte 00, Bits 4 through 0 – Peripheral Device Type

This field, in combination with the Peripheral Qualifier field (byte 00, bits 7 through 5), identifies the device currently connected to the logical unit. The value returned for this field is 01h, which identifies the tape drive as a sequential access device. If the LUN in the CDB or in the Identify message is not 0, the value returned for these fields is 7Fh, which indicates that the LUN is invalid.

Byte 01, Bit 7 – RMB

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 value returned for this field is 00h, which indicates that there are no vendor-specific qualification codes.

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 – AENC

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

Byte 03, Bit 6 – TrmIOP

The value returned for this field is 0, which indicates that the tape drive does not support the Terminate I/O Process message.

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 65h (101) additional bytes of inquiry data available to be returned to the initiator.

Byte 07, Bit 7 – RelAdr

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

Byte 07, Bit 6 – WBus32

The value returned for this field is 0, which indicates that the tape drive does not support 32-bit-wide bus transfers.

Byte 07, Bit 5 – WBus16

The value returned for this field is 0, which indicates that the tape drive does not support 16-bit-wide bus transfers.

Byte 07, Bit 4 – Sync

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

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

The value returned for this field 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

The value contained in these bytes are the ASCII representation of “EXABYTE”, followed by a single space.

Bytes 16 through 31 – Product Identification

The values contained in these bytes are the ASCII representation of EXB-8505, followed by the eight-character default configuration identifier (for example “EXB-85058HE-0000”). Using EXB-8505 as the product identifier provides compatibility with existing drivers for the Exabyte EXB-8505 8mm tape drives.

Bytes 32 through 35 – Product Revision Level

The values contained in these bytes are the ASCII representation of the revision level (for example, “1000” or other Exabyte revision levels).

Bytes 36 through 55 – Vendor Specific

The values contained in these bytes are the ASCII representation of blanks.

Bytes 96 through 105 – Unit Serial Number

The value contained in these bytes is the hexadecimal representation of the actual serial number of the tape drive, as listed on the serial number label. The MSB is contained in byte 96. Serial numbers of less than 10 characters contain trailing blanks (20h).

5.4 Supported Vital Product Data Page

The tape drive returns the Supported Vital Product Data page when the EVPD bit in the CDB is 1 and the Page Code is 0.

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							

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 02h, which indicates the number of additional bytes available to be transferred, excluding this byte.

Byte 04 – First Page Code Supported

The value returned 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.

5.5 Unit Serial Number Page

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 is the number of additional bytes available to be transferred, excluding this byte.

Bytes 04 through 13 – Unit Serial Number

The value returned for this field is the hexadecimal representation of the serial number of the tape drive, as listed on the serial number label. The MSB is contained in byte 04. Serial numbers of less than 10 characters contain trailing blanks (20h).

Notes

6 LOAD/UNLOAD (1Bh)

Bit Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	1	0	1	1
01	Logical Unit Number			Reserved				Immed
02	Reserved							
03								
04	Reserved					EOT	Re-Ten	Load
05	Vendor Unique		Reserved				0	0

6.1 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 data cartridge must be fully inserted into the tape drive when you issue the LOAD command. The LOAD command does not pull the cartridge into the tape drive.

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 6-3).

Notes:

- If you attempt to load a 8200 format tape that is not write-protected, the tape drive immediately ejects the data cartridge and returns Check Condition status with the sense key set to Medium Error (3h) and an FSC of 47h.

- If you load a 160m tape that does not have a Recognition System stripe, the tape drive treats it as a 112m tape. This will result in a lower-than-expected tape capacity (see page 3-2).

Unloading a Data Cartridge

When unloading a data cartridge, the tape drive does the following:

1. If necessary, writes any information in the buffer to tape and writes the EOD mark. (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 LOAD/UNLOAD command is executed.)

2. Rewinds the tape to the physical beginning of tape (PBOT).

3. Unloads the tape from the tape path.

4. Ejects the data cartridge (unless ejection has been prevented by a PREVENT MEDIUM REMOVAL command as described in Chapter 11).

Note: Slightly different actions may occur when you use the unload button instead of the UNLOAD command. Refer to page 3-4 for a description of these actions.

Using the LOAD/UNLOAD Command on a Partitioned Tape

When the tape you are using is formatted with two partitions (see Section 3.7), the LOAD/UNLOAD command performs as follows.

Loading a Partitioned Tape

The LOAD command positions the tape to the beginning of the second partition by default, unless before loading the tape, you set the LPART (Load Partition) bit in the MODE SELECT command to 1, indicating that the tape drive is to position the tape to the beginning of the first partition.

Unloading a Partitioned Tape

The UNLOAD command unloads a dual-partition tape just as it would a single-partition tape. You can issue the UNLOAD command from either partition. The tape drive rewinds the tape to PBOT, unloads the tape from the tape path, and ejects the cartridge (unless ejection has been prevented by a PREVENT MEDIUM REMOVAL command as described in Chapter 11).

Tape Motion Command Received during a Load Operation

When the tape drive receives tape motion commands during a load operation, it returns Check Condition status with the sense key set to Not Ready and does not queue commands.

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

6.2 Field Definitions

Byte 01, Bit 1 – Immed

The Immed bit is used to determine when command status is returned to the initiator, as follows:

0 – Status is reported to the initiator when the load/unload operation is complete.

1 – Status is reported to the initiator 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 by the Identify message) 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. The initiator should issue a REQUEST SENSE (03h) command to determine the cause of the error.

Byte 04, Bit 2 – EOT

This bit is ignored by the tape drive.

Byte 04, Bit 1 – Re-Ten

This bit is ignored by the tape drive.

Byte 04, Bit 0 – Load

The Load bit indicates which operation, load or unload, is to be performed as follows:

0 – Perform an unload operation.
1 – Perform a load operation.

Table 6-1 indicates what action occurs based on the setting of the Load bit and the status of the data cartridge:

Table 6-1 Action occurring based on 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.
1	In	The data cartridge is loaded and positioned at LBOT if the tape is not partitioned. If the tape is partitioned, it is positioned to the default partition (partition 0) or to the partition specified by the MODE SELECT command, as explained on page 6-3. If the data cartridge is already loaded and there is data in the buffer, the data 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.

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for this command.

Notes

7 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	ADE	VU	Reserved				0	0

7.1 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.

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).

Using the LOCATE Command on Partitioned Tapes If the tape is formatted with two partitions, you can use the LOCATE command to position the tape to a location within either partition. If necessary, the LOCATE command causes the tape drive to move from the current partition to the other partition and then to find the requested block in the new partition. If an error occurs during this process, the tape is returned to the previous location in the original partition. (See Section 3.7 starting on page 3-15 for information about creating and using partitioned tapes.)

Notes:

- The LOCATE command is not supported for tapes written in 8200 format and will result in Check Condition status. The sense key will be set to Illegal Request (5h).

- If the disconnect option is enabled, the tape drive can disconnect from the initiator while the LOCATE command is executing.

- If a LOCATE command in the reverse direction is received after a WRITE (0Ah) or WRITE FILEMARKS (10h) command, any buffered data, filemarks, or setmarks are written to the tape before the locate operation is performed.

  If an error occurs when the data in the buffer is being written, the tape drive returns Check Condition status and the locate operation is not performed. The initiator should issue a REQUEST SENSE (03h) command to determine the cause of the error.

7.2 Field Definitions

Byte 01, Bit 2 – BT (Block Type)

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

0 – The SCSI logical block number is returned, numbered sequentially from the beginning of the tape or the beginning of each partition if the tape is formatted with two partitions.

1 – Logical block number is returned, not including setmarks or filemarks.

Byte 01, Bit 1 – CP (Change Partitions)

For a dual-partition tape, the CP bit causes the tape drive to move to the partition specified by the Partition field (byte 08) before positioning to the requested block, as follows:

0 – Ignore the Partition field. That is, do not move the tape from the current partition.

1 – Move to the partition specified in the Partition field.

Note: If the tape contains just one partition, the CP bit must be 0.

Byte 01, Bit 0 – Immed

The Immed bit is used to determine when command status is returned to the initiator.

0 – Status is reported to the initiator when the LOCATE command is completed.

1 – Status is reported to the initiator when the LOCATE command is initiated by the tape drive.

If the tape drive buffer contains data from a previous WRITE command and the LOCATE command is in the reverse direction, the tape drive disconnects from the initiator (if disconnect was enabled by the Identify message) 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 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

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

Byte 08 – Partition

If the CP field (byte 01, bit 1) is set to 1 (change partitions), this field indicates which partition you want to move the tape to, as follows:

0 – Move to the second partition on the tape.
1 – Move to the first 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.

Note: If the tape does not contain two partitions, the Partition byte must be 0.

Byte 09, Bit 7 – ADE (Always Detect EOD)

The tape drive ignores this bit.

Byte 09, Bit 6 – Vendor Unique

There is no vendor unique definition for this bit. The bit is ignored.

7.3 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the LOCATE command.

EOD Detected

If the tape drive detects the end-of-data (EOD) mark during the locate operation, it 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 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.

PEOT or PEOP Encountered

During a locate operation, if the tape drive encounters the physical end of tape (PEOT) or the physical end of partition, 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, 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.

Locating Past the Last Data, Filemark or Setmark

If you attempt to locate past the last data, filemark, or setmark (8500c format only) on the tape (or in the partition on a dual-partition tape), the tape drive returns Check Condition status. The sense key is set to Blank Check (8h) with ASC= 00h, ASCQ= 05h, and FSC= 33h.

Unrecoverable Error

If an unrecoverable media or hardware error occurs during the locate operation, the tape drive terminates the LOCATE 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 logical position and the actual logical position. Note that, depending on the direction of the locate operation, the Information bytes may be positive or negative (2s complement notation).
Other bits and bytes	Depend on the error condition

When the LOCATE command is terminated, the position of the tape drive depends on whether the locate operation was in the forward or reverse direction, as follows:

- If the error occurred during a locate operation in the forward direction, the tape drive is positioned after the unrecovered block.
- If the error occurred during a locate operation in the reverse direction, the tape drive is positioned before or after the unrecovered block.

Illegal Requests

The tape drive will return Check Condition status with the sense key set to Illegal Request (5h) if you attempt the following locate operations:

- A locate operation in the forward direction immediately after the tape drive has executed a WRITE or WRITE FILEMARKS command.
- A locate operation on a tape written in 8200 format.

8 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

8.1 About This Command

The LOG SELECT command allows you to manage the tape drive's parameter values for write and read error recovery operations. 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 9 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 (15h) command and send the Control Mode page (Page Code= 0Ah) with the Report Log Exception Condition (RLEC) bit set to 1. Refer to Chapter 10 for more information.

Figure 8-1 shows the general structure of the LOG SELECT command. With each LOG SELECT CDB, you send a parameter list for each page on which you are changing values. Each parameter list has a Parameter List Header that indicates the number of bytes that follow the header as log parameters. You specify a log parameter for each value on the page that you want to change.

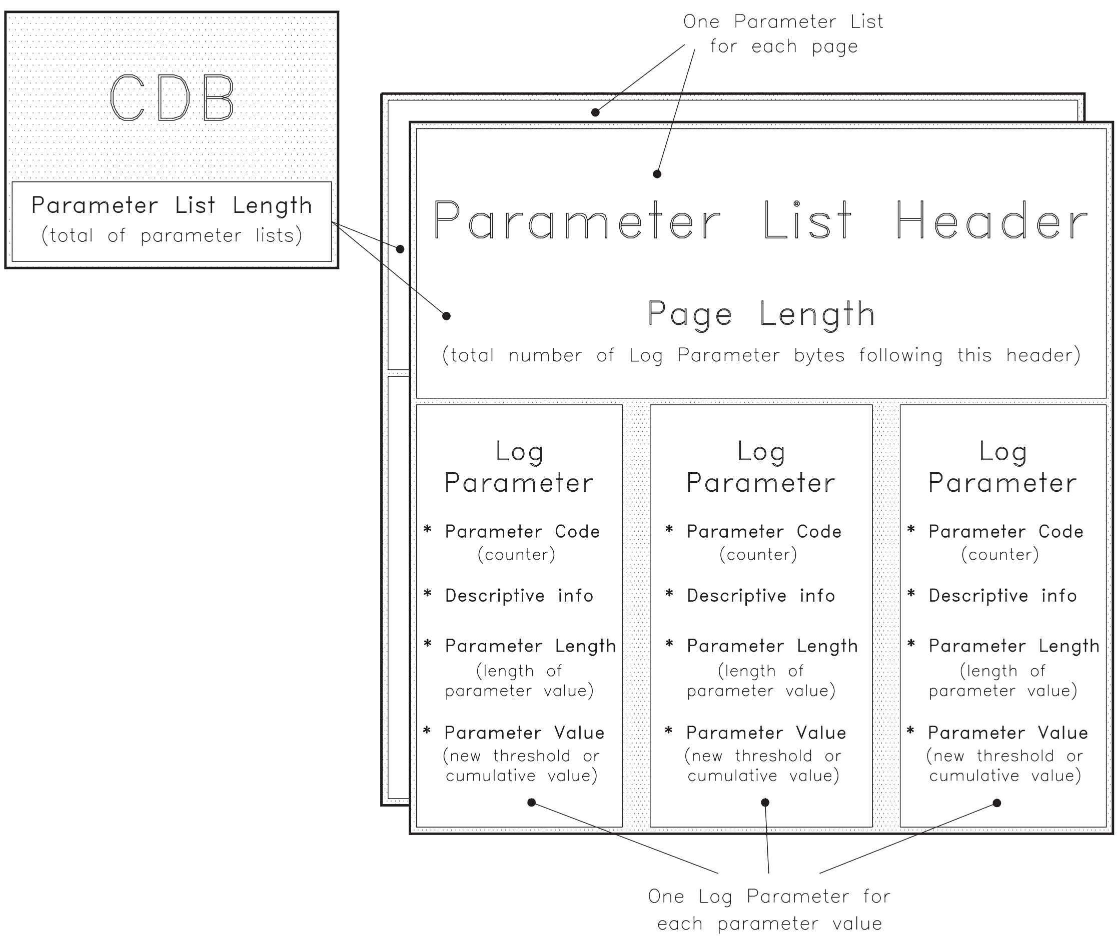


Figure 8-1 Relationship of log parameters and parameter lists to the LOG SELECT CDB

8.2 Field Definitions

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

The PCR bit indicates whether you want to reset some or all of the parameters:

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

1 – Reset all of the parameters on the Write Error Counter, Read Error Counter, and Data Compression pages (Page Codes 02h, 03h, and 39h, respectively). Current cumulative values will be reset to 0, the Enable Threshold Comparison (ETC) bit will be reset to 0 (see page 8-8), and threshold values will be reset to all FFs. (For example, the threshold value for a three-byte counter will be reset to FFFFFFh.)

Notes:

- 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.

- You cannot set threshold values for the Data Compression page (Page Code= 39h).

Byte 01, Bit 0 – SP (Save Parameters)

This bit must be 0 (not supported).

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

If the PCR bit is 0, the PC field specifies what kind of values the tape drive should use to set the counters. If the PCR bit is 1, this bit is ignored. Valid values for the PC field are as follows:

00b – Set threshold values for the counters listed in the parameter list.

01b – Set current cumulative values for the counters 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 8-8).

11b – Set all current cumulative values on the Write Error Counter, Read Error Counter, and Data Compression pages (Page Codes 02h, 03h, and 39h, respectively) to 0.

Notes:

- If you set the PC field to 10b or 11b, 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.

- You cannot set threshold values for the Data Compression page (Page Code= 39h).

Bytes 07 and 08 – Parameter List Length

The Parameter List Length field indicates the number of bytes in the parameter lists that the initiator will send during the Data Out phase. The Parameter List Length must equal the sum of the lengths for each log parameter plus four bytes for each Parameter List Header. If a parameter list is transferred, it must be transferred in its entirety.

Valid values for this field are 0 to FFh (0 to 255). If the Parameter List Length is 0, no data is 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.

Byte 09, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for these bits. Table 8-1 summarizes the valid settings for the PCR, PC, and Parameter List Length fields in the LOG SELECT CDB.

Table 8-1 Valid combinations of values for the fields in the LOG SELECT CDB

<table>
<tr><th>To set...</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 counters to new threshold values</td><td>0</td><td>00b</td><td rowspan="2">The number of bytes in the parameter lists (from 0 to 255)</td></tr>
<tr><td>Specified counters to new cumulative values</td><td>0</td><td>01b</td></tr>
<tr><td>All counters 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 counters to default cumulative values (do not reset threshold values)</td><td>0</td><td>11b</td></tr>
<tr><td>All cumulative counters to 0, all thresholds to FFs, and ETC to 0</td><td>1</td><td>ignored</td></tr>
</table>

8.3 Parameter List Header

The Parameter List Header is sent during the Data Out phase before the log parameters. More than one Parameter List Header can be sent with each LOG SELECT command.

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

The Page Code field indicates the code of the log parameter page you want to modify. Only one page can be modified for each Parameter List Header. Valid page codes are the following:

02h – Write Error Counter page
03h – Read Error Counter page

Note: Do not specify Page Code 39h (Data Compression page) or 3Ch (Drive Usage Information) in the LOG SELECT command. You cannot change the parameters on these pages. You can reset the current cumulative values for the Data Compression page to 0.

Bytes 02 and 03 – Page Length

The Page Length field indicates the number of bytes that follow as log parameters.

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

8.4 Log Parameters

Zero or more log parameters follow the Parameter List Header. 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

The Parameter Code 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 parameter for the supported pages:

- Table 8-2 lists the parameters for the Write Error Counter page.
- Table 8-3 lists the parameters for the Read Error Counter page.

Table 8-2 Parameter Code values for the Write Error Counter page

Parameter Code	Parameter Name	Description	Length (bytes)
0002h	Total Rewrites	Indicates the number of physical blocks the tape drive rewrote to the tape because of errors detected during read-after-write operations. Only user data blocks and short filemark blocks are ever rewritten. **Note:** 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 only a read function (write errors are rewritten). The default value is 0 and will never change.	3
0005h	Total Bytes Processed	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
0006h	Total Unrecoverable Errors	Contains the number of times the tape drive could not write a block to the tape.	2

Table 8-3 Parameter Code values for the Read Error Counter 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	Indicates the number of blocks the tape drive recovered by using the ECC algorithm.	3
0005h	Total Bytes Processed	Indicates the number of user data bytes transferred to the initiator. 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

Byte 02, Bit 7 – Disable Update (DU)

The DU 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 counter.

➤ **Important** If you want the tape drive to compare the current cumulative value to the threshold value for the counter and to return Unit Attention when the threshold criteria are met, first issue a MODE SELECT (15h) 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 – Disable Save (DS)

This field is ignored by the tape drive.

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

This field is ignored by the tape drive.

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

The ETC field indicates whether threshold comparisons for the counter are enabled or disabled, as follows:

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

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) field (byte 02, bits 3 and 2) 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, Bits 3 and 2 – Threshold Met Criteria (TMC)

The TMC field specifies the conditions under which the tape drive will generate 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. Valid values for this field are as follows:

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.

Byte 02, Bit 0 – List Parameter (LP)

List parameters are not supported by the tape drive, so this bit must be 0.

Byte 03 – Parameter Length

The Parameter Length field indicates the length of the threshold or cumulative value in bytes. For example, if the value requires two bytes, you would specify 02h for this field. See Tables 8-2 and 8-3 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

The Parameter Value field indicates either a new threshold value or a new current cumulative value for the counter, depending on the value you specified for PC in the CDB. The length of the value is defined by the Parameter Length field.

- **If the parameter value you specify 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 parameter value you specify 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.

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

8.5 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the LOG SELECT command.

Illegal Page Code in Parameter List Header

If you specify an illegal Page Code, such as 3Ch, in the Parameter List Header, the tape drive returns Check Condition status with a sense key of Illegal Request (5h) and an FSC of CEh.

Illegal Value in LOG SELECT Data

If one of the bytes sent with the LOG SELECT data contains an illegal value or if a reserved bit is set, the tape drive returns Check Condition status. To determine which byte contains the error, issue a REQUEST SENSE command. The sense key will be set to Illegal Request (5h) and the Fault Symptom Code field (byte 28) will indicate which of the consecutively received bytes is in error. For example, if the Page Code field (byte 00, bits 5 through 0) in the Parameter List Header is invalid, the value for the Fault Symptom Code byte would be 01h.

Note: The tape drive counts the first byte received as byte 1, not as byte 0.

Other Errors

The tape drive may return the Fault Symptom Codes (FSCs) listed in Table 8-4 when thresholds are implemented.

➤ **Important** If you want the tape drive to return these Fault Symptom Codes to notify you about changes to the counters, first issue a MODE SELECT (15h) command and send the Control Mode page (Page Code= 0Ah) with the RLEC bit set to 1. Refer to Chapter 10 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 8-4 REQUEST SENSE data for LOG SELECT errors and exceptions

FSC	Sense Key	ASC	ASCQ	Description
CAh	6h	5Bh	01h	**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.)
CBh	6h	2Ah	02h	**Unit Attention**. Log parameter changed.
ECh	1h	5Bh	02h	**Recovered Error**. Log parameter overflow (a cumulative counter reached its maximum value of all FFs). When this occurs, the counter stays at its maximum, the DU bit is set to 1 to disable updates, and the tape drive returns this Fault Symptom Code. This Fault Symptom Code indicates that the tape drive completed the command with no error. Check Condition status is returned only to alert the initiator that a counter reached its maximum.

9 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

9.1 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 Counter page (02h)
- Read Error Counter page (03h)
- Data Compression page (39h)
- Drive Usage Information page (3Ch)

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 02h and 03h. You cannot specify cumulative and threshold values for page 39h or page 3Ch. You can reset the current cumulative values to 0 on page 39h, but not on page 3Ch. See Chapter 8 for more information.

9.2 Field Definitions

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

The PPC bit specifies what type of parameters you are requesting from the tape drive. This bit must be 0, which indicates that the tape drive should return all parameters for the selected log page, beginning with the code 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 valid value for this bit is 0.

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

The PC field indicates what type of parameter values you want the tape drive to return. Valid values for this field are as follows:

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. In addition, the initiator can issue a LOG SELECT (4Ch) command to set these values.

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 counter reaches its maximum value, it is returned as all FFs. (For example, FFFFFFh is returned as the maximum value for a three-byte counter.)

10b – **Return the default threshold values.** The default threshold values cannot be changed. The values returned represent the maximum values each counter 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 counter 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 counters is 0.

Byte 02, Bits 5 through 0 – Page Code

The Page Code field indicates which LOG SENSE page you want the tape drive to return. The type of data returned for the page depends on the value you specify for the PC field. The tape drive supports the following pages:

00h – **Supported Log Pages page.** This page lists the pages supported by the LOG SENSE command and does not include information about the counters.

02h – **Write Error Counter page.** This page includes a log parameter data block for each write error counter.

03h – **Read Error Counter page.** This page includes a log parameter data block for each read error counter.

39h – **Data Compression page.** This page reports the amount of data compressed or decompressed before and after read and write operations.

3Ch – **Drive Usage Information page.** This page reports tape drive lifetime totals for events such as the number of cartridge loads, time since last cleaning, and numbre of cleaning cycles.

Bytes 05 and 06 – Parameter Pointer

The Parameter Pointer field indicates the first parameter you want 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 next available parameter first.

Notes:

- If you set the Page Code field to 00h (Supported Log Pages page), this field is ignored.
- If the value for this field 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

The Allocation Length field specifies the maximum number of bytes you want the tape drive to transfer during the Data In phase. You can specify any value from 0 to FFFFh for this field.

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

Byte 09, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for these bits.

9.3 Parameter List Header

The four-byte Parameter List Header precedes each of the LOG SENSE pages. It specifies a page code 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

The Page Code field identifies the type of LOG SENSE data being returned by the tape drive. The value returned for this field equals the Page Code you specified in the CDB, as follows:

00h – Supported Log Pages page
02h – Write Error Counter page
03h – Read Error Counter page
39h – Data Compression page
3Ch – Drive Usage Information page

Bytes 02 and 03 – Page Length

The Page Length 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 you specified for the Page Code and the Parameter Pointer in the CDB.

9.4 Supported Log Pages Page (Page Code= 00h)

The Supported Log Pages page is returned when the Page Code in the CDB is 00h. Unlike other LOG SENSE pages, no parameter information is returned on this page. Instead, the Supported Log Pages page lists the LOG SENSE pages supported by the tape drive. The page codes are listed in ascending order.

Bit / Byte	7	6	5	4	3	2	1	0
00	Supported Log Pages Page Code							
01	Write Error Counters Page Code							
02	Read Error Counters Page Code							
03	Data Compression Page Code							
04	Drive Usage Information Page Code							

Byte 00 – Supported Log Pages Page Code

The value returned for this field is 00h, which is the Page Code of the Supported Log Pages page.

Byte 01 – Write Error Counters Page Code

The value returned for this field is 02h, which is the Page Code of the Write Error Counters page.

Byte 02 – Read Error Counters Page Code

The value returned for this field is 03h, which is the Page Code of the Read Error Counters page.

Byte 03 – Data Compression Page Code

The value returned for this field is 39h, which is the Page Code of the Data Compression page.

Byte 04 – Drive Usage Information Page Code

The value returned for this field is 3Ch, which is the Page Code of the Drive Usage Information page.

9.5 Log Parameters

The tape drive returns information about its log parameters immediately after it returns the Parameter List Header. For each parameter, 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 for the Parameter Length field plus four.

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 you specified for the Parameter Pointer field in the CDB.

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

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

Byte 0, Bit 7 – DU (Disable Update)

The value returned for the Disable Update field indicates whether updates to the current cumulative value for this counter 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 counter.

Byte 02, Bit 6 – DS (Disable Save)

The tape drive always returns 1 for this bit, indicating that it 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)

The value returned for the ETC bit indicates whether threshold comparisons are enabled or disabled for this counter, as follows:

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

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 counter. When the conditions specified by the TMC field 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.

Threshold comparisons are made when the cumulative value is updated. When the threshold criteria are met, the tape drive returns Unit Attention.

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

The value returned for the TMC bit specifies the conditions under which the tape drive will generate 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. Valid values for this field are as follows:

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.

➤ **Important** If you want the tape drive to return Unit Attention to notify you about changes to the counters, first issue a MODE SELECT (15h) command and send the Control Mode page (Page Code= 0Ah) with the Report Log Exception Condition (RLEC) bit set to 1. Refer to Chapter 10 for more information.

Byte 02, Bit 0 – LP (List Parameter)

The tape drive always returns 0 for this bit, indicating that it does not support List Parameters.

Byte 03 – Parameter Length

The Parameter Length field indicates the length of the threshold or cumulative value in bytes. For example, if the value requires two bytes, the tape drive returns 02h for this field.

Bytes 04 to *nn* – Parameter Value

The Parameter Value field value lists either a threshold value or a cumulative value for the counter, depending on what you specified for the PC field in the CDB.

Write Error Counters Page (Page Code= 02h)

When you specify 02h for the Page Code, the tape drive returns information about the counters listed in Table 9-1.

Table 9-1 Parameters returned for LOG SENSE Write Error Counter page

Parameter Code	Counter Name	Parameter Length (bytes)	Default Cumulative Value	Default Threshold Value
0002h	Total Rewrites	3	0	all FFs
0003h	Total Errors Corrected	3	0	all FFs
0004h	Total Times Errors Processed	3	0	all FFs
0005h	Total Bytes Processed	5	0	all FFs
0006h	Total Unrecoverable Errors	2	0	all FFs

Total Rewrites Indicates the number of physical blocks the tape drive rewrote to the tape because of errors detected during read-after-write operations. Only user data blocks and short filemark blocks are ever rewritten.

Note: 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.

Total Errors Corrected Contains the same value as the Total Rewrites counter.

Total Times Errors Processed Contains 0 since this is only a read function (write errors are rewritten). The default value is 0 and will never change.

Total Bytes Processed 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.

Total Unrecoverable Errors Contains the number of times the tape drive could not write a block to the tape.

Read Error Counter Page (Page Code= 03h)

When you specify 03h for the Page Code, the tape drive returns information about the counters listed in Table 9-2.

Table 9-2 Parameters returned for LOG SENSE Read Error Counter page

Parameter Code	Counter Name	Length in bytes	Default Cumulative Value	Default Threshold Value
0002h	Total Rereads	3	0	all FFs
0003h	Total Errors Corrected	3	0	all FFs
0004h	Total Times Errors Processed	3	0	all FFs
0005h	Total Bytes Processed	5	0	all FFs
0006h	Total Unrecoverable Errors	2	0	all FFs

Total Rereads Contains the number of times the tape drive moved the tape backward to reread a portion of tape because a block was missed.

Total Errors Corrected Contains the number of blocks the tape drive recovered either by using the ECC algorithm or by successfully rereading the block.

Total Times Errors Processed Contains the number of blocks the tape drive recovered by using the ECC algorithm.

Total Bytes Processed Contains the number of user data bytes transferred to the initiator. Rewritten data is not counted.

Total Unrecoverable Errors Contains the number of blocks the tape drive could not read after exhausting all retries.

Data Compression Page (Page Code= 39h)

When you specify 39h for the Page Code, the tape drive returns information about the parameters listed in Table 9-3.

Note: The Data Compression page is not supported by the LOG SELECT command. You cannot set thresholds for the parameters on this page. You can reset the current cumulative values to 0 as described on page 8-3.

Table 9-3 Parameters returned for LOG SENSE Data Compression page

Parameter Code	Parameter Name	Length in bytes
0005h	KB of Data Transferred to Data Compressor	6
0007h	KB of Data Transferred to Tape	6

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.

Drive Usage Information Page (Page Code= 3Ch)

When you specify 3Ch for the Page Code, the tape drive returns information about the parameters listed in Table 9-4. These parameters provide lifetime statistics for the tape drive. If a counter reaches its maximum value, it will remain at that value instead of rolling 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 9-4 Parameters returned for LOG SENSE Drive Usage Information page

Parameter Code	Parameter Name	Length in bytes
0001h	Reserved	8
0002h	Reserved	8
0003h	Reserved	8
0004h	Reserved	8
0005h	Reserved	8
0006h	Total Load Count	3
0007h	Minutes Since Last Clean	3
0008h	Reserved	3
0009h	Reserved	3
000Ah	Cleaning Count	2
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 (bit 0)	1
0012h	Vendor Unique	1
0013h	Reserved	3
0014h	Reserved	3

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

Minutes Since Last Clean Indicates the number of power-on minutes since the tape drive was last cleaned.

Cleaning Count Indicates the total number of cleaning cycles the tape drive has undergone during its lifetime.

Time to Clean If bit 0 of this byte is set to 1, the tape drive needs to be cleaned.

Notes

10 MODE SELECT (15h) and MODE SENSE (1Ah)

This chapter describes the bit and byte settings for both the MODE SELECT and MODE SENSE commands. It consists of separate sections defining the CDB and Parameter List Header fields for the two commands, followed by combined sections for the Block Descriptor, Vendor-Unique Parameters, and parameter pages that are common to both commands.

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

MODE SENSE (1Ah)

<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>0</td></tr>
<tr><td>01</td><td colspan="3">Logical Unit Number</td><td>RSVD</td><td>DBD</td><td colspan="3">Reserved</td></tr>
<tr><td>02</td><td colspan="2">PC</td><td colspan="6">Page Code</td></tr>
<tr><td>03</td><td colspan="8">Reserved</td></tr>
<tr><td>04</td><td colspan="8">Allocation Length</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>

10.1 About These Commands

The MODE SELECT command allows the initiator to specify medium, logical unit, and device parameters. The MODE SENSE command enables the tape drive to report these parameters to the initiator. These values apply to all initiators in a multi-initiator environment.

MODE SELECT and 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. This format is the same as that defined for the EXB-8200 (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 pages of related parameters

Reporting Compression Parameters with MODE SENSE

The data compression parameters that can be returned with the MODE SENSE command depend on whether your SCSI driver uses non-page format or page format:

- **In non-page format,** the only compression-related information that can be returned is the Density Code, which is located in the Block Descriptor (see Section 10.6).
- **In page format**, the compression-related information that can be returned includes the Density Code in the Block Descriptor, the Data Compression Page, and the Data Compression Status Page.

10.2 Field Definitions for MODE SELECT CDB

Byte 01, Bit 4 – PF (Page Format)

The PF bit indicates in which format the MODE SELECT parameters are specified, 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 – Parameter List Length

The Parameter List Length byte indicates the length of the parameter list that will be transferred from the initiator to the tape drive during the Data Out phase. The value for this byte must represent the total number of bytes to be transferred to the tape drive.

