EXABYTE®

Eliant™ 820

Product Specification

316593-002

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Revision History

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000	March 1996 (preliminary)
001	August 1996 (beta)
002	January 1997 (initial release)

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316593-002

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 specifications provided by Exabyte's personnel or agent for the applicable equipment.
- Use of any type of cleaning material other than an Exabyte Premium 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). Refer to the packing instructions in this manual.

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 product specification describes the functional, performance, and environmental specifications for the internal and tabletop models of the Exabyte® Eliant™820 8mm Tape Drive. This manual is for engineering, purchasing, or marketing personnel who want to evaluate the tape drive to determine the feasibility of integrating it into product lines.

How This Manual is Organized

Unless indicated, all specifications in the following chapters apply to both the internal and tabletop models of the tape drive.

- **Chapter 1** describes the features of the tape drive, including capacity, supported data formats, data compression, physical features, and related products.
- **Chapter 2** discusses how the tape drive implements helical-scan recording and describes the physical and logical recording formats used by the tape drive.
- **Chapter 3** describes the write, read, and data flow management functions of the tape drive.
- **Chapter 4** lists the requirements for installing, operating, maintaining, and shipping the tape drive.
- **Chapter 5** describes how the tape drive implements the Small Computer System Interface (SCSI), including an overview of SCSI messages and commands.
- **Chapter 6** lists performance, reliability, power, and environmental specifications.
- **Chapter 7** describes compliance with regulatory and safety agency standards, including electromagnetic susceptibility (EMI), susceptibility to electrostatic discharge (ESD), and radiated susceptibility.
- **Appendix A** provides additional specifications that apply only to the tabletop model of the tape drive.

Related Publications

The following publications list additional, related information.

Eliant 820 8mm Tape Drive

- *Exabyte Eliant 820 8mm Tape Drive SCSI Reference*, 316591
- *Exabyte Eliant 820 8mm Tape Drive Installation and Operation*, 316592

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*

Conventions Used in This Specification

This specification uses the following conventions to highlight notes, important information, and cautions:

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

➤ **Important** Read *Important* text to learn crucial information about the topic or procedure being discussed.

CAUTION

Follow the information in *CAUTION* boxes to avoid damaging the equipment.

1 Overview

The Exabyte® Eliant 820™ is an enhanced 8mm digital helical-scan tape drive that is available as an internal model (Figure 1-1) or tabletop model (Figure A-1 on page A-2). The internal model is packaged in the industry standard, 5.25-inch half-high form factor and 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.

The Eliant 820 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.

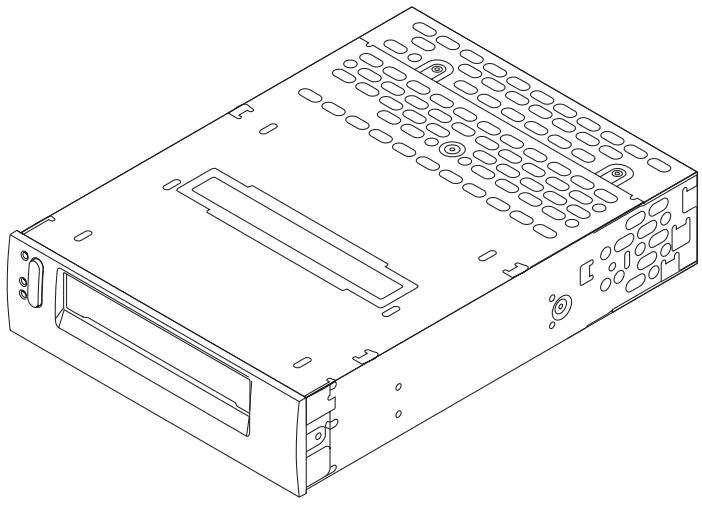

Figure 1-1 Internal model of the tape drive

Supported Data Formats

Write Formats The Eliant 820 writes data in the following formats:

- 8500
- 8500c (compressed)

Read Formats The Eliant 820 reads the following formats:

- 8200
- 8500
- 8500c (compressed)

> ➤ **Important** The tape drive can read 8200 format only if the data cartridge is write protected.

Table 1-1 compares the data formats supported by the Eliant 820.

Table 1-1 Tape drive data formats

	8200 format (read only)	8500 format	8500c format
Maximum sustained data transfer rate	500 KB/sec	1 MB/sec	2.0 MB/sec*
Maximum capacity on a 160m XL tape	3.5 GB	7.0 GB	14.0 GB*
Partitions	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		6 tracks (48 KB)
EOD mark	no	602 tracks	
Search fields	no	yes	

*Assumes a data compression ratio of 2:1.

Chapter 2 provides more information about the physical and logical characteristics of these data formats.

Data Compression

When the Eliant 820 compresses data, it uses the Improved Data Recording Capability (IDRC) algorithm licensed from IBM. The tape drive also uses the Exabyte Compression Integrity Check feature to ensure that data is accurately compressed and decompressed. The compression algorithm is contained in an Exabyte proprietary integrated circuit. Although the actual compression ratio depends on the type of data, the tape drive achieves an average compression ratio of 2:1. For more information about how the tape drive compresses data, see Chapter 3.

Physical Description

This section describes the following physical features of the tape drive:

- Front panel components
- Labels on the internal model
- Back panel components of the internal model
- Internal components
- Dimensions and weight of the internal model

Note: For a description of physical features specific to the tabletop tape drive, refer to Appendix A.

Front Panel Components

Figure 1-2 shows the front panel of the tape drive. (The tabletop tape drive features the same front panel components. See Appendix A for descriptions of additional components on the tabletop enclosure.)

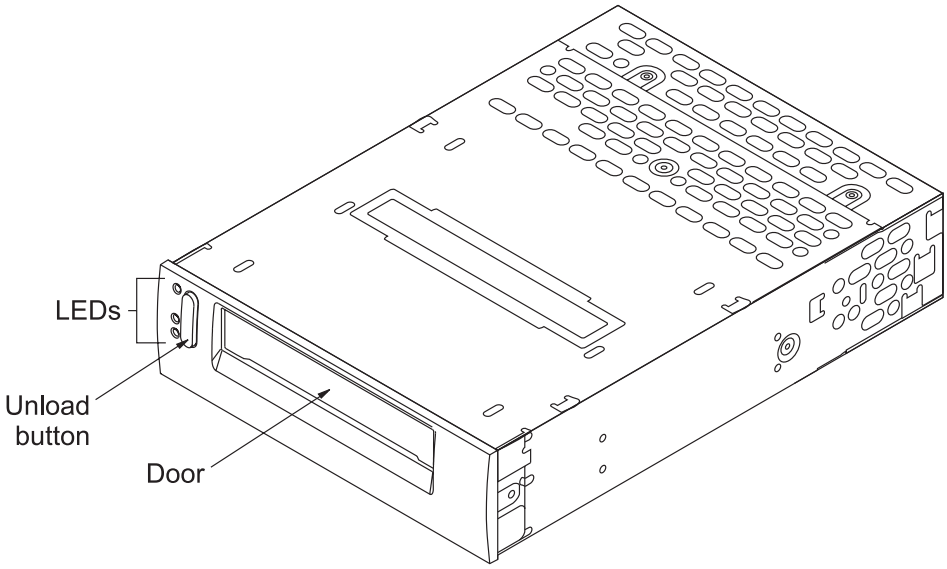

Figure 1-2 Front panel

LEDs

The tape drive has three LEDs on the front panel. Combinations of these LEDs (on, off, or flashing) indicate the status of tape drive operations. Chapter 4 provides details about these statuses.

Unload Button

The unload button is the only operator control on the tape drive. Pushing this button starts the unload procedure. Chapter 4 provides information about the cartridge load and unload process.

Door and Faceplate

Standard colors for the door and faceplate are black and pearl white. Exabyte can provide custom colors at an additional cost. (Contact your account manager for more information.)

Labels

Figure 1-3 shows the location of the agency label and the CEI (process/configuration) label on the internal model of the tape drive. (See page A-6 for information about the labels on the tabletop tape drive.)

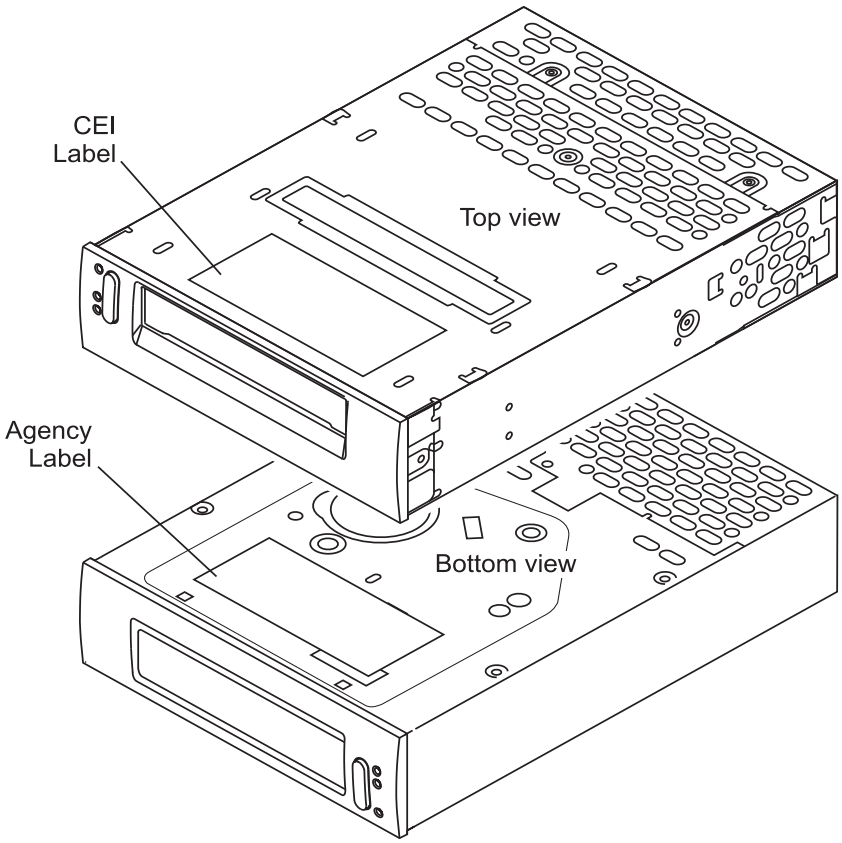

Figure 1-3 Labels on the internal tape drive

Back Panel Components

Figure 1-4 shows the back panel of the internal model of the tape drive. (See Appendix A for information about the back panel components of the tabletop tape drive.)

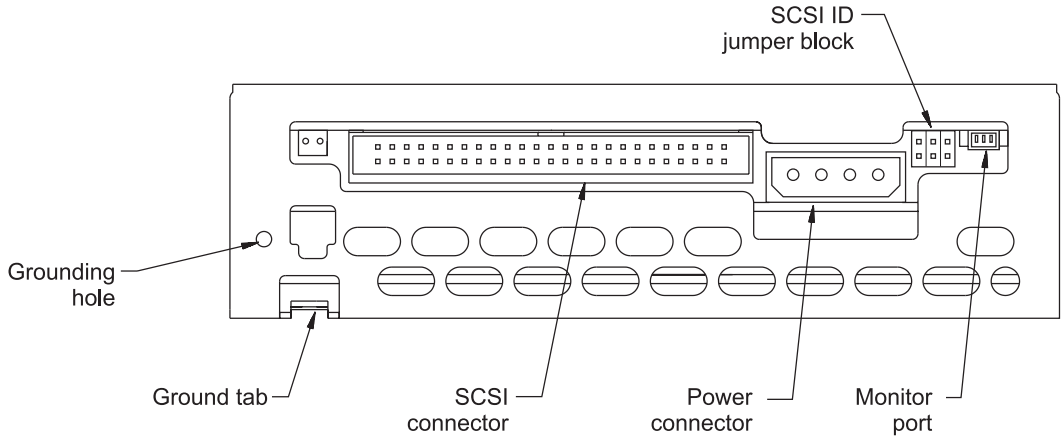

Figure 1-4 Back panel of the internal tape drive

Ground Tab and Grounding Hole

The internal model of the tape drive includes a ground tab and grounding hole to use if you want additional chassis grounding. Chapter 4 describes methods for grounding the tape drive.

SCSI Connector

The 50-pin SCSI connector allows you to connect the tape drive to the SCSI bus. Chapter 4 provides information about connecting the tape drive to the SCSI bus.

Power Connector

The 4-pin power connector is compatible with the power connector used for standard 5.25-inch half-high devices. Chapter 4 provides details about connecting the tape drive to a power supply.

SCSI ID Jumper Block

The SCSI ID jumper block enables you to set the SCSI ID either by using a remote switch or by installing jumpers. Chapter 4 describes the methods for setting the SCSI ID.

Monitor Port

The Monitor port provides a serial interface to the tape drive's microprocessor. Using the Monitor program for your tape drive (available from Exabyte) and a serial cable, you can change some of the tape drive's operating parameters, load code updates, and perform diagnostic procedures on the tape drive.

Internal Components

This section describes the internal components of the tape drive, including the tape transport mechanism, the drum mechanism, and the main cards. These components are the same for the internal model of the tape drive and the tabletop tape drive. Figure 1-5 shows the internal components.

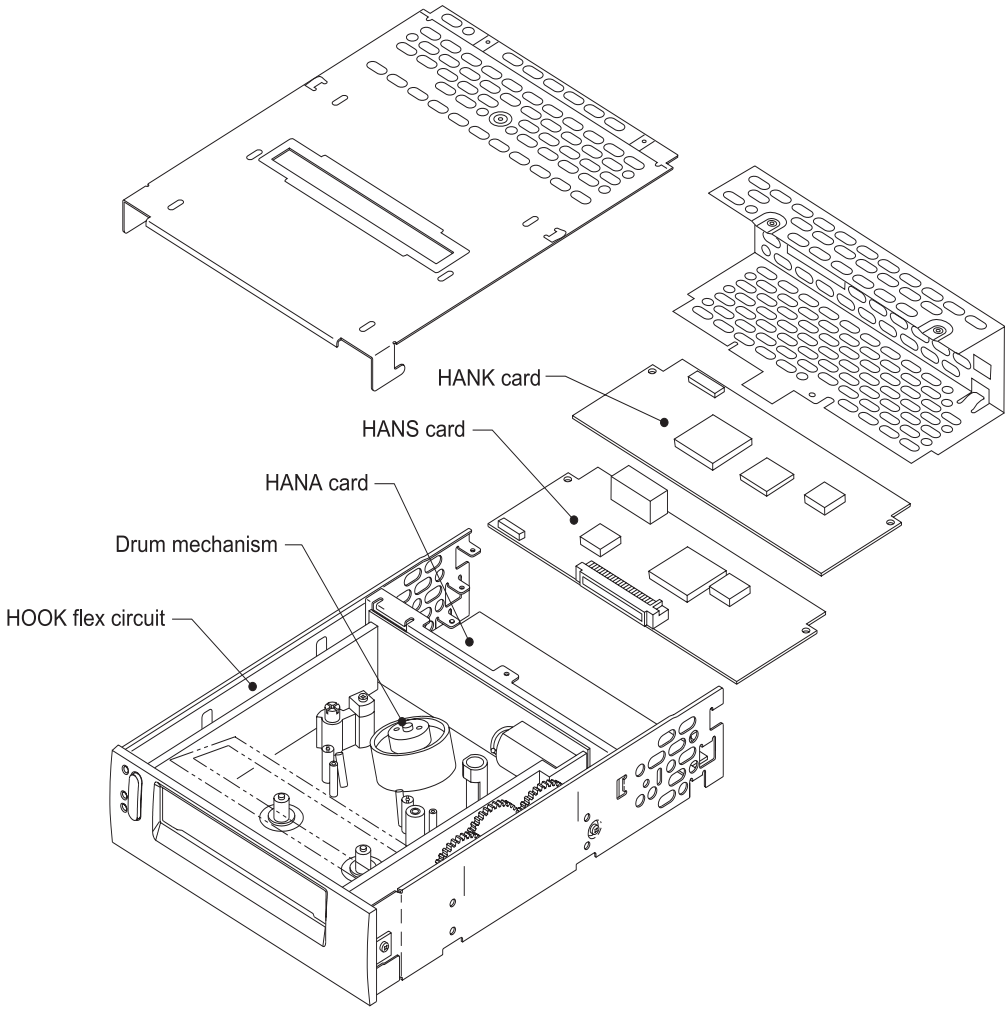

Figure 1-5 Internal components

Tape Transport Mechanism (not shown)

The 8mm tape transport mechanism is compatible with 8mm data cartridges that meet the ANSI/ISO/IEC 11319-1992 standard.