Note: When the value for the Parameter List Length byte is 00h, no data is transferred from the initiator. This is not an error.

Non-Page Format For non-page format, the Parameter List Length byte can contain values ranging from 00h to 11h. Table 10-1 lists the valid lengths for the Parameter List Length byte for non-page format.

Table 10-1 MODE SELECT Parameter List Lengths (non-page format)

To transfer these parameters...	Specify this Parameter List Length...
No parameter list data	00h
Parameter List Header only	04h
Parameter List Header and 1 to 5 bytes of vendor-unique parameters	05h, 06h, 07h, 08h, or 09h
Parameter List Header and Block Descriptor	0Ch
Parameter List Header, Block Descriptor, and 1 to 5 bytes of vendor-unique parameters	0Dh, 0Eh, 0Fh, 10h, or 11h

Page Format For page format, the value of the Parameter List Length byte depends on which combination of parameter pages is being transferred. Table 10-2 shows the number of bytes that should be designated to transfer the various types of MODE SELECT parameters.

Table 10-2 MODE SELECT Parameter List Lengths (page format)

To transfer these parameters...	Designate this amount...
No parameter list data	0 bytes (0h)
Parameter List Header	4 bytes (04h)
Block Descriptor	+ 8 bytes (08h)
Read-Write Error Recovery Page (Page Code= 01h)	+ 9 bytes (09h)
Disconnect-Reconnect Page (Page Code= 02h)	+ 12 bytes (0Ch)
Control Mode Page (Page Code= 0Ah)	+ 8 bytes (08h)
Data Compression Page (Page Code= 0Fh)	+ 16 bytes (10h)
Device Configuration Page (Page Code= 10h)	+ 15 bytes (0Fh)
Medium Partition Page (Page Code= 11h)[a]	+ 8 bytes (08h) or + 10 bytes (0Ah)[b]
Vendor Unique Parameters Page 1 (Page Code= 20h)	+ 6 bytes (06h)
Vendor Unique Parameters Page 2 (Page Code= 21h)	+ 6 bytes (06h)

[a] This page is available for 8500c format only.

[b] The amount you specify depends on whether you are sending the long form or the short form, as explained in Section 10.13.

Example 1 To transfer the Parameter List Header and the Read-Write Error Recovery page:

1. Specify 0Dh for the Parameter List Length byte (04h for the Parameter List Header + 09h for the Read-Write Error Recovery page).

2. Set the Block Descriptor Length byte in the Parameter List Header to 00h.

Example 2 To transfer the Parameter List Header, the Block Descriptor, and the Data Compression Page:

1. Specify 1Ch for the Parameter List Length byte (04h for the Parameter List Header + 08h for the Block Descriptor + 10h for the Data Compression Page).

2. Set the Block Descriptor Length byte in the Parameter List Header to 08h.

Example 3 To transfer the Parameter List Header, the Block Descriptor, and the Vendor Unique Parameters Page 1:

1. Specify 12h for the Parameter List Length byte (04h for the Parameter List Header + 08h for the Block Descriptor + 06h for the Vendor Unique Parameters Page 1).

2. Set the Block Descriptor Length byte in the Parameter List Header to 08h.

Table 10-3 summarizes the values you should designate for the Parameter List Length byte when you want to transfer the Parameter List Header, the Block Descriptor, and only one of the parameter pages. Use this table as a quick reference when you are interested in changing the parameters for only one of the MODE SELECT pages.

Table 10-3 Values to designate for the MODE SELECT parameter List Length (page format)

Designate this amount...	For this page plus the Parameter List Header and Block Descriptor...
15h	Read-Write Error Recovery Page (Page Code= 01h)
18h	Disconnect-Reconnect Page (Page Code= 02h)
14h	Control Mode Page (Page Code= 0Ah)
1Ch	Data Compression Page (Page Code= 0Fh)
1Bh	Device Configuration Page (Page Code= 10h)
14h (short form) or 16h (long form)	Medium Partition Page (Page Code= 11h)[a]
12h	Vendor Unique Parameters Page 1 (Page Code= 20h)
12h	Vendor Unique Parameters Page 2 (Page Code= 21h)

[a] This page is available for 8500c format only.

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 4-byte Parameter List Header must be transferred before the Block Descriptor or any parameter pages 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.

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for these bits.

10.3 Field Definitions for MODE SENSE CDB

Byte 01, Bit 3 – DBD (Disable Block Descriptor)

The Disable Block Descriptor bit indicates whether the initiator wants the 8-byte Block Descriptor returned as part of the MODE SENSE parameter data. This bit is defined 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 (see Table 10-5).

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

The Page Control field indicates the type of MODE SENSE parameter data to be returned. The tape drive supports the following values:

00h – Return current values. These are the parameters set by the last successful MODE SELECT command, or the power-on default values if a MODE SELECT command has not been executed since the last power-on reset, SCSI bus reset, or Bus Device Reset message.

01h – Return changeable values. All values that are changeable are indicated by 1s in each bit of the changeable field.

Note: This field is used only for page format and must be 00h for non-page format.

Byte 02, Bits 5 through 0 – Page Code

The Page Code field indicates which MODE SENSE parameter page or pages the initiator is requesting. A value of 0 for this field indicates that the parameters will be returned in non-page format.

Table 10-4 lists the values supported by the tape drive for the Page Code field.

Table 10-4 Values for the Page Code field in the MODE SENSE command

To return the parameters in...	Specify this Page Code...	And this information will be returned...
Non-page format	00h[a]	1 to 5 bytes of vendor-unique parameters
Page format	01h	Read-Write Error Recovery Page
	02h	Disconnect/Reconnect Page
	0Ah	Control Mode Page
	0Fh	Data Compression Page
	10h	Device Configuration Page
	11h	Medium Partition Page[b]
	20h	Vendor Unique Parameters Page 1
	21h	Vendor Unique Parameters Page 2
	22h	Data Compression Status Page
	3Fh	All available pages[c]

[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).

[b] This page is available for 8500c format only.

[c] When the Page Code is 3Fh, pages 01h through 22h are returned in the order listed in the table.

Byte 04 – Allocation Length

The Allocation Length byte indicates the amount of memory in bytes that the initiator has allocated for the return of MODE SENSE parameters from the tape drive.

Non-Page Format For non-page format, the Allocation Length byte can contain values ranging from 00h to 11h. Table 10-5 lists the valid values for the Allocation Length byte in non-page format.

Table 10-5 MODE SENSE Allocation Lengths (non-page format)

To return these parameters...	Allocate this length...
No parameter list data	00h
Parameter List Header data	04h
Parameter List Header data and 1 to 5 bytes of vendor-unique parameters	05h, 06h, 07h, 08h, or 09h
Parameter List Header and Block Descriptor	0Ch
Parameter List Header, Block Descriptor, and 1 to 5 bytes of vendor-unique parameters	0Dh, 0Eh, 0Fh, 10h, or 11h

Page Format For page format, the Allocation Length byte can contain values ranging from 00h to FFh, depending on which parameter page is being returned and whether you want the Block Descriptor to be returned (that is, whether you set the DBD bit to 0 or 1).

Table 10-6 shows the minimum values you can specify for the Allocation Length when the Page Code field is set to a non-zero value.

Note: To return the Parameter List Header or the Block Descriptor without pages, set the Page Code to 0 (non-page format) and refer to Table 10-6 to determine what to specify for the Allocation Length field.

Table 10-6 MODE SENSE Allocation Lengths (page format)

To return this page...	Length of page in bytes (hex)	Specify at least this amount for the Allocation Length...[a]	
		... if DBD= 0 (return 8-byte Block Descriptor)	...if DBD= 1 (do not return 8-byte Block Descriptor)
Read-Write Error Recovery Page (Page Code= 01h)	9 (9h)	15h	0Dh
Disconnect-Reconnect Page (Page Code= 02h)	12 (Ch)	18h	10h
Control Mode Page (Page Code= 0Ah)	8 (8h)	14h	0Ch
Data Compression Page (Page Code= 0Fh)	16 (10h)	1Ch	14h
Device Configuration Page (Page Code= 10h)	15 (Fh)	1Bh	13h
Medium Partition Page[b] (Page Code= 11h)	10 (Ah)	16h	0Eh

Table 10-6 MODE SENSE Allocation Lengths (page format) *(continued)*

To return this page...	Length of page in bytes (hex)	Specify at least this amount for the Allocation Length...[a]	
		... if DBD= 0 (return 8-byte Block Descriptor)	...if DBD= 1 (do not return 8-byte Block Descriptor)
Vendor Unique Parameters Page 1 (Page Code= 20h)	6 (6h)	12h	0Ah
Vendor Unique Parameters Page 2 (Page Code= 21h)	6 (6h)	12h	0Ah
Data Compression Status Page (Page Code= 22h)	13 (Dh)	19h	11h
All available pages (Page Code= 3Fh)		FFh	FFh

[a] The transfer must include the 4-byte Parameter List Header.

[b] This page is available for 8500c format only.

Example 1 To return the Parameter List Header, the Block Descriptor, and the Vendor Unique Parameters Page 1:

1. Set the DBD bit to 0.
2. Set the Page Code to 20h.
3. Specify at least 12h for the Allocation Length byte (04h for the Parameter List Header + 08h for the Block Descriptor + 06h for the Vendor Unique Parameters Page 1).

Example 2 To return the Parameter List Header, the Block Descriptor, and the Data Compression Page:

1. Set the DBD bit to 0.
2. Set the Page Code to 0Fh.
3. Specify at least 1Ch for the Allocation Length byte (04h for the Parameter List Header + 08h for the Block Descriptor + 10h for the Data Compression Page).

Example 3 To return all possible MODE SENSE data:

1. Set the DBD bit to 0.

2. Set the Page Code to 3Fh.

3. Specify FFh for the Allocation Length byte.

Truncating Pages If the Allocation Length is smaller than the amount of data available, the tape drive returns the requested information, then terminates the command with Check Condition status. The sense key is set to Illegal Request and the Additional Sense Code is set to Parameter List Length Error. For example: Suppose you set the Page Code to 20h (for Vendor Unique Parameters Page 1), the DBD bit to 0 (to send the Block Descriptor), and the Allocation Length to 11h (17 bytes). These values cause the tape drive to return the entire Parameter List Header (4 bytes), the entire Block Descriptor (8 bytes), but only 5 of the 6 available bytes for Vendor Unique Parameters Page 1. It then terminates the command and returns Check Condition status.

Restrictions for MODE SENSE Data:

- In non-page format, for any data transfer greater than 0 bytes, the entire 4-byte Parameter List Header must be received from the tape drive. That is, the entire 4-byte Parameter List Header must be received before the Block Descriptor or any vendor-unique parameters can be received.

- In non-page format, if the Block Descriptor is requested, it must be received in its entirety (that is, all 8 bytes).

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for these bits.

10.4 Parameter List Header for MODE SELECT

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

Byte 02, Bits 6 through 4 – Buffered Mode

The tape drive supports two data transfer modes, as follows:

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

In buffered mode, data from a WRITE command and filemarks or setmarks (8500c format only) 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.
- 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) in the reverse direction
- 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 Section 10.12 on page 10-33 for more information about the Write Delay Time field.

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 – 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 – Block Descriptor Length

This byte contains the length of the Block Descriptor in bytes. The tape drive does not support multiple block descriptions. The valid values for this byte are 00h (for no Block Descriptor) and 08h (for the entire Block Descriptor).

10.5 Parameter List Header for 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							

Byte 00 – Mode Data Length

The Mode Data Length byte indicates how many bytes of MODE SENSE data are available to be transferred, excluding this byte. The value returned for this field is the remaining number of bytes in the Parameter List Header (03h) plus the number of bytes of data to be returned based on the field settings in the CDB.

Note: The value returned for the Mode Data Length does not reflect the value you specified for the Allocation Length in the CDB.

Byte 01 – Medium Type

The value returned in the Medium Type byte represents the length of tape currently loaded in the tape drive. The values that can be returned are shown in Table 10-7.

> ➤ **Important** To ensure the archivability of your data, Exabyte strongly recommends that you use EXATAPE data cartridges for data storage.

Table 10-7 Values returned for Medium Type byte in MODE SENSE data

Value returned	Length of tape loaded (and equivalent EXATAPE)
00h	No tape loaded
81h	15m (EXATAPE 15m)
83h	54m (EXATAPE 54m)
86h	160m (EXATAPE 160m XL)[a]
C4h	112m (EXATAPE 112m)

[a] If you load a 160m tape that does not have a Recognition System stripe, the tape drive treats it as a 112m tape and returns a Medium Type value of C4h (see page 3-2).

Byte 02, Bit 7 – WP (Write Protect)

The Write Protect bit indicates if the data cartridge loaded in the tape drive is write protected. This bit is defined as follows:

0 – The data cartridge loaded in the tape drive is not write protected.
1 – The data cartridge loaded in the tape drive is write protected.

Byte 02, Bits 6 through 4 – Buffered Mode

Indicates whether the tape drive buffers data during a write operation, as explained on page 10-12. The values returned are as follows:

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

Byte 02, Bits 3 through 0 – Speed

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

Byte 03 – Block Descriptor Length

This byte contains the length of the Block Descriptor in bytes. The tape drive does not support multiple block descriptions. The values for this byte are 00h and 08h.

10.6 Block Descriptor

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

In the MODE SELECT command, the Density Code field specifies the format in which you want the tape drive to write data to tape. In the MODE SENSE command, the Density Code field identifies the current operating density of the tape drive.

Table 10-8 lists the valid values for the Density Code.

Note: Refer to Section 10.18 on page 10-53, for examples of using the tape drive to write, read, and append data in the various tape formats it supports. Refer to page 10-59 in that section if you want to change the Density Code and you cannot issue MODE SELECT commands.

Restrictions for Setting the Density Code:

- The entire tape must be written in the same format. That is, the Density Code applies to the entire tape, not to individual blocks and files. You can change the Density Code only when the tape is logically positioned at LBOT.
- For read operations, the tape drive automatically determines the correct format.
- A blank tape written before the first MODE SELECT command will be written in the power-on default format (8500c).

Table 10-8 Values for the Density Code field

This Density Code...	Indicates this data format...	Notes
00h	Default format (error checking suppressed)	Use this Density Code at LBOT if you want to write default format tapes (8500c). The tape drive ignores this Density Code (does not return Check Condition status) if you attempt to use it to change the tape format from a non-default format to the default format when the tape is not at LBOT.
14h	8200 (read only)	The tape drive can read but not write 8200 format tapes. If you attempt to write after specifying this Density Code with MODE SELECT, the tape drive returns Check Condition status with the sense key set to Illegal Request (5h) and an FSC of D0h. The tape drive returns this Density Code in the Mode Sense Block Descriptor when a write-protected 8200 format tape is loaded.
15h	8500 (full error checking)	Use this Density Code at LBOT if you want to write 8500 format tapes. The tape drive returns Check Condition status with the sense key set to Illegal Request (5h) if you attempt to use this Density Code to change the tape format from 8500c to 8500 when the tape is not at LBOT.
7Fh	No change in the format (error checking suppressed)	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.
8Ch	8500c (full error checking)	Use this Density Code at LBOT if you want to write 8500c format tapes. The tape drive returns Check Condition status with the sense key set to Illegal Request (5h) if you attempt to use this Density Code to change the tape format from 8500 to 8500c format when the tape is not at LBOT.

Table 10-8 Values for the Density Code field *(continued)*

This Density Code...	Indicates this data format...	Notes
90h	8200c (not supported)	The tape drive cannot read or write 8200c format tapes. The tape drive returns Check Condition status with the sense key set to Illegal Request (5h) and an FSC of D0h if you attempt to use this Density Code.

As described in Table 10-9, the value reported for the Density Code field by the MODE SENSE command depends on the most recent activity.

Table 10-9 Effect of various actions on the Density Code reported by MODE SENSE

If the most recent activity was a...	...then the value reported for the Density Code is the...	
	... actual format of the data on the tape (format for reading tape)	...power-on default or format set with the most recent MODE SELECT (format for writing tape)[a]
Power on (tape not loaded)		✔
Load operation — previously written tape	✔	
Load operation — blank tape		✔
MODE SELECT		✔
READ	✔	
WRITE		✔

[a] The Density Code reported in these cases reflects the format set by the most recent MODE SELECT command that set the Density Code to a non-7Fh value.

Notes:

- The RTF field on the Vendor Unique Parameters Page 1 (Page Code 20h) indicates the format of the data on the currently loaded data cartridge. The WTF field on the same page indicates the format that will be used when the tape drive writes data. The values returned for these fields do not depend on the last operation performed by the tape drive.

- If the tape is written in an unrecognized format or if the tape drive is not ready, the Density Code returned by the tape drive corresponds to the density in which it would write if the tape were positioned at LBOT (that is, the currently selected write density).

- When the tape drive appends new data to existing data, it writes the new data in the same format as the data already on the tape. In this case, the writing format is automatically changed to the reading format (no user intervention is required). Once this automatic density change has occurred, it remains in effect for all operations on the particular tape—including the rewriting of LBOT.

Bytes 01 through 03 – Number of Blocks

In the MODE SENSE data, this field indicates the total capacity of the tape in 1-KB physical blocks (LBOT to LEOT). The tape drive determines this value when it loads a tape. This field is ignored by the tape drive in the MODE SELECT command.

Bytes 05 through 07 – Block Length

The Block Length field defines the length in bytes of each logical block, in uncompressed format, described by the Block Descriptor. A value of 0 for the Block Length field indicates variable-length logical blocks. A value greater than 0 indicates fixed-length logical blocks.

The power-on default value for the block length is 400h (1,024) bytes. The limit on the block length is 03C000h or 240 KB, which is the maximum block length specified by the Read Block Limits data (see Chapter 13).

Notes:

- If you specify a number greater than 03C000h (240 KB) for the Block Length, the tape drive returns Check Condition status with the sense key set to Illegal Request (5h).

- If the value specified for the Block Length field is not divisible by 4, even-byte disconnect is disabled when the tape drive updates the logical block length.

10.7 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)

The tape drive ignores this bit.

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

This bit is used to enable the tape drive to 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 during the data transfer phase.

Restrictions when the ND bit is 1:

- During a write operation, the data transfer from the initiator does not start until the number of bytes of available space in the tape drive's buffer is greater than or equal to the total transfer length specified by the CDB.
- During a read operation, the data transfer to the initiator does not start until all of the data requested by the CDB is resident in the tape drive's buffer.
- If the Reconnect Threshold byte is set to a value less than A0h or greater than C0h, it will be changed to A0h. This is necessary for proper buffer management.

Byte 00, Bit 3 – NBE (No Busy Enable)

This bit is included for compatibility only. This bit is set to 1 in the MODE SENSE data and is ignored by the tape drive in the MODE SELECT command.

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

This bit is used to enable disconnects on even (4-byte) boundaries. This bit is ignored by the tape drive in the MODE SELECT command because the tape drive always disconnects on 4-byte boundaries between data phases. The value returned is 1.

Note: Even-byte disconnect apples 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 bit is used to enable parity checking on the SCSI bus. When this bit is set to 1, every byte received by the tape drive is checked for parity.

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

Byte 00, Bit 0 – NAL (No Auto Load)

This bit is used to disable the automatic loading of the tape into the tape path when a data cartridge is inserted into the tape drive and the door is closed, as follows:

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

Byte 01, Bit 0 – 112m

The tape drive ignores this bit.

Byte 02 – Motion Threshold

The value in the Motion Threshold byte 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 is expressed in 4-KB increments. The default is 80h (512 KB). Valid values range from 20h to D0h (128 to 832 KB). For more information about the motion threshold, see Section 3.6.

Byte 03 – Reconnect Threshold

The value in the Reconnect Threshold byte 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. To optimize tape drive performance, the reconnect threshold is measured differently for read and write operations.

The reconnect threshold is measured in 3-KB increments for a read operation and in 4-KB increments for a write operation. The default is 80h (384 KB for a read operation and 512KB for a write operation). Valid values range from 20h to D0h (96 to 624 KB for a read operation and 128 to 832 KB for a write operation). For more information about the reconnect threshold, see Section 3.6.

Note: If the ND bit is 1 and you set the Reconnect Threshold byte to a value less than A0h or greater than C0h, the value will automatically be changed to A0h. If, however, you set the Reconnect Threshold byte to a value between A0h and C0h, that value will take effect. If the ND bit is 0, the Reconnect Threshold byte can have any value from 20h to D0h (96 to 624 KB for a read operation and 128 to 832 KB for a write operation).

Byte 04 – Gap Threshold

The Gap Threshold byte 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.

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.

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

10.8 Read-Write Error Recovery Page (Page Code= 01h)

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

Byte \ Bit	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							

Byte 00, Bits 5 through 0 – Page Code

The Page Code identifies the page being transferred. The valid value is 01h (Read-Write Error Recovery Page).

Byte 01 – Page Length

The Page Length byte indicates the number of bytes in the Read-Write Error Recovery Page that follow this byte. The valid value is 07h.

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

The Read Retry Count field specifies the maximum number of times the tape drive should attempt 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 read error. You can set the Read Retry Count to any value between 00h and 0Bh. The default value is 0Bh.

As soon as the tape drive encounters an unreadable data block, the value for the Read Retry Count is automatically set as follows:

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

- If you specified 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.

Byte 08 – Write Retry Count

The Write Retry Count field specifies how many times the tape drive should rewrite a physical block before an unrecoverable write error is reported. The value for this field can only be changed when the tape is positioned at LBOT. The valid values for this field are 00h and 0Bh. The default value is 0Bh.

Specify 00h for this field to set the Write Retry Count to 0. Specify any other nonzero value to set the Write Retry Count to 0Bh. A value of 00h for the Write Retry Count indicates that the tape drive will not rewrite any physical blocks during a write operation and will continue to write additional data. If a value of 00h is used, the tape drive may not be able to recover the data written on the tape since its write integrity cannot be guaranteed.

Note: If this field was set to 00h when the tape was written, the WWR (Write Without Retries) bit in the MODE SENSE Vendor Unique Parameters Page 2 will be set to 1.

10.9 Disconnect-Reconnect Page (Page Code= 02h)

The Disconnect-Reconnect Page specifies parameters for 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)

Byte 00, Bits 5 through 0 – Page Code

The Page Code identifies the page being transferred. The valid value is 02h (Disconnect-Reconnect Page).

Byte 01 – Page Length

The Page Length indicates the number of bytes in the Disconnect-Reconnect Page that follow this byte. The valid value is 0Ah.

Byte 02 – Buffer Full Ratio

The Buffer Full Ratio represents 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 is expressed in 3-KB increments. The default value for the Buffer Full Ratio is 80h (384 KB). Valid values range from 20h to D0h (96 to 624 KB).

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

Note: If the ND bit is 1 and you set the Buffer Full Ratio to a value less than A0h or greater than C0h, the value will automatically be changed to A0h. If, however, you set the Buffer Full Ratio to a value between A0h and C0h, that value will take effect. If the ND bit is 0, the Buffer Full Ratio can have any value from 20h to D0h (96 to 624 KB).

Byte 03 – Buffer Empty Ratio

The Buffer Empty Ratio represents how empty the buffer must be during a buffered write operation before the tape drive will attempt to reconnect to the initiator. The value is expressed in 4-KB increments. The default value for this byte is 80h (512 KB). Valid values range from 20h to D0h (128 to 832 KB).

The Buffer Empty Ratio must equal the Buffer Full Ratio (see above). 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 in the Disconnect-Reconnect Page are equivalent to the Reconnect Threshold byte in the vendor-unique parameters for non-page format. For more information about the reconnect threshold, see Section 3.6.

Bytes 04 and 05 – Bus Inactivity Limit

The tape drive does not recognize any values other than 0 for the Bus Inactivity Limit. It uses 0 as a default value, meaning that there is no limit to the amount of time that the tape drive can assert a BSY signal without a REQ /ACK handshake.

Bytes 06 and 07 – Disconnect Time Limit

The only value supported by the tape drive for the Disconnect Time Limit field is 0. This value cannot be changed.

Note: The disconnect time limit is determined by the minimum time it takes the tape drive to disconnect from the SCSI bus and then initiate a reselection sequence. The minimum disconnect time for the tape drive is 265 μsec. The initiator cannot change this field, so the value returned for this field by the MODE SENSE command is 0.

Bytes 08 and 09 – Connect Time Limit

The tape drive does not recognize any values other than 0 for the Connect Time Limit. It uses 0 as a default value, meaning that it will disconnect from the bus after the amount of data defined by Maximum Burst Size has been transferred.

Bytes 10 and 11 – Maximum Burst Size

The Maximum Burst Size defines the amount of data to be transferred before disconnecting. The value is expressed in increments of 512 bytes. A value of 0 indicates that there is no limit to the amount of data transferred before disconnecting. The tape drive supports all values for this field. The default value is 0, which means that disconnects and reconnects are performed using the value specified by the Buffer Full and Buffer Empty Ratios.

Note: If you set the Maximum Burst Size field to a non-zero value, the tape drive will automatically set the ND bit to 0 to allow disconnects during the data transfer phase. That is, Maximum Burst Size field has precedence over the ND bit. For more information about the ND bit, see Section 10.14 on page 10-46.

10.10 Control Mode Page (Page Code= 0Ah)

The Control Mode Page allows you to specify whether the tape drive should return 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 8.

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 Page Code identifies the page being transferred. The valid value is 0Ah (Control Mode Page).

Byte 01 – Page Length

The Page Length 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)

The RLEC bit indicates whether the tape drive should return 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, so this field must be 0.

Byte 03, Bit 1 – QErr (Queue Error)

The tape drive does not support the Simple Queue Tag message, so this bit must be 0.

Byte 03, Bit 0 – DQue (Disable Queuing)

The tape drive does not support the Simple Queue Tag message, so this bit must be 1.

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

The tape drive does not support extended contingent allegiance, so this bit must be 0.

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

The tape drive does not support asynchronous event notification (AEN), so this bit must be 0.

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

The tape drive does not support asynchronous event notification, so this bit must be 0.

Byte 06 and 07 – Ready AEN Holdoff Period

The tape drive does not support asynchronous event notification, so this field must be 0.

10.11 Data Compression Page (Page Code= 0Fh)

The Data Compression Page specifies parameters for the control of data compression. This page allows you to turn data compression on or off in 8500c format independently of the tape's position

Using the Data Compression Page for 8500c Compressed Format Tapes

If your driver uses page format and you are reading and writing 8500c format tapes, follow these steps to control compression:

1. When the tape is at LBOT, set the Density Code in the Block Descriptor to 8Ch. This specifies 8500c format for the tape and turns data compression on.

2. If you want, send this page to turn data compression off and back on again when you write individual logical blocks.

   - To turn compression off, set the DCE bit to 0.
   - To turn compression back on, set the DCE bit to 1.

Bit / Byte	7	6	5	4	3	2	1	0
00	RSVD		Page Code					
01	Page Length							
02	DCE	DCC	Reserved					
03	DDE	RED		Reserved				
04 … 07	(MSB) Compression Algorithm (LSB)							
08 … 11	(MSB) Decompression Algorithm (LSB)							
12 … 15	Reserved							

Byte 00, Bits 5 through 0 – Page Code

The Page Code identifies the page being transferred. The valid value is 0Fh (Data Compression Page).

Byte 01 – Page Length

The Page Length 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)

The Data Compression Enable bit specifies whether the tape drive should enable or disable data compression. When writing data in 8500c format, you can turn compression on or off using the DCE bit as follows:

0 – Disable data compression.
1 – Enable data compression.

In the MODE SENSE data, the values returned for the DCE bit indicate the following:

0 – Data compression is disabled. The write density is set to 8Ch (8500c format) and compression is turned off. Or, the write density is set to 15h (8500 format).

1 – Data compression is enabled. The write density is set to 8Ch (8500c format) and data compression is turned on.

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

The Data Compression Capable bit is used by the MODE SENSE command to indicate that the tape drive supports data compression. The value returned is 1. This bit is ignored by the tape drive in the MODE SELECT command.

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

When the tape drive reads compressed data from tape, it automatically decompresses the data before sending to the initiator. Data decompression is always enabled, so this bit must be set to 1 (enable data decompression). Note that a value of 1 is valid for any 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

The Compression Algorithm field indicates which compression algorithm the tape drive will use to compress data from the initiator. The only value currently supported for this field is 10h (write data using the IDRC data compression algorithm). This is the only compression algorithm currently supported by the tape drive.

Note: Specifying a value other than 10h for this field causes the tape drive to return Check Condition status with the sense key set to Illegal Request (5h).

Bytes 08 through 11 – Decompression Algorithm

The Decompression Algorithm field indicates which decompression algorithm the tape drive will use when decompressing data from the tape. The only value currently supported for this field is 10h (decompress data using the IDRC data compression algorithm). This is the only compression algorithm currently supported by the tape drive.

Note: Specifying a value other than 10h for this field causes the tape drive to return Check Condition status with the sense key set to Illegal Request (5h).

10.12 Device Configuration Page (Page Code= 10h)

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							

Byte 00, Bits 5 through 0 – Page Code

The Page Code identifies the page being transferred. The valid value is 10h (Device Configuration Page).

Byte 01 – Page Length

The Page Length indicates the number of bytes in the Device Configuration Page that follow this byte. The valid value is 0Dh.

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

If the loaded tape is formatted with two partitions (8500c format only), you can use the CAP bit to move the tape from the current partition to the other partition. You specify the new partition in the Active Partition field (byte 03). Note that the tape drive does not actually move the tape until it receives a tape motion command such as READ or WRITE. Values for the CAP bit are as follows:

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

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

Notes:

- If the tape drive is not ready when it receives a request to change the active partition, it returns Check Condition status with the sense key set to Not Ready (2h).
- If the currently loaded tape does not contain two partitions, the CAP bit must be 0. The CAP bit must be 0 for tapes in 8500 format.
- In the MODE SENSE data, the value returned for this bit is always 0 (no change in position).

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

The CAF bit indicates that the active format is to be changed and to use the values in the Active Format field, as follows:

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

In the MODE SENSE data, the value returned for this bit is always 0.

Byte 02, Bits 4 through 0 – Active Format

The Active Format 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 The Gap Threshold 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. After writing the number of gap blocks specified by this field, the tape drive either continues the write operation (if there is new data in the buffer) or begins 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.

Valid values for the Gap Threshold field are 0h to 7h. The default value for the Gap Threshold byte is 7h.

Note: The Gap Threshold in the Device Configuration Page has the same function as the Gap Threshold in the Vendor Unique Parameters Page 1. If both pages are sent, the value that is received last by the tape drive takes precedence.

Byte 03 – Active Partition

If you have set the CAP bit (byte 02, bit 6) to 1 to change the active partition, the Active Partition byte indicates the number of the new partition that the tape is to be moved to, as follows:

0 – Move to the logical beginning (LBOP) of the second partition.
1 – Move to the logical beginning (LBOP) of the first partition.

Notes:

- If the tape contains no partitions, the Active Partition byte must be 0.
- If the CAP bit is 0, the tape drive ignores the Active Partition byte.
- In the MODE SENSE data, the Active Partition byte indicates the currently active partition. A value of 0 indicates that the tape either has no partitions, or the currently active partition is the second partition. A value of 1 indicates that the currently active partition is the first partition.

Byte 04 – Write Buffer Full Ratio

The Write Buffer Full Ratio represents 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 is expressed in 4-KB increments. The default value for this byte is 80h (512 KB). Valid values range from 20h to D0h (128 to 832 KB).

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 (5h).

Byte 05 – Read Buffer Empty Ratio

The Read Buffer Empty Ratio represents how empty the buffer must be during a buffered read operation before additional data will be read from the tape. The value is expressed in 4-KB increments. The default value for this byte is 80h (512 KB). Valid values range from 20h to D0h (128 to 832 KB).

The Read Buffer Empty Ratio must equal the Write 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 Write Buffer Full Ratio and the Read Buffer Empty Ratio in the Device Configuration Page have the same function as the Motion Threshold in the Vendor Unique Parameters Page 1. If both pages are sent, the value that is received last by the tape drive takes precedence. For more information about the motion threshold, see Section 3.6.

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 the Write Delay Time field is used to determine 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 in the reverse direction, and so on).

The default value for this byte is 0. Valid values for this field are 0000h to 3FFFh (approximately 27 minutes). A value greater than 3FFFh is not an error and will be truncated to 3FFFh.

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

The DBR bit is not supported by the tape drive. The valid value for this bit is 0.

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

The BIS bit 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)

The RSmk bit specifies whether the tape drive should return 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 – Return Check Condition status when a setmark is encountered (default).