Drum Mechanism

The drum mechanism has five heads: two write heads (W1, W2), two read heads (R1, R2), and one servo head. Figure 1-6 shows the location of the heads.

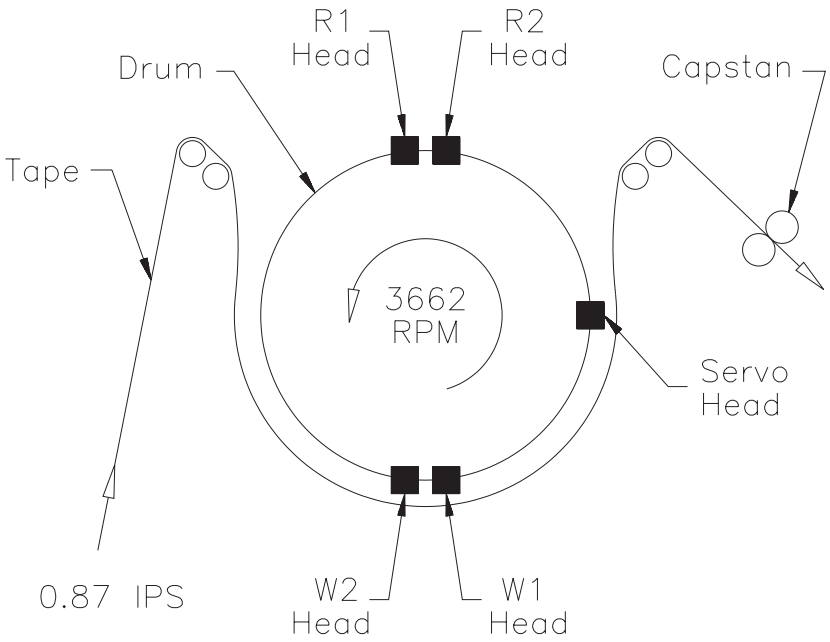

Figure 1-6 Location of the heads on the drum mechanism

The write and read heads can write and read two tracks of information simultaneously. The servo head is used for reading servo data, which enables the tape drive to control linear tape velocity to ensure accurate positioning of the read heads over the tape.

Chapter 6 provides information about tape and drum speeds.

HANA Card (Write/Read Channel)

The HANA card contains the tape drive's write and read electronics. The write electronics consist of write control circuits for digital data and servo information, as well as the write head driver circuits. The read electronics consist of preamplifiers and equalization circuits for the read channels, the servo channel, amplitude sensing, and data clocking and detection.

HANS Card (Servo)

The HANS card contains the tape drive's servo circuits, a dedicated 68HC11-compatible microprocessor, and a 128-KB FEPROM. The HANS card controls all the mechanics of the tape drive, including:

- Tape transport mechanism
- Adjustment of tape velocity based on track-embedded servo information
- Drum and capstan servos
- Circuits that control the load motor, the drum and capstan motors, and the front load motor
- Sensor interface circuits for the drum and capstan tachometers
- Sensor interface circuits for the load and mode states
- Sensor interface circuits for detecting physical beginning of tape (PBOT), physical end of tape (PEOT), tape length and type, and write protect and cartridge load states

HANK Card (Controller)

The HANK card controls communication between the tape drive and the SCSI bus and contains the data processor, error correction code, buffer memory, and control circuitry. The tape drive's data buffer includes 1 MB of dynamic random access memory (DRAM).

The HANK card contains a microprocessor that implements the following controller functions:

- Data compression
- SCSI bus management
- SCSI command decode and status presentation
- Scheduling of all tape drive operations
- Motion control management
- Data transfer and buffer management
- Logical-to-physical block packing and unpacking
- Tape formatting; header and search field generation
- Read-after-write verification and rewrite management
- Tape drive statistics and sense data
- Error recovery procedures
- Monitor interface
- 1-MB buffer

HOOK Flex Circuit

The HOOK flex circuit is the backplane interconnect between the HANS, HANA, and HANK cards.

Dimensions and Weight

The internal model of the tape drive has the following dimensions and weight:

Table 1-2 Dimensions and weight of the internal tape drive

Dimensions	1.62 inches high × 5.75 inches wide × 8.00 inches deep (41.2 × 146.0 × 203.2 mm)
Weight	2.6 pounds (1.2 kilograms)

Figure 1-7 shows the dimensions of the internal model of the tape drive. For information about mounting requirements, see Chapter 4.

Note: For size and weight specifications for the tabletop tape drive, see Appendix A.

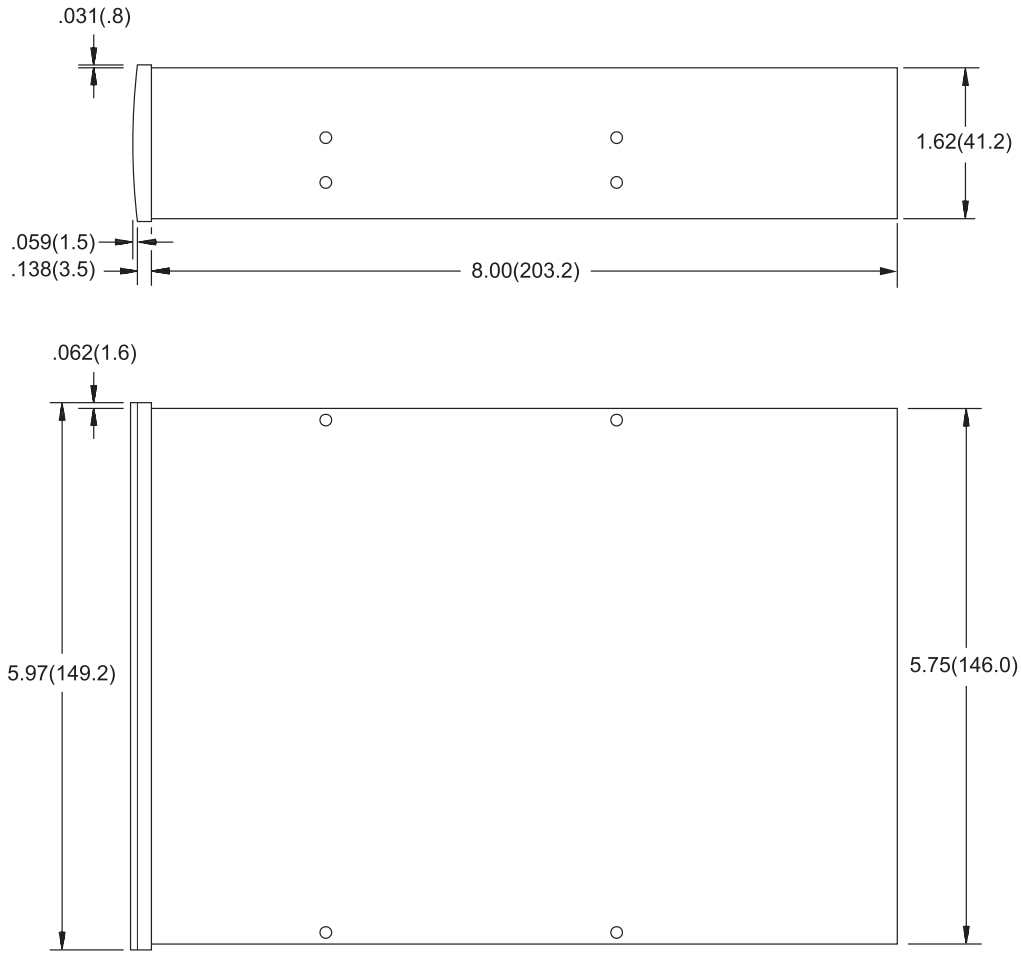

Figure 1-7 Dimensions of the internal tape drive in inches (and mm)

Related Products

This section describes the following products used with the Eliant 820:

- EXATAPE™ 8mm Data Cartridges
- Exabyte Premium 8mm Cleaning Cartridges

EXATAPE™ 8mm Data Cartridges

The Eliant 820 uses data-quality removable, rewriteable 8mm metal-particle (MP) data cartridges. These data cartridges require no formatting or other media conditioning before use.

➤ **Important** Exabyte strongly recommends that you use EXATAPE data-grade media with all Exabyte tape drives. EXATAPE media is specifically manufactured for use in data storage environments and offers reliability, extended durability, and long-term archivability. Exclusive use of EXATAPE media with Exabyte 8mm tape drives has been shown to prolong head and tape life.

Table 1-3 shows the Eliant 820's compatibility with EXATAPE 8mm data cartridges.

Table 1-3 EXATAPE 8mm data cartridge compatibility

EXATAPE	Compatible with the Eliant 820?	Approximate capacity*
15m MP	Yes	1.2 GB
54m MP	Yes	4.7 GB
112m MP	Yes	10.0 GB
160m XL MP (recommended tape length)	Yes	14.0 GB
22m AME	The Eliant 820 does not support AME (advanced metal evaporated) cartridges. These cartridges are automatically ejected.	
170m AME		

* Assumes data is written in 8500c format at a 2:1 data compression ratio.

EXATAPE 160m XL Data Cartridges

The EXATAPE 160m XL Data Cartridge is the recommended tape for the Eliant 820. The 160m XL data cartridge offers the same reliability and performance as all other EXATAPE data cartridges, but offer increased capacity with used with the Eliant 820 or the Exabyte XL tape drives (EXB-8205XL and EXB-8585XL).

All EXATAPE 160m XL data cartridges contain a Recognition System (RS) stripe located on the tape leader for media identification. The Eliant 820 uses this stripe to distinguish data-quality metal-particle media, such as EXATAPE, from other 160m media. The Eliant 820 automatically ejects 160m data cartridges or equivalent length video cartridges that are not equipped with the Recognition System stripe. By rejecting potentially inferior media, the tape drive ensures greater data reliability and protects the read and write heads from unnecessary wear.

As shown in Figure 1-8, data cartridges equipped with the Recognition System stripe have the RS logo on the label:

Figure 1-8 EXATAPE 160m XL Data Cartridge

Exabyte Premium 8mm Cleaning Cartridges

Use an Exabyte Premium 8mm Cleaning Cartridge or a cleaning cartridge approved by Exabyte for use with the Eliant 820 to clean the tape drive. By using this cleaning cartridge on a regular basis, you maintain data integrity and reliability of the tape drive. Details on the cleaning requirements are provided in Chapter 4.

CAUTION

The Exabyte Premium 8mm Cleaning Cartridge (or a cleaning cartridge approved by Exabyte for use with the Eliant 820) is the only authorized method for cleaning the tape drive. If you use any other type of cleaning material, you will void the tape drive's warranty.

2 Recording Format

This chapter describes the recording format used by the Eliant 820. It includes information about the following:

- Helical-scan recording
- Physical track structure
- Logical data structures

Helical-Scan Recording

The Eliant 820 implements advanced helical-scan recording in which very narrow tracks of data are written at an acute angle to the edge of the tape (see Figure 2-1). This recording method creates a track length that is several times longer than the width of the tape. Tracks are accurately positioned by the geometry of the tape path to precise minimal tolerances, resulting in a very high number of tracks per inch.

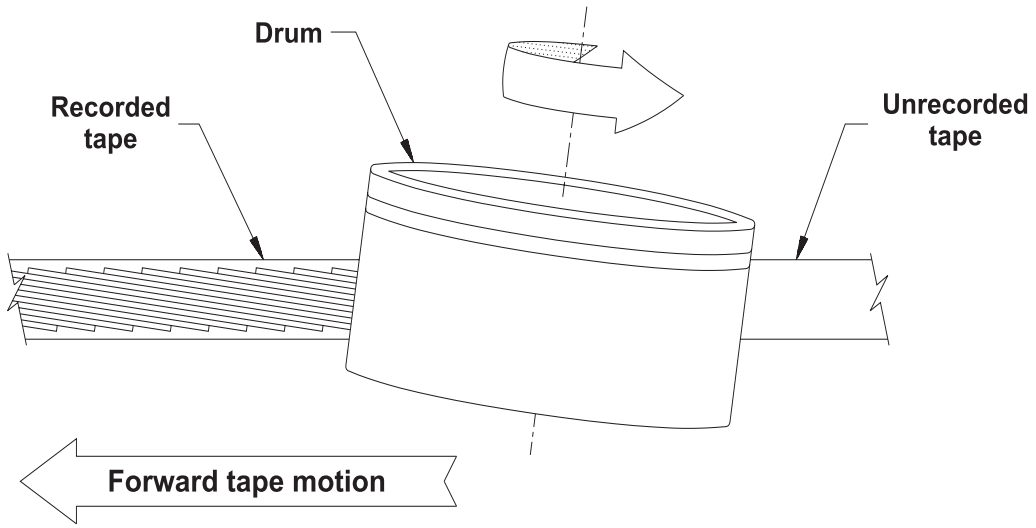

Figure 2-1 Helical-scan recording

Table 2-1 summarizes the tape drive's helical-scan recording parameters.

Table 2-1 Helical-scan recording parameters

	Data format	
	8500/8500c	**8200 (read only)**
Tape width	8.00 mm (0.315 in)	
Track angle	4.9 degrees	
Wrap angle	221 degrees	
Tracks per revolution of drum assembly	2	1
Track length (data + servo)	62.651 mm (2.47 in)	71.628 mm (2.82 in)
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 (1638.453 trk/in)	32.254 trk/mm (819.245 trk/in)
Areal recording density	144.23 Mfc/mm^2 (93.052 Mfc/in^2)	68.68 Mfc/mm^2 (44.311 Mfc/in^2)

Physical Track Structure

The Eliant 820 writes tracks of data to tape using the 8500/8500c physical track structure. In this dual-azimuth track structure, the tape drive writes two partially overlapping tracks to the tape for each revolution of the drum. Each track contains physical data blocks and search fields. In addition, track 2 of each track pair contains servo areas.

Figure 2-2 shows the structure of 8500/8500c physical tracks.