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 ASCQ fields will be set to 00h and 03h.

Note: If the tape format does not support setmarks (8500 format), this bit is ignored in the MODE SELECT data. However, the tape drive can return 1 for the RSmk bit in the MODE SENSE data, even if the tape format does not support setmarks.

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

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

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

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

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

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

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

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

Byte 09 – Gap Size

The Gap Size field is not supported by the tape drive. The valid value is 0.

Byte 10, Bits 7 through 5 – EOD Defined

The EOD Defined field is not supported by the tape drive. The valid value is 0.

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

The EEG bit indicates that the tape drive will generate an EOD mark. The EEG bit is set to 1 in the MODE SENSE data and is ignored by the tape drive in the MODE SELECT command.

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

The SEW bit 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. This bit is set to 1 in the MODE SENSE data and is ignored by the tape drive in the MODE SELECT command.

Bytes 11 through 13 – Buffer Size at Early Warning

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

Byte 14 – Select Data Compression Algorithm

The Select Data Compression Algorithm is not supported by the tape drive. The valid value is 0.

10.13 Medium Partition Page (Page Code= 11h)

The Medium Partition Page enables you to format a tape containing one or two partitions (see Section 3.7 for information about partitions).

Before formatting new partitions, you must position the tape at LBOT (if it is currently a single-partition tape), or at the logical beginning of one of the partitions (if it is a dual-partition tape).

➤ **Important** The Medium Partition Page is available for 8500c format only. If you send this page and the tape drive is set to write 8500 format, it returns Check Condition status with the sense key set to Illegal Request (5h).

The Medium Partition Page is available in a "short form" and a "long form." The short form is 8 bytes long and enables you to format a single-partition tape. The long form is 10 bytes long and enables you to format either a single-partition or a dual-partition tape. The long form is shown below; the short form is the same without the last two bytes (bytes 08 and 09).

Note: The MODE SENSE command always returns the long form.

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							
09								LSB

Byte 00, Bit 7 – PS (Parameters Savable)

The Parameters Savable bit indicates if the MODE SELECT parameter data contained in this page is savable. The tape drive does not support this feature. The valid value for this bit is 0.

Byte 00, Bits 5 through 0 – Page Code

The Page Code identifies the page being transferred. The valid value is 11h (Medium Partition Page).

Byte 01 – Page Length

The Page Length indicates the number of bytes in the Medium Partition Page that follow this byte. The two valid values for this byte are 06h (for the short form) and 08h (for the long form). Note that the MODE SENSE command always returns the long form (08h).

Byte 02 – Maximum Additional Partitions

The Maximum Additional Partitions byte indicates the maximum number of *additional* partitions that can be defined for the loaded tape. That is, it specifies how many partitions in addition to the original partition (the entire tape) can be defined. The tape drive supports a maximum of two partitions on a tape, so the value returned for this byte in the MODE SENSE data is 01h. This field is ignored by the tape drive in the MODE SELECT command.

Byte 03 – Additional Partitions Defined

The Additional Partitions Defined byte indicates how many additional partitions you are defining with the Medium Partition Page. The valid value depends on which form of the Medium Partition Page you are using, as follows:

- **For the short form,** specify 00h to indicate that you are defining no additional partitions (the tape will have only one partition).

- **For the long form,** specify either 00h or 01h. Specify 00h to define no additional partitions (that is, the tape will have only one partition). Specify 01h to define one additional partition (the tape will have two partitions).

  Notes:

  - If you are using the long form and specify 00h for Additional Partitions Defined, the tape drive ignores bytes 08 and 09 of the Medium Partition Page (Partition Size field).

  - In the MODE SENSE data, the Additional Partitions Defined byte indicates the number of partitions defined on the currently loaded tape in addition to the original partition (the entire tape).

Byte 04, Bit 7 – FDP (Fixed Data Partitions)

The FDP bit tells the tape drive to format the tape based on its “fixed” definition of partitions. The fixed definition is a single partition encompassing the entire tape. The values for FDP are as follows:

0 – Do not format the tape. (A value of 0 is always returned in the MODE SENSE data.)

1 – Format the tape with a single partition encompassing the entire tape.

Note: If Additional Partitions Defined (byte 03) is 01h, FDP must be 0.

Byte 04, Bit 6 – SDP (Select Data Partitions)

The SDP bit tells the tape drive to format the first partition on the tape based on a predefined size. This size is “hard coded” in the tape drive as 15 MB and cannot be changed. The values for SDP are as follows:

0 – Do not format the tape. (A value of 0 is always returned in the MODE SENSE data.)

1 – If Additional Partitions Defined is 01h, format the tape with two partitions and set the size of the first partition to 15 MB. (The tape drive ignores the partition size specified in the Partition Size field.) If Additional Partitions Defined is 00h, format the tape with a single partition encompassing the entire tape.

Byte 04, Bit 5 – IDP (Initiator Defined Partitions)

The IDP bit tells the tape drive to format the first partition on the tape based on the size provided in the Partition Size field (bytes 08 and 09). The values for IDP are as follows:

0 – Do not format the tape. (A value of 0 is always returned in the MODE SENSE data.)

1 – Format the tape with two partitions, as long the value in the Partition Size field (bytes 08 and 09) is not 0. If the value in the Partition Size field is 0, the tape drive formats a tape with one partition.

Note: If Additional Partitions Defined (byte 03) is 00h, IDP must be 0.

Table 10-10 summarizes the results of all possible combinations of the FDP, SDP, and IDP bits. Note that the FDP, SDP, and IDP bits are mutually exclusive. When one of these bits is set to 1, the others must be 0.

Table 10-10 Results of combinations of the FDP, SDP, and IDP bits in the Medium Partition Page (MODE SELECT)

For these combinations...			**These results occur...**	
FDP	**SDP**	**IDP**	**When you specify no additional partitions (Additional Partitions Defined = 00h)...**	**When you specify one additional partition (Additional Partitions Defined = 01h)...**
0	0	0	The tape drive does not format the tape.	
0	0	1	not supported	If the Partition Size field ≠ 0, the tape drive formats a tape with two partitions. The size of the first partition is set to the value specified by Partition Size. If the Partition Size field = 0, the tape drive formats a tape with one partition.
0	1	0	The tape drive formats a tape with one partition. If you are sending the long form of the Medium Partition page, the tape drive ignores the Partition Size field.	The tape drive formats a tape with two partitions. The size of the first partition is set to 15 MB.
0	1	1	not supported	
1	0	0	The tape drive formats a tape with one partition. If you are sending the long form of the Medium Partition page, the tape drive ignores the Partition Size field.	not supported
1	0	1	not supported	
1	1	0		
1	1	1		

Byte 04, Bits 4 and 3 – PSUM (Partition Size Unit of Measure)

If you set IDP (Initiator Defined Partitions) to 1 and are defining additional partitions (Additional Partitions Defined = 01h), use the PSUM field to indicate the units you are using to specify the size of the additional partition. The valid values for PSUM are as follows:

00b – The partition size is specified in bytes.
01b – The partition size is specified in KB.
10b – The partition size is specified in MB. (A value of 10b is always returned in the MODE SENSE data.)

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.)
- It is illegal to set the PSUM field to 11b.
- For the long form, if you are not using the Partition Size field to specify the partition size (that is, FDP= 0, SDP= 1, and IDP= 0), the tape drive ignores the PSUM field.
- When Additional Partitions Defined is 00h, the PSUM field is ignored in the MODE SELECT command.

Byte 05 – Medium Format Recognition

The Medium Format Recognition byte indicates the tape drive's ability to recognize the medium format and partition information when an unknown tape is loaded. The value returned for this field in the MODE SENSE data is 03h, indicating that the tape drive can recognize both format and partition information. This field is ignored by the tape drive in the MODE SELECT command.

Bytes 08 and 09 – Partition Size

The Partition Size field specifies the size of the first partition on the tape when IDP = 1 and Additional Partitions Defined is 01h. The partition size represents the amount of data space that will be available between the logical beginning of the partition (LBOP) and the logical end of the partition (LEOP). The size of the second partition is the remainder of the tape.

The Partition Size field is available only in the long form of the Medium Partition Page and is valid only when two partitions are defined for the tape. If Additional Partitions Defined is 00h, the tape drive ignores this field in the MODE SELECT command, and any value returned for this field in the MODE SENSE data is invalid.

Specify the units for the Partition Size field in the PSUM field (byte 04, bits 4 and 3). The value you specify for Partition Size is converted to MB and rounded down to the nearest MB. If the resulting value is 0, the partition size is automatically set to 1 MB.

Note: If you set the IDP bit to 1 and the Partition Size field to 0, the tape drive will format a tape with one partition.

Table 10-11 indicates how much data space is available between LEOP and PEOP in the first partition.

Table 10-11 Available data space between LEOP and PEOP in the first partition of a dual-partition data tape

If the first partition is this size...	The available space between LEOP and PEOP is...
1 to 10 MB	10 MB
11 to 200 MB	40 MB
201 or more MB	70 MB

10.14 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 Page Code identifies the page being transferred. The valid value is 20h (Vendor Unique Parameters Page 1).

Byte 01 – Page Length

The Page Length indicates the number of bytes in the Vendor Unique Parameters Page 1 that follow this byte. The valid value is 04h.

Byte 02, Bit 7 – CT (Cartridge Type)

The tape drive ignores this bit.

Byte 02, Bit 5 – ND

This bit 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 during the data transfer phase.

Restrictions when the ND bit is 1:

- During a write operation, the data transfer from the initiator does not start until the number of bytes of available space in the tape drive's buffer is greater than or equal to the total transfer length specified by the CDB.

- During a read operation, the data transfer to the initiator does not start until all of the data requested by the CDB is resident in the tape drive's buffer.

- If the Buffer Full Ratio and Buffer Empty Ratio (see Section 10.9) are set to values less than A0h or greater than C0h, they will be changed to A0h. This is necessary for proper buffer management.

- The Maximum Burst Size field (see Section 10.9) has precedence over the ND bit. For this reason, if the Maximum Burst Size has already been set to a non-zero value, attempting to set the ND bit to 1 causes the tape drive to return Check Condition status with the sense key set to Illegal Request.

Byte 02, Bit 3 – NBE (No Busy Enable)

This bit is included for compatibility only. This bit is set to 1 in the MODE SENSE data and is ignored by the tape drive in the MODE SELECT command.

Byte 02, Bit 2 – EBD (Even Byte Disconnect)

This bit is used to enable disconnects on even (4-byte) boundaries. This bit is ignored by the tape drive in the MODE SELECT command because the tape drive always disconnects on 4-byte boundaries between data phases. The value returned is 1.

Note: Even-byte disconnect apples 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 bit is used to enable parity checking on the SCSI bus. When this bit is set to 1, every byte received by the tape drive is checked for parity.

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

Byte 02, Bit 0 – NAL (No Auto Load)

This bit is used to disable the automatic loading of 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)

These bits are ignored by the tape drive in the MODE SELECT command. They are returned by the MODE SENSE command to indicate the format of the data on the currently loaded data cartridge, as follows:

000b – The data on the tape is in 8500 format.
001b – The data on the tape is in 8200 format.
010b – The data on the tape is in 8500c format.

The value returned by the RTF field indicates the format that the tape drive will use when it reads the tape.

Note: If the tape is blank or written in an unrecognized format or if the tape drive is not ready, the tape drive returns the format in which it would write if the tape were positioned at LBOT (that is, the currently selected write density).

Byte 03, Bits 4 through 2 – WTF (Write Tape Format)

These bits are ignored by the tape drive in the MODE SELECT command. They are returned by the MODE SENSE command to indicate the format that will be used when the tape drive writes data to the tape, as follows:

010b – 8500c format
000b – 8500 format
001b – 8200 format

Note: You cannot write to an 8200 format tape. A write-enabled 8200 format tape is automatically ejected. The tape drive returns Check Condition status with the sense key set to Medium Error (3h) and an FSC of 47h.

The value returned for these bits reflects the default density, the density set with the most recent MODE SELECT command, or the density of the data already on the tape.

Byte 03, Bit 0 – 112m

The tape drive ignores this bit.

Byte 04 – Motion Threshold

The value in the Motion Threshold byte 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 is expressed in 4-KB increments. The default is 80h (512 KB). Valid values range from 20h to D0h (128 to 832 KB). For more information about the motion threshold, see Section 3.6.

Byte 05 – Gap Threshold

The Gap Threshold byte 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 buffered write operation.

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 a complete gap track.

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

10.15 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	Reserved						LPART	WWR
04	Reserved							
05								

Byte 00, Bits 5 through 0 – Page Code

The Page Code identifies the page being transferred. The valid value is 21h (Vendor Unique Parameters Page 2).

Byte 01 – Page Length

The Page Length indicates the number of bytes in the Vendor Unique Parameters Page 2 that follow this byte. The valid value is 04h.

Byte 03, Bit 1 – LPART (Load Partition)

The LPART bit indicates which partition you want the tape drive to position the tape to the next time it loads a tape or after it formats two partitions on the current tape. The values for this bit are as follows:

0 – For a dual-partition tape, position to the beginning of the second partition on the tape.

Note: This is the default position immediately after a dual-partition tape is loaded or a tape is formatted with two partitions.

1 – For a dual-partition tape, position to the beginning of the first partition on the tape (LBOT).

The tape drive ignores this bit if you load a single-partition tape after issuing this command.

Byte 03, Bit 0 – WWR (Write Without Retries)

The tape drive ignores this bit in the MODE SELECT command. In the MODE SENSE data, the tape drive returns this bit to indicate whether the tape was written with retries, as follows:

0 – Tape was written with retries.
1 – 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 (located on the 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 1, issue a MODE SELECT command to set the Read Retry Count field (also located on the Read-Write Error Recovery Page) to 00h.

10.16 Data Compression Status Page (Page Code= 22h)

The Data Compression Status Page is available as MODE SENSE data only. You can use the information returned on this page to determine the tape drive's compression ratio. The Data Compression Status Page applies only when the tape drive is writing in a 8500c format. If the tape drive is set to 8500 format, attempting to receive this page is not an error; however, bytes 03 through 12 are invalid and will be set to FFh.

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code					
01	Page Length							
02	Reserved							
03 ⋮ 07	(MSB) Total Bytes Received (LSB)							
08 ⋮ 12	(MSB) Total Bytes Written (LSB)							

Byte 00, Bits 5 through 0 – Page Code

The Page Code identifies the page being transferred. The value returned is 22h (Data Compression Status Page).

Byte 01 – Page Length

The Page Length indicates the number of Data Compression Status Page bytes that follow this byte. The value returned is 0Bh.

Bytes 03 through 07 – Total Bytes Received

The value returned for the Total Bytes Received field is a cumulative count of all data bytes received from the SCSI bus since one of the following events occurred:

- The tape drive was reset (by a power-on, device, or SCSI bus reset).
- A change in the direction of tape motion occurred.
- The data cartridge was unloaded.
- The operating mode was changed from write to read.

Note: If no data bytes have been received, the value returned for this field is FFh.

Bytes 08 through 12 – Total Bytes Written

The value returned for the Total Bytes Written field is a cumulative count of all bytes written to the buffer since one of the following events occurred:

- The tape drive was reset (by a power-on, device, or SCSI bus reset).
- A change in the direction of tape motion occurred.
- The data cartridge was unloaded.
- The operating mode was changed from write to read.

The value in this field represents the total size of the data after it has been processed by the data compression algorithm.

Note: If no bytes have been written to the tape drive's buffer, the value returned for this byte is FFh.

Determining the Compression Ratio

You can use the Total Bytes Received and Total Bytes Written fields to calculate the compression ratio as follows:

$$\text{Compression ratio} = \frac{\text{Total Bytes Received}}{\text{Total Bytes Written}}$$

10.17 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the MODE SELECT command.

Illegal Value in MODE SELECT Data

If one of the bytes sent with the MODE SELECT data contains an illegal value or if a reserved bit is set, the tape drive returns Check Condition status. To determine which byte contains the error, issue a REQUEST SENSE command. The sense key will be set to Illegal Request (5h) and the Fault Symptom Code field (byte 28) will indicate which of the consecutively received bytes is in error. For example, if the Block Descriptor Length field (byte 03) in the Parameter List Header is invalid, the value for the Fault Symptom Code byte would be 04h.

Note: The tape drive counts the first byte received as byte 1, not as byte 0.

10.18 Tape Format Examples

This section provides examples for using the tape drive to write, append to, and read tapes in the following formats:

- 8500c format
- 8500 format
- 8200 format (read only)

As you review and use the examples in this section, keep the following rules in mind:

- The tape drive allows only one format on any one tape.
- If you are writing data, you must decide on the tape's format at LBOT. This is because the LBOT blocks define the format for the tape. If you do not select a format, the tape drive writes in the power-on default format.

  Note: To rewrite the tape in a different format, you must overwrite the previously written LBOT pattern by issuing a WRITE (0Ah) or WRITE FILEMARKS (10h) command at LBOT.

- If you are appending to a previously written tape at a location other than LBOT, the tape drive automatically writes in the format of the data already on the tape.

  Note: You cannot append to a tape written in 8200 format. A write-enabled 8200 format tape is automatically ejected. The tape drive returns Check Condition status with the sense key set to Medium Error (3h) and an FSC of 47h.

- If you are reading a previously written tape, the tape drive automatically determines the tape's format for you. However, you can determine the format for yourself by following these steps:

  a. Load the data cartridge in the tape drive.

  b. Issue a MODE SENSE (1Ah) command.

  c. Look at the Density Code in the Block Descriptor or the RTF field in the Vendor Unique Parameters Page 1 (Page Code= 20h).

- If you are using a tape that has been formatted with two partitions, you must read and write data in 8500c format. If you attempt to change the format of the tape, you will destroy the partition information.

Writing and Reading in 8500c Format

This section describes how to use the tape drive to write, append to, and read tapes in 8500c format.

Writing 8500c Format Tapes

The procedure you follow for writing in 8500c format depends on whether your SCSI driver supports MODE SELECT pages. (Refer to page 10-59 if you cannot issue MODE SELECT commands.)

If Your SCSI Driver Does Not Support MODE SELECT Pages If your SCSI driver does not support MODE SELECT pages, follow these steps to write data in 8500c format:

1. Load a blank data cartridge in the tape drive (or load a previously written data cartridge that you want to overwrite).
2. Issue a MODE SELECT (15h) command at LBOT. Set the Density Code in the Block Descriptor to 8Ch.
3. Issue a WRITE (0Ah) or WRITE FILEMARKS (10h) command to write the data.

If Your SCSI Driver Supports MODE SELECT Pages If your SCSI driver supports MODE SELECT pages, follow these steps to write data in 8500c format:

1. Load a blank data cartridge in the tape drive (or load a previously written data cartridge that you want to overwrite).
2. Issue a MODE SELECT (15h) command at LBOT. Set the Density Code in the Block Descriptor to 8Ch.
3. Issue a WRITE (0Ah) or WRITE FILEMARKS (10h) command to write the data.
4. If desired, issue additional MODE SELECT commands to turn data compression on and off.
   - To turn compression off, set the DCE bit in the Data Compression Page to 0.
   - To turn compression back on, set the DCE bit in the Data Compression Page to 1.

Appending to 8500c Format Tapes

If a tape has already been written in 8500c format and you want to write additional data on the tape, follow these steps:

1. Load the data cartridge in the tape drive.

   Note: If you issue a MODE SELECT command at LBOT, be sure that the Density Code in the Block Descriptor is set to 8Ch.

2. Issue a READ (08h), SPACE (11h), or LOCATE (2Bh) command to move away from LBOT and to a legal position for appending.

   Note: Legal positions for appending in 8500c format are either side of a long filemark or setmark and at the end-of-data (EOD) mark.

3. Issue a WRITE (0Ah) or WRITE FILEMARKS (10h) command to write the additional data. The tape drive automatically sets the Density Code and the DCE and DDE bits to 8500c format.

   Note: The WTF field in the MODE SENSE command indicates that the tape drive is writing in 8500c format.

Reading 8500c Format Tapes

To use the tape drive to read an 8500c format tape, follow these steps:

1. Load the data cartridge in the tape drive.

2. Issue a READ (08h) command to read the data. The tape drive decompresses any compressed data before transferring it to the initiator.

Writing and Reading in 8500 Format

This section describes how to use the tape drive to write, append to, and read tapes in 8500 format.

Writing 8500 Format Tapes

To write tapes in 8500 format, follow these steps:

1. Load a blank data cartridge in the tape drive (or load a previously written data cartridge that you want to overwrite).

2. Issue a MODE SELECT command at LBOT. Set the Density Code in the Block Descriptor to 15h.

Note: Refer to page 10-59 if you cannot issue MODE SELECT commands.

3. Issue a WRITE or WRITE FILEMARKS command to write the data.

Appending to 8500 Format Tapes

If a tape has already been written in 8500 format and you want to write additional data on the tape, follow these steps:

1. Load the data cartridge in the tape drive.

Note: If you issue a MODE SELECT command at LBOT, be sure that the Density Code in the Block Descriptor is set to 15h.

2. Issue a READ, SPACE, or LOCATE command to move away from LBOT and to a legal position for appending.

Note: Legal positions for appending in 8500 format are either side of a long filemark and at the end-of-data (EOD) mark.

3. Issue a WRITE or WRITE FILEMARKS command to write the additional data. The tape drive automatically sets the Density Code to 8500 format.

Note: The WTF bit in the MODE SENSE data indicates that the tape drive is writing in 8500 format (000b).

Reading 8500 Format Tapes

To use the tape drive to read an 8500 format tape, follow these steps:

1. Load the data cartridge in the tape drive.

2. Issue a READ command to read the data. The tape drive automatically determines the tape's format.

Writing, Reading, and Appending in 8200c Format

➤ **Important** The tape drive cannot write, read, or append to 8200c format tapes. If you attempt to read a 8200c format tape the tape drive returns Check Condition status to the initiator with a sense key of Medium Error (3h) and an FSC of 1Ch.

Reading in 8200 Format

To use the tape drive to read an 8200 format tape, follow these steps:

1. Write protect the data cartridge, then load it in the tape drive. The tape drive automatically ejects an 8200 format tape if the data cartridge is not write-protected.

2. Issue a READ command to read the data. The tape drive automatically determines the tape's format.

➤ **Important** The tape drive cannot write or append to 8200 format tapes. If you attempt one of these actions, the tape drive returns Check Condition status with the sense key set to Illegal Request (5h).

If You Cannot Issue MODE SELECT Commands

If you cannot issue MODE SELECT commands to set the Density Code, follow these steps to write tapes in different formats:

1. Obtain a tape that has already been written in the desired format. This tape must include an LBOT pattern plus data or at least one filemark (or setmark in 8500c format).

2. Load the previously written tape in the tape drive.

3. Issue a SPACE or READ command to move the tape away from LBOT. The tape drive automatically sets the Density Code to the format it finds on the tape.

4. Issue a WRITE or WRITE FILEMARKS command to write information (data, a filemark, or a setmark).

   Note: After you complete steps 2, 3, and 4, the Density Code remains as set in step 3 for as long as that tape is loaded.

5. Rewind the tape to LBOT.

6. Issue a WRITE or WRITE FILEMARKS command to write new information to the tape and to overwrite the existing information. The tape will be written in the desired format.

7. To change the format, repeat steps 1 through 6 with a tape written in the new format. Or, load a blank tape to write in the tape drive's power-on default format.

Notes

11 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.

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.

Note: 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.

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 unloaded from the tape path or ejected.

Effect on the UNLOAD (1Bh) Command

When removal of the data cartridge is prevented by the PREVENT/ ALLOW MEDIUM REMOVAL command, issuing an 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 Field Definitions

Byte 04, Bit 0 – Prevent

The Prevent bit is used to prevent the removal of the 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, unload button reset, or power-on reset.

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for this command.

12 READ (08h)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	0	1	0	0	0
01	Logical Unit Number			Reserved			SILI	Fixed
02	(MSB)							
03	Transfer Length							
04								(LSB)
05	Vendor Unique		Reserved				0	0

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 can read tapes written in 8500c, 8500, and 8200 formats.

➤ **Important** The tape drive cannot read tapes written in 8200c format. If you attempt to read an 8200c format tape, the tape drive returns Check Condition status with a sense key of Medium Error (3h) and an FSC of 1Ch.

Notes:

- For a read operation, the tape drive automatically sets itself to the data format used when the tape was written.
- The tape drive can read tapes that have a combination of fixed-length and variable-length data blocks.
- If the disconnect option is enabled, the tape drive can disconnect from the initiator while the READ command is executing.
- If the requested logical block length is greater than the actual logical block length, the tape drive will not disconnect from the SCSI bus between the Data In phase and the Status In phase. The tape drive sets the Illegal Length Indicator (ILI) bit in the REQUEST SENSE data to 1.

12.2 Field Definitions

Byte 01, Bit 1 – SILI

The SILI (Suppress Illegal Length Indication) 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.
- When the SILI bit is 1, Check Condition status is suppressed for all cases in which the length of the logical lock 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 being performed, as follows:

0 – A single logical block is read, and the length of this block is specified in the Transfer Length field.

1 – One or more fixed-length logical blocks are read, and the number of blocks is specified in the Transfer Length field. The length of each block is either the power-on default block length or the length specified with the currently active MODE SELECT parameters (bytes 5 through 7 of the Block Descriptor).

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 defines the amount of data to be read, as follows:

- When the Fixed bit is set to 0, the Transfer Length field contains the length of the logical block in bytes. The logical block can be any size from 0 to 240 KB.
- When the Fixed bit is set to 1, the Transfer Length field contains the number of logical blocks to be read. The block length is the length specified with the MODE SELECT command. The allowable block sizes are defined by the READ BLOCK LIMITS (05h) command.

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 this command.

12.3 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the READ command.

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.

Setmark Detected

Note: This error applies to tapes written in 8500c format only.

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, 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 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.

EOD Detected

If the tape drive detects the EOD mark (or blank tape for 8200 format) 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.

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) for 8500c format only, it returns Check Condition status. The REQUEST SENSE data is set as follows:

Valid	0 or 1
EOM	1
Sense Key	Volume Overflow (Dh)
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	00h
ASCQ	02h
PEOT	1
FSC	14h

When the READ command terminates, the logical position is undefined.

Unrecoverable 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.

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

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).

Illegal Requests

The following conditions cause the tape drive to return Check Condition status with the sense key set to Illegal Request (5h):

- The Fixed bit is set to 1 and the block length in the MODE SELECT command is 0.
- The Fixed bit is set to 1 and the SILI bit is set to 1.
- The Fixed bit is set to 0 and the requested block length is greater than 240 KB.
- 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).
- The tape drive is not ready or no data cartridge is loaded.

Compression Errors

The tape drive can report two types of compression errors during a read operation:

- If the compression circuit is unable to decompress previously compressed data during a read operation, the tape drive returns Check Condition status. The REQUEST SENSE data is set as follows:

Sense Key	Hardware Error (4h)
ASC	11h
ASCQ	00h
FSC	18h

- If the read decompression CRC fails during a read operation, the tape drive returns Check Condition status. The REQUEST SENSE data is set as follows:

Sense Key	Aborted Command (Bh)
ASC	11h
ASCQ	02h
FSC	19h

To recover from either of these errors, follow these steps:

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).

If the error persists, the tape drive requires service.

Notes

13 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 Field Definitions

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for this command.

13.3 Read Block Limits Data

The tape drive returns Read Block Limits data to the initiator to indicate the maximum and minimum block lengths it supports.

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved							
01	(MSB)							
02	Maximum Block Length							
03								(LSB)
04	(MSB) Minimum Block Length							
05								(LSB)

Bytes 01 through 03 – Maximum Block Length

The value returned for the Maximum Block Length field is 03C000h (240 KB).

Bytes 04 and 05 – Minimum Block Length

The value returned for the Minimum Block Length field is 0001h (1 byte).

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 copy the tape drive's microcode across the SCSI bus to the initiator. This command is used with the WRITE BUFFER (3Bh) command to copy the microcode from one tape drive to another tape drive.

To copy microcode from one tape drive to another tape drive, follow these steps:

1. Issue a READ BUFFER command to place the tape drive's microcode into the correct format and to transfer the microcode image across the SCSI bus to the initiator.

   Note: The READ BUFFER command does not transfer the tape drive configuration options or the MODE SELECT defaults to the initiator.

2. Issue one or more WRITE BUFFER commands to download the microcode from the initiator to other tape drives. For information about using the WRITE BUFFER command, refer to Chapter 26.

14.2 Field Definitions

Byte 01, Bits 2 through 0 – Mode

The Mode field determines the type of operation to be performed. The only operation supported by the tape drive is reading the microcode image. The bits in this field must be set to 001b.

Byte 02 – Buffer ID

This field must be 0.

Bytes 03 through 05 – Buffer Offset

This field must be 0.

Bytes 06 through 08 – Allocation Length

The Allocation Length field specifies the number of bytes to be transferred across the SCSI bus. The valid value for this field is 54E28h (347,688).

Byte 09, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for this command.

14.3 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the READ BUFFER command.

Hardware or SCSI Bus Error

If a hardware or SCSI bus error occurs while the microcode is being transferred from the tape drive to the initiator, the tape drive terminates the command and returns Check Condition status. The sense key is set to Aborted Command (Bh). If this occurs, retry the operation.

Allocation Length Incorrect

If you specify a value other than 54E28h (347,688) for the Allocation Length field, the tape drive returns Check Condition status. The sense key is set to Illegal Request (5h).

Notes

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 7, the READ POSITION command is intended to be used with the LOCATE (2Bh) command to enable you to position the tape at a specified logical block address.

Notes:

- The READ POSITION command is not supported for tapes written in 8200 format and will result in Check Condition status with the sense key set to Illegal Request (5h).

- If you issue a READ POSITION command when no data cartridge is loaded, the tape drive returns Check Condition status with the sense key set to Not Ready (2h). The ASC and ASCQ fields are set to 3Ah and 00h.

15.2 Field Definitions

Byte 01, Bit 0 – BT (Block Type)

This bit determines the type of block number to be returned to the initiator, as follows:

0 – The SCSI logical block number is returned. The blocks are numbered sequentially, starting with zero, from the beginning of the tape or the beginning of each partition if the tape is formatted with two partitions. The number includes setmarks and filemarks.

1 – The logical block number is returned. The blocks are numbered sequentially, starting with zero, from the beginning of the tape or the beginning of each partition if the tape is formatted with two partitions. The number does not include setmarks or filemarks (Exabyte unique).

Byte 09, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for this command.

15.3 Read Position Data

When it completes the READ POSITION command, the tape drive returns 20 bytes of Read Position data to the initiator, 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)

The BOP bit 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 dual-partition tape, the tape is positioned at the logical beginning of the currently active partition (LBOP). For a single-partition tape the tape is positioned at LBOT.

Byte 00, Bit 6 – EOP (End of Partition)

The EOP bit 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 dual-partition 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 single-partition tape, the tape is positioned between LEOT and PEOT.

Byte 00, Bit 2 – BPU (Block Position Unknown)

The BPU bit 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

When a dual-partition tape is loaded, the Partition Number field returns the number of the partition in which the tape is currently located, as follows:

0 – The current location is in the second partition on the tape.
1 – The current location is in the first partition on the tape.

If the loaded tape has no partitions, the value returned for this field is 0.

Bytes 04 through 07 – First Block Location

The First Block Location 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 bytes 03 through 06 of the LOCATE CDB.

Note: If a READ POSITION command follows an immediate command, the tape drive completes the immediate command so that the position can be accurately reported.

Bytes 08 through 11 – Last Block Location

The Last Block Location field is not valid for 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 valid for 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 valid for the tape drive. The value returned for this field is 0.

Notes

16 RECEIVE DIAGNOSTIC RESULTS (1Ch)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	1	1	0	0
01	Logical Unit Number			Reserved				
02	Reserved							
03	(MSB) Allocation Length							
04								(LSB)
05	VU		Reserved				0	0

16.1 About This Command

You can use the RECEIVE DIAGNOSTIC RESULTS command to obtain the results of test requested by a previous SEND DIAGNOSTIC RESULTS 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.

As described in this chapter, the bit and byte settings for the RECEIVE DIAGNOSTIC RESULTS command descriptor block depend on whether you are using the command to obtain diagnostic results data or a processor memory listing.

16.2 Field Definitions

Bytes 03 and 04 – Allocation Length

The Allocation Length field specifies the number of bytes that the initiator has allocated for the return of RECEIVE DIAGNOSTICS 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 5 and 6 – VU (Vendor Unique)

There is no vendor unique definition for these bits.