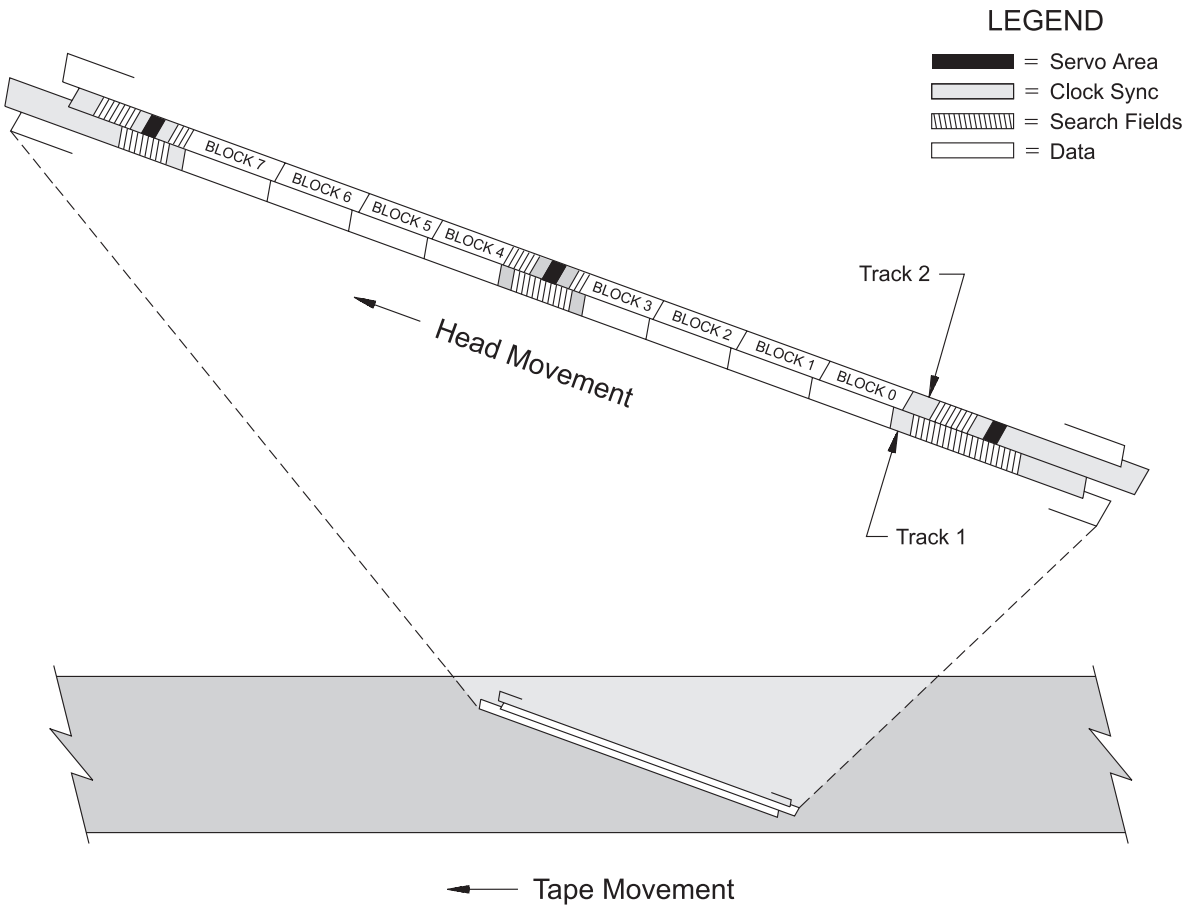

Figure 2-2 8500/8500c physical track structure

Figure 2-3 shows the position of the tape drive's write (W1, W2), read (R1, R2), and servo heads, relative to the tracks as the heads pass across the tape when the tape drive is writing or reading 8500/8500c tracks.

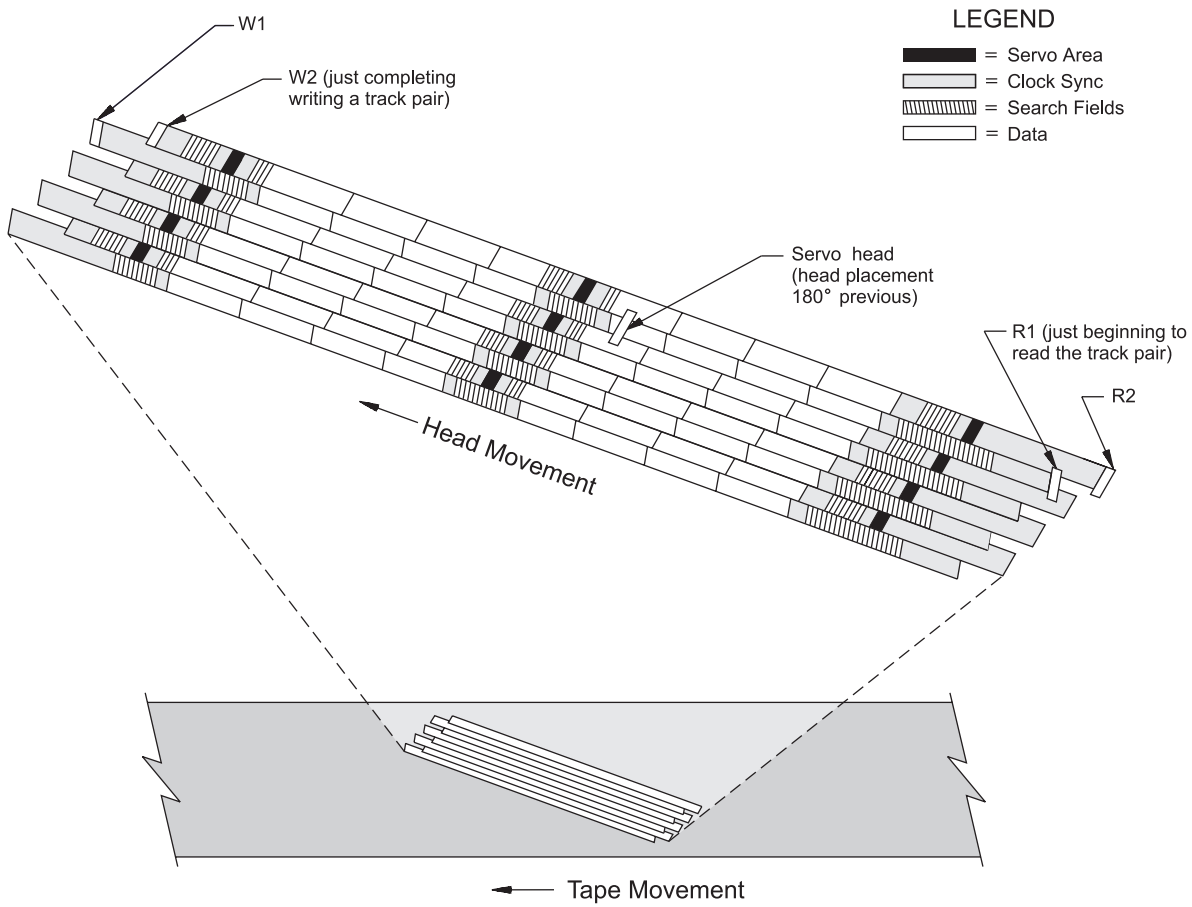

Figure 2-3 Position of the tape drive's heads relative to the tracks (8500/8500c format)

Physical Blocks

Each physical track contains eight physical blocks of data. A physical block can include user data and other logical data structures (described on page 2-6).

Each physical block can contain up to 1,024 bytes of uncompressed user data (or 2,048 bytes of compressed user data assuming a 2:1 compression ratio). A physical block containing user data also includes the following information (see Figure 2-4):

- 2 bytes of cyclic redundancy check (CRC) data (see page 3-3)
- 400 bytes of error correction code (ECC) data (see page 3-3)
- 14 bytes of header information (see page 2-7)

Note: The CRC, ECC, and header information do not affect the data capacity of the tape.

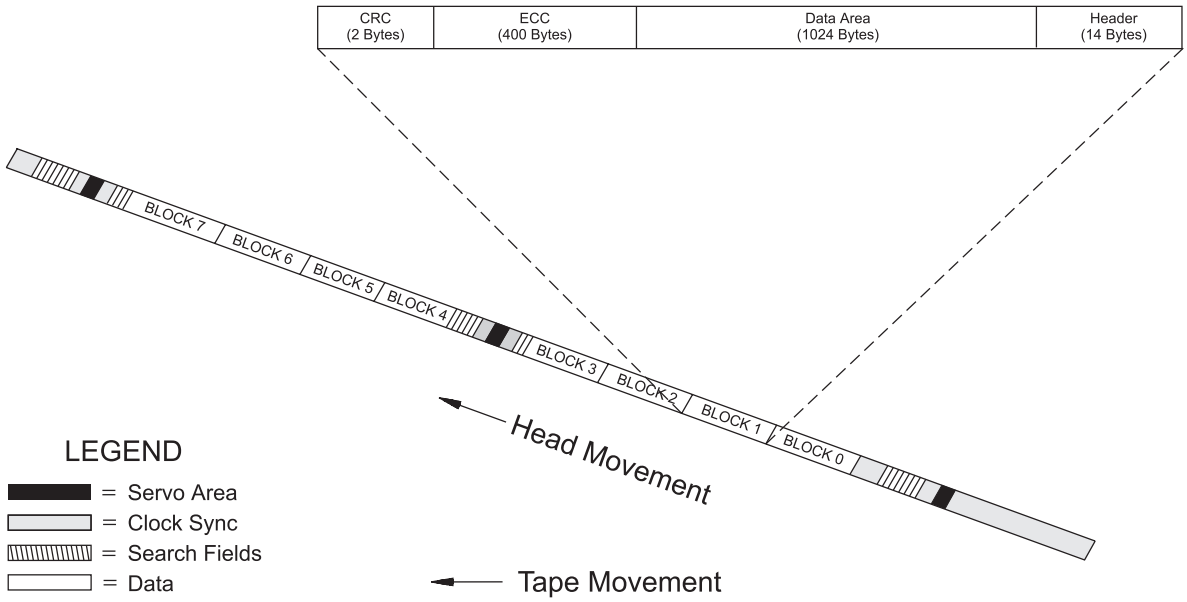

Figure 2-4 Physical block format

Search Fields

As shown in Figure 2-4, each track contains search fields. Search fields are the only areas of the tape that are read during a high-speed search. The search fields contain information for locating files and blocks and detecting the end of data (EOD).

Note: Tapes written in 8200 format do not contain search fields. For this reason, 8200 format tapes do not support high-speed search.

Servo Areas

The tape drive places a servo area at the beginning, middle, and end of every other track. Each servo area contains a servo signal surrounded by an erase signal. The tape drive's servo head detects the servo signal and uses it to control linear tape velocity. This track-following servo process results in accurate positioning of the track under the read head.

Note: In 8200 format, the servo area is at the beginning of each track.

Logical Data Structures

This section describes the logical characteristics of the information recorded in the physical tracks. Logical data structures include the following:

- Logical beginning of tape (LBOT)
- Logical blocks of user data
- Filemarks
- Setmarks
- End-of-data (EOD) mark
- Logical end of tape (LEOT)
- Partitions

Logical Beginning of Tape (LBOT)

When you issue a write operation at the beginning of a tape, the tape drive automatically records LBOT at approximately 29 inches (74 cm) from the point where the translucent leader material is attached to the media (physical beginning of tape or PBOT).

LBOT includes tracks of information that are used to indicate its location, to calibrate the servo system, and to indicate whether the tape is written in uncompressed or compressed format.

Logical Blocks

After LBOT, the tape drive can write logical blocks containing user data transferred from the host. Logical blocks can be compressed (8500c format) or uncompressed (8500 format).

Logical Block Compression

When writing data in 8500c format, the tape drive compresses the logical blocks before placing them into physical blocks. Thus, assuming an average compression ratio of 2:1, each physical block can contain the compressed equivalent of 2,048 bytes of user data.

Logical blocks can have fixed or variable lengths, which can be intermixed on the tape. The tape drive supports uncompressed logical block sizes from 1 to 240 KB. For information about setting the logical block size, refer to the *Exabyte Eliant 820 SCSI Reference*.

Logical Block Packing

To optimize tape capacity, the tape drive packs logical blocks into physical blocks (for example, two 512-byte uncompressed logical blocks can be written in one physical block). The tape drive can also begin writing a logical block in one physical block and end it in a subsequent physical block.

Each physical block includes a 14-byte header that can define only two logical blocks. If the physical block contains more than two logical blocks, the tape drive adds an additional two-byte header in the data field for each logical block after the second one.

Note: When it is physically impossible to start a logical block in the current physical block, the tape drive automatically writes gap bytes (undefined data) to complete the current physical block. This situation occurs when less than three bytes are available in the current physical block. (The two-byte header and at least one data byte must be written in the current physical block before the logical block can spill over to the next physical block.)

Figure 2-5 shows two examples of how multiple logical blocks can be written into one physical block.

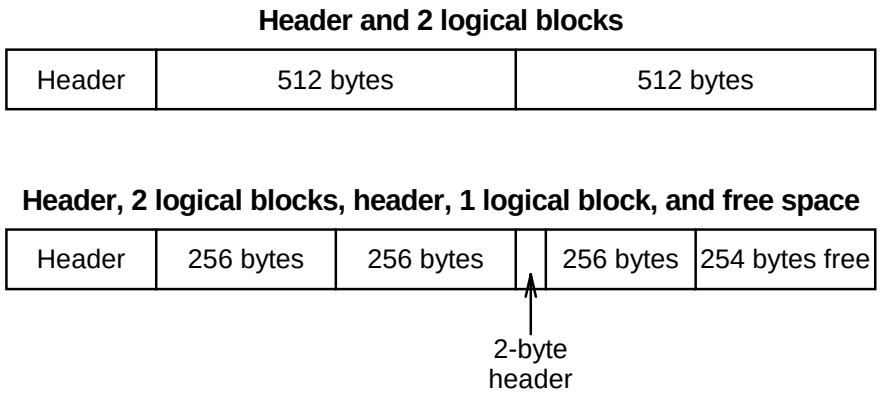

Figure 2-5 Logical block packing in one physical block

Filemarks

Filemarks enable the tape drive to locate particular blocks of data on the tape during a high-speed search (see page 6-3 for information about search speeds). The tape drive writes and reads long and short filemarks.

Long Filemarks

A long filemark in 8500 or 8500c format is 48 KB long and consists of the following:

- Two gap tracks at the beginning. A gap track is a track containing undefined data (eight blocks of 1,024 gap bytes).
- Two tracks of filemark blocks
- Two gap tracks at the end

A long filemark in 8200 format (read only) is 2,160 KB long and consists of the following:

- An erase gap equivalent in length to 249 tracks
- 21 tracks (168 blocks) of long filemark blocks

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

Short Filemarks

In 8500 and 8500c formats, a short filemark consists of a single, 1-KB block. This block contains information identifying the filemark's number and location on the tape.

In 8200 format (read only), a short filemark consists of 21 tracks of information (184 KB).

Setmarks

When the tape drive is writing in 8500c format, you can issue a WRITE FILEMARKS (10h) command to write one or more setmarks to the tape. Setmarks provide an additional way to indicate data boundaries on the tape; in a sense, they can be thought of as “hierarchically superior” filemarks. Each setmark is 48 KB long and consists of the following:

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

You can issue a SPACE (11h) command to space to setmarks. If necessary, you can use a MODE SELECT (15h) command to suppress setmark detection during read, verify, space block, and space filemark operations.

End of Data (EOD)

The tape drive always writes an end-of-data (EOD) mark when it completes a write operation. The EOD mark consists of the following:

- One or more gap tracks. The gap tracks provides the track orientation required to append data.

- 600 tracks of end-of-data blocks. When the initiator issues a SPACE (11h) command to locate the last data written to tape, the tape drive searches for these tracks.

When a subsequent write operation begins, the tape drive repositions the tape and records the data on a track adjacent to the gap tracks. The EOD tracks are overwritten with the new data.

Note: In 8200 format, there is no EOD mark, but you can space to the end of data.

Logical End of Tape (LEOT)

LEOT is a logical position on the tape that serves as an early warning that the physical end of tape (PEOT) is approaching. PEOT is the point where the translucent trailer material is attached to the media. No data can be recorded beyond PEOT.

LEOT is determined by the number of recorded tracks that occur after LBOT. When the tape reaches LEOT, the tape drive sets internal indicators that can be detected by an application program. If necessary, data can be written between LEOT and PEOT. However, if data remains to be written when the tape drive reaches PEOT, that data is lost.

Table 2-2 lists the number of tracks and physical blocks between LBOT and LEOT for EXATAPE data cartridges written in 8500/8500c format. The table also lists the approximate number of tracks and physical blocks between LEOT and PEOT.

Table 2-2 Track and physical block counts for 8500/8500c format

EXATAPE Size	LBOT to LEOT				LEOT to PEOT			
	Number of tracks		Number of blocks		Approx. number of tracks		Approx. 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

Partitions

In 8500c format, the tape drive supports tapes divided into two partitions. Partitions are self-contained areas that can be written and read independently. Both partitions contain markers for the physical beginning of partition (PBOP), logical beginning of partition (LBOP), logical end of partition (LEOP), and physical end of partition (PEOP). The data written in both partitions is followed by an EOD mark.

Partitions provide an effective way to maintain a directory on a tape. Typically, the first partition is used as the directory and the second partition (the remainder of the tape) is used to archive data. Because the partitions are independent of each other, there is never a risk of overwriting archived data in the second partition while updating the directory in the first partition.

Notes

3 Write and Read Functions

This chapter describes the Eliant 820's write and read functions, including data compression, error correction, and data flow management.

Write Operations

When writing data from the logical beginning of tape (LBOT), the tape drive writes in the default format or the format selected with the MODE SELECT (15h) command. If the tape is positioned at any other valid position for writing data, the tape drive writes data in the same format as the data already on the tape, as long as that format is supported for writing.

Figure 3-1 provides a high-level overview of the tape drive's flow of data during a write operation.

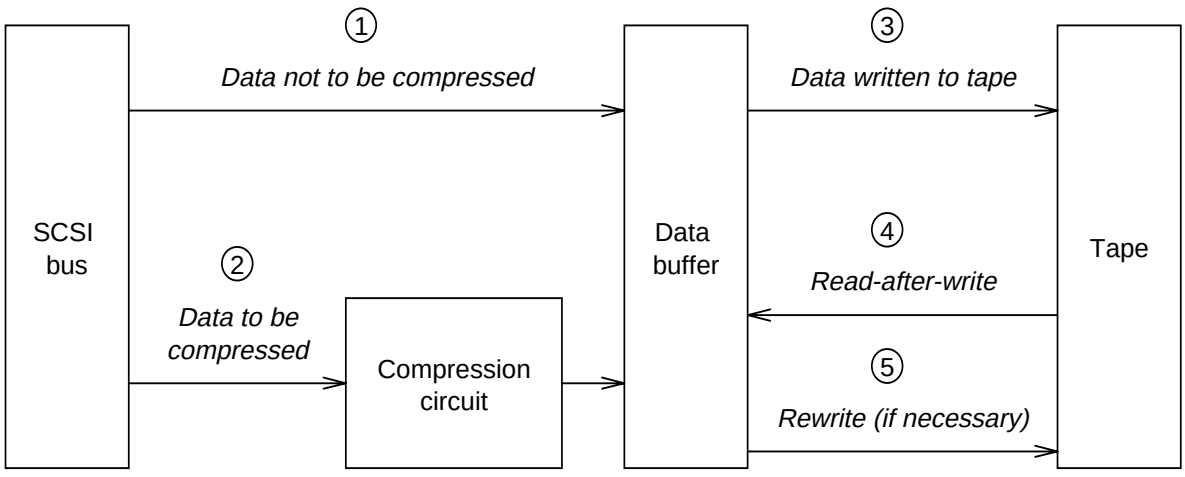

Figure 3-1 Data flow during a write operation

Data Flow and Data Compression

The data-flow process during a write operation is outlined below. (The step numbers correspond to the circled numbers in Figure 3-1.) These steps are described in further detail in the rest of this section.

1. If you select uncompressed format for the tape, the data goes directly from the SCSI bus to the tape drive's 1-MB DRAM data buffer. The data buffer's formatter formats logical user data blocks into physical blocks, and appends tag, address, and index information to each data block (Data transfers between the SCSI bus and the buffer occur asynchronously or synchronously.)

2. If you select compressed format for the tape, the tape drive looks at the currently active MODE SELECT parameters to see if data compression has been turned on.

   If data compression is turned on, the data goes from the SCSI bus to the compression integrated circuit where it is compressed and then decompressed. The tape drive performs a compression integrity check by comparing the decompressed data to the original data.

   If the decompressed data does not match the original data, the tape drive indicates that a compression error has occurred and does not write the data to tape.

   If the decompressed data matches the original data or if data compression was turned off, the tape drive appends two bytes of CRC data to each logical block. Then, it transfers the data to its data buffer.

   Note: The tape drive compresses data at an average ratio of 2:1. However, the actual compression ratio achieved depends on the type of data to be compressed.

3. Once the motion threshold (see page 3-6) is exceeded in the data buffer, tape motion begins, ECC and physical-block CRC bytes are integrated with each physical block, and data is written to tape.

4. The tape drive performs a read-after-write check on the written data to ensure that the data on tape was written accurately.

5. If necessary, the tape drive rewrites the data.

Logical Block CRC

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

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 logical block 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, $2 \div 1{,}024 \times 100\%$).

Error Detection, Correction, and Recovery Procedures

As the tape drive writes data to tape, it integrates error correction code (ECC) and physical-block cyclic redundancy check (CRC) bytes with each physical block. After it writes data, the tape drive uses the ECC and CRC to perform a read-after-write check to ensure data reliability. By using read-after-write error checking and sophisticated error correction procedures, the tape drive offers a non-recoverable error rate of less than one bit in 10^{17} bits read.

Error Correction Code (ECC)

The Reed/Solomon ECC algorithms can correct a burst as long as 264 consecutive bytes in error and as many as 80 additional random errors in each physical data block. The ECC is capable of multiple burst and random error corrections. It has been designed to be extremely effective against the types of error patterns that may occur in cartridge tape subsystems that use helical-scan technology.

Cyclic Redundancy Check (CRC)

The tape drive also adds two bytes of CRC data to every physical block on tape. The CRC data is used in the read-after-write check.

Read-After-Write Checking

The tape drive performs a read-after-write check of the recorded user data to ensure full data reliability. If the tape drive determines that any data blocks should be rewritten, it rewrites the data without requiring host intervention or repositioning of the tape. For more information about how the tape drive corrects data during the read-after-write check, refer to Chapter 6.

Read Operations

When reading data from tape, the tape drive automatically determines the tape's format. Figure 3-2 provides a high-level overview of the tape drive's flow of data during a read operation.

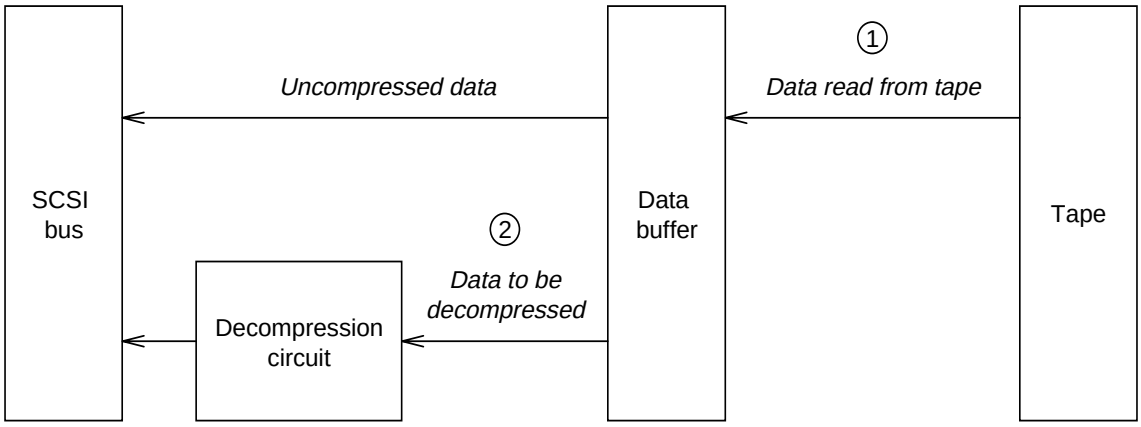

Figure 3-2 Data flow during a read operation

The process for reading logical blocks of user data is outlined below.

1. The tape drive reads data from tape, uses ECC to correct errors as necessary for each physical block, and transfers data to the data buffer. The read operation continues until the buffer is full and tape motion stops.

2. If the data has not been compressed, the data goes directly from the data buffer to the SCSI bus. If the data has been compressed, the data goes from the data buffer to the decompression circuit to be decompressed. Then, the decompressed data is sent to the SCSI bus.

   In either case, the 2-byte logical block CRC appended when the data was written is again verified. This final integrity check ensures that all block reconstruction and decompression was successful.

Data Flow Management

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

To enable the tape drive to operate in streaming mode, the host must be able to transfer data at a minimum sustained rate of:

- 2 MB/sec for 8500c format (assuming a 2:1 compression ratio)
- 1 MB/sec for 8500 format
- 525 KB/sec for 8200 format (read only)

Streaming Mode

When operating in streaming mode, the tape drive transfers data continuously (to tape or to the host) without stopping tape motion. The tape drive adapts to the host's transfer rate by disconnecting from and reconnecting to the SCSI bus. The tape drive determines when to disconnect and reconnect by comparing how full its buffer is to a value called the *reconnect threshold*, as follows:

- During a write operation, if the 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 and continues to write data until the buffer has emptied to a level equal to the reconnect threshold. The tape drive then reconnects to the SCSI bus to accept more data.

- During a read operation, if the host can accept data from the buffer faster than the tape drive can fill the buffer with data from the tape, the tape drive disconnects from the SCSI bus and continues to read data until the buffer is refilled to the reconnect threshold. The tape drive then reconnects to the SCSI bus to transfer more data.

When the tape drive is operating in streaming mode, you can fine-tune performance by using the MODE SELECT command to adjust the reconnect threshold. Refer to the *Exabyte Eliant 820 SCSI Reference* for information about adjusting the reconnect threshold.

Start/Stop Mode

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

- During a write operation, the tape drive waits until its buffer is filled to a level equal to 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 its 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.

When the tape drive is operating in start/stop mode, you can fine-tune performance by using the MODE SELECT command to adjust the motion threshold. Refer to the *Exabyte Eliant 820 SCSI Reference* for information about adjusting the motion threshold.

4 Requirements for Use

This chapter describes the requirements for installing, operating, maintaining, and shipping the tape drive.

Operation and maintenance requirements are the same for the internal and tabletop tape drives. However, installation and shipping requirements differ. See Appendix A for tabletop installation and shipping requirements.

Installation Requirements

Installing the internal model of the tape drive involves the following steps:

- Setting the SCSI ID
- Mounting the tape drive in a mounting frame (if desired)
- Terminating the tape drive (if necessary)
- Connecting a SCSI cable to the tape drive
- Connecting the tape drive to the power supply
- Grounding the tape drive

This section describes the requirements for these steps. For detailed instructions for completing the installation tasks, refer to *Exabyte Eliant 820 Installation and Operation*.

Note: See Appendix A for information about installing the tabletop tape drive.

Setting the SCSI ID

The *SCSI ID* is the address asserted by the tape drive during arbitration. The SCSI ID is set at the factory. If you want to change the internal tape drive's SCSI ID (0 through 7), you can do one of the following:

- Remove and reposition the jumpers on the SCSI ID jumper block on the back of the tape drive. Figure 4-1 shows the jumper block location and jumper settings for SCSI IDs 0 through 7.

- Remove the jumpers and connect a remote switch to the SCSI ID jumper block. A remote switch is not provided with the tape drive. Use a female Molex® 22-55-2061 or equivalent cable connector to control the address remotely.

Note that changes in the SCSI ID setting will not take effect until one of the following conditions occur:

- Normal power-on
- The tape drive is reset by a SCSI bus reset
- The tape drive receives a Bus Device Reset message

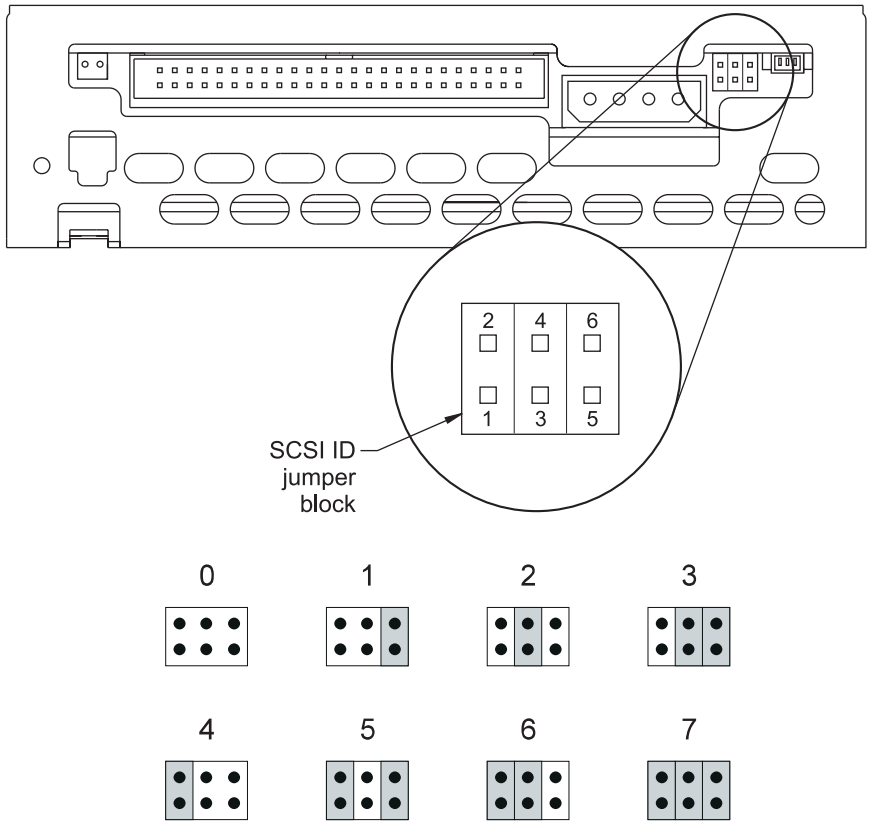

Figure 4-1 SCSI ID jumper block on the back of the internal tape drive

Mounting the Tape Drive

The main housing of the internal model of the tape drive includes three sets of mounting holes (two sets on the sides and one set on the bottom) to allow for a number of mounting positions. The tape drive can be mounted either horizontally or vertically and in a stationary or sliding position.

When mounting the tape drive, follow these guidelines:

- Use either one of the two sets of four mounting holes on the sides of the tape drive (shown as “A” or “B” in Figure 4-2) or the four mounting holes on the bottom of the tape drive (shown as “C” in Figure 4-3).
- Use all four holes in whichever set you choose. Do not use combinations of mounting holes from different sets.
- Ensure that the tape drive is securely mounted and that the chassis is not subject to distortion.
- Ensure that no objects such as screw heads, cables, or adjacent devices are pressing against the frame.
- Do not obstruct the ventilation slots on the device. This ensures that the tape drive can be adequately cooled.