16.3 Returning SEND DIAGNOSTIC Data

When the initiator issues a RECEIVE DIAGNOSTIC RESULTS command, the tape drive returns a diagnostic page that reports the results of the previous SEND DIAGNOSTIC command.

Note: To ensure that data in the diagnostic page is valid, 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.

Diagnostic Page

Bit / Byte	7	6	5	4	3	2	1	0
00	Page Code							
01	Reserved							
02	(MSB) Page Length							
03								(LSB)
04 … *nn*	Diagnostic Parameters							

Byte 00 – Page Code

The Page Code field identifies which of the three diagnostic pages is being returned. The tape drive supports the Page Codes listed in Table 16-1.

Table 16-1 Page Codes for RECEIVE DIAGNOSTIC RESULTS

Page Code	Returned for...
90h	Test 100 or Test 110 (Power-on test)
91h	Test 101 or Test 111 (Power-on, write/read, and load tests)
94h	Processor memory listing

Bytes 02 and 03 – Page Length

The Page Length field indicates the number Diagnostic Parameter bytes that follow this field. Table 16-2 indicates the Page Length values for each Page Code supported by the RECEIVE DIAGNOSTIC RESULTS command.

Table 16-2 Page Lengths for RECEIVE DIAGNOSTIC RESULTS command

Page Code	Value for Page Length field	Total length of page
90h	0001h (1 byte)	5 bytes
91h	0001h (1 byte)	5 bytes
94h	0000h to 9060h (0 to 36,960 bytes)	0 to 36,964 bytes

Bytes 04 through *nn* – Diagnostic Parameters

The Diagnostic Parameter bytes start with byte 04. Table 16-3 indicates how these bytes are defined for each Page Code.

Table 16-3 Meaning of Diagnostic Parameter bytes for each Page Code

<table>
<tr><th>If the Page Code (Diagnostic Test) is...</th><th>This many Diagnostic Parameter bytes are returned...</th><th>The meaning of the Diagnostic Parameter bytes is...</th></tr>
<tr><td>90h (Test 100 or Test 110</td><td>1 (byte 04)</td><td rowspan="2">Pass/ Fail Code. Indicates if the tape drive passed or failed the test. Values for this byte are as follows:
00h – Passed the test
01h to FFh – 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 D.</td></tr>
<tr><td>91h (Test 101 or Test 111)</td><td>1 (byte 04)</td></tr>
<tr><td>94h (Processor memory listing)</td><td>up to 36,960 bytes (bytes 04 through nn)</td><td>Memory listing information (Monitor dump)</td></tr>
</table>

16.4 Receiving a Processor Memory Listing

The processor memory listing contains the current information from specified locations in the tape drive’s processor memory.

To receive a processor memory listing (Monitor dump), issue a RECEIVE DIAGNOSTIC RESULTS command with the Allocation Length field set to 9064h. Refer to Section 21.4 for information about using SEND DIAGNOSTIC to obtain a processor memory listing.

➤ **Important** When you suspect a problem that must be investigated by examining the processor memory, always request the complete processor memory listing (9064h bytes). Partial processor memory listings do not contain useful information.

17 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 Dev ID			RSVD
02	Reserved							
03								
04								
05	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 (16h) 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.

17.2 Field Definitions

Byte 01, Bit 4 – 3rdPty

The 3rdPty bit is used 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 – Third Party Device ID

The Third Party Dev ID field indicates the SCSI ID of the device for which the tape drive is reserved.

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for this command.

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. This sense data is preserved in the tape drive for the initiator receiving the Check Condition status. Sense data is cleared when any subsequent command that is not a REQUEST SENSE or an INQUIRY (12h) command is received from the initiator receiving the Check Condition status.

18.2 Field Definitions

Byte 04 – Allocation Length

The Allocation Length field specifies the number of bytes that the initiator has allocated for returned sense data. The tape drive provides a total of 29 (1Dh) bytes of sense data.

Byte 05, Bit 7 – CLRCNT

The CLRCNT bit enables the initiator to reset the Read/Write Data Error counter, the Tracking Retry counter, the Read/Write Retry counter, and the Underrun/Overrun counter. Values for the CLRCNT bit are 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 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.

18.3 Extended Sense Bytes

The tape drive supports the standard extended sense bytes, as follows:

Bit / Byte	7	6	5	4	3	2	1	0
00	Valid	Error Code						
01	Segment Number							
02	FMK	EOM	ILI	RSVD	Sense Key			
03	(MSB) Information							
⋮								
06								(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								
16	(MSB) Read/Write Data Error Counter							
17								
18								(LSB)
19	PF	BPE	FPE	ME	ECO	TME	TNP	LBOT
20	RSVD	TMD	WP	FMKE	URE	WEI	SSE	FE
21	RSVD	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							

Byte 00, Bit 7 – Valid

0 – The data in the Information bytes is undefined.

1 – The data in the Information bytes (bytes 03 through 06) is valid for the command receiving the Check Condition status.

Byte 00, Bits 6 through 0 – Error Code

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 01 – Segment Number

This byte is always 0.

Byte 02, Bit 7 – FMK (Filemark)

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 LBOT.
- The tape is at or past the early warning (logical end of tape).

Byte 02, Bit 5 – ILI (Illegal Length Indicator)

1 – The logical block length requested did not match the actual logical block length of the data recorded on the tape.

Byte 02, Bit 3 through 0 – Sense Key

The values contained in the Sense Key field are defined in Table 18-1.

Table 18-1 Sense key values

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 an error condition that may have been caused either because a write-enabled 8200 format tape was loaded, the tape was written in 8200c format, or because there is 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, an unload button 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. ▪ A data cartridge was inserted and automatically ejected because the media was incompatible with the tape drive. (For example, a advanced metal evaporated (AME) tape was inserted.) ▪ 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. Refer to Section 3.8 for more information about the Unit Attention condition.
7h	Data Protect	Indicates that a command that writes to tape was attempted on a write-protected data cartridge. The write operation was not performed.

Table 18-1 Sense key values *(continued)*

Sense Key	Meaning	Explanation
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.
Ah	Copy Aborted	This sense condition is not supported by the tape drive.
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.
Ch	Equal	This sense condition is not supported by the tape drive.
Dh	Volume Overflow	Indicates that the last WRITE or WRITE FILEMARKS command reached PEOT and that data may remain in the buffer.
Eh	Miscompare	This sense condition is not supported by the tape drive.
Fh	Reserved	Reserved for future implementation in the ANSI SCSI standard.

Bytes 03 through 06 – Information

The Information bytes contain a value that 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.

The value in the Information bytes 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 these bytes is invalid.

Byte 07 – Additional Sense Length

This byte indicates the Additional Sense Length provided by the tape drive, excluding this byte. The value is 21 (15h) 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 8.

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 8.

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.

The counter 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 that in order for the reset to be performed, 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 FFFFFFh to 0 but remains at FFFFFFh until reset.

Byte 12 – Additional Sense Code (ASC)

The Additional Sense Code, in conjunction with the Additional Sense Code Qualifier (byte 13), provides additional information about each sense key. Appendix D lists the possible combinations of this byte and the ASCQ byte for each sense key. Only those ASC values used by the tape drive are shown in the appendix.

Byte 13 – Additional Sense Code Qualifier (ASCQ)

The Additional Sense Code Qualifier, in conjunction with the Additional Sense Code (byte 12), provides additional information about each sense key. Appendix D lists the possible combinations of this byte and the ASC byte for each sense key. Only those ASCQ values used by the tape drive are shown in the appendix.

Bytes 16 through 18 – Read/Write Data Error Counter

The Read/Write Data Error Counter is a dual-function counter for logging rewrites and read ECCs for recovered physical blocks (physical block size is 1 KB). The mode of operation determines what is being counted. The counter is incremented in write mode when a specific physical block is rewritten following a read-after-write failure. The counter is incremented in read mode when the physical block was reconstructed in the formatter by the Error Correction Code (ECC) operation.

The counter 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 that in order for the reset to be performed, 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 FFFFFFh to 0 but remains at FFFFFFh until reset.

Bytes 19 through 21 – Unit Sense

For each status bit defined in the Unit Sense bytes, the normal or Good status is 0. When set to 1, these bytes indicate the condition defined for that bit, as follows. Note that the effective value for the RSVD bits is 0.

Note: The status bits provided in the Unit Sense bytes reflect the current status of the tape drive and may not match the information available in the sense key, ASC, ASCQ, and FSC fields.

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 is set to indicate a permanent write error. In read mode, this bit is set to indicate 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) An error occurred when the tape drive was attempting to perform a space filemark operation, resulting in an invalid location relative to the requested location. The Valid bit is set to 1, and the Information bytes (bytes 03 through 06) indicate the difference between the number of filemarks specified by the initiator and the actual number of filemarks processed by the tape drive. This may be a host recoverable error. The initiator needs to re-send the SPACE command with the correct number of filemarks.

Note: This bit is valid for tapes in 8200 format only.

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.

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 6 – UCLN 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 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 The tape drive needs to be cleaned. This bit is reset to 0 when a successful cleaning cycle is performed.

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.

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.

Bytes 23 through 25 – Remaining Tape

The Remaining Tape field indicates the amount of tape remaining in 1,024-byte physical blocks. This is the LEOT position minus the current physical position. If the position is past the LEOT, the value is negative, indicating the number of physical blocks past LEOT. If there is no data cartridge loaded, the value is 0.

Byte 26 – Tracking Retry Counter

The Tracking Retry Counter field increments when a tracking error occurs during tape motion start-up. This counter 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 that in order for the reset to be performed, 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

The Read/Write Retry Counter field increments whenever a read or write operation is unsuccessful and a recovery/retry action is performed. The counter 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 that in order for the reset to be performed, 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 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. Appendix D lists the errors indicated by the Fault Symptom Code byte.

Note: The Fault Symptom Code field can also be used to determine the location of errors in the data sent with LOG SELECT (4Ch) and MODE SELECT (15h) commands. If one of the bytes sent with the LOG SELECT or MODE SELECT command contains an illegal value or if a reserved bit is set, the tape drive returns Check Condition status. To determine which byte contains the error, issue a REQUEST SENSE command. The sense key will be set to Illegal Request (5h) and the Fault Symptom Code field will indicate which of the consecutively received bytes is in error.

For example, if the Block Descriptor Length field (byte 03) in the MODE SELECT Parameter List Header is invalid, the value for the Fault Symptom Code byte would be 04h (the tape drive counts the first byte received as byte 1 not as byte 0). Note that this use of the Fault Symptom Code byte applies to the MODE SELECT and LOG SELECT commands only and is not described in Appendix D.

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 execution that is not an INQUIRY or REQUEST SENSE command for the same initiator.
- Error information is reset by a power-on reset, a Bus Device Reset message, or a SCSI bus reset condition.

19 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 Dev ID			RSVD
02	Reserved							
03								
04								
05	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 (17h) 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 any command (other than an INQUIRY (12h), PREVENT/ALLOW MEDIUM REMOVAL (1Eh), or REQUEST SENSE (03h) command) is received from another initiator, the command will not be honored. Reservation Conflict (18h) status is returned to the initiator that sent the command.

19.2 Field Definitions

Byte 01, Bit 4 – 3rdPty

The 3rdPty bit is used to request third-party reservations, as follows:

0 – A third-party reservation is not requested.
1 – A third-party reservation is requested.

Byte 01, Bits 3 through 1 – Third Party Dev ID

The Third Party Dev ID field indicates the SCSI ID of the device for which the initiator is making the third-party reservation.

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for this command.

20 REWIND (01h)

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

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 formatted with two partitions, to the logical beginning of the partition (LBOP) in which the tape is currently positioned. (See Section 3.7 on page 3-15 for information about formatting and using partitioned tapes.)

Notes:

- If the disconnect option is enabled, the tape drive disconnects from the initiator while the REWIND command is executing.
- If the REWIND command is received after a WRITE (0Ah) or WRITE FILEMARKS (10h) command, buffered data, filemarks, or setmarks are written to the tape before it is rewound.
- If the tape is already at LBOT (or LBOP for a dual-partition tape) and there is no data in the buffer, no tape motion results.

- If an error occurs during the writing of the data in the buffer to the tape, the tape drive returns Check Condition status. The rewind operation is not performed. The initiator should issue a REQUEST SENSE (03h) command to determine the cause of the error.

- 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 for a dual-partitioned tape).

- 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 Field Definitions

Byte 01, Bit 0 – Immed

The Immed bit is used to determine when command status is returned to the initiator, as follows:

0 – Status is reported to the initiator when the REWIND command is completed.

1 – Status is reported to the initiator 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 was enabled by the Identify message) 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 this command.

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	DevOfL	UntOfL
02	Reserved							
03	(MSB) Parameter List Length							
04	(LSB)							
05	MD	VU	Reserved				0	0

21.1 About This Command

The SEND DIAGNOSTIC command causes the tape drive to perform certain self-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, the SEND DIAGNOSTIC command returns Check Condition status with the sense key set to Illegal Request (5h) and the ASC and ASCQ fields set to 53h and 02h under either of the following conditions:
  - 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 1 (autoloading disabled).

21.2 Field Definitions

Byte 01, Bit 4 – PF (Page Format)

The Page Format bit specifies the format of the parameter list for the SEND DIAGNOSTIC command. The tape drive does not support any pages, so the valid value for this field is 0.

Byte 01, Bits 2 through 0 – SelfTest, DevOfL, UntOfL

The SelfTest, DevOfL (Device Offline), and UntOfL (Unit Offline) bits are used together to determine the test to be performed and the data to be returned to the initiator. Refer to Table 21-1 for the valid combinations of these three bits.

Bytes 03 and 04 – Parameter List Length

The Parameter List Length field is used only when the MD bit (byte 05, bit 7) is 1. If the MD bit is 0, the Parameter List Length field must be set to 0000.

As shown in Table 21-1, if the MD bit is 1 and the SelfTest, DevOfL, and UntOfL bits are set to 0, the Parameter List Length field specifies the starting address for the memory listing. Valid values for the memory listing starting address are 0000h to9063h.

Byte 05, Bit 7 – MD (Memory Dump)

> **CAUTION**
>
> Requesting a processor memory listing causes the data in the RAM buffer to be destroyed.

This bit indicates if a processor memory listing (dump) is requested, as follows:

0 – Memory listing not requested
1 – Memory listing requested

If the MD bit is 1, the SelfTest, DevOfL, and UntOfL bits must be 0.

Note: If the MD bit is 1 and the SelfTest, DevOfL, and UntOfL bits are not 0, the SEND DIAGNOSTIC command is rejected with Check Condition status. The sense key is set to Illegal Request (5h), and the ASC and ASCQ fields are set to 24h and 00h.

Byte 05, Bit 6 – VU (Vendor Unique)

There is no vendor unique definition for this bit.

21.3 Diagnostic Tests

Table 21-1 lists the valid combinations of the SelfTest, DevOfL, UntOfL, Parameter List Length, and MD fields in the SEND DIAGNOSTIC command and the resulting actions performed by the tape drive. Note that 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	Parameter List Length	MD	Type of test
0	0	0	0 to 9063h	1	Processor memory listing
1	0	0	0	0	Test 100 (Power-on tests without tape)
1	0	1	0	0	Test 101 (Power-on, write/read, and load tests with tape—Tape not loaded at start of test)
1	1	0	0	0	Test 110 (Power-on tests with tape)
1	1	1	0	0	Test 111 (Power-on, write/read, and load tests with tape—Tape preloaded at start of test)

21.4 Test Descriptions

This section describes the memory listing and each type of diagnostic test.

Processor Memory Listing

CAUTION

Requesting a processor memory listing causes the data in the RAM buffer to be destroyed.

➤ **Important** When you suspect a problem that must be investigated by examining the processor memory, always request the complete processor memory listing (9064h bytes). Partial processor memory listings do not contain useful information.

The processor memory listing returns the current information from the tape drive's processor memory.

To obtain a complete processor memory listing, follow these instructions:

1. Issue a SEND DIAGNOSTIC command with the SelfTest, DevOfL, and UntOfL bits set to 0; the Parameter List Length set to 0; and the MD bit set to 1.

2. Issue a RECEIVE DIAGNOSTIC RESULTS command with the Allocation Length field set to 9064h.

Note: If the initiator requests more bytes than are available (that is, more than 9064h bytes), the tape drive will send all available bytes and then terminate. This is not an error.

Test 100 (Power-on Tests without Tape)

During this test, the tape drive performs its power-on RAM and servo diagnostic tests. The tape drive returns Good status if it finds no errors. Incorrect test setup causes the tape drive to return Check Condition status with the sense key set to Illegal Request.

The tape drive disconnects during this test.

Note: The unload button is disabled during this test.

Setup for Test 100

Before starting this test, power the tape drive on but do not insert a data cartridge. Issue a TEST UNIT READY (00h) command. The tape drive must return Check Condition status. Then, issue a REQUEST SENSE command. The sense key should be set to Not Ready (no data cartridge present).

Test 101 (Power-on, Write/Read, and Load Tests with Tape – Tape Not Loaded at Start of Test)

During this test, the tape drive first performs its power-on RAM and servo diagnostic tests. If no failures are found, the top LED flashes to prompt you to insert a write-enabled, “scratch” data cartridge. The tape drive then loads the tape and performs the following operations:

- Writes internally generated data to the buffer
- Writes buffered data to the tape
- Rewinds the tape
- Reads data from the tape to the buffer
- Reads and verifies the data in the buffer
- Rewinds the tape

If these operations complete successfully, the tape drive returns Good status, then unloads and ejects the data cartridge. Improper test setup causes the tape drive to return Check Condition status with the sense key set to Illegal Request.

The tape drive disconnects during this test.

Note: The unload button is disabled during this test.

Setup for Test 101

Before starting this test, power the tape drive on but do not insert a data cartridge. Issue a TEST UNIT READY (00h) command. The tape drive must return Check Condition status. Then, issue a REQUEST SENSE command. The sense key must be set to Not Ready (no data cartridge present).

> **CAUTION**
>
> When performing this test, be sure to use a data cartridge that does not contain needed data ("scratch" data cartridge). Data on the tape will be destroyed during the write portion of this test.

Test 110 (Power-on Tests with Tape)

During this test, the tape drive performs its power-on RAM and servo diagnostic tests. If these tests complete successfully, the tape drive returns Good status and positions the tape at LBOT. Improper test setup causes the tape drive to return Check Condition status with the sense key set to Illegal Request.

The tape drive disconnects during this test.

Note: The unload button is disabled during this test.

Setup for Test 110

Before starting this test, power the tape drive on and insert a write-enabled, "scratch" data cartridge. Issue a TEST UNIT READY (00h) command. The tape drive must return Good status.

Test 111 (Power-on, Write/Read, and Load Tests with Tape – Tape Preloaded at Start of Test)

During this test, the tape drive first performs its power-on RAM and servo diagnostic tests. If these tests complete successfully, the tape drive continues by performing the following operations:

- Writes internally generated data to the buffer
- Writes buffered data to the tape
- Rewinds the tape
- Reads data from the tape to the buffer
- Reads and verifies the data in the buffer
- Rewinds the tape

If these operations complete successfully, the tape drive returns Good status and unloads and ejects the data cartridge. Improper test setup causes the tape drive to return Check Condition status with the sense key set to Illegal Request.

The tape drive disconnects during this test.

Note: The unload button is disabled during this test.

Setup for Test 111

Before starting this test, power the tape drive on and insert a write-enabled, “scratch” data cartridge. Issue a TEST UNIT READY (00h) command. The tape drive must return Good status. Then, issue a REQUEST SENSE command. The EOM and LBOT bits must be set to indicate that the tape is positioned at LBOT.

CAUTION

When performing this test, be sure to use a data cartridge that does not contain needed data. Data on the tape will be destroyed during the write portion of this test.

Note: Data created during SEND DIAGNOSTIC tests cannot be interpreted by normal tape drive read operations. However, the tape can be reused for normal use.

22 SPACE (11h)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	0	0	0	1
01	Logical Unit Number			Reserved		Code		
02	(MSB)							
03				Count				
04								(LSB)
05	ADE	VU	Reserved				0	0

22.1 About This Command

The SPACE command enables the tape drive to perform forward or backward searches. You can use this command to space directly to the end of data 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 information to tape and writing an EOD mark.

- On a partitioned tape, you can only space to locations within the current partition. If you want to space to a location outside the current partition, you must move to the new partition using the LOCATE or MODE SELECT command.

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.

22.2 Field Definitions

Byte 01, Bits 2 through 0 – Code

As shown inTable 22-1, the Code field specifies the type of space operation you want the tape drive to perform.

Table 22-1 Values of Code Field for the SPACE command

Value of Code field	Type of operation	Usage notes
000b	Space over *n* fixed or variable-length blocks	See Section 22.3 for information about the errors and exceptions that can occur for this setting.
001b	Space over *n* filemarks	See Section 22.3 for information about the errors and exceptions that can occur for this setting.
011b	Space to end of data	If 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 (blank tape for 8200 format). 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. If you use this Code field setting and the tape is not in 8500c format, the tape drive returns Check Condition status with the sense key set to Illegal Request (5h). The Fault Symptom Code is D7h.
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 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 2s 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 nth 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, Bit 7 – ADE

The tape drive ignores this bit.

Byte 05, Bit 6 – Vendor Unique

There is no vendor unique definition for this bit.

22.3 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the SPACE command.

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. If the filemark was detected during a backward search, the Information bytes are negative (2s complement notation).
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 100b to space over setmarks.

Setmark Detected

Note: This error applies to tapes written in 8500c format only.

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. If the setmark was detected during a backward search, the Information bytes are negative (2s complement notation).
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.

EOD (Blank Tape) 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 (or blank tape in 8200 format) 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.
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 (blank tape).

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	1
EOM	1
Sense Key	Medium Error (3h)
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. **Note:** If the Code field is 011b, the Information bytes are invalid.
ASC	00h
ASCQ	02h
PEOT	1
FSC	34h

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. Since the error was encountered during a backward search, the Information bytes are negative (2s complement notation).
ASC	00h
ASCQ	04h
LBOT	1
FSC	35h

After PBOT (or PBOP) is encountered, the tape is positioned at LBOT (or LBOP).

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. **Note:** Depending on the direction of the space operation, the Information bytes may be positive or negative (2s complement notation), indicating how many blocks were unreadable.
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 or after the unrecovered block.

Illegal Requests

The following conditions cause the tape drive to return Check Condition status with the sense key set to Illegal Request (5h):

- You attempt a forward space operation immediately after the tape drive has completed a WRITE or WRITE FILEMARKS command.
- You attempt to space over setmarks on a tape written in a format that does not support setmarks (8500 or 8200).

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 if the tape drive is ready to accept a medium access command without returning Check Condition status. The TEST UNIT READY command returns Check Condition status with the sense key set to Not Ready (2h) if the tape drive is not ready to accept a medium access command.

Note: The TEST UNIT READY command is not a request for a unit self-test.

23.2 Field Definitions

Byte 05, Bits 7 and 6 – Vendor Unique

There are no vendor unique definitions for this command.

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)							
03				Verification Length				
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 Field Definitions

Byte 01, Bit 2 – Immed

The Immed bit determines when command status is returned to the initiator, as follows:

0 – Status is returned to the initiator when the verify operation is complete.

1 – Status is returned to the initiator 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 the BytCmp bit is 0.

Byte 01, Bit 0 – Fixed

The Fixed bit defines the type of verify operation to be performed, as follows:

0 – A single logical block is verified and the length of this block is specified in the Verification Length field.

1 – One or more fixed-length logical blocks are verified and the number of blocks is specified in the Verification Length field. The length of each block is either the power-on default block length or the length specified with the currently active MODE SELECT command (bytes 5 through 7 of the Block Descriptor).

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

The Verification Length field defines the amount of data to be verified, as follows:

- When the Fixed bit is set to 0, the Verification Length field contains the length of the logical block in bytes. The logical block can be any size from 0 to 240 KB.
- When the Fixed bit is set to 1, the Verification Length field contains the number of logical blocks to be verified. The block length is the length specified with the MODE SELECT command.

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 this command.

24.3 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the VERIFY command.

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.

Setmark Detected

Note: This error applies to tapes written in 8500c format only.

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.

EOD Detected

If the tape drive detects the EOD mark (or blank tape in 8200 format) 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.

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.

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.

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).

Illegal Requests

The following conditions cause the tape drive to return Check Condition status with the sense key set to Illegal Request (5h):

- The Fixed bit is set to 0 and the requested block length is greater than 240 KB.
- The Fixed bit is set to 1 and the block length in the MODE SELECT command is 0.
- A VERIFY command is issued immediately after a WRITE or WRITE FILEMARKS command has been executed.

Notes

25 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. As described in Section 1.2, the tape drive can write data in 8500c or 8500 format. The data format is set with the MODE SELECT (15h) command. Only one data format can be written on a data cartridge. If the tape is written in 8500c format, data is compressed or uncompressed according to the setting of the DCE (data compression enable) bit in the MODE SELECT command (see Section 10.11).

When you issue a WRITE command at the beginning of tape, the tape drive automatically records an LBOT (logical beginning of tape) pattern before writing the data. The first track containing data blocks is recorded immediately after the last block containing the LBOT information. You cannot alter or access the data contained in the LBOT blocks

Note: If the disconnect option is enabled, the tape drive can disconnect from the initiator while the WRITE command is executing.

25.2 Field Definitions

Byte 01, Bit 0 – Fixed

The Fixed bit defines the type of write operation you want the tape drive to perform, as follows:

0 – Write a single 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. The length of each block is either the power-on default block length or the length specified with the currently active MODE SELECT parameters (bytes 5 through 7 of the Block Descriptor).

Note: If the Fixed field in the WRITE 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 tape drive returns Check Condition status with the sense key set to Illegal Request (5h). The ASC and ASCQ bits are set to 81h and 00h (fixed/variable mismatch).

Bytes 02 through 04 – Transfer Length

The Transfer Length field defines the amount of data you want the tape drive to write, as follows:

- When the Fixed bit is set to 0 (variable length), the Transfer Length field contains the length of the logical block in bytes. The logical block can be any size from 0 to 240 KB.

- When the Fixed bit is set to 1 (fixed length), the Transfer Length field contains the number of logical blocks to be written. The block length is the length specified with the MODE SELECT command. The allowable block sizes are defined by the READ BLOCK LIMITS (05h) command.

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.

25.3 Tape Positioning

This section describes the legal tape positions for a write operation.

Tape Positioned at LBOT or LBOP

When writing to a tape positioned at LBOT or LBOP, the tape drive automatically writes a new LBOT (or LBOP) pattern and then writes the data from the buffer. The data is written in the power-on default density or in the density specified with the currently active MODE SELECT command.

Appending Data

When writing to tape, the tape drive can append new data to existing data at certain locations only. The legal positions depend on the format of the data being written. Table 25-1 summarizes the legal locations for appending data in the data formats supported by the tape drive. If the tape is not positioned at a legal location for appending data, the tape drive returns Check Condition status with the sense key set to Illegal Request (5h).

Table 25-1 Legal locations for appending data on a previously written tape

If the tape is in this data format...	Data can be appended at the...		
	EOD mark[a]	Beginning or end of a long filemark[a]	Beginning or end of a setmark[a]
8500c	✔	✔	✔
8500	✔	✔	

[a] The EOD mark, long filemark, or setmark is overwritten as additional data is written to tape.

25.4 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 3.6).

- 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) in the reverse direction

- 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 Section 10.12 for more information about the Write Delay Time field.

25.5 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the WRITE command.

Write-Protected Data Cartridge

If a write operation is attempted on a data cartridge that is write protected, the tape drive returns Check Condition status with the sense key set to Data Protect (7h).

LEOT or LEOP Encountered

As described in Table 25-2, 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.
- Whether LEOT (or LEOP) was encountered during the current write operation or during a previous write operation (buffered mode)

Table 25-2 Action if LEOT or LEOP is encountered during a WRITE command

<table>
<tr><th></th><th colspan="2">Setting of Fixed bit in current CDB</th></tr>
<tr><th></th><th>Fixed= 0
(variable-length logical block)</th><th>Fixed= 1
(fixed-length logical blocks)</th></tr>
<tr><td>LEOT or LEOP encountered during current write operation</td><td>The tape drive returns Check Condition status after all data has been written to tape. The extended sense data is set as follows:
▪ Error Code= 70h
▪ EOM= 1
▪ Sense Key= 0h (No Sense)
▪ LBOT= 0</td><td>The tape drive returns Check Condition status after all data in the buffer and the block currently being transferred has been written to tape. The extended sense data is set as follows:
▪ Valid= 1
▪ Error Code= 70h
▪ EOM= 1
▪ Sense Key= 0h (No Sense) Information bytes= requested transfer length – actual number of blocks written to tape
▪ LBOT= 0</td></tr>
<tr><td>LEOT or LEOP encountered during previous write operation (buffered mode)</td><td>The tape drive returns Check Condition status after all data has been written to tape. The extended sense data is set as follows:
▪ Error Code= 70h
▪ EOM= 1
▪ Sense Key= 0h (No Sense)
▪ LBOT= 0</td><td>The tape drive returns Check Condition status but does not transfer any data. The extended sense data is set as follows:
▪ Valid= 1
▪ Error Code= 71h (error associated with previous command)
▪ EOM= 1
▪ Sense Key= 0h (No Sense)
▪ Information bytes= requested transfer length
▪ ASC= 00h
▪ ASCQ= 00h
▪ LBOT= 0</td></tr>
</table>

Encountering LEOT or LEOP Because of a Previous WRITE Command

To understand how LEOT or LEOP (8500c format only) can be encountered because of a previous WRITE command, consider the following hypothetical situation.

➤ **Important** If LEOT (or LEOP) is encountered as a result of a previous WRITE command, the tape drive may write as much as 1 MB of data (in compressed format) after LEOT (or LEOP) before reporting this condition. This represents the full contents of the buffer. As a result, the tape may be as much as 1 MB closer to PEOT (or PEOP) than it would be if LEOT (or LEOP) had been encountered during the current WRITE operation.

Assumptions For the purposes of this example, assume the following:

- The initiator is issuing a series of buffered WRITE commands. Each WRITE command transfers 100 fixed-length blocks, and each block is 1-KB long (that is, each WRITE command transfers 100 KB of data).
- The motion threshold is set to its default value of 512 KB (80h).
- The tape drive’s buffer is empty.
- Tape tension has been released, but drum motion has not been suspended. It will take approximately 10 seconds to re-tension the tape before data can be written.
- Less than 2 KB of space exist between the current tape position and LEOT.

Example

1. The initiator issues five buffered WRITE commands to the tape drive (WRITE 1 through WRITE 5). The 500 KB of data (assumed to be uncompressed) associated with these commands is transferred to the tape drive's buffer, but it does not cause tape motion to begin because the 512-KB motion threshold has not been exceeded.

   After receiving the data for each command, the tape drive returns Good status to the initiator, indicating that the command completed successfully.

2. The initiator issues a sixth buffered WRITE command to the tape drive (WRITE 6). The 100 KB of data associated with this command exceeds the motion threshold and causes the tape drive to re-tension the tape.

   The tape drive returns Good status to the initiator, indicating that the command completed successfully.

3. While the tape is being re-tensioned, the initiator issues two more buffered WRITE commands to the tape drive (WRITE 7 and WRITE 8). The data associated with these commands is transferred to the tape drive's buffer; however, none of the data in the buffer has been written to tape yet.

   These commands also receive Good status.

4. After the tape is re-tensioned, the data associated with the first two WRITE commands (WRITE 1 and WRITE 2) is transferred from the buffer to tape.

5. As the tape drive writes the data associated with WRITE 2 to tape, it encounters LEOT. As a result, the next WRITE command (WRITE 9) terminates abnormally and receives Check Condition status. The REQUEST SENSE data is set as follows:

Valid	1
Error Code	71h (error associated with previous command)
EOM	1
Sense Key	No Sense (0h)
Information bytes	Indicate the requested transfer length
ASC	00h
ASCQ	00h (Indicates that no error occurred, but the initiator should note that PEOT is closer than would otherwise be expected. See “Important” on page 25-7.)
LBOT	0

6. The remaining data in the buffer (from WRITE 3 through WRITE 8) is written to tape. Thus, the tape is between 600 and 700 KB closer to PEOT than it would be if LEOT had been encountered during the current write operation.