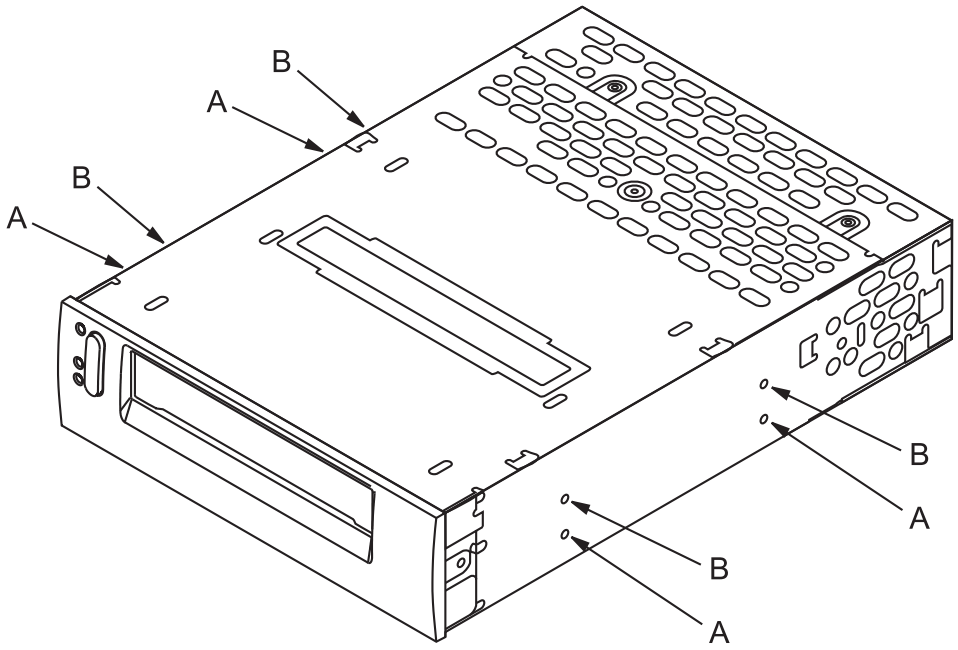

Figure 4-2 Mounting holes on the sides of the internal tape drive

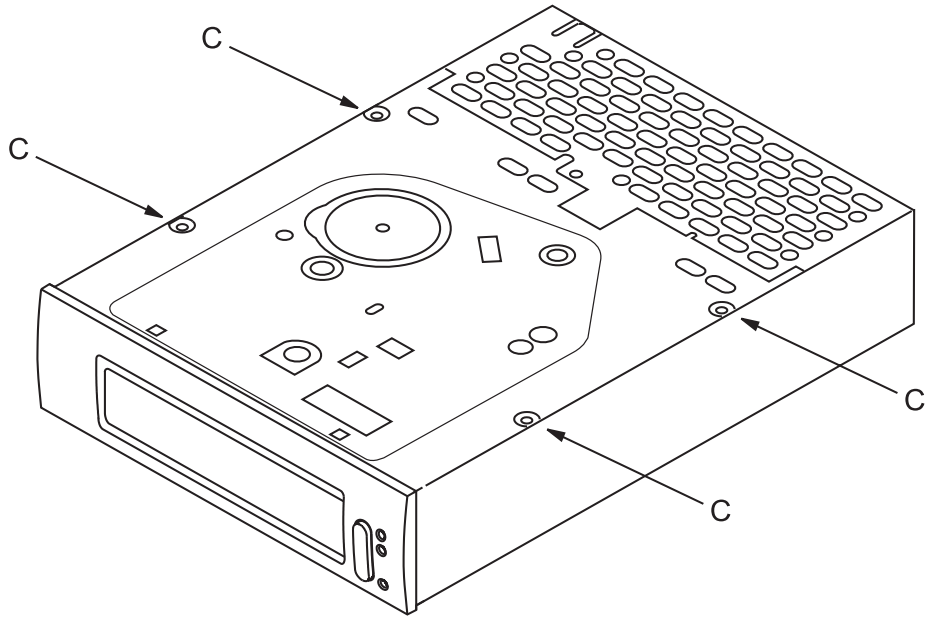

Figure 4-3 Mounting holes on the bottom of the internal tape drive

The mounting holes accommodate M3 × 0.5 × 6 mm screws and are designed for standard 5.25-inch half-high form factor mounting requirements. The holes are 0.31 inches (7.9 mm) deep.

Figure 4-4 shows the dimensions for the internal tape drive's mounting holes.

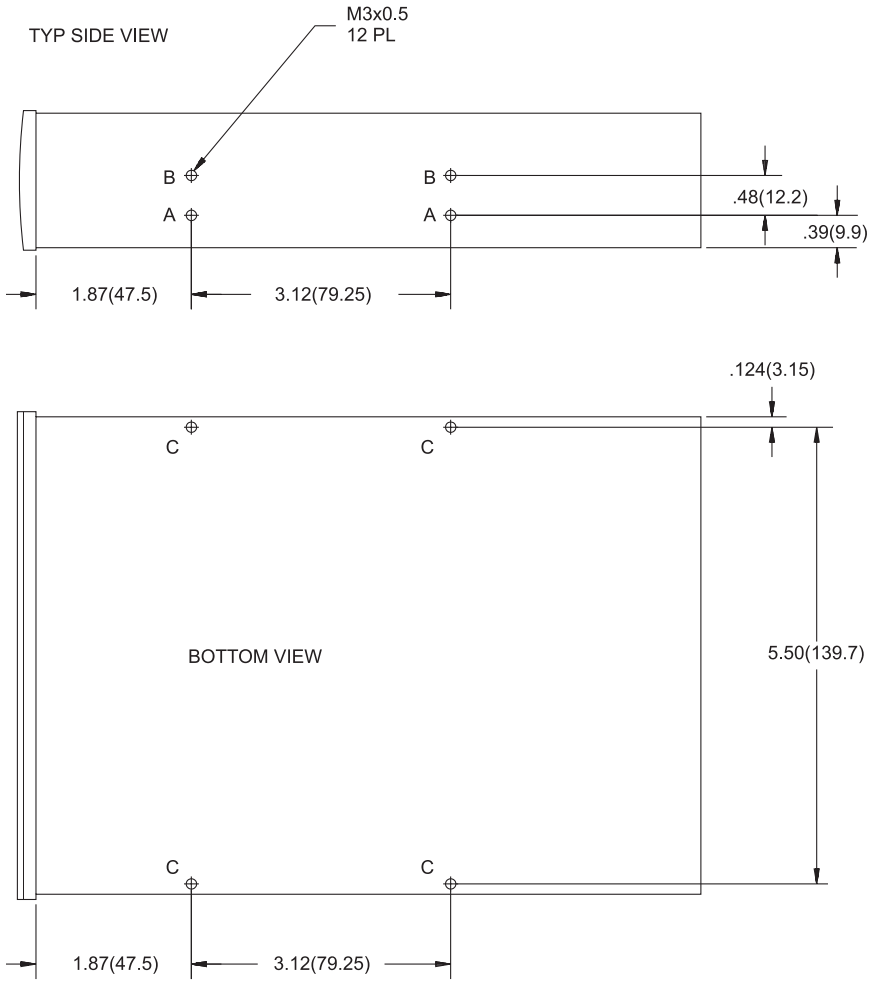

Figure 4-4 Mounting hole dimensions in inches (and mm)

Terminating the Tape Drive

The internal model of the tape drive does not include terminators. If the tape drive is the last device on the SCSI bus, it must be terminated externally using one of the following terminators:

- **For a single-ended configuration**, Exabyte recommends a Methode Electronics, Inc. dataMate® DM550-06-R pass-through terminator (Exabyte part number 319632).
- **For a differential configuration**, Exabyte recommends a Methode Electronics, Inc. dataMate DM550-05-0 pass-through terminator (Exabyte part number 319633).

Connecting a SCSI Cable

The cable for connecting the internal tape drive to the SCSI bus is not provided with the tape drive. You must provide a cable that complies with the specifications outlined in this section. (See page A-11 for SCSI cable specifications for the tabletop tape drive.)

➤ **Important** If the SCSI cable is external to the mounting enclosure, you must use a shielded cable to comply with FCC, Canadian DOC, and VDE limits.

Cable Length

The maximum length of the SCSI cable depends on whether you are using a single-ended or differential SCSI configuration, as follows:

- **For single-ended SCSI configurations,** the maximum allowable bus length is 6 meters (19.7 feet). A stub length of no more than 0.1 meters (4 inches) is allowed off the mainline interconnection within any connected equipment.
- **For differential SCSI configurations,** the maximum allowable bus length is 25 meters (82 feet). A stub length of no more than 0.2 meters (8 inches) is allowed off the mainline interconnection within any connected equipment.

SCSI Cable Connector Requirements

The SCSI cable connector for the internal tape drive is shown in Figure 4-5. The connector is a 50-pin male ribbon cable connector. The stub length within the internal tape drive is less than 50 mm.

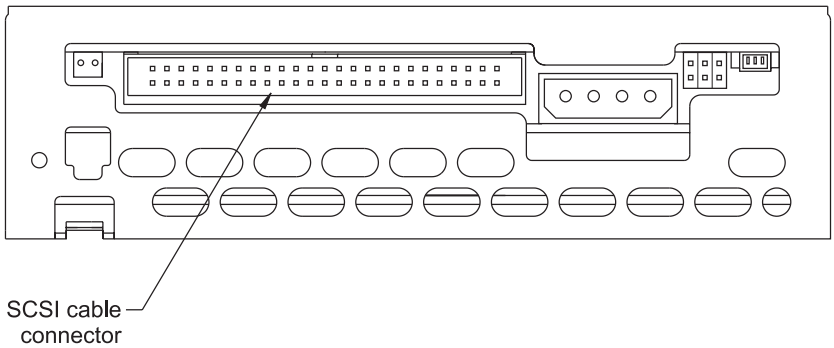

Figure 4-5 SCSI connector on the back of the internal tape drive

To connect the internal tape drive to the SCSI bus, use a 50-pin female ribbon cable connector (AMP No. 1-746285-0 or equivalent).

Table 4-1 shows the connector pin assignments for differential tape drives; Table 4-2 shows the connector pin assignments for single-ended tape drives.

Table 4-1 SCSI connector pin assignments for the differential tape drive

Signal	Pin Number		Signal
SHIELD GROUND	1	2	GROUND
+ DB(0)	3	4	–DB(0)
+ DB(1)	5	6	–DB(1)
+ DB(2)	7	8	–DB(2)
+ DB(3)	9	10	–DB(3)
+ DB(4)	11	12	–DB(4)
+ DB(5)	13	14	–DB(5)
+ DB(6)	15	16	–DB(6)
+ DB(7)	17	18	–DB(7)
+ DB(P)	19	20	–DB(P)
DIFFSENS	21	22	GROUND
GROUND	23	24	GROUND
TERMPWR	25	26	TERMPWR
GROUND	27	28	GROUND
+ ATN	29	30	–ATN
GROUND	31	32	GROUND
+ BSY	33	34	–BSY
+ ACK	35	36	–ACK
+ RST	37	38	–RST
+ MSG	39	40	–MSG
+ SEL	41	42	–SEL
+ C/D	43	44	–C/D
+ REQ	45	46	–REQ
+ I/O	47	48	–I/O
GROUND	49	50	GROUND

Table 4-2 SCSI connector pin assignments for the single-ended tape drive

Signal	Pin Number*
–DB(0)	2
–DB(1)	4
–DB(2)	6
–DB(3)	8
–DB(4)	10
–DB(5)	12
–DB(6)	14
–DB(7)	16
–DB(P)	18
GROUND	20
GROUND	22
GROUND	24
TERMPWR	26
GROUND	28
GROUND	30
–ATN	32
GROUND	34
–BSY	36
–ACK	38
–RST	40
–MSG	42
–SEL	44
–C/D	46
–REQ	48
–I/O	50

* All odd pins except pin 25 are connected to ground. Pin 25 is left open.

Impedance

Ideally, to match the cable terminators, the SCSI cable should have a characteristic impedance of 122 ohms (differential) or 132 ohms (single-ended). However, since cables with this high of a characteristic impedance are not generally available, somewhat lower impedances are acceptable. A characteristic impedance of 100 ohms ± 10% is recommended for unshielded flat or twisted-pair ribbon cable. A characteristic impedance greater than 90 ohms is recommended for shielded cables.

➤ **Important** To minimize discontinuities and signal reflections, Exabyte recommends that all SCSI cables used on the same bus have the same impedances.

Primary Conductor

A minimum primary conductor size of 28 AWG is recommended to minimize noise effects and ensure proper distribution of terminator power.

Connecting the Tape Drive to the Power Supply

To provide power to the internal model of the tape drive, connect an available power lead (from the computer's power supply, for example) to the tape drive's power connector (shown in Figure 4-6). The power lead must be a wire cable with an AMP 1-480424-0 series or equivalent female connector.

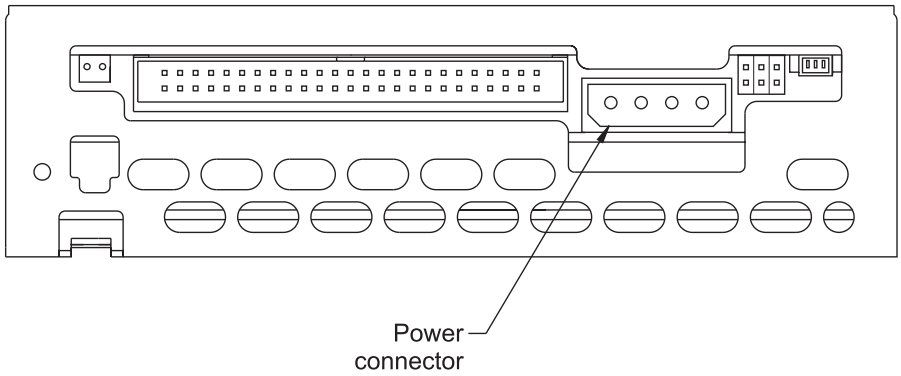

Figure 4-6 Power connector on the back of the internal tape drive

Table 4-3 lists the pin assignments for the power connector.

Table 4-3 Power connector pin assignments

Pin Number	Assignment
1	+ 12 VDC
2	Ground, 12 VDC return
3	Ground, 5 VDC return
4	+ 5 VDC

Grounding the Tape Drive

To protect the tape drive from electrostatic discharge (ESD) and ensure proper operation, you must attach the internal tape drive to the enclosure's metal chassis (using the mounting holes shown on page 4-4).

The rear panel of the internal tape drive includes a grounding hole and a ground tab, as shown in Figure 4-7. These can be used to provide additional chassis grounding if desired. The grounding hole uses an M3 × 0.5 × 6 mm self-tapping screw, while the ground tab uses a 1/4-inch female spade connector.

Note: The power supply returns are connected to the chassis, so you cannot isolate logic common ground from chassis ground.

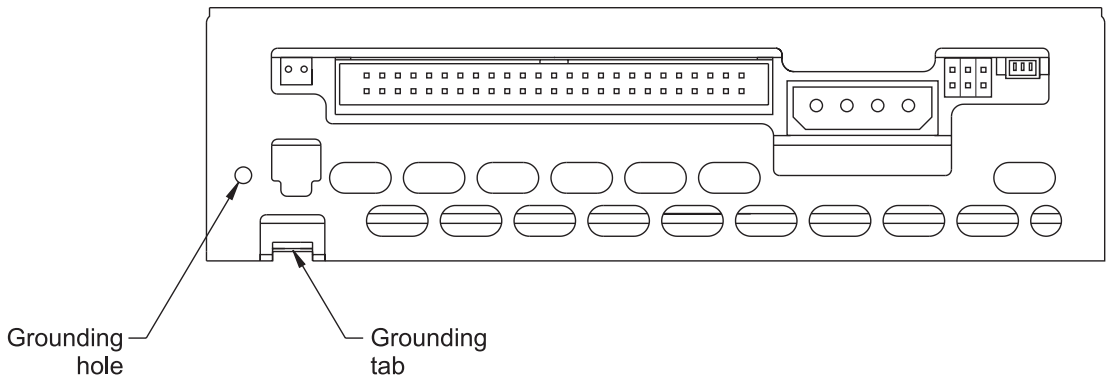

Figure 4-7 Chassis grounding points on the internal tape drive

Operation

This section provides general information about operating both the internal tape drive and the tabletop tape drive. For detailed instructions, refer to *Exabyte Eliant 820 Installation and Operation*.

Power-On Mode

In its normal power-on mode, the tape drive completes a power-on self-test in approximately 30 seconds. Once the power-on self test is complete, the tape drive loads the tape (if already inserted), and positions the tape at LBOT.

Note: The tabletop tape drive has an LED that illuminates when power is on (see page A-3).

Tape Drive Controls

The only operator control on the tape drive is the unload button on the front panel. Pushing this button starts the unload procedure. This button can also be used to reset the tape drive if a servo error occurs.

Device States

Figure 4-8 shows the three LEDs on the front panel of the tape drive.