WRITE Command Issued after LEOT or LEOP Encountered

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 all of the data is written to tape. The REQUEST SENSE data is set as follows:

Valid	1
EOM	1
Sense Key	No Sense (0h)
Information bytes	0 (Indicates that all data was written to tape.)
ASC	00h
ASCQ	00h
LBOT	0

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. The REQUEST SENSE data is set as follows:

Valid	0 or 1
EOM	1
Sense Key	Volume Overflow (Dh)
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.
ASC	00h
ASCQ	02h
PEOT	1
FSC	AFh

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. 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.

Compression Errors

If you are writing in compressed format and the decompressed data does not match the compressed data during the Compression Integrity Check, the tape drive aborts the data transfer. The data block containing the compression error is not written to tape.

After aborting the data transfer, the tape drive sends Check Condition status to the initiator, followed by a Command Complete message. The sense key is set to Aborted Command (Bh), and the ASC and ASCQ are set to 10h and 00h.

You may be able to recover from this unlikely error by performing the following actions:

- **If you are attempting to write a variable-length block**, reissue the WRITE command an unlimited number of times. Each time a failure is detected, the tape drive returns Check Condition status.

- **If you are attempting to write fixed-length blocks**, follow these steps:

  a. Issue a REQUEST SENSE command.

  b. Look at the Information bytes to determine how many fixed blocks need to be re-sent. These bytes indicate how many logical blocks were not transferred successfully (including the logical block with the compression error).

  c. Adjust the initiator's data pointer to reflect the number of blocks that were successfully transferred.

  d. Issue a WRITE command to re-send the blocks that were not successfully transferred.

Illegal Requests

The following conditions cause the tape drive to return Check Condition status with the sense key set to Illegal Request (5h):

- The Fixed bit is set to 0 and the requested block length is greater than 240 KB.

- The Fixed bit is set to 1 and the block length in the MODE SELECT command is 0.

- The tape position is invalid.

- A READ (08h), SPACE (11h) in a forward direction, LOCATE (2Bh) in a forward direction, or VERIFY (13h) command is issued after the WRITE command is issued.

- The Density Code in the MODE SELECT (1Ah) command Block Descriptor is set to 8200 format (14h).

26 WRITE BUFFER (3Bh)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	1	1	1	0	1	1
01	Logical Unit Number			Reserved		Mode		
02	Buffer ID							
03	(MSB)							
04	Buffer Offset							
05								(LSB)
06	(MSB)							
07	Parameter List Length							
08								(LSB)
09	WBF	VU	Reserved				0	0

26.1 About This Command

The WRITE BUFFER command allows you to transfer new microcode over the SCSI bus into the tape drive's RAM buffer and then either make a microcode update tape or program the tape drive's control memories with the new microcode. You can obtain microcode update files on diskette or 8mm tape from Exabyte Technical Support. You can also download microcode files from the Exabyte Technical Support bulletin board or the Exabyte World Wide Web site (http: //www.exabyte.com).

Notes:

- You can also obtain microcode updates on 8mm tape. When loading code from an 8mm microcode update tape, you do not use the WRITE BUFFER command. See Appendix E for instructions on using a microcode update tape.

- If the WRITE BUFFER command is received after a WRITE (0Ah) or WRITE FILEMARKS (10h) command, any buffered data, filemarks, or setmarks will be written to the tape before the microcode is transfer to the RAM buffer. If an error occurs while this buffered data is being transferred to tape, the tape drive returns Check Condition status. The WRITE BUFFER request is not performed. The initiator should issue a REQUEST SENSE (03h) command to determine the cause of the error.

- If you use this command to create a microcode update tape, make sure there is a write-enabled data cartridge in the tape drive before issuing the command. Additionally, the tape must be positioned at LBOT. If all of these conditions are not met, the command will terminate with Check Condition status.

- If you use this command to program the tape drive's control memories and there is a data cartridge in the tape drive, the cartridge will be unloaded and ejected.

CAUTION

If you use this command to create a microcode update tape, any data previously recorded on the tape will be destroyed.

- You may want to issue more than one WRITE BUFFER command if the initiator has less than 176 KB of buffer space available. By setting the WBF bit (byte 09, bit 7) to 1, you can specify that you are using a sequence of WRITE BUFFER commands to upgrade the microcode or make a microcode update tape.

26.2 Field Definitions

Byte 01, Bits 2 through 0 – Mode

The Mode field determines the type of operation to be performed.

101b – Load and save microcode.
110b – Load microcode and create a microcode update tape.

Both modes allow you to use multiple WRITE BUFFER commands to load the microcode into the RAM buffer.

Byte 02 – Buffer ID

0 – Save microcode to the tape drive's control memories.
1 – Create a microcode update tape.

Note: If the Buffer ID is set to 0 and the Mode is set to a value other than 101b, or if the Buffer ID is set to 1 and the Mode is set to a value other than 110b, the command is rejected with Check Condition status. The sense key is set to Illegal Request (5h); the ASC and ASCQ fields are set to 24h and 00h.

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 the 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

The Parameter List Length 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 are using only one WRITE BUFFER command, the Parameter List Length corresponds to the length of the microcode file (54E28h= 347,688 bytes).

- If you are using more than one WRITE BUFFER command, specify a multiple of 400h 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 number of bytes to be transferred (that is, 54E28h –[400h × number of WRITE BUFFER commands]).

Byte 09, Bit 7 – WBF (WRITE BUFFERs Follow)

The WBF 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.

For each setting of the WBF bit, the Parameter List Length field (bytes 06 through 08) specifies the number of bytes to be transferred by the current command.

Byte 09, Bit 6 – VU (Vendor Unique)

There is no vendor unique definition for this bit. This bit must be 0.

26.3 Using the WRITE BUFFER Command

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 any partially received microcode is discarded. To prevent termination of the write buffer operation, reserve the tape drive for the initiator's exclusive use during the WRITE BUFFER command.

The microcode file size is approximately 347 KB. If necessary, you can issue multiple consecutive WRITE BUFFER commands to transfer the microcode to the tape drive's RAM buffer. After the entire code image is stored in the buffer, the image is validated. During validation, the microcode is checked for the following:

- Correct header format
- Proper number of files
- Correct internal format
- Hardware/boot code support for new microcode version

If the new microcode passes these tests, it can either be loaded into the tape drive's control memories or copied to tape to create a microcode update tape, as specified by the setting of the Buffer ID byte in the CDB.

Loading New Code into the Tape Drive Control Memories

If you set the Mode field to 101b and the Buffer ID to 0, the WRITE BUFFER command updates the tape drive's control memories with the validated code image stored in the tape drive's RAM buffer. After the microcode has been loaded, 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.

Note: If there is a data cartridge in the tape drive, the cartridge will be unloaded and ejected

Upon successful completion of the power-on self-test, the tape drive returns Good status to the initiator that issued the WRITE BUFFER command or command sequence. It returns Check Condition status with the sense key set to Unit Attention (6h) in response 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).

Making a Microcode Update Tape

If you set the Mode field to 110b and the Buffer ID to 1, the WRITE BUFFER command causes the tape drive to create a microcode update tape by writing the code image stored in the RAM buffer to tape. After the image is successfully transferred to tape, the tape drive returns Good status to the initiator that issued the WRITE BUFFER command or command sequence. The microcode update tape can then be used to update the microcode for other Exabyte Eliant 820 tape drives.

➤ **Important** If you use the WRITE BUFFER command to create a microcode update tape, make sure there is a write-enabled data cartridge in the tape drive before issuing the command. Additionally, the tape must be positioned at LBOT. If all of these conditions are not met, the command will terminate with Check Condition status.

Note: When the Mode field is set to 110b and the Buffer ID to 1, the microcode transferred to the RAM buffer by the WRITE BUFFER command is only used to create a microcode update tape. It is not used to update the tape drive's control memories.

Cautions for Using the WRITE BUFFER Command

CAUTION

Be sure to heed these cautions when issuing the WRITE BUFFER command:

- The WRITE BUFFER command allows you to load new microcode over the SCSI bus into the tape drive's control memories or to make a microcode update tape. 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 or making a microcode update tape).
- Do not load microcode from one model of tape drive into another. (For example, do not load microcode from an EXB-8505 into the Exabyte Eliant 820 or vice versa.)
- Be sure that the tape drive is reserved for the initiator's exclusive use while the WRITE BUFFER command is executing.
- The tape drive must be allowed to disconnect from the SCSI bus during the WRITE BUFFER operation. (Set the DiscPriv bit to 1 in the Identify message.)
- Do not send other SCSI commands, such as TEST UNIT READY, to the tape drive while the WRITE BUFFER command is executing.
- Do not power off or reset the tape drive while this command is executing.

If a reset, hardware failure, or power failure occurs during the execution of this command, the tape drive may not be able to operate. If this occurs, contact Exabyte Technical Support for assistance.

26.4 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the WRITE BUFFER command.

Aborting a WRITE BUFFER Command or Command Sequence

To terminate a WRITE BUFFER command or an entire sequence of WRITE BUFFER commands, send an Abort message to the tape drive. This will reset the tape drive. Then, reissue the WRITE BUFFER command or the entire sequence of WRITE BUFFER commands.

Microcode Not Valid

If the data loaded from the SCSI bus is not valid, the tape drive returns Check Condition status with the sense key set to Medium Error (3h). The tape drive will not attempt to load the new code. If this occurs, make sure you have the correct file and try again or load new microcode using a microcode update tape.

Fatal Load Error

Once the load process is started, it is irreversible. If a hardware or power failure occurs during the load operation, the tape drive may not be able to operate. If this occurs, contact Exabyte Technical Support for assistance.

Aborted Command

If you issue a command other than WRITE BUFFER, INQUIRY, or REQUEST SENSE to the tape drive during a WRITE BUFFER command sequence, the tape drive terminates the command with Check Condition status. The sense key is set to Aborted Command (Bh), and the ASC and ASCQ are set to 00h. The Fault Symptom Code is set to EBh.

Illegal Request

If you have not enabled the tape drive to disconnect from the SCSI bus during the WRITE BUFFER operation, the tape drive returns Check Condition status with the sense key set to Illegal Request (5h).

27 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 one or more filemarks or setmarks to tape after any data remaining in the buffer has been written to tape.

Note: Filemarks and setmarks can be buffered. Each buffered filemark or setmark uses 1 KB of the tape drive's 1-MB buffer.

27.2 Field Definitions

Byte 01, Bit 1 – WSmk (Write Setmark)

The WSmk bit allows you to specify whether you want the tape drive to write setmarks instead of filemarks at the current position, as follows:

0 – Write filemarks at the current position.
1 – Write setmarks at the current position.

Note: Setmarks are supported for tapes written in 8500c format only. If you set the WSmk bit to 1 and the tape is in 8500 format, the tape drive returns Check Condition status. The sense key is set to Illegal Request (5h), the ASC and ASCQ are 30h and 02h, and the Fault Symptom Code is D7h.

For information about the differences between filemarks and setmarks, refer to Chapter 3.

Byte 01, Bit 0 – Immed

The Immediate bit determines when command status is returned to the initiator, as follows:

0 – Status is reported to the initiator when the WRITE FILEMARKS command is completed. All buffered data, filemarks, and setmarks (8500c format only) 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).

Bytes 02 through 04 – Number of Filemarks

The Number of Filemarks field specifies the number of filemarks (or setmarks) to be written to tape. A value of 0 for the Number of Filemarks field 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 Short bit determines the size of the filemark written to tape by the tape drive, 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.

Refer to page 3-9 in Chapter 3 for more information about long and short filemarks.

Byte 05, Bit 6 – VU (Vendor Unique)

There are no vendor unique definitions for this bit.

27.3 Tape Positioning

This section describes the legal tape positions for a write filemarks operation.

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) for 8500c format, 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 locations listed in Table 27-1. 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).

➤ **Important** The tape drive cannot append data to a tape written in 8200 format. A write-enabled 8200 format tape is automatically ejected. The tape drive returns Check Condition with a sense key of Medium Error (3h) and an FSC of 47h.

Table 27-1 Legal positions for appending filemarks and setmarks

If the tape is in this data format...	Data can be appended at the...		
	EOD mark[a]	Beginning or end of a long filemark[a]	Beginning or end of a setmark[a]
8500c	✔	✔	✔
8500	✔	✔	

[a] The EOD mark, long filemark, or setmark is overwritten as additional data is written to tape.

27.4 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the WRITE FILEMARKS command.

Write-Protected Data Cartridge

If a write filemarks operation is attempted on a data cartridge that is write protected, the tape drive returns Check Condition status with the sense key set to Data Protect (7h).

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.

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

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.

A Recording Format

This appendix describes the physical and logical recording formats used by the Eliant 820. It discusses:

- The physical structure of tracks written to tape — how data tracks are placed on the tape and how the physical track structure corresponds to the logical data formats supported by the tape drive.
- The elements of data written to the tape — the physical and logical beginning and end of tape, the end-of-data mark, physical and logical data blocks, filemarks, setmarks, and so forth.
- The recording parameters for the tape drive when writing and reading data in 8500/8500c and 8200 formats.

A.1 Physical Track Structure

This section defines the physical track structure of the tape, including the types of physical track structures, physical blocks, search fields, and servo areas.

The Eliant 820 writes data to tape in 8500/8500c physical track structure. It can read data in 8500/8500c or in 8200 track structure.

- **In 8500/8500c track structure**, the tape drive *writes or reads* two overlapping tracks of data for each revolution of the drum. Each track contains data blocks, servo areas (track 2 only), clock sync areas, and search fields. 8500/8500c track structure is also called *dual-azimuth track structure.*

  Note: 8500 and 8500c physical track structures are identical. Using the compressed logical format (8500c), the tape drive compresses data before storing it in physical blocks. Using the uncompressed logical format (8500), the tape drive does not compress data.

- **In 8200 track structure**, the tape drive *reads* a single track of data for each revolution of the drum. Each track contains data blocks and one servo area for accurate positioning of the tape. The 8200 track structure is also called *single-azimuth track structure.*

Figure A-1 shows the relationship between the physical track structures and the three logical data formats.

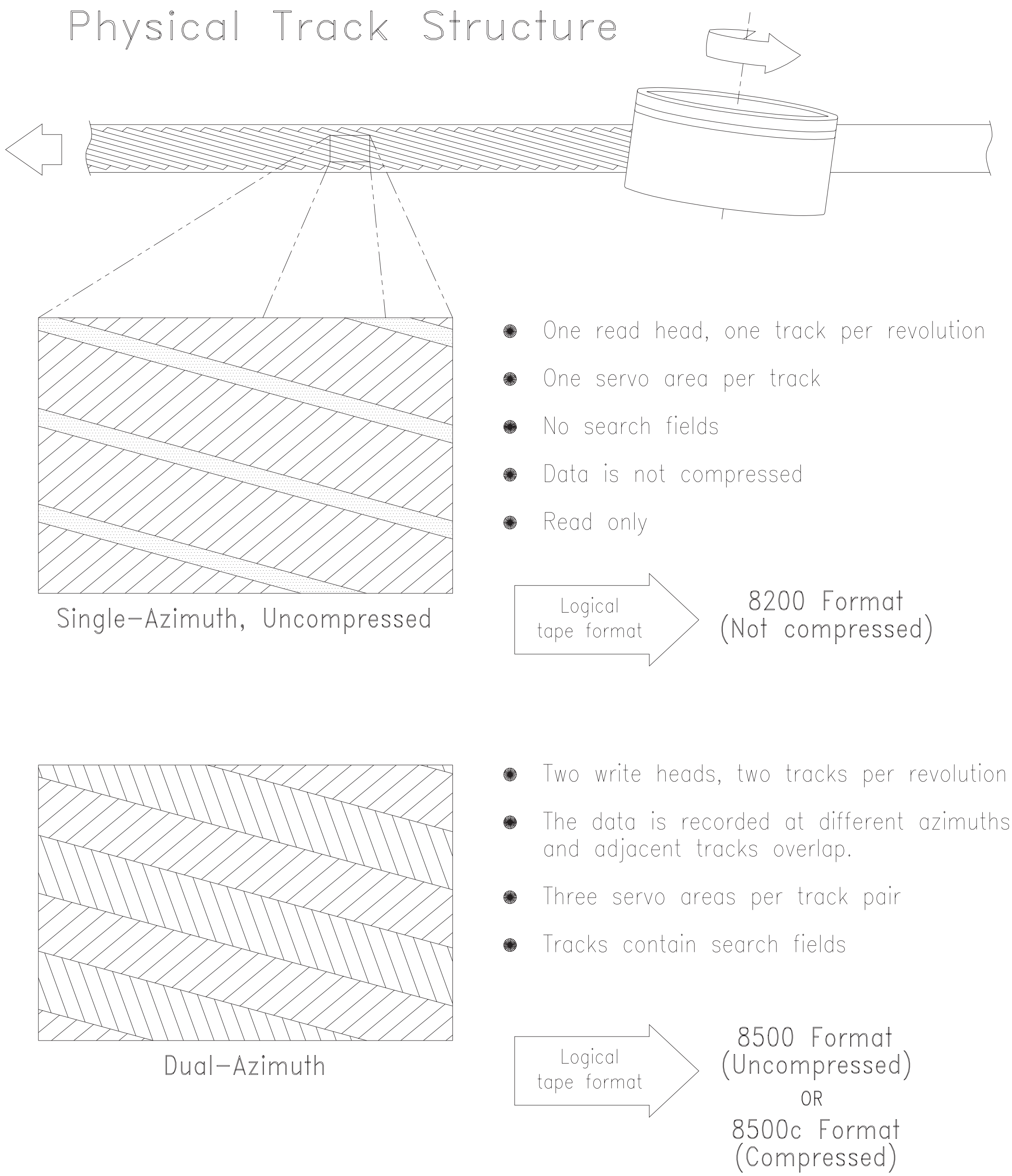


Figure A-1 Relationship of 8mm physical track structures to logical data formats

A.2 Data Elements on Tape

Figure A-2 shows the structure of data written to tape and the elements that make up data tracks and blocks. This illustration shows data written in 8500/8500c physical format. Explanations of the data elements follow the figure.

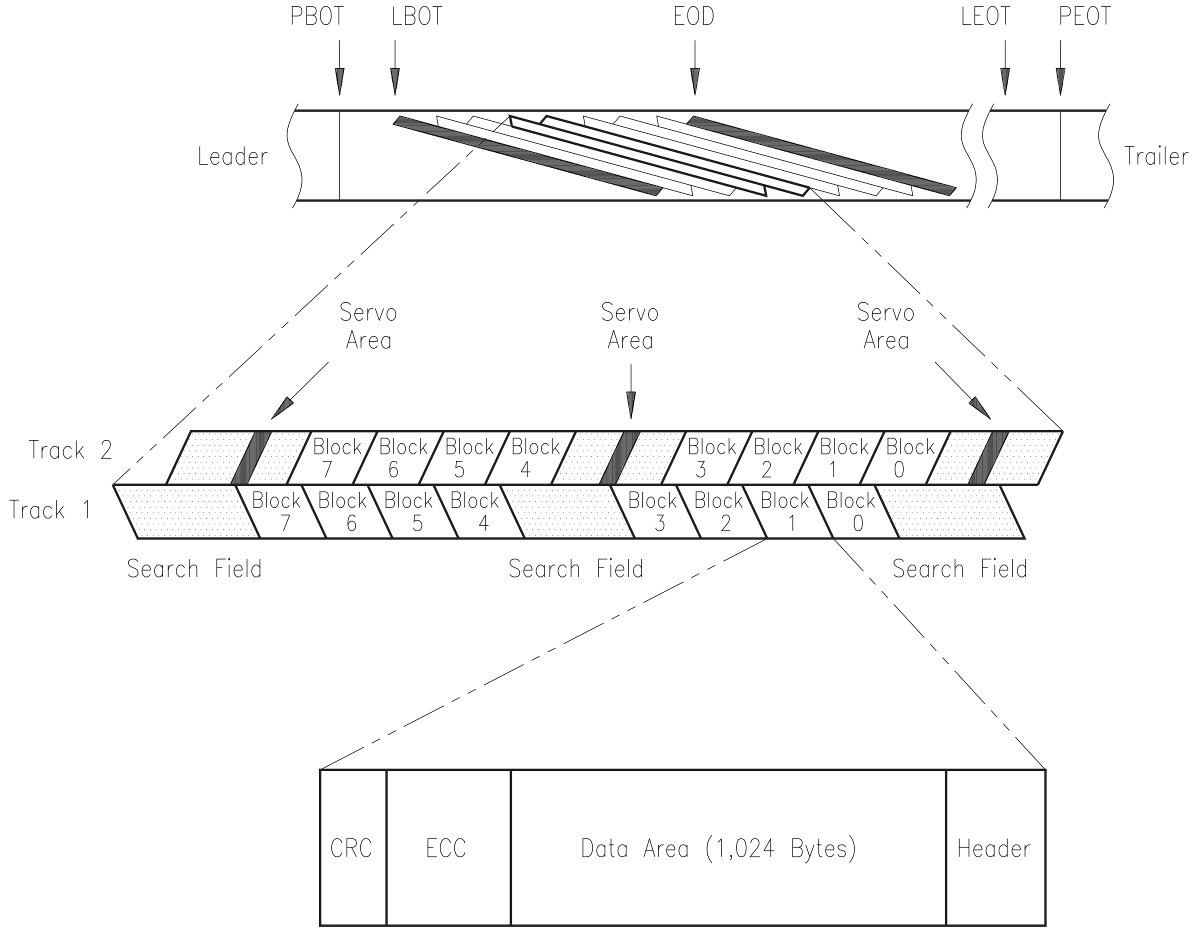


Figure A-2 Structure of data on tape (8500/8500c physical format)

Physical Beginning of Tape (PBOT)

PBOT is located at the point on the tape where the translucent leader material is attached to the media. This position is detected by an optical sensor in the tape transport mechanism.

Note: The leader material of the EXATAPE 160m XL data cartridge contains a Recognition System stripe that identifies it as data-grade media. All 160m tapes used in the Eliant 820 should have this stripe to ensure the proper characteristics for data storage.

Logical Beginning of Tape (LBOT)

When you issue a write operation at the beginning of tape, the tape drive automatically records LBOT approximately 29 inches (74 cm) from PBOT.

LBOT consists of a series of tracks that are used to indicate LBOT's location and to calibrate the servo system. 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 blocks.

The tape can be repositioned and a write operation can be performed to erase the LBOT and record a new LBOT in the same space. This process occurs, for example, when a write operation is performed at LBOT on a previously written tape.

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 entire process is repeated. If the retry fails, a Medium Error is reported.

During read operations, LBOT blocks are not transferred to the initiator.

End of Data (EOD)

After writing data, the tape drive writes an end-of-data (EOD) mark to indicate the location of the last data on tape. In 8500c and 8500 format, the EOD mark includes two or more tracks of erase gap and 600 tracks of EOD physical blocks.

The tape drive writes an EOD mark when you press the unload button or issue one of the following commands immediately after the tape drive completes a WRITE or WRITE FILEMARKS operation:

- ERASE (19h)
- LOAD/UNLOAD (1Bh)
- LOCATE (2Bh) in the reverse direction
- REWIND (01h)
- SPACE (11h) in either direction

The EOD mark is overwritten when additional data is appended to the last data on the tape.

Note: The EOD mark is not used for 8200 format; however, in 8200 format, the end of actual data on the tape indicates where additional data can be appended.

Logical End of Tape (LEOT)

LEOT is determined by the number of recorded tracks that occur after LBOT. For this purpose, lengths of erased segments are converted into an equivalent number of tracks. The number of tracks depends on the length of the tape. (See Appendix B for information about tape capacities based on tape length.)

Physical End of Tape (PEOT)

PEOT is located at the point on the tape where the translucent trailer material is attached to the media. This position is detected by an optical sensor in the tape transport mechanism.

Data Blocks

Data is written to tape in blocks. The tape drive receives “logical” blocks of data from an initiator and writes them as “physical” blocks of data to the tape.

Logical Blocks A logical block is a unit of data transferred from an initiator to the tape drive. Logical blocks can have fixed or variable lengths and can range from 0 to 240 KB. Chapter 3 provides information about controlling the size of logical blocks sent from an initiator to the tape drive.

Physical Blocks Each physical track contains eight physical blocks. A physical block containing user data includes the following:

- 14 bytes of header information
- Up to 1,024 bytes of user data
- 2 bytes of cyclic redundancy check (CRC) data
- 400 bytes of error correction code (ECC) data

Note that the header, ECC data, and CRC data do not affect the user data capacity of the tape.

Since each physical track contains eight 1,024-byte physical blocks, each track can contain a maximum of 8,192 *uncompressed* bytes of user data. Assuming an average compression ratio of 2:1, each track written in a compressed format can contain 16,384 *compressed* bytes of user data. (The actual compression ratio depends on the type of data.)

Each 1,024-byte physical block can contain multiple logical blocks (for example, two uncompressed 512-byte logical blocks can be written in one physical block). In addition, a logical block can start in one physical block and end in a subsequent physical block. This logical block packing prevents the loss of data capacity for tapes with small logical blocks.

Note: In 8200 format, only one logical block can be written in each physical block.

Servo Areas

Data tracks contain servo areas that the tape drive uses to read tapes written by other tape drives. Each servo area contains a signal that the servo head uses to control linear tape velocity. This process results in accurate positioning of the track under the read head. In 8500c and 8500 formats, servo areas are placed at the beginning, middle, and end of every other track. In 8200 format, servo areas are placed at the beginning of each track.

Note: The tape drive cannot overwrite data in 8200 format, because it cannot erase the servo areas written in this format.

Search Fields

Each track of data contains search fields used for high-speed search. High-speed search occurs when the initiator issues a LOCATE (2Bh) or SPACE (11h) command. The search fields are the only areas of the tape that are read during a high-speed search. They consist of small data areas interspersed with clock sync areas. The search field data contains information for locating files and blocks and detecting the end-of-data (EOD) mark during high-speed searches.

Note: Tapes written in 8200 format do not contain search fields. For this reason, 8200 format tapes do not support high-speed search.

A.3 Track and Physical Block Counts

The number of tracks and physical blocks on the tape depend on the following markers:

- Physical beginning of tape (PBOT)
- Logical beginning of tape (LBOT)
- Logical end of tape (LEOT)

The number of tracks between LBOT and LEOT depends on the tape length. Table A-1 lists the following information for tapes written in 8500/8500c physical format:

- The number of tracks and 1,024-byte physical blocks between LBOT and LEOT

- The approximate number of tracks and 1,024-byte physical blocks that occur between LEOT and PEOT

Table A-1 Number of tracks and physical blocks for 8500/8500c physical format

EXATAPE Size	LBOT to LEOT				LEOT to PEOT[a]			
	Number of tracks		Number of blocks		Number of tracks		Number of blocks	
	Hex	Decimal	Hex	Decimal	Hex	Decimal	Hex	Decimal
15m	11888h	71,816	8C440h	574,528	954h	2,388	4AA0h	19,104
54m	45FE4h	286,692	22FF20h	2,293,536	229Eh	8,862	114F0h	70,896
112m	93568h	603,496	49AB40h	4,827,968	22A2h	8,866	11510h	70,928
160m XL	D2DF2h	863,730	696F90h	6,909,840	3361h	13,153	19B08h	105,224

[a] Track and block counts from LEOT to PEOT are approximate.

A.4 Recording Parameters

Table A-2 shows the parameters for writing and reading data in the two physical formats.

Table A-2 Recording parameters

Parameter	Physical Format	
	8500/ 8500c	**8200 (read only)**
Tape width	8.00 mm (0.315 in)	8.00 mm (0.315 in)
Track length (data + servo)[a]	62.651 mm (2.47 in)	71.628 mm (2.82 in)
Tracks per revolution[b]	2	1
Track pitch	15.5 µm (0.000610 in)	31.0 µm (0.001221 in)
Track width	15.5 µm (0.000610 in)	25.0 µm. (0.000984 in)
Track density	64.506 trk/mm (1638.455 trk/in)	32.254 trk/mm (819.253 trk/in)
Areal recording density	144.23 Mfc/mm^2 (93.052 Mfc/in^2)	68.68 Mfc/mm^2 (44.312 Mfc/in^2)
Drum speed	3662.109 rpm	3845.215 rpm
Tape speed	22.159 mm/sec (0.872 ips)	23.266 mm/sec (0.916 ips)
Track angle	4.9 degrees	4.9 degrees
Wrap angle	216 degrees	216 degrees

[a] In 8500/8500c format, servo information is embedded in three places along the length of the track. In 8200 format, servo information is embedded at the beginning of the track.

[b] Tracks per revolution is the number of tracks written or read for each revolution of the rotating drum assembly.

Notes

B Data Cartridge Capacities

This appendix lists capacities and track and physical block counts for the different sizes of EXATAPE™ data cartridges. It also describes how the tape drive autosizes these different data cartridge sizes.

B.1 EXATAPE™ Capacities

Exabyte strongly recommends that you use EXATAPE data-grade metal particle media with your tape drive. Do not attempt to use “Hi-8” metal particle or any type of metal evaporative tape (for example, AME tape). These tapes will be ejected automatically by the tape drive.

EXATAPE is specifically controlled for use in data storage environments and offers extended durability, long-term archivability, and greater reliability. In addition, exclusive use of EXATAPE with Exabyte 8mm tape storage systems has been shown to prolong head and tape life.

Metal particle EXATAPE data cartridges are available in the following lengths:

- 15m
- 54m
- 112m
- 160m XL

Table B-1 lists the approximate storage capacities of 8mm data cartridges written in the three logical formats. For more information about EXATAPE 8mm data cartridges, see Appendix A.

Table B-1 Approximate capacities of EXATAPE 8mm data cartridges

Length of EXATAPE	Approximate Capacity[a] to LEOT in MB		
	8500c format[b]	8500 format	8200 format
15m	1,176	588	294
54m	4,697	2,348	1,174
112m	9,888	4,944	2,349
160m XL	14,000	7,000	3,500

[a] Refer to Table A-1 for detailed information about data cartridge capacities.

[b] This column assumes an average compression ratio of 2:1 (on average, each compressed 1,024-byte physical block represents 2,048 bytes of user data).

B.2 Autosizing of Data Cartridges

Autosizing is the process that occurs during a load operation when the tape drive spaces forward from the physical beginning of tape (PBOT) to the logical beginning of tape (LBOT) and determines the length of the tape in use.

The tape drive accurately determines the length of the EXATAPE 15m and 54m cartridges during the load operation. It uses the Media Recognition stripe to identify the 160m XL data cartridge. The tape drive treats all other lengths of tape as 112m.

Note: If you load a 160m tape that does not have a Recognition System stripe, the tape drive treats it as a 112m tape. This will result in a lower-than expected tape capacity (see page 3-2).

C Message Processing and Error Recovery

This appendix describes message processing and error handling by the tape drive and the appropriate initiator response when error conditions are detected during different SCSI bus phases. The errors and responses are separated into two categories:

- Errors and responses for initiators that support only the Command Complete message.
- Errors and responses for initiators that support messages in addition to the Command Complete message.

C.1 Initiator Only Supports the Command Complete Message

This section describes the actions to be taken by the initiator and the tape drive when a SCSI bus parity error occurs and the initiator only supports the Command Complete message.

Parity Error in Command Out Phase

When parity checking is enabled and the tape drive detects a parity error during the Command Out phase, it immediately sends Check Condition status to the initiator, followed by a Command Complete (00h) message. The sense key is set to Aborted Command (Bh) and the SCSI Bus Parity Error (BPE) bit is set to 1. The initiator should reissue the command.

Parity Error in Data Out Phase

When parity checking is enabled and the tape drive detects a parity error in the user data associated with the WRITE command, it aborts the data transfer.

When this condition occurs, the tape drive immediately sends Check Condition status to the initiator, followed by a Command Complete (00h) message. The sense key is set to Aborted Command (Bh) and the SCSI Bus Parity Error (BPE) bit is set to 1. The initiator may be able to recover by reissuing the WRITE command.

Parity Error in the Data In Phase

If the parity error is detected in the user data associated with a READ command, the initiator should do a backspace-*n*-blocks operation and set up to reread the blocks by reissuing the command.

If the parity error is detected during the execution of any other data command (for example, during sense operations), it is only necessary to reissue the command. If the command was REQUEST SENSE, valid sense data will be returned because the sense data is not reset until the next non-REQUEST SENSE or non-INQUIRY command is issued.

C.2 Initiator Supports Messages in Addition to the Command Complete Message

This section describes tape drive message processing and SCSI bus error recovery for initiators supporting messages in addition to Command Complete. It includes a number of charts showing the actions that the tape drive will take in response to each message it receives from the initiator.

The charts are organized by phase transitions; that is, there is a chart for each possible initial phase with the transition to the Message Out phase. The charts indicate the specific action the tape drive will take for each type of message. The text accompanying each chart also describes the actions to be taken by the initiator and the tape drive when a SCSI bus parity error occurs.

Tape Drive Response to the Attention Signal

Once the physical path management mechanism has been established by the initiator using the Identify message, the tape drive will accept and process messages from the initiator whenever the Attention signal is driven true. The tape drive will respond to the Attention signal for each SCSI bus phase as described in Table C-1.

Table C-1 Responses to the Attention signal

If the initiator asserts the Attention signal during this phase...	The tape drive responds...
Selection	Immediately following the selection.
Command	At the end of the phase, after all CDB bytes have been received.
Data In	After a number of bytes (up to 16) have been transferred to the initiator.
Data Out	After a number of bytes (up to 16) have been transferred from the initiator.
Status	After the Status byte has been received by the initiator.
Message In	After the next message byte has been received by the initiator.
Message Out	After the next message byte has been received by the tape drive (will stay in Message Out phase).

Message Processing after the Selection Phase

Figure C-1 shows that the tape drive will only accept three legal messages immediately after the Selection phase (Abort, Reset, and Identify).

Parity Error in the Selection Phase

When parity checking is enabled and the tape drive detects a parity error during the Selection phase, it stays in the Message Out phase until the Attention signal goes low. Then, it retries by going to the Message Out phase again. If a parity error is detected the second time the message is received, the tape drive goes to the Bus Free phase by releasing the BSY signal.

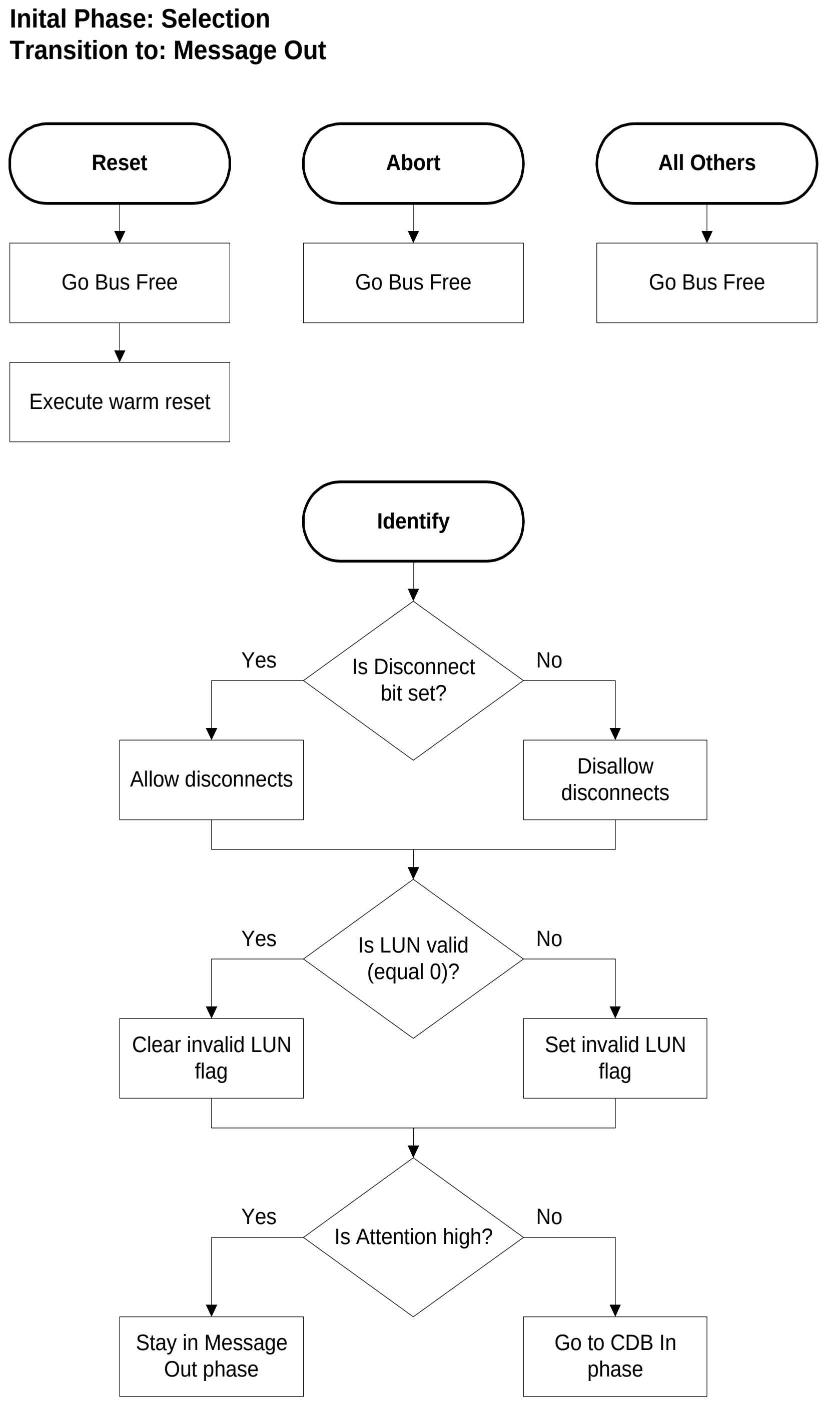


Figure C-1 Message processing after the Selection phase

Message Processing in the Message Out Phase

Figure C-2 shows the message sequences for Message Out bytes received during a previously initiated Message Out phase.

Parity Error in the Message Out Phase

When parity checking is enabled and the tape drive detects a parity error in a message received from the initiator, the tape drive requests that the initiator reissue the message by going to the Message Out phase again.

If a parity error occurs during the first message sequence (Identify message followed by contiguous Message Out bytes), the entire sequence must be retransmitted (that is, the initiator should reissue the Identify message and all following bytes). If a parity error is detected the second time the message is received, the tape drive goes to the Bus Free phase by releasing the BSY signal.

Inital Phase: Message Out
Transition to: Message Out

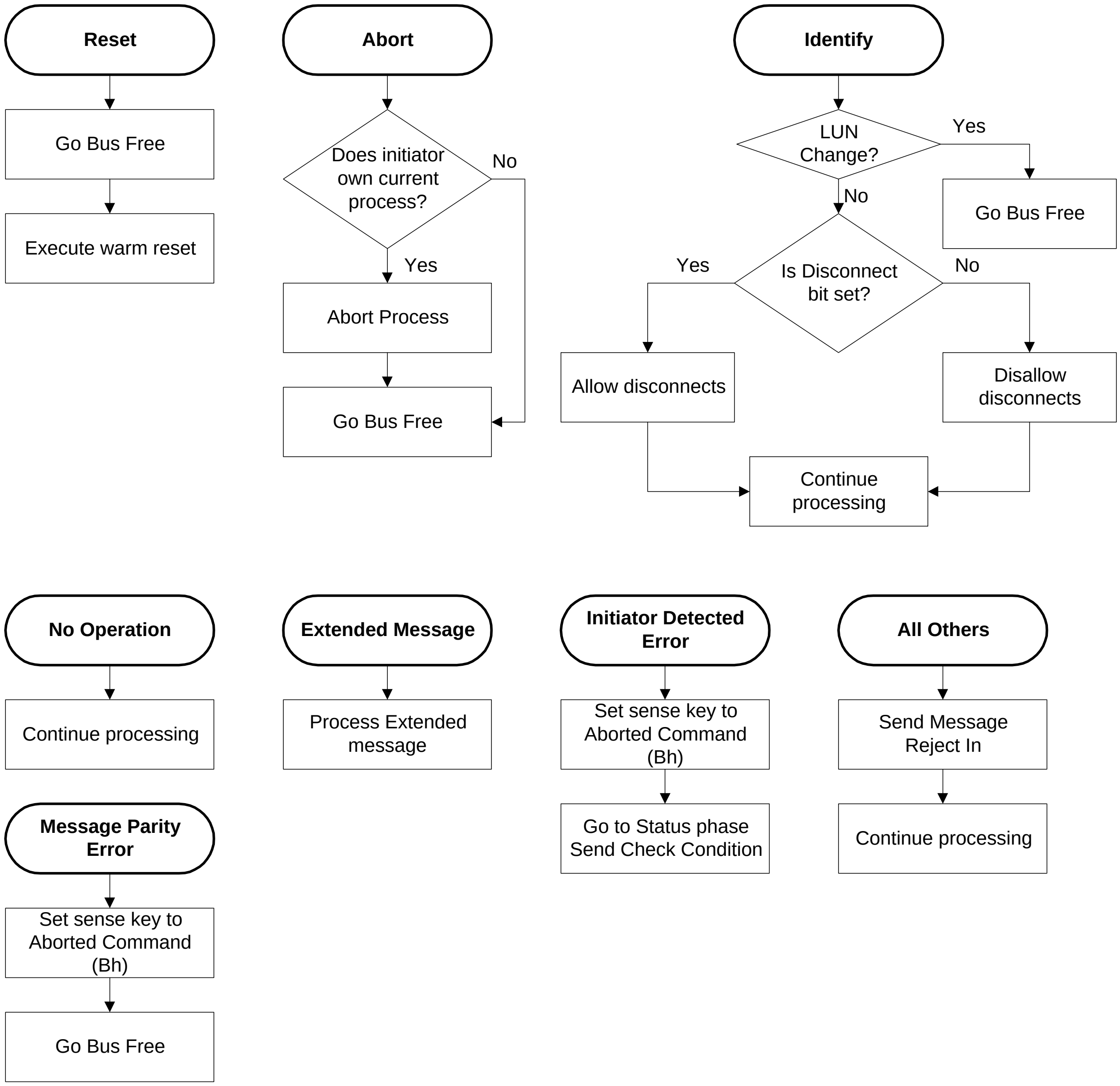


Figure C-2 Message Out bytes received after previous Message Out phase

Processing during the Command Out Phase

Figure C-3 shows how CDB bytes are processed. If the initiator asserts the Attention signal during the Command Out phase, the tape drive waits until all CDB bytes have been received and then goes to the Message Out phase.

The Group Code is the upper three bits of the first CDB byte. The OP Code is the lower five bits of the first CDB byte. The Group Code determines how many CDB bytes are to be transmitted by specifying one of the following groups:

Group 0	Six-byte commands
Group 1	Ten-byte commands
Group 2	Ten-byte commands
Group 3	Six-byte commands
Group 4	Six-byte commands
Group 5	Twelve-byte commands
Group 6	Six-byte commands
Group 7	Ten-byte commands

Parity Error in Command Out Phase

If a parity error is detected in the CDB byte being sent by the initiator, the tape drive goes to the Message In phase and sends a Restore Data Pointers message. Then, the tape drive transitions to the Command Out phase and tries to process the CDB again. If this retry process occurs 15 times (16 times total), the tape drive goes to Status phase and returns Check Condition status. The sense key is set to Aborted Command (Bh) and the ASC and ASCQ are set to 43h and 00h. The Fault Symptom Code is set to E6h.

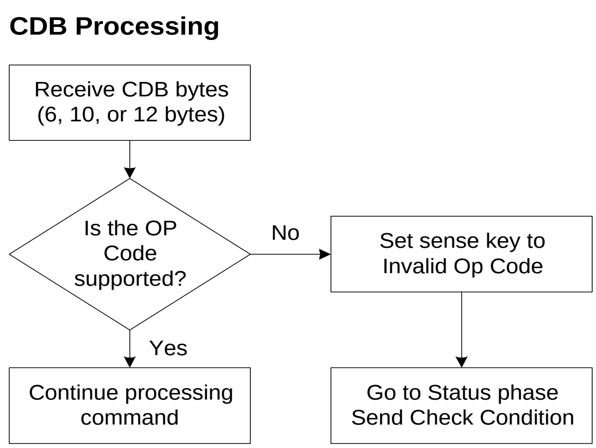


Figure C-3 Processing of CDB bytes

Message Processing in the Message Out Phase after Command Phase

Figure C-4 shows how messages are processed after the Command phase.

If the tape drive detects a parity error in the Command Out phase, it sends a Restore Data Pointers message to the initiator. Figure C-5 shows how messages are processed after a Restore Data Pointers message during the Command Out phase.

Parity Error in the Message Out Phase

When parity checking is enabled and the tape drive detects a parity error in a message received from the initiator, the tape drive goes to the Message Out phase again to request that the initiator reissue the message.

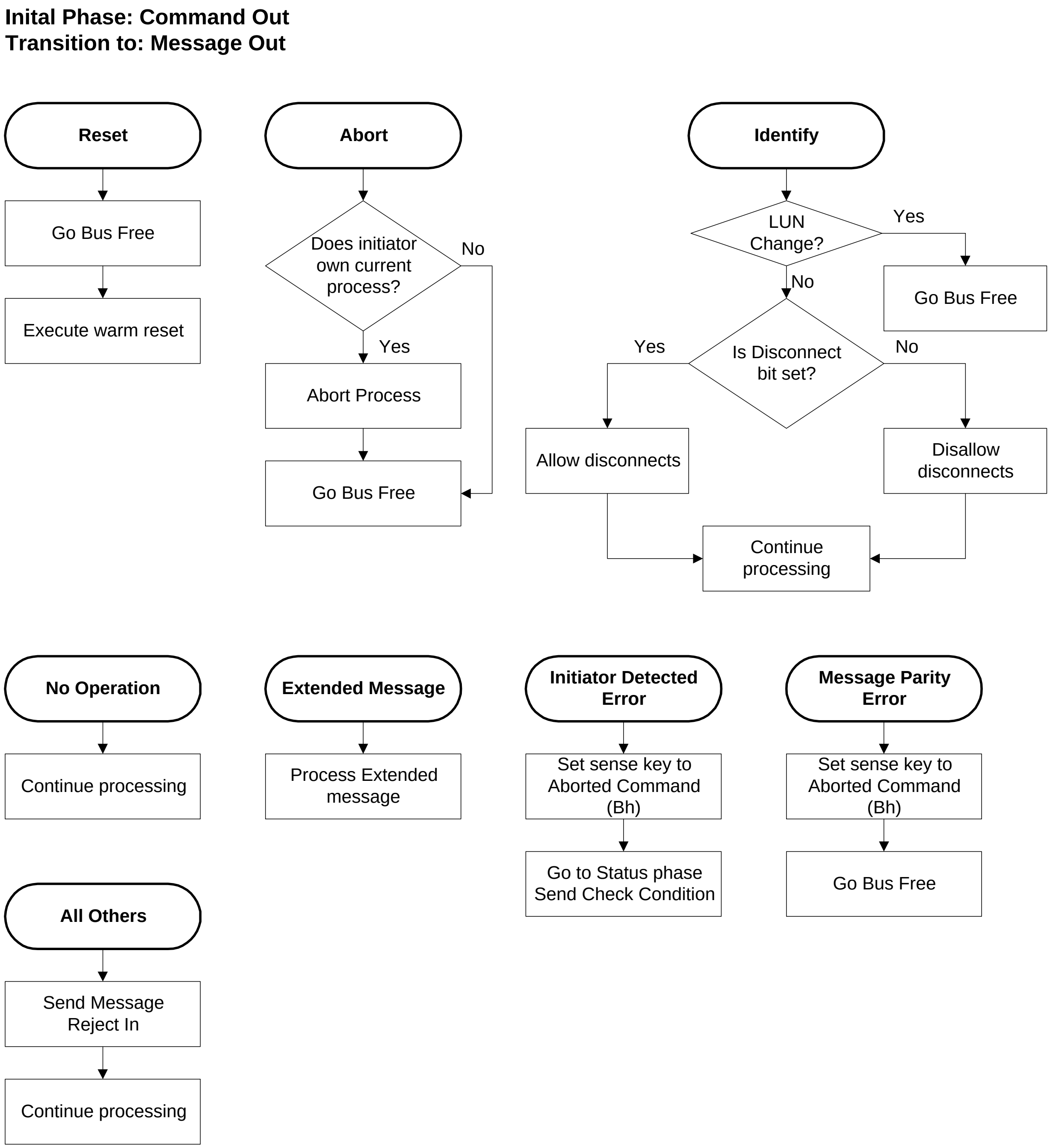


Figure C-4 Message processing after the Command phase

Inital Phase: Message In (Restore Data Pointers)
Transition to: Message Out

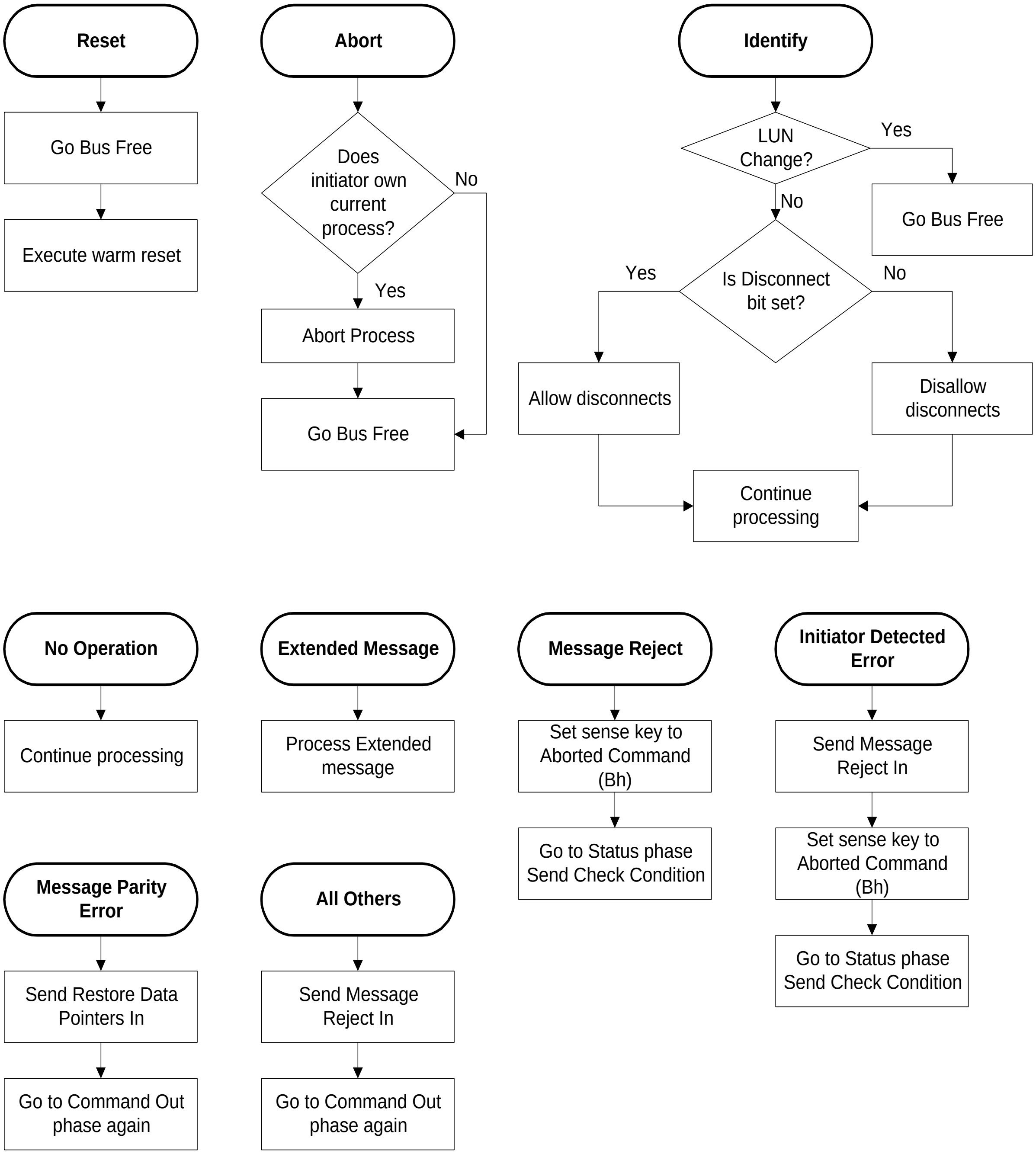


Figure C-5 Message processing after a Restore Data Pointers message when attempting to retry the Command Out phase

Processing of Extended Message Out

Figure C-6 shows how Extended Message Out messages are processed. Note that the Attention signal must coincide with the message byte numbering sequence. The tape drive responds to the initiator's Synchronous Data Transfer Request with a transfer period of *xx* or 32h (200 nanoseconds), whichever is larger (slower), and a REQ /ACK offset of *yy* or Fh (15), whichever is smaller.

Parity Error in Extended Message Out

When parity checking is enabled and the tape drive detects a parity error in the Synchronous Data Transfer Request message received from the initiator, the tape drive stays in the Message Out phase until the Attention signal goes low. Then, it goes to the Message Out phase again to request that the initiator reissue the entire message sequence.

If a parity error is detected the second time the extended message is received, the tape drive goes to the Bus Free phase by releasing the BSY signal.

Extended Message Processing (message bytes out)

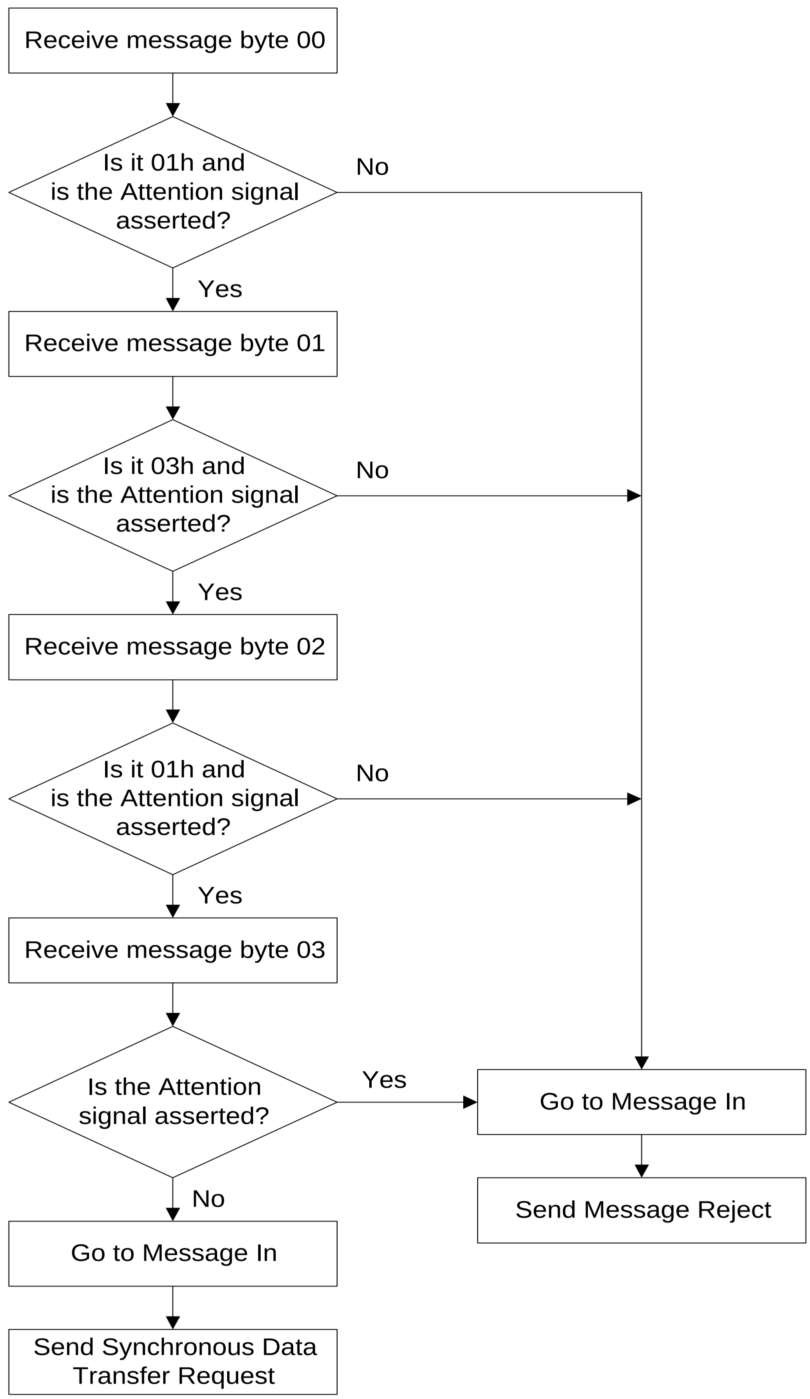


Figure C-6 Message processing of Extended Message Out bytes

Processing of Extended Message In

Figure C-7 shows how the Extended Message In messages are processed. The tape drive executes this message sequence in response to an initiator's Synchronous Data Transfer Request.

Parity Error in Extended Message In

If the initiator detects a parity error in the Synchronous Data Transfer Request byte being sent by the tape drive, it responds by sending a Message Parity Error message to the tape drive. The tape drive responds by re-sending the Synchronous Data Transfer Request byte. If the tape drive receives 16 consecutive Message Parity Error messages or one Message Reject message, it cancels the Synchronous Data Transfer Request and resumes asynchronous data transfer for that initiator.

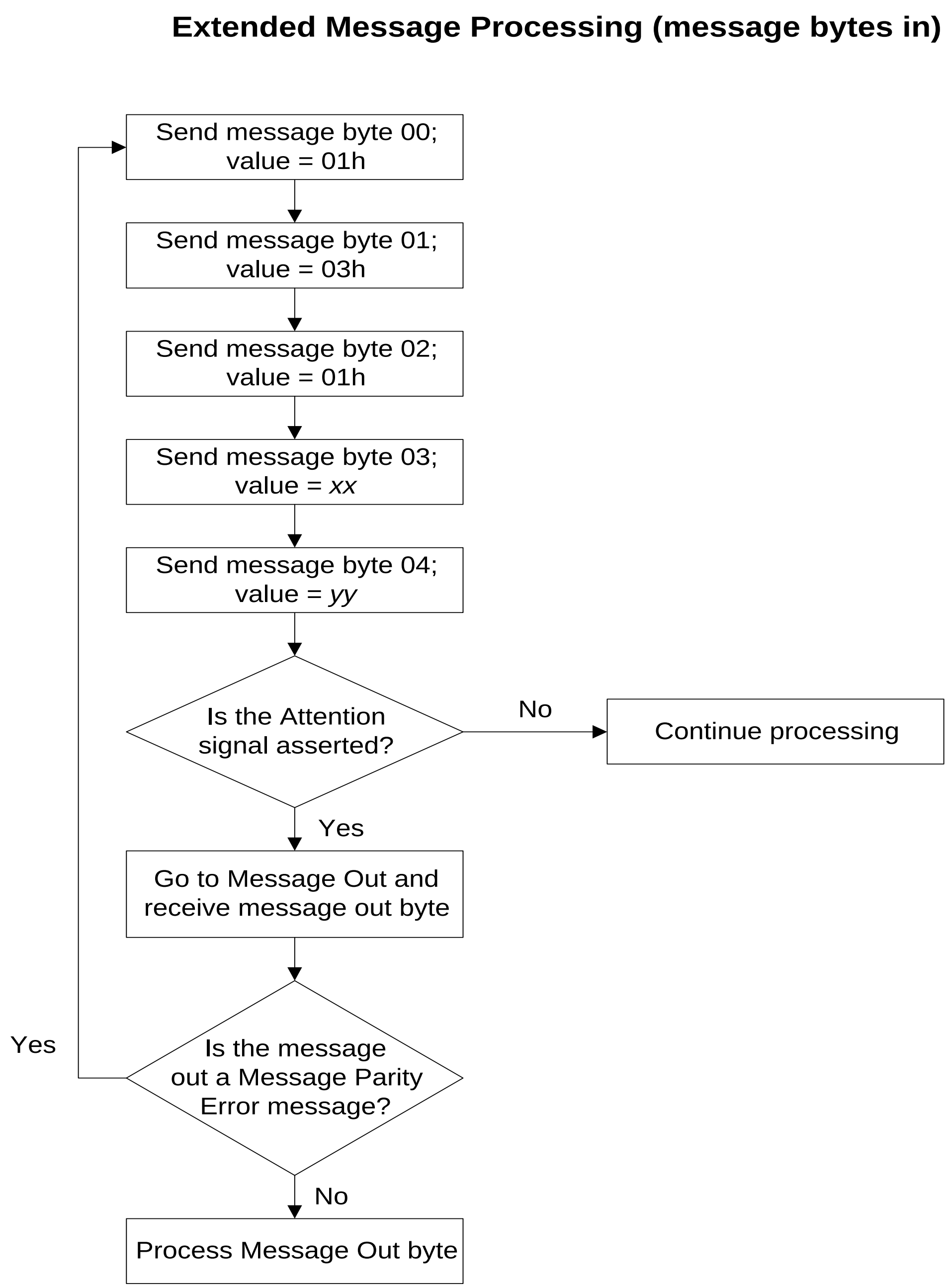


Figure C-7 Message processing for Synchronous Data Transfer Request message

Message Processing in Data Out Phase (WRITE Command)

Figure C-8 shows how each message is processed during the Data Out phase of a WRITE command.

Parity Error in User Data Associated with WRITE Command

When parity checking is enabled and the tape drive detects a parity error in the logical blocks of user data received from the initiator, the tape drive aborts the data transfer. The data block containing the parity error is not written to tape.

After aborting the data transfer, the tape drive sends Check Condition status to the initiator, followed by a Command Complete message. The sense key is set to Aborted Command (Bh) and the ASC and ASCQ bytes are set to 47h and 00h. The SCSI Bus Parity Error (BPE) bit is set to 1.

- **If you are attempting to write a variable-length block**, you may be able to recover by reissuing the WRITE command an unlimited number of times. Each time a failure is detected, the tape drive returns Check Condition status.

- **If you are attempting to write fixed-length blocks**, you may be able to recover by following these steps:

  1. Issue a REQUEST SENSE command.
  2. Look at the Information Bytes to determine how many fixed blocks need to be re-sent. These bytes indicate how many logical blocks were not transferred successfully (including the logical block with the parity error).
  3. Adjust the initiator's data pointer to reflect the number of blocks that were successfully transferred.
  4. Issue a WRITE command to re-send the blocks that were not successfully transferred.

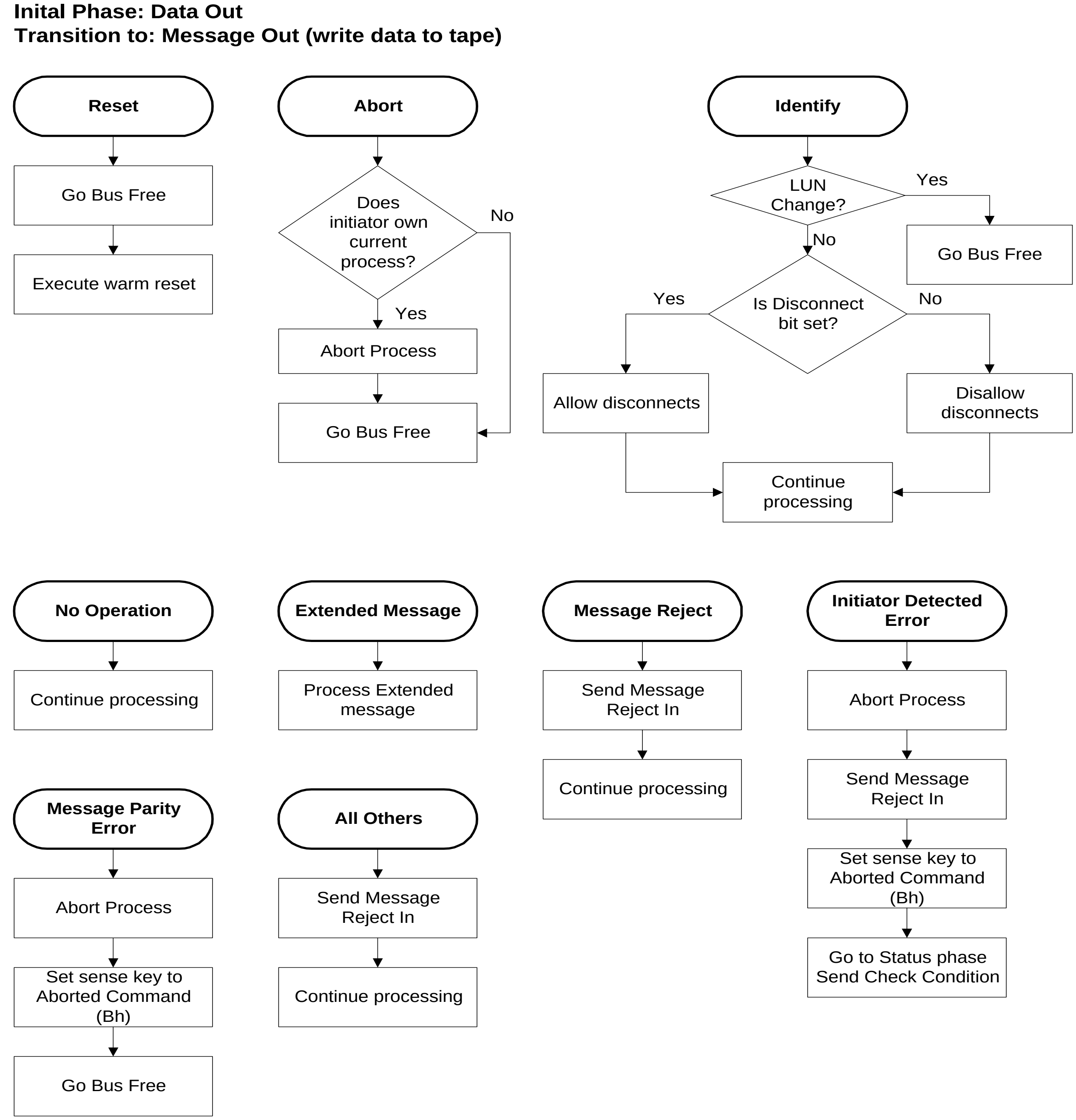


Figure C-8 Message processing during the Data Out phase of a WRITE command

Message Processing in Data Out Phase (Information Commands)

Figure C-9 shows how messages are processed during the Data Out phase for commands other than WRITE (for example, MODE SELECT).