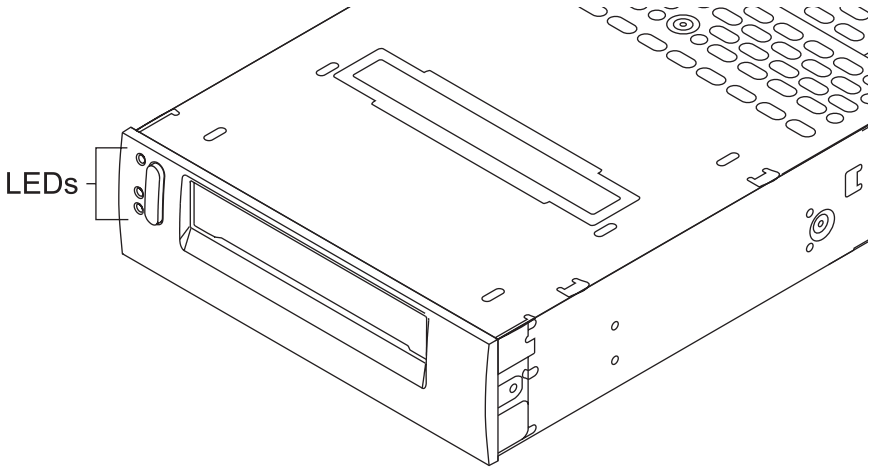

Figure 4-8 Tape drive LEDs

LED combinations indicate the tape drive's operating state, as follows:

- When the top LED (amber) is flashing, the tape drive either has an error or needs to be cleaned.
- When the middle LED (green) is flashing, SCSI bus activity is occurring.
- When the bottom LED (green) is on, a tape is loaded. When it is flashing, tape motion is occurring or the tape drive needs cleaning.

Table 4-4 shows various combinations of LEDs that may occur during tape drive operation.

Table 4-4 LED states during operation

	Tape Drive State									
	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 in progress**
Top LED (error)	●	❊ fast	❍	❍	❍	❍	●	❊ slow	❊ fast	❍
Middle LED (SCSI)	●	❊ irreg	❊ irreg	❊ irreg	❊ irreg	❊ irreg	❊ irreg	n/a	n/a	❊ irreg
Bottom LED (tape)	●	❍	❍	●	❊ slow	❊ fast	●	❍	❊ fast	❊ slow

Key for table:

● = On ❍ = Off ❊ = Flashing: ❊ **slow** = 1 flash/second (0.94 Hz)

❊ **fast** = 4 flashes/second (3.76 Hz)

❊ **irreg** = Rate of flash varies with SCSI bus activity. If the tape drive is not connected to the SCSI bus, this LED will be off.

Note: Table 4-4 documents the LED combinations that you are likely to observe during normal tape drive operation. You may occasionally observe other LED combinations and sequences. These other combinations represent special or unusual conditions that are beyond the scope of this table.

Loading Data Cartridges

When you insert a cartridge into the tape drive, the tape drive automatically loads the cartridge (unless the initiator has issued a MODE SELECT (15h) command to disable the autoload function). The tape drive spaces forward from PBOT and determines the following:

- **The tape format.** If the cartridge has data on it, the tape drive determines whether the data is in a readable format.
- **The adaptive servo parameters.** This process enables the tape drive to read tapes produced by different manufacturers, tapes that are aged and worn, and tapes written by other 8mm tape drives.
- **The length of the tape in use.** The tape drive autosizes the data cartridge to determine the tape length. For more information about autosizing, refer to the *Exabyte Eliant 820 SCSI Reference*.

Once the data cartridge is loaded, the tape drive presents ready status (bottom LED on) and commands requiring loaded media will execute normally.

Note: If you disabled the autoload function, the tape drive does not present ready status until the initiator issues a LOAD (1Bh) command.

Automatic Ejection of Data Cartridge

The tape drive automatically ejects a data cartridge under the following circumstances:

- You attempt to load a data cartridge during the power-on self-test.
- You attempt to load a 160m data cartridge that is not equipped with an Exabyte Recognition System stripe.
- You attempt to load an AME (advanced metal evaporated) data cartridge.
- You attempt to load a data cartridge written in 8200 format without the write-protect switch set to write protect.

Refer to *Exabyte Eliant 820 Installation and Operation* for instructions for loading cartridges into the tape drive. Refer to the *Exabyte Eliant 820 SCSI Reference* for information about the MODE SELECT and LOAD commands.

Unloading Data Cartridges

You can unload a data cartridge by either pressing the unload button or by issuing an UNLOAD (1Bh) command. This section describes what happens when the unload button is pressed. For information about using the LOAD/UNLOAD (1Bh) command, see the *Exabyte Eliant 820 SCSI Reference*.

If a data cartridge is loaded and the tape drive is error free, the tape drive performs the following actions when you press the unload button:

- Completes any command that is currently in progress
- Writes any buffered information to tape
- Writes EOD
- Rewinds the tape to physical beginning of tape (PBOT)
- Unloads the tape from the tape path and ejects the tape

In addition, the tape drive has several unload button options for "normal," "fast," and "super fast" unload operations. Contact your Exabyte account manager for more information.

Effect of PREVENT/ALLOW MEDIUM REMOVAL Command

If an initiator has issued a PREVENT MEDIUM REMOVAL (1Eh) command to prevent the removal of the data cartridge, the tape drive will not eject the data cartridge until the initiator sends an ALLOW MEDIUM REMOVAL (1Eh) command to allow you to remove the data cartridge.

For more information about using the PREVENT/ALLOW MEDIUM REMOVAL command, see the *Exabyte Eliant 820 SCSI Reference.*

Error During Unload Procedure

If an error exists before or during the unload procedure, the tape drive suspends the preceding sequence of events and the top amber LED will flash. If you press the unload button again, the tape drive reattempts the unload sequence; however, the tape drive does not write data in the buffer to tape. The tape drive clears the buffer and errors.

Resetting the Tape Drive

You can reset the tape drive using any of the following methods:

- Powering the tape drive off and back on again (power-on reset).
- Sending an RST pulse on the SCSI bus for a minimum of 25 µsec (SCSI bus or “hard” reset). A SCSI bus reset immediately clears all devices from the bus and resets their associated equipment.
- Issuing a Bus Device Reset (0Ch) message to the tape drive (device or message reset). A device reset clears the tape drive from the bus and causes all commands to be cleared.
- Pressing the unload button to clear a servo error.

Note: If a SCSI bus or device reset occurs during a power-on reset, the tape drive will perform a full power-on reset.

If the tape drive has a data cartridge inserted or loaded when a reset condition occurs, it rewinds the tape and positions to LBOT after the reset operation is complete. The total time required for the reset may be as long as four minutes if the tape is positioned near the end of tape.

Preventive Maintenance

Except for cleaning, the tape drive has no user serviceable adjustments or maintenance procedures. All service or repairs to the tape drive must be performed by Exabyte Corporation or authorized service personnel.

Cleaning the Tape Drive

The tape drive's tape heads and tape path should be cleaned on a regular basis. The only cleaning material authorized for use with the tape drive is the Exabyte Premium 8mm Cleaning Cartridge or a cleaning cartridge approved by Exabyte for use with the Eliant 820. For instructions for using the cleaning cartridge, refer to *Exabyte Eliant 820 Installation and Operation*.

CAUTION

To prevent contamination of the tape drive and damage to the heads, do not attempt to rewind the material in the cleaning cartridge and reuse it. Discard the cleaning cartridge after you have used it for the specified number of cleaning cycles.

Using any cleaning cartridges not approved by Exabyte for use with the Eliant 820 will void the warranty on the tape drive.

Note: The Eliant 820 does not support the cleaning cartridge designed for Exabyte Mammoth tape drives. It also does not support older versions of the Exabyte 8mm Cleaning Cartridge. The Eliant 820 automatically ejects these cleaning cartridges without performing a cleaning.

Determining When to Clean the Tape Drive

You should clean the tape drive's heads and tape path when the top and bottom LEDs flash. For best results, clean the tape drive as soon as possible after the LEDs begin flashing. Cleaning the tape drive helps to ensure that it will perform according to its specifications.

If the top and bottom LEDs start flashing again soon after you have cleaned the tape drive, you may be using a data cartridge that is nearing the end of its useful life. Discard the data cartridge and use a new one.

REQUEST SENSE (03h) Command

An application program can issue a REQUEST SENSE (03h) command to check the settings of the CLN and CLND bits (byte 21, bits 4 and 3). If the CLN bit is set to 1, the tape drive needs to be cleaned. This bit is reset to 0 when a successful cleaning cycle has been performed. The CLND bit is set to 1 when the tape drive has been cleaned and is reset to 0 when the next REQUEST SENSE command is received.

Loading Microcode

Occasionally, Exabyte may make microcode upgrades available. To upgrade the tape drive's microcode, you can:

- Use a microcode update tape from Exabyte (no special software required).
- Create a microcode update tape from another tape drive using the Monitor program for your tape drive.
- Copy microcode from the Exabyte Technical Support bulletin board, the Exabyte World Wide Web site, or Exabyte microcode update diskettes, and load the microcode in your tape drive using the Monitor program or across the SCSI bus using the WRITE BUFFER command.
- Use the READ BUFFER command to copy the new code from a tape drive across the SCSI bus to an initiator. Then, use the WRITE BUFFER command to copy the code from the initiator to another tape drive.

For more information about the Monitor program, refer to the Monitor documentation available from Exabyte. For more information about using SCSI commands, refer to the *Exabyte Eliant 820 SCSI Reference*.

Shipping Requirements

This section describes the requirements for shipping the internal model of the tape drive.

Note: For information about shipping the tabletop tape drive, see page A-15.

Shipping Cartons

The internal model of the tape drive is sealed in a static protection bag and is shipped with either one drive per carton (single pack) or with three to five drives per carton (multi-pack). Table 4-5 shows the shipping dimensions and weights for the internal tape drive.

Table 4-5 Shipping dimensions and weights for the internal tape drive

	Dimensions	Weight
Single-pack	13.5 inches long × 10.75 inches wide × 8.5 inches high (34.3 × 27.3 × 21.6 cm)	**1 tape drive**: 4.5 lbs (2.0 kg)
Multi-pack	23.25 inches long × 13.5 inches wide × 11.5 inches high (59.1 × 34.3 × 29.2 cm)	**3 tape drives**: 12 lbs (5.4 kg) **4 tape drives**: 15 lbs (6.5 kg) **5 tape drives**: 18 lb (8.2 kg)

Both the single-pack and the multi-pack shipping cartons and packing materials are designed so that an enclosed tape drive does not receive a shock greater than 45 g when the carton is dropped on any surface, corner, or edge from the following heights:

- 48 inches (121.9 cm) at a velocity change of 192 inches per second (488 cm/sec) for the single-pack carton
- 36 inches (91.4 cm) at a velocity change of 167 inches per second (424 cm/sec) for the multi-pack carton

Both sizes of shipping carton pass the tests described in the International Safe Transit Association (ISTA) Project 1A and 2A for packaged products weighing less than 100 pounds.

The packing materials are unbleached, reusable, recyclable, and environmentally safe. The materials contain no chlorofluorocarbons (CFCs) or heavy metals.

Packing instructions for the tape drive are included in *Exabyte Eliant 820 Installation and Operation*. To avoid damaging the tape drive, use the original shipping carton and packing materials (or replacement packaging obtained from the vendor). The shipping carton and packing materials are not intended to be used for shipping items other than an Exabyte half-high tape drive. Do not use a multi-pack shipping carton when shipping a single tape drive. If you use a multi-pack shipping carton, you must place three, four, or five tape drives in the carton.

See page 6-12 for information about the environmental requirements for shipping a tape drive.

5 Interface Specifications

This chapter describes the tape drive's SCSI interface, including the following sections:

- SCSI features
- Physical path
- SCSI messages
- SCSI commands
- Using SCSI commands

SCSI Features

Implementation characteristics of the Small Computer System Interface (SCSI) controller include the following:

- Support for single-ended or differential SCSI configurations.
- SCSI bus parity checking configurable through the MODE SELECT command.
- Support for multiple initiator configurations.
- Support of the disconnect, reconnect, and arbitration feature, which releases the tape drive from the bus so that it can operate under its own internal intelligence system, enabling the SCSI bus to perform other I/O requests.

The SCSI implemented for the tape drive conforms to the following standard for a sequential access device: ANSI *Small Computer System Interface-2 (SCSI-2),* X3.131–1994.

Physical Path

The physical path implemented by the tape drive includes an eight-port, daisy-chained bus with the following features:

- Single-host or multiple-host computer system capability
- Bus contention handled by distributed arbitration on a prioritized basis
- Accommodation of multiple peripheral device types
- Multiple overlap of peripheral device operations
- Orientation toward intelligent peripheral devices
- Enhanced operation with buffered devices

SCSI Messages

The SCSI message system supported by the tape drive allows communication between the initiator and the tape drive for physical path management. Table 5-1 lists the supported SCSI messages.

Refer to the *Exabyte Eliant 820 SCSI Reference* for detailed information about SCSI communications and messages.

Table 5-1 SCSI messages

Hex Value	Description	In (Tape drive to initiator)	Out (Initiator to tape drive)
00h	Command Complete	✔	
01h	Extended Message (Synchronous Data Transfer Request)	✔	✔
02h	Save Data Pointers	✔	
03h	Restore Pointers	✔	
04h	Disconnect	✔	
05h	Initiator Detected Error		✔
06h	Abort		✔

Table 5-1 SCSI messages *(continued)*

Hex Value	Description	In (Tape drive to initiator)	Out (Initiator to tape drive)
07h	Message Reject	✔	✔
08h	No Operation		✔
09h	Message Parity Error		✔
0Ch	Bus Device Reset		✔
80h or C0h	Identify	✔	✔

SCSI Commands

The SCSI-2 command set supported by the tape drive consists of 19 six-byte commands (Group 0 command set) and 6 ten-byte commands (Group 1 command set). These commands are listed in Table 5-2.

Table 5-2 SCSI-2 command set

Command	OP Code	Description
ERASE	19h	Causes the tape drive to erase all tape from the current tape position to the physical end of tape.
INQUIRY	12h	Requests that information about the tape drive parameters be sent to the initiator.
LOAD/UNLOAD	1Bh	Causes the tape drive to load or unload the data cartridge.
LOCATE	2Bh	Allows you to position the tape at a specified logical block address. Used in conjunction with the READ POSITION command.
LOG SELECT	4Ch	Allows you to manage the counters that the tape drive maintains about its write and read error recovery operations.
LOG SENSE	4Dh	Allows you to retrieve statistical information about the tape drive's read and write error recovery operations.
MODE SELECT	15h	Allows you to specify medium, logical unit, and device parameters.
MODE SENSE	1Ah	Enables the tape drive to report medium, logical unit, or device parameters.
PREVENT/ALLOW MEDIUM REMOVAL	1Eh	Allows or disallows the removal of the data cartridge from the tape drive.
READ	08h	Transfers one or more bytes or blocks of data from the tape to the initiator.

Table 5-2 SCSI-2 command set *(continued)*

Command	OP Code	Description
READ BLOCK LIMITS	05h	Requests that the tape drive return data identifying the maximum and minimum logical block lengths supported.
READ BUFFER	3Ch	Copies the tape drive's microcode across the SCSI bus to the initiator. Used in conjunction with the WRITE BUFFER command.
READ POSITION	34h	Reports the tape drive's current logical position but does not cause tape motion to occur. Used in conjunction with the LOCATE command.
RECEIVEDIAGNOSTIC RESULTS	1Ch	Reports the results of the diagnostic test requested by a previous SEND DIAGNOSTIC command.
RELEASE UNIT	17h	Releases a tape drive from an initiator's exclusive use, or if third-party reservations are in effect, from another SCSI device's use. Used in conjunction with the RESERVE UNIT command.
REQUEST SENSE	03h	Requests that the tape drive transfer sense data to the initiator.
RESERVE UNIT	16h	Reserves the tape drive for an initiator's exclusive use, or if third-party reservations are in effect, for another SCSI device's use. Used in conjunction with the RELEASE UNIT command.
REWIND	01h	Causes the tape drive to rewind the tape to the logical beginning of tape.
SEND DIAGNOSTICS	1Dh	Causes the tape drive to perform certain self-diagnostic tests.
SPACE	11h	Enables the tape drive to perform forward or backward searches.
TEST UNIT READY	00h	Allows you to determine if the tape drive is ready to accept an appropriate medium access command.
VERIFY	13h	Enables the tape drive to verify one or more logical blocks of data on the tape.
WRITE	0Ah	Transfers one or more bytes or blocks of data from the initiator to the tape drive.
WRITE BUFFER	3Bh	Allows you to load new microcode from the SCSI bus into the tape drive's control memories. Used in conjunction with the READ BUFFER command.
WRITE FILEMARKS	10h	Causes the tape drive to write zero, one, or more filemarks or setmarks (8500c format) to tape.