Parity Error in Data Out Phase (Information Command)

When parity checking is enabled and the tape drive detects a parity error in the data sent after the MODE SELECT CDB, it goes to the Message In phase and sends a Restore Pointers message. The initiator must restore the pointer to the start of the data. The tape drive then goes to the Data Out phase and requests the data again.

Figure C-10 shows how messages are processed after a Restore Data Pointers message is sent to the initiator while reattempting the Data Out phase for an information command.

The initiator should count the Restore Pointers messages received during the Data Out phase to qualify the communication. If the count exceeds some threshold, the initiator should clear the tape drive from the bus by doing one of the following:

- Sending the Abort message
- Performing a SCSI bus reset
- Sending the Bus Device Reset message

Inital Phase: Data Out (Information Command)
Transition to: Message Out (for example, MODE SELECT)

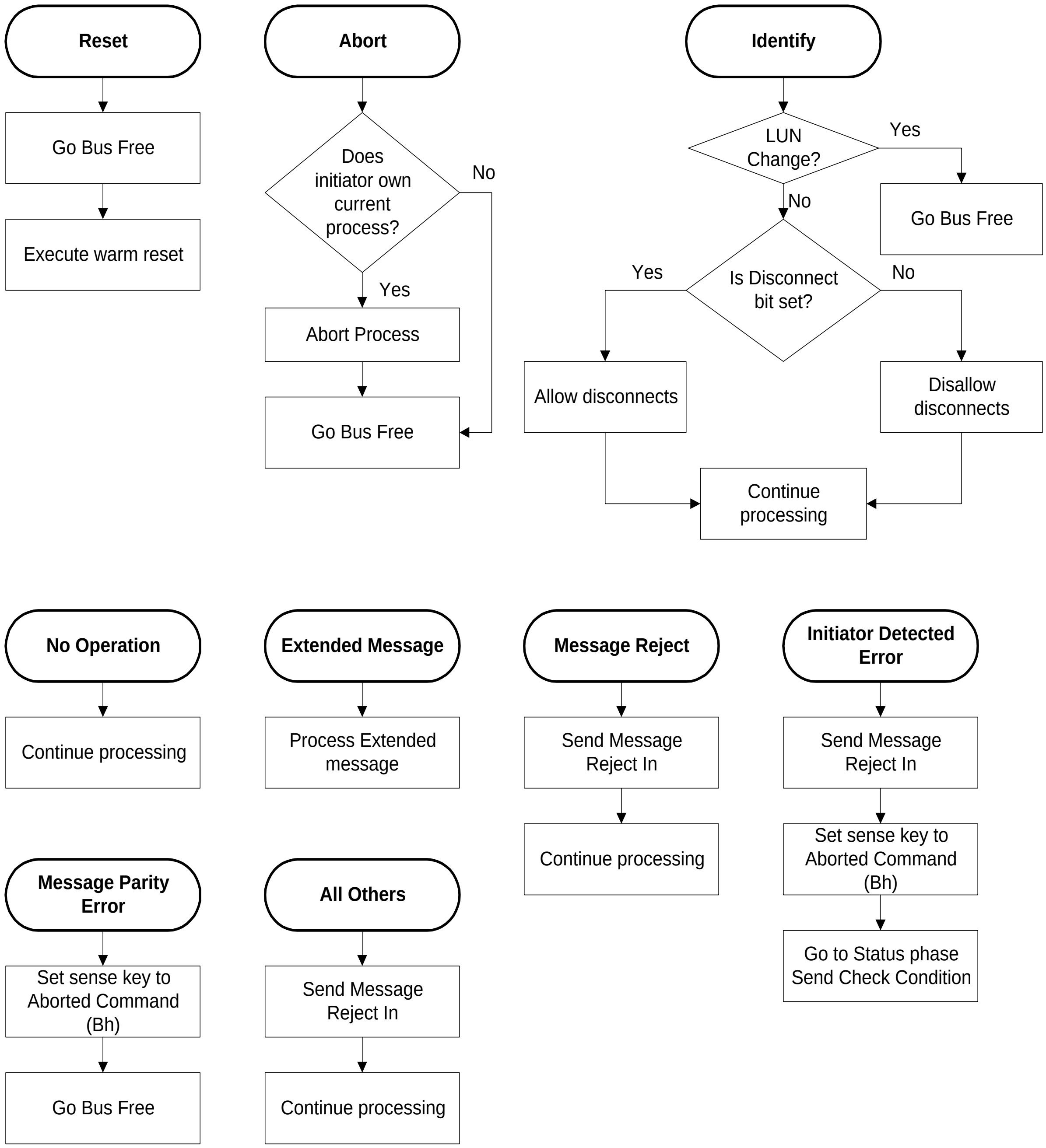


Figure C-9 Message processing during the Data Out phase for an information command

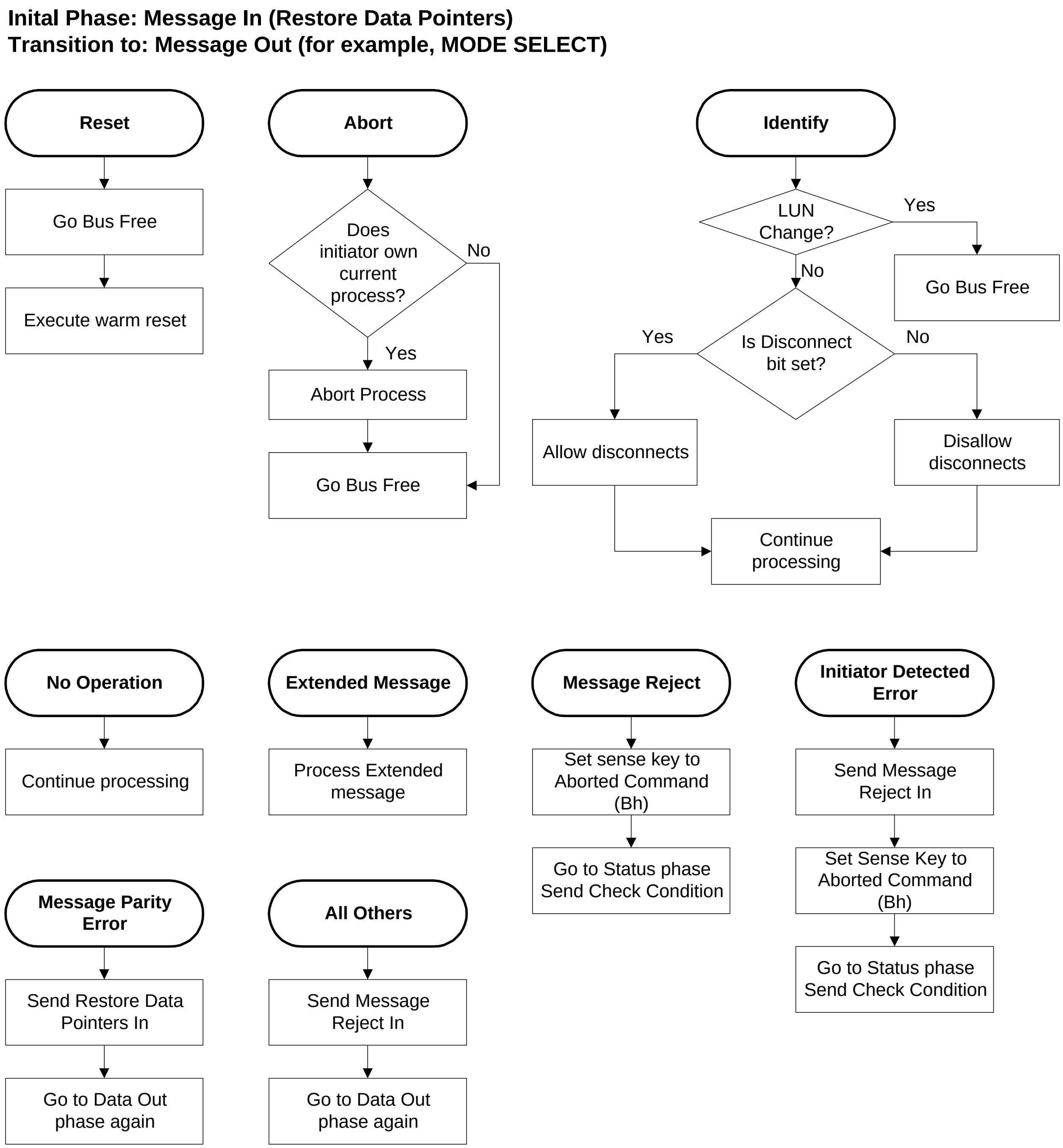


Figure C-10 Message processing after a Restore Data Pointers message when reattempting the Data Out phase for an information command

Message Processing in Data In Phase (READ Command)

Figure C-11 shows how messages are processed during the Data In phase of a READ command (that is, when the initiator asserts the Attention signal while it is receiving user data from the tape drive).

Parity Error in Data Associated with READ Command

If the initiator detects a parity error in data transferred from the tape drive during a READ command, it should assert the Attention signal. This causes the tape drive to stop the data transfer. The initiator should then send an Initiator Detected Error message to the tape drive.

When it receives the Initiator Detected Error, the tape drive assumes that a parity error has occurred and aborts the data transfer. The tape drive is positioned at the start of the next block.

After aborting the data transfer, the tape drive sends Check Condition status to the initiator followed by a Command Complete message. The sense key is set to Aborted Command (Bh), and the ASC and ASCQ are set to 47h and 00h. The SCSI Bus Parity Error bit is set to 1. In fixed-block mode, the Information bytes contain the number of blocks not sent to the initiator.

The initiator should backspace *n* blocks and attempt to reread the blocks by reissuing the READ command.

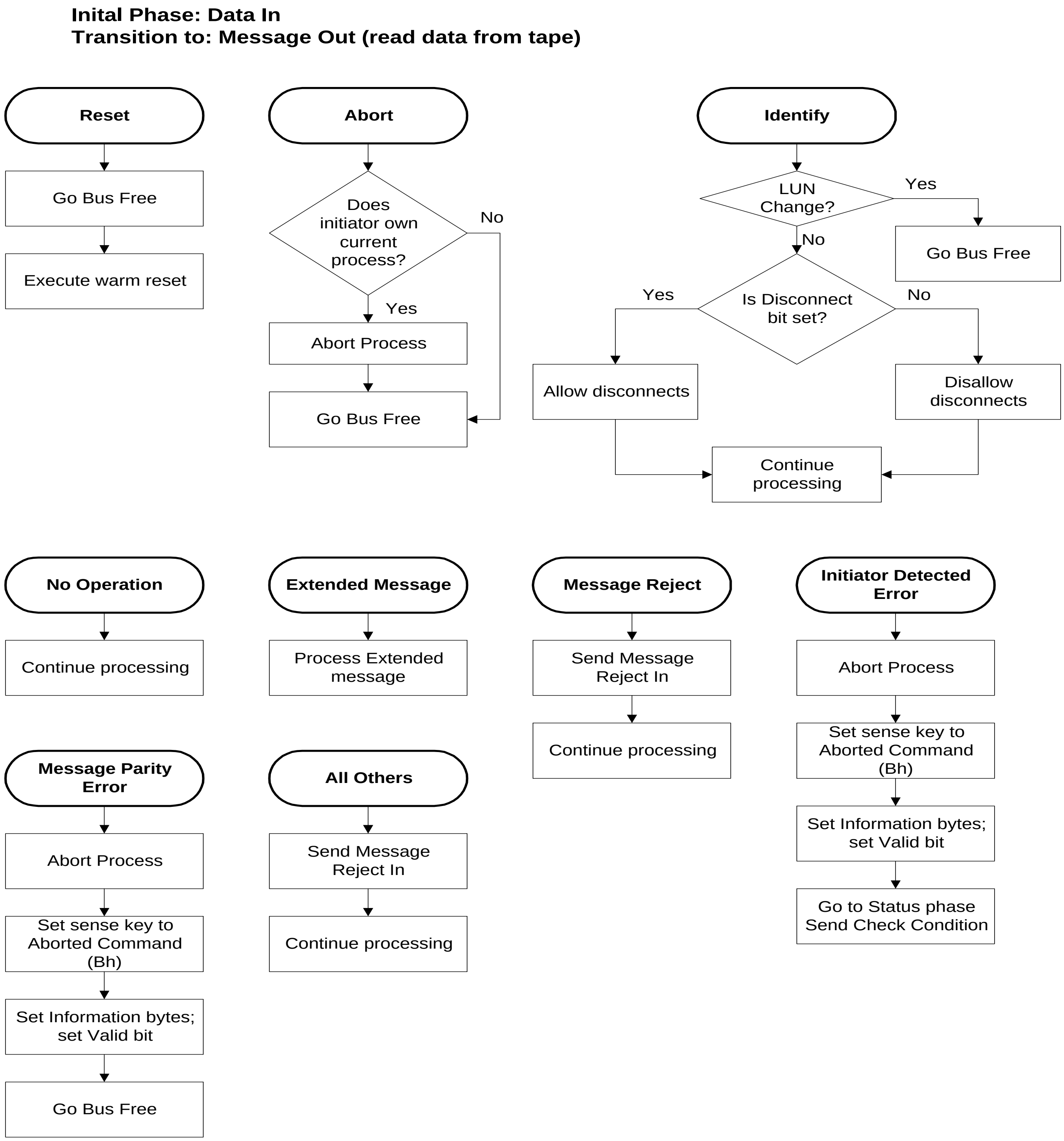


Figure C-11 Message processing during the Data In phase of a READ command

Message Processing in Data In Phase (Information Commands)

Figure C-12 shows how messages are processed during the Data In phase for commands other than READ (for example, INQUIRY, REQUEST SENSE, and MODE SENSE).

Parity Error in Data In Phase (Information Commands)

If the initiator detects a parity error in data transferred from the tape drive during a REQUEST SENSE, MODE SENSE, READ POSITION, or INQUIRY command, it should assert the Attention signal. This causes the tape drive to stop the data transfer. The initiator should then send an Initiator Detected Error message to the tape drive.

When it receives the Initiator Detected Error, the tape drive issues a Restore Pointers message and re-sends the data.

Figure C-13 shows how messages are processed after a Restore Data Pointers message is sent to the initiator while reattempting the Data In phase for an information command.

Inital Phase: Data In (Information Command)
Transition to: Message Out (for example, INQUIRY, REQUEST SENSE)

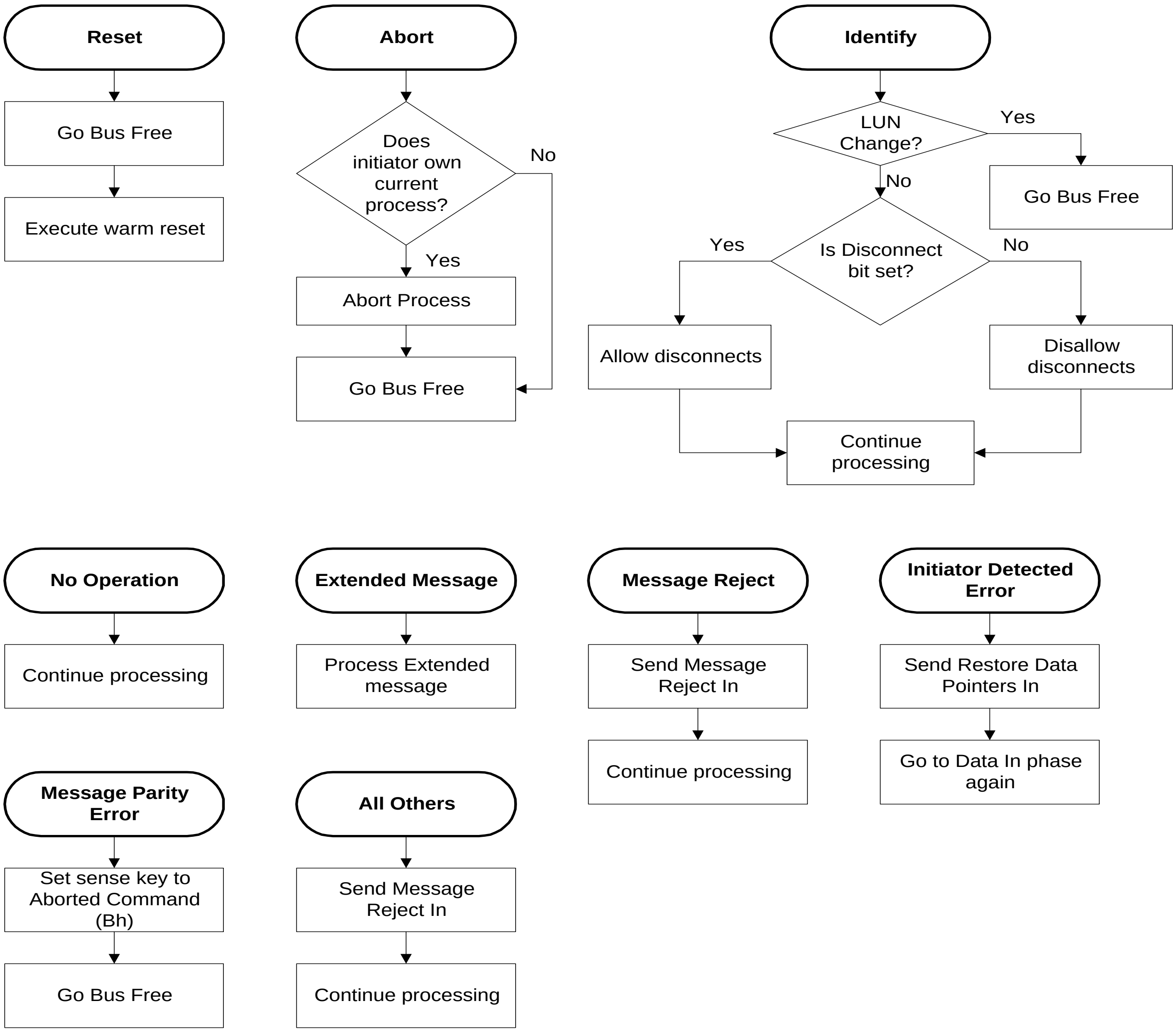


Figure C-12 Message processing during the Data In phase of an information command

Inital Phase: Message In (Restore Data Pointers)
Transition to: Message Out (for example, INQUIRY, REQUEST SENSE)

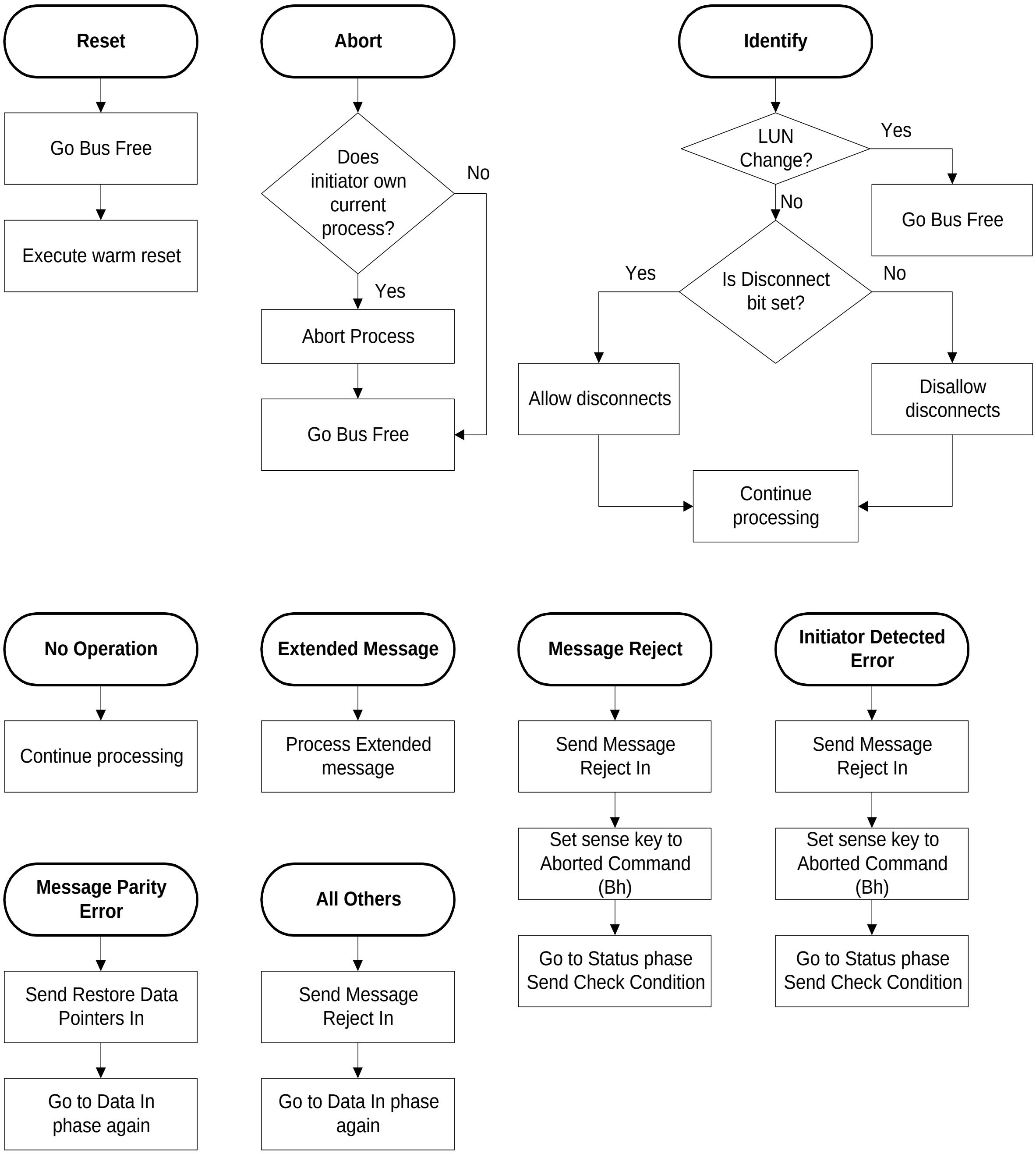


Figure C-13 Message processing after a Restore Data Pointers message when reattempting the Data In phase for an information command

Message Processing In Status In Phase

Figure C-14 shows how messages are processed during the Status In phase. Note that attempts to change the physical path characteristics are not processed.

Parity Error in Status In Phase

If the initiator detects a parity error on the status transferred from the tape drive, it should assert the Attention signal. This causes the tape drive to go to the Message Out phase. The initiator should then send an Initiator Detected Error message to the tape drive.

When the tape drive receives the Initiator Detected Error message, it issues a Restore Data Pointers message and resents the status. Figure C-15 shows how messages are processed after a Restore Data Pointers message is issued by the tape drive when reattempting the Status In phase.

The initiator should count the Restore Pointers messages received during the Data Out phase to qualify the communication. If the count exceeds some threshold, the initiator should clear the tape drive from the bus by doing one of the following:

- Sending the Abort message
- Performing a SCSI bus reset
- Sending the Bus Device Reset message

Inital Phase: Status In
Transition to: Message Out

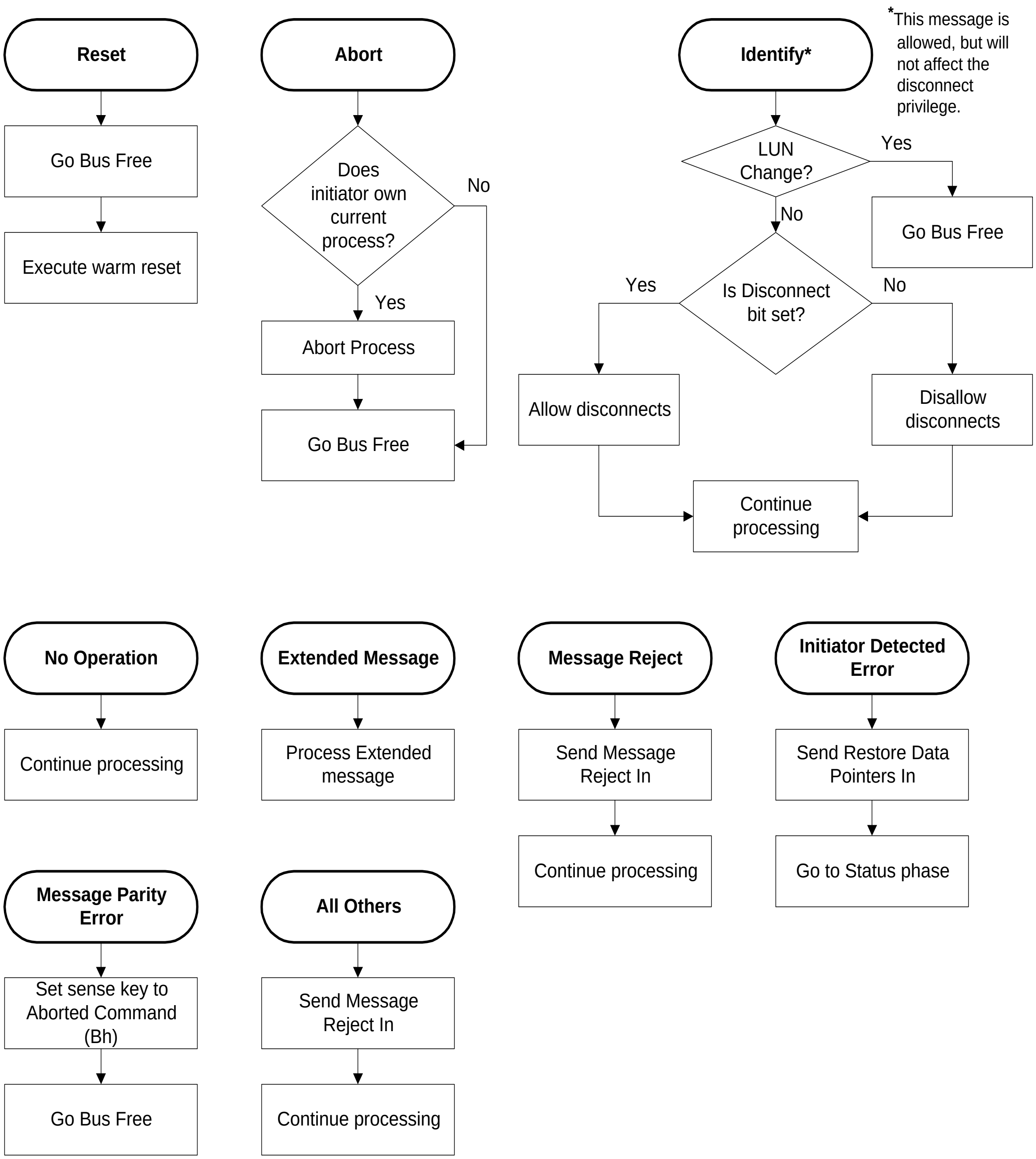


Figure C-14 Message processing during the Status In phase

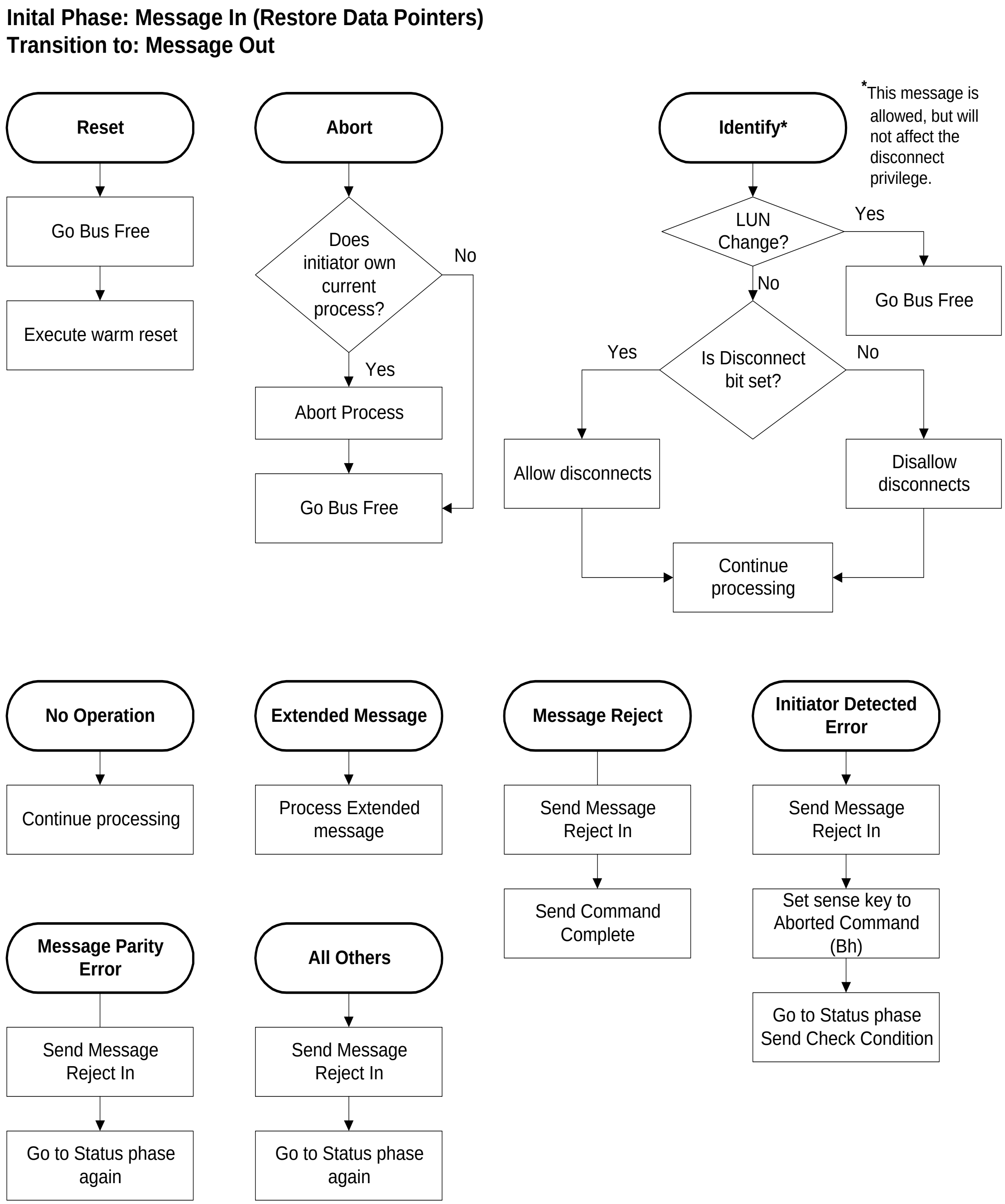


Figure C-15 Message processing after a Restore Data Pointers message when reattempting the Status In phase

Message Processing in Message In Phase (Command Complete)

Figure C-16 shows how messages are processed while the tape drive is attempting to send the Command Complete message.

Parity Error Sending the Command Complete Message In

If the initiator detects a parity error during the Command Complete Message In phase, it sends a Message Parity Error message to the tape drive. The tape drive responds by re-sending the Command Complete message.

The initiator should count Message Parity Error messages to qualify the communication. If the count exceeds some threshold, the initiator should clear the tape drive from the bus by doing one of the following:

- Sending the Abort message
- Performing a SCSI bus reset
- Sending the Bus Device Reset message

Initial Phase: Message In (Command Complete)
Transition to: Message Out

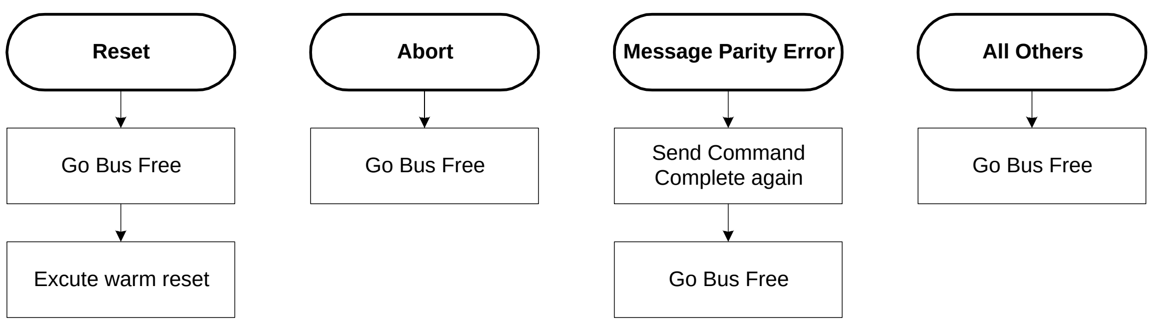


Figure C-16 Message processing during Command Complete Message In phase

Message Processing after Resection

Figure C-17 shows how messages are processed after the tape drive has reselected the initiator and sent the Identify message in. Note that if the initiator sends the tape drive a Message Reject message, this will be treated as a catastrophic error committed by the initiator.

Parity Error Sending the Identify Message In

If the initiator detects a parity error when the tape drive sends the Identify message in, it responds by sending a Message Parity Error message to the tape drive. The tape drive responds by re-sending the Identify message.

The initiator should count Message Parity Error messages to qualify the communication. If the count exceeds some threshold, the initiator should clear the tape drive from the bus by doing one of the following:

- Sending the Abort message
- Performing a SCSI bus reset
- Sending the Bus Device Reset message

Inital Phase: Reselection with Identify In
Transition to: Message Out

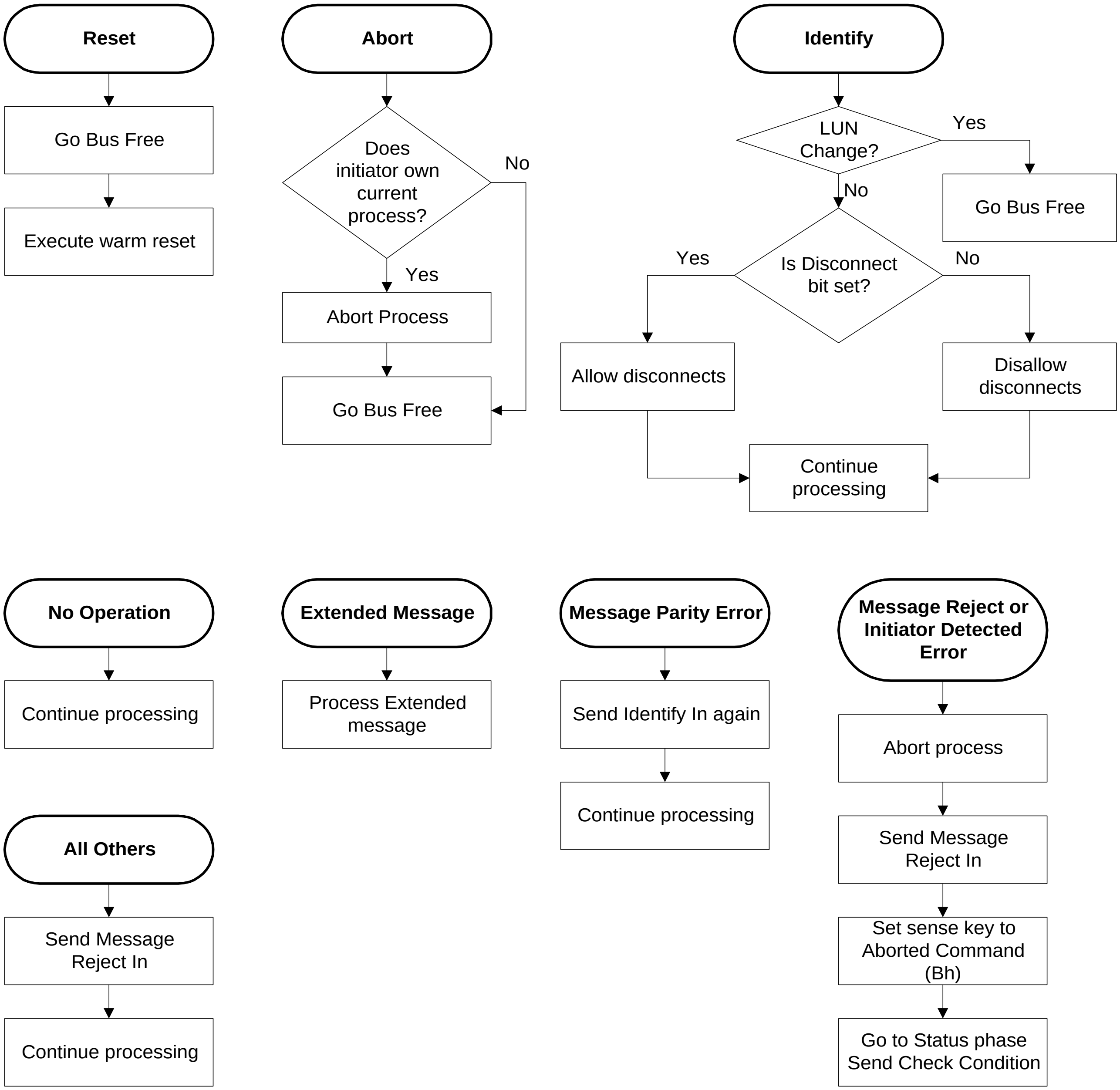


Figure C-17 Message processing after tape drive reselects initiator with Identify message

Message Processing during Disconnect Sequence

Figure C-18 shows how messages are processed while the tape drive is executing the “disconnect” sequence. Note that attempts to change the physical path characteristics are not allowed. Also, the disconnect sequence may be aborted if the initiator sends a Message Reject message.

Parity Error Sending Disconnect or Save Data Pointers Message In

If the initiator detects a parity error when the tape drive sends a Disconnect or Save Data Pointers message in, it responds by sending a Message Parity Error message to the tape drive. The tape drive responds by re-sending the Disconnect or Save Data Pointers message.

The initiator should count Message Parity Error messages to qualify the communication. If the count exceeds some threshold, the initiator should clear the tape drive from the bus by doing one of the following:

- Sending the Abort message
- Performing a SCSI bus reset
- Sending the Bus Device Reset message

Inital Phase: Message In sending Save Data Pointers or Disconnect
Transition to: Message Out

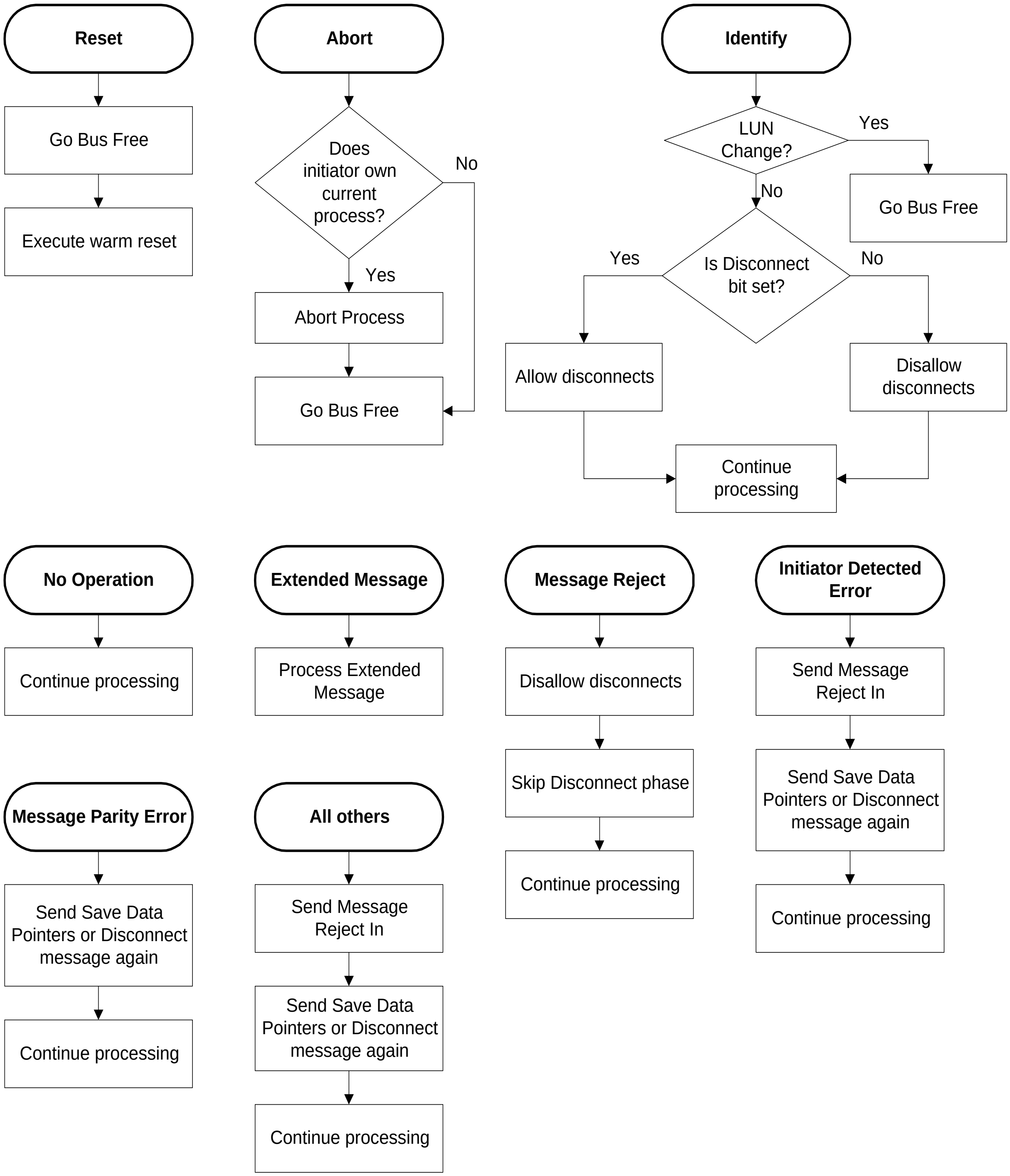


Figure C-18 Message processing while tape drive is executing the Disconnect sequence

Notes

D Error Information

This appendix is a reference for:

- The Additional Sense Codes (ASCs) and Additional Sense Code Qualifiers (ASCQs) returned by the REQUEST SENSE (03h) command. These codes provide additional information about each sense key.
- The Fault Symptom Codes (FSCs) returned by the REQUEST SENSE command. These Exabyte-unique codes can be used to determine the nature of hardware and software errors and other events. Recommended recovery procedures for each FSC are also provided.

D.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 Bytes returned by the REQUEST SENSE (03h) command. Each ASC and ASCQ combination is correlated with one or more of the Exabyte-unique Fault Symptom Codes (FSC) that are returned as byte 28 in the Extended Sense Bytes.

For ease of reference, the information in this section is listed in numerical order for each sense key (byte 02, bits 3 through 0).

Sense Key = 0h (No Sense)

Table D-1 REQUEST SENSE information for Sense Key 0h

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
00h	00h	Lengths did not match on read.	0Ah
00h	01h	A filemark was encountered during a read, space, or locate operation. The tape is positioned at the EOT-side of the filemark.	0Dh, 32h
00h	02h	LEOT or LEOP was encountered during a read, write, or write filemarks operation.	04h, 06h, 09h, 28h
00h	03h	A setmark was encountered during a read, space, or locate operation. The tape is positioned at the EOT-side of the setmark.	1Dh, 31h
00h	04h	PBOT or PBOP was encountered during a space or locate operation.	35h

Sense Key = 1h (Recovered Error)

Table D-2 REQUEST SENSE information for Sense Key 1h

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
5Bh	02h	Log parameter overflow (a cumulative counter reached its maximum value of all FFs).	ECh

Sense Key = 2h (Not Ready)

Table D-3 REQUEST SENSE information for Sense Key 2h

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
04h	00h	Logical unit not ready. No additional sense information. Refer to the Fault Symptom Code.	C6h, C8h, DDh
04h	01h	Logical unit not ready, but is in process of becoming ready (rewinding or loading tape).	C7h
30h	3h	The tape drive is being cleaned	DCh
3Ah	00h	Logical unit not ready. Command requires a tape, and no tape is present.	C9h

Sense Key = 3h (Medium Error)

Table D-4 REQUEST SENSE information for Sense Key 3h

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
00h	02h	PEOT or PEOP was encountered during a space or locate operation.	34h
03h	02h	Excessive write errors.	94h, 96h, 97h, 9Bh, 9Dh-9Fh, B3h
09h	00h	Tracking error.	AEh, B0h
11h	00h	An uncorrectable block was encountered during a read, space, or locate operation.	37h, B5h
11h	01h	An uncorrectable block was encountered during a read operation.	0Bh
11h	03h	Too many permanent read errors—can't sync.	11h
14h	00h	A Medium Error was detected during a read, space, or locate operation.	16h, 38h
15h	00h	There is no information at this position on tape. The tape drive cannot perform a space operation.	3Dh
26h	01h	Parameter not supported. The boot code did not allow a load from tape, or the code version was not supported by the boot code.	66h
26h	02h	A write buffer parameter value was invalid.	61h-65h, 69h
30h	00h	Incompatible media (such as non-write protected 8200 format or metal evaporative) was ejected after a LOAD command was issued.	47h
30h	01h	The tape format is incompatible with the tape drive.	1Ch
31h	00h	A tape format error was encountered during a space or locate operation, or a switch partition operation failed.	36h, 79h
31h	01h	The format partition operation failed.	74h
3Bh	02h	PEOT or PEOP encountered. Tape position error at end of medium or partition.	14h
44h	00h	Internal software error	A2h
50h	01h	Write failure after retry limit (specified with MODE SELECT) exceeded.	95h

Sense Key = 4h (Hardware Error)

Table D-5 REQUEST SENSE information for Sense Key 4h

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
00h	00h	Undetermined hardware error.	58h, 5Ah, 67h, 68h, 6Dh, FCh, FDh
08h	01h	Logical unit communication timeout.	9Ah, 9Ch, ABh
08h	02h	Logical unit communication parity error.	A4h, A5h, A7h, A8h
0Ch	00h	Hardware failure—Head sync error during write.	A1h
11h	00h	A hardware error was detected during a read operation.	17h, 18h
15h	01h	Servo hardware failure.	ADh
40h	80h	Controller hardware failure.	8Dh
44h	00h	Internal software failure.	8Ch, 98h, 99h, ACh

Sense Key = 5h (Illegal Request)

Table D-6 REQUEST SENSE information for Sense Key 5h

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
00h	05h	The tape drive was in write mode and a READ or VERIFY command was issued.	0Eh
1Ah	00h	Illegal Parameter List Length in the CDB.	CCh, D4h
20h	00h	Illegal operation code.	CDh
21h	00h	Logical block address out of range.	D9h
24h	00h	Invalid field in the CDB.	CEh
25h	00h	Logical unit not supported.	CFh, D1h
26h	00h	Invalid field in parameter list.	D0h, EAh
27h	00h	The data cartridge is write protected.	73h
30h	02h	The tape format is incompatible with the command (for example, you are attempting to write setmarks in 8500 format).	D7h
	05h	Cannot write to the data cartridge. The tape format is not supported (for example, you are attempting to write to an 8200 format tape).	DBh

Table D-6 REQUEST SENSE information for Sense Key 5h (*continued*)

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
3Dh	00h	Illegal bit set in Identify message.	DAh
50h	01h	Write append position error, or illegal position to format partitions.	02h, 26h, 4Bh, 71h
53h	02h	Media removal prevented.	D2h
81h	00h	Mode mismatch. Fixed/variable.	D3h
82h	00h	The command requires no tape, but a tape is loaded (SEND DIAGNOSTICS).	D5h
84h	00h	Could not change the MODE SELECT parameters or create a code load tape (WRITE BUFFER) because the tape was not at LBOT (or LBOP).	D6h

Sense Key = 6h (Unit Attention)

Table D-7 REQUEST SENSE information for Sense Key 6h

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
28h	00h	A tape was just loaded and the media may have been changed.	C1h
29h	00h	Power-on reset, SCSI bus reset, or device reset has occurred.	C0h
2Ah	01h	MODE SELECT parameters have been changed.	C2h
2Ah	02h	Log parameter changed.	CBh
30h	00h	Incompatible media (such as non-write protected 8200 format or metal evaporative) was rejected after the cartridge was inserted.	C5h
3Fh	01h	New microcode (firmware) was loaded.	C3h
5Ah	01h	Operator requested media removal.	C4h
5Bh	01h	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.)	CAh

Sense Key = 7h (Data Protect)

Table D-8 REQUEST SENSE information for Sense Key 7h

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
27h	00h	The tape is write protected.	03h, 27h, 4Ch

Sense Key = 8h (Blank Check)

Table D-9 REQUEST SENSE information for Sense Key 8h

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
00h	05h	End of data encountered on a read operation.	0Ch, 0Fh, 33h

Sense Key = 9h (Exabyte)

Table D-10 REQUEST SENSE information for Sense Key 9h

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
15h	02h	Positioning error detected by read of medium during a space or locate operation.	15h, 3Ah

Sense Key = Bh (Aborted Command)

Table D-11 REQUEST SENSE information for Sense Key Bh

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
00h	00h	No additional sense information. Refer to the Fault Symptom code.	05h, 10h, 3Bh, 4Eh, 75h, 7Ah, E7h, EBh
08h	02h	IPORT write or read parity error.	A3h, A6h
10h	00h	Compression Integrity Check failed.	08h
11h	02h	Read decompression CRC failed.	19h
43h	00h	Message error.	E0h, E1h, E3h-E5h
47h	00h	The command was aborted because of a SCSI bus parity error.	E6h
48h	00h	Initiator detected error.	E2h
4Eh	00h	Overlapped commands attempted—Bad initiator-target-LUN (ITL) nexus.	D8h

Sense Key = Dh (Volume Overflow)

Table D-12 REQUEST SENSE information for Sense Key Dh

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
00h	02h	EOT or EOP encountered, or partition size too big for tape.	72h, 93h, AFh, B6h

D.2 Fault Symptom Codes

This section lists the Fault Symptom Codes that may be returned by the REQUEST SENSE (03h) command. The Fault Symptom Code is returned as byte 28 in the Extended Sense Bytes. It is an Exabyte-unique byte that specifies the reason for the most recent Check Condition status.

Note: You can also use the Fault Symptom Code field to determine the location of errors in data sent with the MODE SELECT (15h) command and the LOG SELECT (4Ch) command. For more information about this use of the Fault Symptom Code, refer to Section 10.17 for MODE SELECT and Section 8.5 for LOG SELECT.

For ease of reference, the Fault Symptom Codes (FSC) are listed in hexadecimal order. The information provided for each code includes the sense key (SK) associated with the code, an error recovery procedure (ERP) code, and a brief description of the problem or event.

Note: For more information about the suggested actions for each ERP code, refer to “Error Recovery Procedures” on page D-15.

➤ **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.

Fault Symptom Code Descriptions

Table D-13 Fault Symptom Codes

FSC	SK	ERP	Description
02h	5h	11	A WRITE command was received when the tape was not at a legal position to write.
03h	7h	5	A WRITE command was received when the data cartridge was write protected.
04h	0h	11	LEOT or LEOP was encountered during the current write operation (the command may have terminated early).
05h	Bh	11	The write operation was aborted, as requested.
06h	0h	10	LEOT or LEOP was encountered during the last write operation (the command completed successfully).
08h	Bh	3	Compression Integrity Check failed.
09h	0h	11	LEOT or LEOP was encountered during a read operation.
0Ah	0h	11	The actual block size read did not match the requested block size during a read operation.
0Bh	3h	13, 9	An uncorrectable block was encountered during a read operation.
0Ch	8h	11	EOD was encountered during a read operation.
0Dh	0h	11	A filemark was encountered during a read or verify operation.
0Eh	5h	11	The tape drive was in write mode and a READ or VERIFY command was issued.
0Fh	8h	13	Already at blank tape, so it is an error to attempt a read operation.
10h	Bh	11	The read operation was aborted, as requested.
11h	3h	13	Too many permanent read errors—cannot sync.
14h	3h	11, 13	PEOT or PEOP was encountered during a read or verify operation.
15h	9h	13	An invalid file number was detected in a filemark during a read operation (8200 format tapes only).
16h	3h	13, 9	A Medium Error was detected during a read operation.
17h	4h	8, 3, 12	A Hardware Error was detected during a read operation.
18h	4h	8, 3, 12	Read decompression failed.
19h	Bh	8, 3, 12	Read decompression CRC failed.
1Ch	3h	14	The tape format is incompatible with the tape drive.
1Dh	0h	11	A setmark was encountered during a read or verify operation.
26h	5h	11	A WRITE FILEMARKS command was received when the tape was not at a legal position to write.

Table D-13 Fault Symptom Codes (*continued*)

FSC	SK	ERP	Description
27h	7h	5	A WRITE FILEMARKS command was received when the data cartridge was write protected.
28h	0h	11	LEOT or LEOP was encountered during or before the write filemarks operation—the filemark was written.
31h	0h	11	A setmark was encountered during a space operation.
32h	0h	11	A filemark was detected during a space operation.
33h	8h	11	EOD was encountered during a space or locate operation.
34h	3h	11	PEOT or PEOP was encountered during a space or locate operation.
35h	0h	1, 3	PBOT or PBOP was encountered during a space or locate operation.
36h	3h	13	A tape format error was encountered during a space or locate operation.
37h	3h	13, 9	An uncorrectable block was encountered during a read operation.
38h	3h	13, 9	A Medium Error was detected during a space or locate operation.
3Ah	9h	13	A wrong file number was encountered in a filemark during a space operation (8200 format tapes only).
3Bh	Bh	11	The SPACE or LOCATE command was aborted, as requested.
3Dh	3h	1, 9	There is no information at this position on tape. The tape drive cannot perform a space operation.
47h	3h	11	Incompatible media (such as non-write protected 8200 format or metal evaporative) was ejected after a LOAD command was issued.
4Bh	5h	11	The tape is not at a legal place to erase.
4Ch	7h	5	The data cartridge is write protected and cannot be erased.
4Eh	Bh	11	The ERASE command was aborted, as requested.
58h	4h	11	An error occurred during the send diagnostics operation.
5Ah	4h	11	An error occurred during the send diagnostics operation.
61h	3h	11	The code header was not valid when loading firmware.
62h	3h	11	The servo load image was not valid when loading firmware.
63h	3h	11	Bank 0 of control load image was not valid when loading firmware.
64h	3h	11	Bank 1 of control load image was not valid when loading firmware.
66h	3h	11	The boot code did not allow a load from tape, or the code version was not supported by the boot code.
67h	4h	12	One of the memories could not be programmed.

Table D-13 Fault Symptom Codes (*continued*)

FSC	SK	ERP	Description
68h	4h	12	A Hardware Error occurred while loading new firmware.
69h	3h	3	The CRC in the load image in the buffer was incorrect.
6Dh	4h	12	The READ BUFFER command failed.
71h	5h	11	The tape is not at a legal position to format partitions.
72h	Dh	11	The value you specified for the partition size was too big for the tape.
73h	5h	5	The data cartridge is write protected.
74h	3h	6	The format partition operation failed.
75h	Bh	11	The format partition operation was aborted.
79h	3h	3, 11	The switch partitions operation failed.
7Ah	Bh	11	The switch partitions operation was aborted.
8Ch	4h	8	Controller firmware logic error.
8Dh	4h	8	Controller hardware failure.
93h	Dh	11	The physical end of partition (PEOP) was detected.
94h	3h	6	Write setmark failure after internal retry limit exceeded.[a]
95h	3h	6, 9	Write failure after retry limit (specified with MODE SELECT) exceeded.
96h	3h	6	Write filemark failure after internal retry limit exceeded.[a]
97h	3h	6	Write EOD failure after internal retry limit exceeded.[a]
98h	4h	8, 12	Hardware failure—Invalid BRT.
99h	4h	8, 12	Hardware failure—Buffer empty.
9Ah	4h	8, 12	Hardware failure—Deformatter Intrp timeout on search.
9Bh	3h	6, 9	The read-back-check operation detected a different block type from what was written (old data is not being fully overwritten).
9Ch	4h	8, 12	Hardware failure—Formatter Intrp timeout on write.
9Dh	3h	9, 6	Permanent write error—Write recovery failure.[b]
9Eh	3h	9, 6	Permanent write error—Rewrite threshold exceeded.[b]
9Fh	3h	9, 6	Servo zone read-back-check failure on a write.
A1h	4h	8, 12	Hardware failure—Head sync error during write.
A2h	4h	2, 3 or 1, 3	Underrun error during write.
A3h	Bh	13	IPORT write buffer parity error.

Table D-13 Fault Symptom Codes (*continued*)

FSC	SK	ERP	Description
A4h	4h	8, 12	DPORT write buffer parity error.
A5h	4h	8	Buffer positioning lost during write abort process.
A6h	Bh	13	IPORT read buffer parity error.
A7h	4h	8, 12	DPORT read buffer parity error.
A8h	4h	8, 12	PPORT parity error.
ABh	4h	9, 8, 3, 6	Servo timed out.
ACh	4h	9, 8, 3, 6	Servo software error.
ADh	4h	9, 8, 3, 6	Servo hardware failure.
AEh	3h	9, 8, 3, 6	Unable to achieve or maintain tracking.
AFh	Dh	11	PEOT or PEOP was encountered during a tape motion command.
B0h	3h	9, 8, 3, 6	Tape damaged—unable to achieve or maintain tracking.
B3h	3h	9, 8, 3, 6	LBOT or LBOP write failure—read-back-check criteria not met after retry limit exceeded.[a]
B4h	3h	9, 8, 3, 6	LBOT failure—unable to write tape-mark tracks in 8200 format.
B5h	3h	9	Physical Read Manager could not read LBOT or LBOP.
B6h	Dh	11	EOT encountered during buffer flush.
C0h	6h	3	Unit Attention—Power-on reset occurred.
C1h	6h	3	Unit Attention—Data cartridge may have been changed.
C2h	6h	3	Unit Attention—MODE SELECT parameters were changed.
C3h	6h	3	Unit Attention—New microcode was loaded.
C4h	6h	3	Unit Attention—Operator requested media removal.
C5h	6h	3	Unit Attention—Incompatible media (such as non-write protected 8200 format or metal evaporative) was rejected after the cartridge was inserted.
C6h	2h	7, 3	Not Ready — Cause not known.
C7h	2h	3	Not Ready, but becoming ready.
C8h	2h	2, 3	A tape motion command is required to move the tape from its current location.
C9h	2h	7	The command requires a tape, but no tape is loaded.
CAh	6h	3	Unit Attention — Log threshold met. (For more information about this error, look at the Log Parameter Page Code and Log Parameter Code bytes in the REQUEST SENSE data.)
CBh	6h	3	Unit Attention — Log parameter changed.

Table D-13 Fault Symptom Codes (*continued*)

FSC	SK	ERP	Description
CCh	5h	4	Parameter List Length error in the MODE SELECT CDB.
CDh	5h	4	Illegal Op Code.
CEh	5h	4	Invalid field or reserved bits set in the CDB.
CFh	5h	4	The LUN is not supported.
D0h	5h	4	Invalid field in Parameter List (MODE SELECT).
D1h	5h	4	The LUN in the Identify message is illegal (not zero).
D2h	5h	11	Media removal is prevented.
D3h	5h	4	A variable/fixed mismatch occurred between the CDB and the MODE SELECT parameters.
D4h	5h	4	Illegal transfer length in CDB.
D5h	5h	11	The command requires no tape, but a tape is loaded (SEND DIAGNOSTICS).
D6h	5h	11	Could not change the MODE SELECT parameters or create a code load tape (WRITE BUFFER) because the tape was not at LBOT (or LBOP).
D7h	5h	11	The tape format is incompatible with the command.
D8h	Bh	3	Overlapped commands attempted—Bad initiator-target-logical unit (ITL) nexus.
D9h	5h	4	Logical block out of range.
DAh	5h	4	Illegal bit set in Identify message.
DBh	5h	14	Cannot write to the data cartridge. The tape format is not supported (for example, you are attempting to write to an 8200 format tape).
DCh	2h	10	The tape drive is being cleaned.
DDh	2h	10	A head sync tape was detected.
E0h	Bh	3	The command was aborted in the first Message Out phase or CDB phase—Abort message or other error.
E1h	Bh	3	The command was aborted before the Data phase—Received bad message.
E2h	Bh	11	The command was aborted in the Data phase—Initiator Detected Error or Abort message.
E3h	Bh	3	The command was aborted in the Data phase—Received bad message out.
E4h	Bh	3	The command was aborted after the Data phase—Received bad message out.
E5h	Bh	3	The command was aborted after the Data phase—Other error.

Table D-13 Fault Symptom Codes (*continued*)

FSC	SK	ERP	Description
E6h	Bh	3	The command was aborted because of a SCSI bus parity error.
E7h	Bh	11	The initiator sent an Abort or Initiator Detected Error message during a read operation and the command was aborted.
EAh	5h	4	Conflict between Density Code and Data Compression Page in MODE SELECT.
EBh	Bh	11	Operation illegal during write buffer sequence.
ECh	1h	10, 11	Log parameter overflow (a cumulative counter reached its maximum value of all FFs).
FCh	4h	12	The tape drive lost calibration.
FDh	4h	15	The FEPROM configuration data is invalid.

[a] If the read-back-check criteria are not met for an LBOT, LBOP, filemark, setmark, or EOD block written to tape, the tape drive moves the tape backward and retries the operation 11 times. 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, and 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 Medium Error (3h) and the FSC set to 9Eh. If the recovery splice operation cannot be completed, the FSC is 9Dh.

Error Recovery Procedures

Table D-14 describes the error recovery procedures (ERPs) recommended for each Fault Symptom Code listed in Table D-13.

Note: If two or more ERP codes are listed for the Fault Symptom Code, perform the action for the first code, then perform the action for the second code, and so on.

Table D-14 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).
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 unload 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	The tape drive cannot read the tape or the tape may be written an incompatible format. Perform one of the following actions: ▪ Repeat the operation with a different data cartridge. ▪ To read an 8200 format tape, make sure the cartridge is write-protected. ▪ Write in either 8500 or 8500c format starting from LBOT.
15	Contact Exabyte Technical Support.

Notes

E Microcode Update Tape

Exabyte may periodically release new levels of microcode for the Eliant 820 tape drive. When new releases are available, you can obtain microcode update files on diskette or 8mm tape from Exabyte Technical Support. You can also download microcode files from the Exabyte Technical Support bulletin board or the Exabyte World Wide Web site (http://www.exabyte.com).

The following instructions explain how to use the microcode update tape. You can also use the WRITE BUFFER command to copy the microcode from a microcode file to your tape drive across the SCSI bus (see Chapter 26 for instructions).

E.1 Procedure for Updating Microcode

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.

   If you have a single-ended tape drive, you can disconnect it from the SCSI bus to ensure that a reset cannot occur. If you disconnect the tape drive and it has an external terminator, remove the terminator also.

If you have a differential tape drive, do not disconnect it from the SCSI bus and do not remove the terminator.

> **CAUTION**
>
> If a SCSI bus reset occurs during the microcode update process, the tape drive may not be operable. If this happens, use the Monitor program for the tape drive to reload the microcode over the tape drive's diagnostic port.

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.

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 the Monitor for the tape drive to load the code from diskettes over the tape drive's diagnostic port.

E.2 Obtaining a Microcode Update Tape

To obtain a microcode update tape, contact Exabyte Technical Support at 1-800-445-7736 or 303-417-7792. You can also contact Exabyte Technical Support by email: support@ exabyte.com. Technical Support will help you determine the specific code you need and provide you with instructions for obtaining the tape.

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