Using SCSI Commands

This section describes the SCSI commands that an application program can use to write, read, erase, and search for data, and to copy microcode, inquire about tape drive status, set operating parameters, and perform diagnostic tests.

Writing Data

To transfer bytes or blocks of data from the initiator to the tape drive, use the WRITE command. The data can be written in either of the supported logical tape formats (8500 and 8500c), which are specified by the MODE SELECT command.

To write filemarks or setmarks (8500c format only), use the WRITE FILEMARKS command.

Reading Data

To transfer bytes or blocks of data from the tape drive to the initiator, use the READ command. The tape drive automatically sets itself to the format used when the tape was written and can read tapes that have a combination of fixed-length and variable-length blocks.

Erasing Data

Use the ERASE command to erase all tape from the current valid tape position to the physical end of tape (PEOT). When the erase operation is successfully completed, the tape is automatically rewound to the logical beginning of tape (LBOT).

Searching for Data

To enable the tape drive to perform forward or backward searches, use the SPACE or LOCATE commands. The tape drive moves the tape at its high-speed search speed (see page 6-2). The tape drive can space over both fixed and variable blocks. The tape drive determines the type of spacing to use according to the type of block found on the tape.

Copying Microcode

Use the READ BUFFER and the WRITE BUFFER commands to copy the microcode from one tape drive to another. First, issue a READ BUFFER command to place the microcode into the correct format and to transfer the microcode image across the SCSI bus to the initiator. Next, issue a WRITE BUFFER command to transfer the microcode from the initiator to other tape drives. See page 4-18 for information about other methods for loading new microcode into the tape drive.

Inquiring About Tape Drive Status

To inquire about tape drive status, you can use the commands described below.

REQUEST SENSE Command

Use the REQUEST SENSE command to determine the type of error when an error occurs or to determine tape drive status. For errors, this command returns the following information:

- Sense Key for the error that indicates the type of error (such as, Not Ready, Hardware Error, Illegal Request, Unit Attention, Aborted Command)
- Additional Sense Code (ASC) that indicates the type of error for the given sense key
- Additional Sense Code Qualifier (ASCQ) that indicates the specific error for the sense key and ASC
- Fault Symptom Code (FSC) that indicates the specific nature of hardware and software errors or other events (the FSC is an Exabyte-unique byte)

INQUIRY Command

Use the INQUIRY command to obtain information about the tape drive's firmware level, the version of SCSI supported by the tape drive, and so on.

LOG SENSE and LOG SELECT Commands

Use the LOG SENSE command to retrieve the tape drive's read and write error counters. You can use the LOG SELECT command to set threshold values for these counters.

SEND DIAGNOSTICS and RECEIVE DIAGNOSTIC RESULTS Commands

Use the SEND DIAGNOSTICS and RECEIVE DIAGNOSTICS commands to obtain a processor memory listing that provides information about the status of tape drive operations.

Performing Diagnostic Tests

You can use the SEND DIAGNOSTICS command to perform diagnostic tests to find out detailed information about tape drive operations. The RECEIVE DIAGNOSTIC RESULTS command allows you to obtain the diagnostic results.

Setting Operating Parameters

To set operating parameters for the tape drive, use the MODE SELECT command. To find out how the parameters are set for the tape drive, use the MODE SENSE command.

Notes

6 Functional Specifications

This chapter lists functional specifications for the internal and tabletop tape drive, including:

- Performance specifications
- Reliability specifications
- Power specifications
- Environmental specifications

Performance Specifications

This section lists the following tape drive performance specifications:

- Load time
- Tape speeds
- Data transfer rates
- High-speed search rates
- Write and read access times
- Reposition time
- Tape tension release and drum motion suspension
- Rewind times
- Reselection phase timeout

Load Time

After a data cartridge is inserted into the tape drive, the time required to load the tape and position it to LBOT is approximately 35 seconds.

Tape Speeds

Table 6-1 lists the tape speeds at which data can be written, read, and searched by the tape drive.

Table 6-1 Tape speeds

Data format	Nominal tape speed	Forward search tape speed	Backward search tape speed
8500 and 8500c	22.159 mm/sec (0.872 in/sec)	665 mm/sec max (26.17 in/sec)	
8200 (read only)	23.266 mm/sec (0.916 in/sec)	233 mm/sec (9.16 in/sec)	175 mm/sec (6.87 in/sec)

Table 6-2 lists the drum rotational speed and the resulting head-to-tape speed when the tape drive is reading or writing 8500/8500c format data.

Table 6-2 Drum and head-to-tape speeds

Drum rotational speed	3662.11 rpm
Resulting head-to-tape speed	301.1 in/sec (7.6 m/sec)

Data Transfer Rates

The maximum obtainable data transfer rates for the tape drive depend on the type of data transfer and the data format. Table 6-3 shows the data transfer rates. For comparison, data transfer rates for the EXB-8505XL are included.

Table 6-3 Data transfer rates (Eliant 820 compared to EXB-8505XL)

Type of transfer	Rate achieved by the Eliant 820 for these formats . . .			Rate achieved by the EXB-8505XL for these formats . . .		
	8500c	**8500**	**8200 (read only)**	**8500c**	**8500**	**8200**
Sustained	up to 2 MB/sec*	up to 1 MB/sec	up to 525 KB/sec	up to 1 MB/sec*	up to 500 KB/sec	up to 262.5 KB/sec
Synchronous burst	up to 5.0 MB/sec					
Asynchronous burst	up to 2.5 MB/sec					

* Assumes a 2:1 compression ratio

Notes:

- When compression is enabled, the tape drive can increase the sustained transfer rate up to five times. Compression throughput and capacity ratios depend on the type of data.
- The maximum burst data transfer rate is limited by the performance of the SCSI host bus adapter, the SCSI bus interface controller, and the tape drive's buffer control hardware.

High-Speed Search Rates

High-speed search occurs when the initiator issues a LOCATE command (for tapes written in 8500 or 8500c formats) or a SPACE command. Table 6-4 shows the rates at which the tape drive performs high-speed searches.

Table 6-4 High-speed search rates

	Data written in...		
	8500c format*	**8500 format**	**8200 format**
Forward search	60 MB/sec	30 MB/sec	5.3 MB/sec
Backward search			4.0 MB/sec

*Assumes a data compression ratio of 2:1.

Write and Read Access Times

Write access time starts when the tape drive receives the last byte of the WRITE command (that is, when the initiator de-asserts ACK) and ends when the tape drive asserts REQ to request that the initiator transfer the first data byte across the SCSI bus.

Read access time starts when the tape drive receives the last byte of the READ command (that is, when the initiator de-asserts ACK) and ends when the tape drive asserts REQ to indicate that it is ready to transfer the first data byte across the SCSI bus to the initiator.

Write and read access times depend on whether the tape drive is operating in start/stop mode or streaming mode (see page 3-5).

Table 6-5 Typical write and read access times

Mode	Typical write access time	Typical read access time
Start/stop	1.7 msec	1.8 msec
Streaming	3.1 msec	3.2 msec

Note: The measurement of write access time does not include the initial WRITE command received after the mode is changed from read to write.

Reposition Time

Reposition time starts when the initiator issues a command that stops the tape drive's motion control system and ends when the tape is repositioned, at nominal speed, so that the next byte of data can be transferred. Reposition time is independent of any interface delays.

Reposition time for the tape drive ranges from 1.2 sec to 1.5 sec.

Tape Tension Release and Drum Motion Suspension

The tape drive releases tape tension under either of the following conditions:

- The tape is at LBOT and the tape drive has not received a command to move the tape in the last 5 seconds.
- The tape is not at LBOT and the tape drive has not received a command to move the tape in the last 15 seconds.

After releasing tape tension, the tape drive will stop drum rotation if it does not receive a tape motion command within the next 60 seconds.

If tape tension has been released, approximately 1.5 seconds will elapse before the tape drive can perform a tape motion command. If the drum rotation has been stopped, approximately 7 seconds will elapse before the tape drive can perform a tape motion command.

Rewind Times

Table 6-6 lists the typical rewind times for the EXATAPE 8mm data cartridges supported by the tape drive.

Rewind time starts when the initiator issues a REWIND (01h) command and ends when the tape drive returns a Command Complete message (for a non-immediate rewind). All times listed in the table assume the following:

- The tape is positioned at LEOT when the REWIND command is issued.
- The drum has not stopped rotating.
- Tape tension has not been released.

Table 6-6 Rewind times

EXATAPE length	Rewind time
15m	25 sec
54m	75 sec
112m	180 sec
160m XL	250 sec

Reselection Phase Timeout

If the initiator fails to respond to a device reselection sequence, the tape drive times out after 250 msec. The tape drive continues to repeat the reselection process until it is reset or the initiator finally responds.

Reliability Specifications

This section lists the following reliability specifications for the tape drive:

- Service life
- Machine reliability (mean time between failures)
- Data integrity
- Data reliability

Service Life

The tape drive has been designed to exceed a useful service life of five years, during which time all performance and reliability specifications are applicable.

Machine Reliability: Mean Time Between Failures (MTBF)

The predicted mean time between failures (MTBF) value for the tape drive is 200,000 power-on hours. This value is based on a 10% duty cycle.

The MTBF value for the tape drive is defined as follows:

$$\text{MTBF} = \frac{\text{Total Power-on Hours}}{\text{Number of Relevant Equipment Failures}}$$

where:

- **Total Power-on Hours** is the total time the tape drive is drawing current from the input power supply system.
- **Relevant Equipment Failures** are those failures that cannot be corrected by the operating personnel and require the intervention of maintenance personnel.

Test Conditions

The MTBF value for the tape drive is determined under the following conditions:

- MTBF is specified for a maximum duty cycle of 10%, where duty cycle is defined as:

$$\textbf{Duty Cycle} = \frac{\text{Total Hours of Mechanical Operation}}{\text{Total Power-on Hours}} \times 100\%$$

- The tape drive is tested at an ambient temperature of 23° C ± 2° and a relative humidity of 50% ± 10% (non-condensing).
- The tape drive is operated in accordance with operating specifications.

Conditions for the MTBF Value

Conditions under which the specifications for MTBF apply are as follows:

- The EXATAPE data cartridges used must comply with the ANSI/ISO/IEC 11319-1992 standard.
- Environmental conditions for the tape drive and the 8mm data cartridges must be maintained as specified in "Environmental Specifications" starting on page 6-12.
- The tape drive must be cleaned with a cleaning cartridge approved by Exabyte for the Eliant 820 using the recommended cleaning procedure. Refer to *Exabyte Eliant 820 Installation and Operation* for instructions.

Restrictions for the MTBF Value

The following types of failures are excluded from the calculation of MTBF:

- Failures arising from incorrect operating procedures
- Cable failures, power supply failures, or other failures not caused by equipment
- Failures caused by incorrect grounding procedures or by interference from external sources
- Media failures, or any failures or degraded performance caused by use of faulty or damaged media
- New failures that arise from continued use of a failed, misaligned, or damaged tape drive
- Failures caused by incorrect maintenance procedures and all failures that occur within the first 40 power-on hours of any maintenance activity that includes the modification, adjustment, or replacement of any tape drive assembly
- Failures of new tape drives that occur within the first 40 power-on hours

Data Integrity

Conditions under which data integrity is maintained are as follows:

- If there is a power loss while the tape drive is reading, no recorded data will be lost.
- If there is a power loss while the tape drive is writing, any data remaining in the buffer will be lost.
- The tape drive will not record incorrect data to tape without posting an error condition.
- The tape drive will not return incorrect data to the system without posting an error condition.

Data Reliability

Data reliability is specified as a bit error rate (BER) in units of errors per total number of bits transferred.

Conditions for Data Reliability

The conditions under which the specifications for write and read reliability apply are as follows:

- The EXATAPE data cartridges used must comply with the ISO/IEC 12246 standard.
- Data cartridges must be written and read on a tape drive that is in good operating condition and properly grounded.
- Environmental conditions for the tape drive and the 8mm data cartridges must be maintained as specified in "Environmental Specifications" starting on page 6-12.
- The tape drive must be cleaned with a cleaning cartridge approved by Exabyte for the Eliant 820 using the recommended cleaning procedure. Refer to *Exabyte Eliant 820 Installation and Operation* for instructions.

Restrictions for Data Reliability

The following types of errors are not included in the determination of data reliability:

- Errors caused by a failure of the tape drive
- Errors caused by faulty or damaged cartridges or media
- Errors caused by failure to comply with input power and grounding requirements, interference from external sources, or incorrect system operation or failure
- Errors corrected by the tape drive's ECC
- Errors occurring in blocks other than blocks containing user data

Write Reliability

Write reliability is determined by the rate of permanent write errors. During a write operation, the tape drive uses read-after-write checking to determine whether physical data blocks are correctly written to tape. When the read-after-write check criteria are not met for a data block, the tape drive rewrites the block. The tape drive keeps track of the number of times blocks are rewritten and stores this number internally. The number is available through the REQUEST SENSE (03h) command and the LOG SENSE (4Dh) command.

If the tape drive can rewrite the data block correctly, the error is a temporary write error, which does not affect write reliability. However, if the tape drive cannot rewrite the data block correctly after completing its write recovery procedures, the error is a permanent write error. When a permanent write error occurs, the tape drive returns Check Condition status.

The rate for permanent write errors is as follows:

Bit error rate: less than 1.0×10^{-17}

Read Reliability

Read reliability is determined by the rate of permanent read errors. If, during a read operation, the tape drive cannot read a block that has been correctly written, it attempts to reread the block. The tape drive keeps track of the number of times it attempts to reread a block and stores this number internally. This number is available through the REQUEST SENSE (03h) command and the LOG SENSE (4Dh) command.

If the tape drive can reread the data block correctly, the error is a temporary read error, which does not affect read reliability. However, if the tape drive cannot reread the data block correctly after completing its read recovery procedures, the error is a permanent read error. When a permanent read error occurs, the tape drive returns Check Condition status.

The rate for permanent read errors is as follows:

Bit error rate: less than 1.0×10^{-17}

Power Specifications

The tape drive operates from standard + 5 VDC and + 12 VDC supply voltages, as specified in Table 6-7. The internal model of the tape drive uses no external AC power and does not provide any overvoltage or overcurrent protection.

The tabletop tape drive has its own internal power supply that operates from an external AC power source. See page A-13 for information about the tabletop tape drive's power specifications and AC power requirements.

Table 6-7 Power specifications for standard voltages

	+ 5 Volts DC	+ 12 Volts DC
Nominal tolerance:		
DC	± 5%	
Ripple and Noise[a] (60 Hz to 20 MHz)	125 mVpp max	
Operating current:		
Idle		
Single-ended	1.4A	0.2A
Differential	1.5A	0.2A
Nominal[b]		
Single-ended	1.9A	0.2A
Differential	2.5A	0.2A
Peak[c]		
Single-ended	2.7A	2.5A
Differential	2.9A	2.5A
Operating power consumption:		
Idle		
Single-ended	9.4 watts	
Differential	9.9 watts	
Nominal[b]		
Single-ended	11.9 watts	
Differential	14.9 watts	

[a] The ripple voltage is included in the total voltage tolerance.

[b] Nominal current occurs during streaming write or read operation.

[c] The peak current occurs during load, unload, or at the start of search or rewind operations, and lasts for less than 1.5 seconds.

Safety agency certification requires that the supplied voltages be from a Safety Extra-Low Voltage source (per IEC 950).

Environmental Specifications

This section describes the following environmental specifications for the tape drive:

- Operating environment
- Air flow requirements
- Particulate contamination limits
- Shock and vibration specifications
- Acoustic noise limits

Operating Environment

Figure 6-1 shows the temperature and humidity requirements for the tape drive, as measured at the tape path. The area within the dotted line represents the operating environment. Table 6-8 defines the points in the chart.

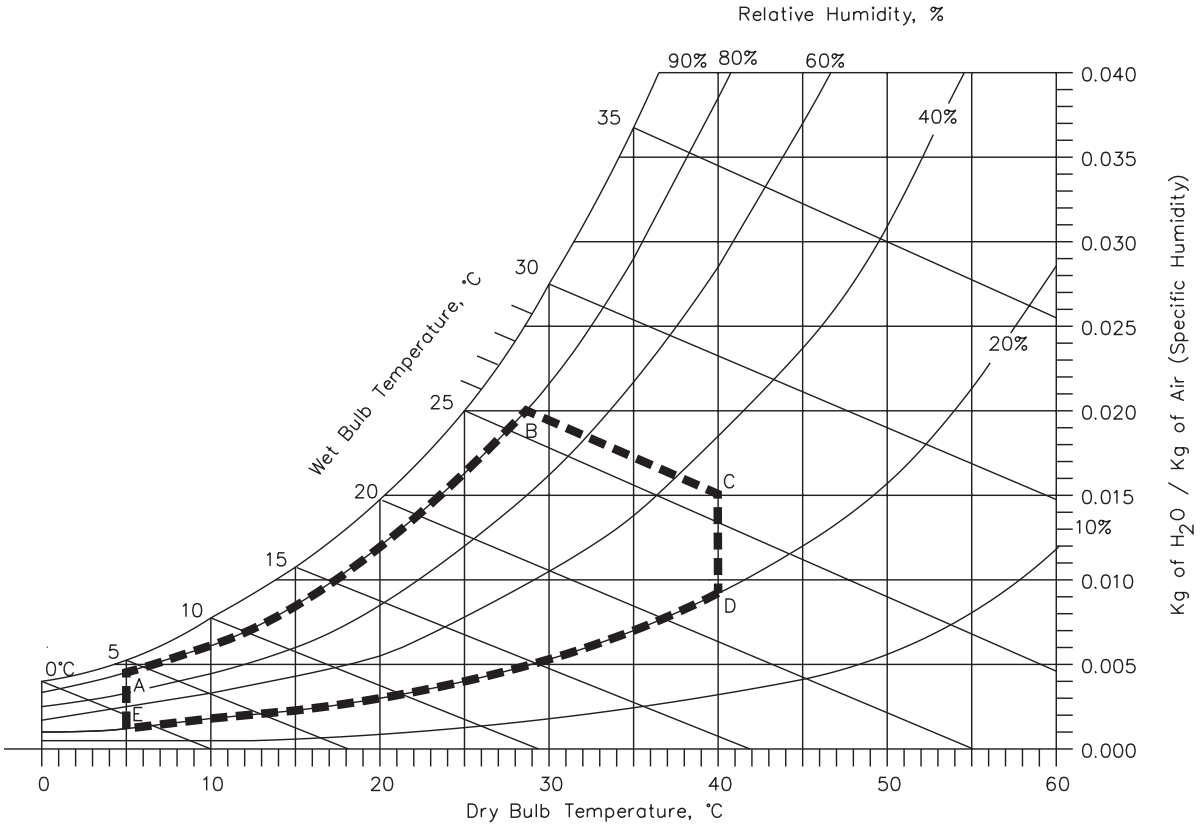

Figure 6-1 Tape path temperature and humidity ranges for operation

Table 6-8 Temperature and humidity points for Figure 6-1

Point	Temperature	Humidity
A	5°C	80%
B	29°C	80%
C	40°C	34%
D	40°C	20%
E	5°C	20%

➤ **Important** The operating temperature and humidity specifications are for the tape path. When the tape drive is in an enclosure, the ambient temperature typically must be lower than the maximum temperature to avoid exceeding the maximum at the tape path. See page A-7 for information about how the tabletop enclosure affects these requirements.

Table 6-9 summarizes the environmental specifications for operating, storing, and shipping the tape drive.

Table 6-9 Environmental specifications

	Operating (cartridge inserted)	**In storage (in original packaging, no cartridge), or not operating (unpacked, no cartridge)**	**Being shipped (in original packaging, no cartridge)**
Tape path temperature range	+ 5°C to + 40°C (+ 41°F to + 104°F)	–40°C to + 60°C (–40°F to + 140°F)	
Temperature variation*	1°C per minute; max 10°C per hour (2°F per minute; max 18°F per hour)	1°C per minute; max 20°C per hour (2°F per minute; max 36°F per hour)	
Relative humidity*	20% to 80% non-condensing	10% to 90% non-condensing	
Wet bulb	26°C (79°F) max		
Altitude	–304.8 m to + 3,048 m (–1,000 ft to + 10,000 ft)	–304.8 m to + 3,048 m (–1,000 ft to + 10,000 ft)	–304.8 m to + 12,192 m (–1,000 ft to + 40,000 ft)

*The data cartridge's temperature and humidity must be allowed to stabilize in the specified ambient environment for 24 hours.

Air Flow Requirements

When the tape drive is incorporated into an enclosure, adequate air flow must be provided for the tape drive to dissipate heat resulting from approximately 15 watts of power consumption. The air flow around the entire tape drive must be sufficient to prevent the tape path temperature from exceeding 40° C (104° F). However, air flow within the enclosure must be minimal at the tape path. Otherwise, particulate contamination of the media can result.

Note: For information about airflow for the tabletop model of the tape drive, see page A-9.

Particulate Contamination Limits

The ambient operating environment should not exceed the particulate counts shown in Table 6-10.

Table 6-10 Particle contamination limits

Particle size (microns)	Number of particles ≥ particle size per cubic meter	Number of particles ≥ particle size per cubic foot
0.1	8.8×10^7	2.5×10^6
0.5	3.5×10^7	1.0×10^6
5.0	2.5×10^5	7.0×10^3

Figure 6-2 shows the particulate contamination profile of a typical office compared to the specifications for the tape drive. Contamination profiles of individual office areas vary.

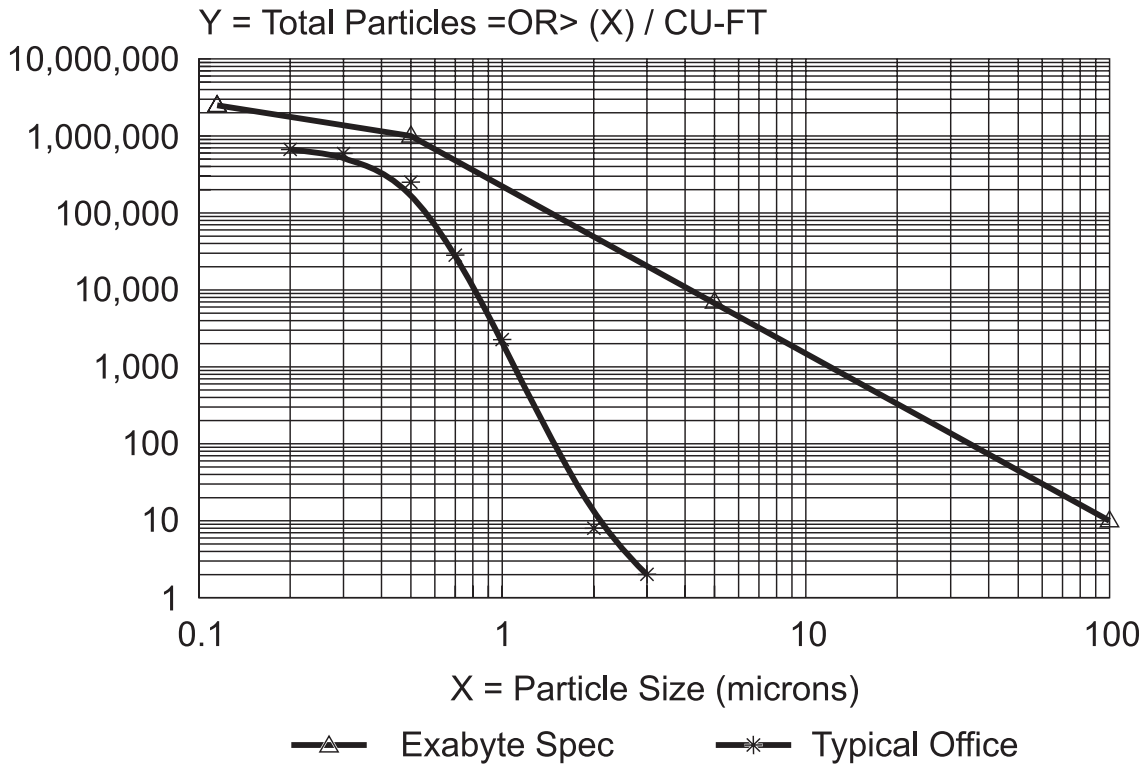

Figure 6-2 Particulate contamination specification vs. typical office

Shock Specifications

Table 6-11 lists the shock specifications for the tape drive. The operating shock levels indicate how much shock the tape drive can withstand while it is reading and writing data. The non-operating and storage shock levels indicate how much shock the tape drive can withstand when it is not operating. After withstanding this amount of shock, the tape drive will operate normally.

Table 6-11 Shock specifications

Operating (reading and writing)	In storage (in original packaging, no cartridge), or not operating (unpacked, no power applied)	Being shipped (in original packaging, no cartridge)	Handling
3 g for 5 ms[a]	**Internal model:** 45 g at a velocity change of 192 in/sec[b] **Tabletop model:** 45 g at a velocity change of 180 in/sec	ISTA Project 1A and 2A	Drop and Topple per IEC 68-2-31

[a] A minimum of 20 shock pulses were applied to each of the three orthogonal axes. The shock pulses were half-sine waves and were applied at a rate not exceeding one shock per second.

[b] A minimum of three trapezoidal shock pulses of 45 g were applied to each of the tape drive's six sides at a velocity change of 192 inches per second (equivalent height equals 48 inches).

Vibration Specifications

Table 6-12 lists the vibration specifications for the tape drive during operation, non-operation, storage, and transportation. The operating specifications listed in this table indicate the amount of vibration that the tape drive can withstand while reading and writing data.

Table 6-12 Vibration specifications

Random vibration[a] applied during operation (reading and writing)	
1 Hz	PSD = 0.000003 g^2/Hz
5 Hz	PSD = 0.00002 g^2/Hz
10 – 150 Hz	PSD = 0.0003 g^2/Hz
200 – 400 Hz	PSD = 0.00008 g^2/Hz
Random vibration[b] applied during non-operation (unpacked) or storage (in original packaging)	
1 Hz	PSD = 0.0003 g^2/Hz
3 Hz	PSD = 0.00055 g^2/Hz
12 – 100 Hz	PSD = 0.01 g^2/Hz
400 Hz	PSD = 0.000003 g^2/Hz
Vibration applied during shipping (in original packaging)	
ISTA Project 1A and 2A	
Swept sine applied during non-operation[c] and operating[d]	
5 to 400 to 5 Hz	

[a] A 0.30 g RMS random vibration spectrum is applied to each of three orthogonal axes for a minimum of 20 minutes per axis.

[b] A 1.06 g RMS random vibration spectrum is applied to each of three orthogonal axes for a minimum of 20 minutes per axis.

[c] Three sweeps at one octave per minute are applied to each axis at 0.75 g (peak) input.

[d] Three sweeps at one octave per minute are applied to each axis at 0.3 g (peak) input.

Acoustic Noise

The overall, averaged A-weighted sound pressure levels (decibels) for the tape drive do not exceed the upper limits specified in Table 6-13.

Table 6-13 Acoustic noise limits

Operating mode	L_{WA}* (internal model)	L_{WA}* (tabletop model)
The tape drive is powered on and idle	40 dBA	45 dBA
The tape drive is fully operational and operating in streaming mode for a read or write operation	45 dBA	45 dBA

* L_{WA} is the average A-weighted sound pressure level over the following frequency range: 5 Hz to 12.5 KHz.

Notes

7 Safety and Regulatory Agency Compliance

This chapter lists the following safety and regulatory agency requirements met by both the internal and tabletop models of the tape drive:

- Safety agency standards
- Electrostatic discharge (ESD) limits
- Electrical fast transient/noise (EFT/N) limits
- Surge immunity
- Electromagnetic interference (EMI)
- Radiated electromagnetic field immunity

Note: For the tabletop tape drive, the requirement for a shielded cabinet is met by the tabletop enclosure.

Safety Agency Standards

When purchased from Exabyte Corporation, both the internal and tabletop models of the tape drive comply with the following domestic and international product safety standards.

- UL Standard 1950, 3rd Edition, Information Technology Equipment including Electrical Business Equipment
- CSA Standard C22.2 No. 950-95, Safety of Information Technology Equipment including Electrical Business Equipment
- EN60950/IEC 950, Safety of Information Technology Equipment including Electrical Business Equipment

Note: The internal model of the tape drive is certified as a component only. Certification of the final integrated product is the responsibility of the system integrator.

Electrostatic Discharge (ESD) Limits

When properly installed in a shielded cabinet with shielded cables and adequate grounding of the SCSI bus and input power, the tape drive meets the following requirements of EN 61000-4-2, 1995, Immunity to Electrostatic Discharge (ESD) for Information Technology Equipment (ITE):

- The tape drive can withstand a contact discharge of severity level 2 or an air-gap discharge of severity level 3 without degradation or non-recoverable loss of function due to damaged equipment or firmware.

Electrical Fast Transient/Noise (EFT/N) Limits

When properly installed in a shielded cabinet with shielded cables and adequate grounding of the SCSI bus and input power, the tape drive meets the following requirement of EN 61000-4-4, 1995, Electromagnetic Compatibility for Industrial-Process Measurement and Control Equipment, Part 4 - Electrical Fast Transient/Burst Requirements:

- The tape drive will continue to operate without error when subjected to EFT/N of severity level 2 on the AC power ports and I/O ports (SCSI and serial ports).

Surge Immunity

When properly installed in a shielded cabinet with shielded cables and adequate grounding of the SCSI bus and input power, the tape drive meets the following requirement of EN61000-4-5, 1995, Electromagnetic Compatibility for Industrial-Process Measurement and Control Equipment, Part 5 - Surge Immunity Requirements:

- The tape drive will continue to operate without error when subjected to a surge of severity level 3 on the AC ports or a surge of severity level 2 on the DC ports.

Electromagnetic Interference (EMI)

When properly installed in a shielded cabinet with shielded cables and adequate grounding of the SCSI bus and input power, the tape drive meets the requirements for radiated and conducted emissions as defined by the following standards:

- FCC Rules and Regulations, Part 15 - Radio Frequency Devices, Subpart B - Unintentional Radiators, Class B
- Industry Canada Notice ICES-003: Class B Digital Apparatus
- CISPR Publication 22 (1985) Class B

Radiated Electromagnetic Field Immunity

When properly installed in a shielded cabinet with shielded cables and adequate grounding of the SCSI bus and input power, the tape drive meets the following requirement of EN 61000-4-3, First Edition, 1984, Electromagnetic Compatibility for Industrial-Process Measurement and Control Equipment, Part 3 - Radiated Electromagnetic Field Requirements:

- The tape drive will continue to operate without error when subjected to electromagnetic energy of severity level 2 (3 volts/meter)

Notes

A Specifications for the Tabletop Tape Drive

This appendix describes specifications for the tabletop tape drive that are not covered in the rest of this book. Unless noted, the specifications in the previous chapters apply to both the internal and tabletop models. The specifications that apply only to the tabletop tape drive are the following:

- Physical features
- Environmental specifications
- Installation requirements
- Power specifications
- Reliability specifications
- Shipping requirements

Overview

The tabletop tape drive, shown in Figure A-1, is a fully integrated, standalone data storage system that includes the following features:

- An internal power supply
- A thermistor-controlled fan
- A remote SCSI ID switch
- Two SCSI connectors
- A shielded cabinet that meets the regulatory and safety agency requirements described in Chapter 7

The tabletop tape drive can be used in either a vertical or horizontal position. It is available in single-ended and differential SCSI configurations.

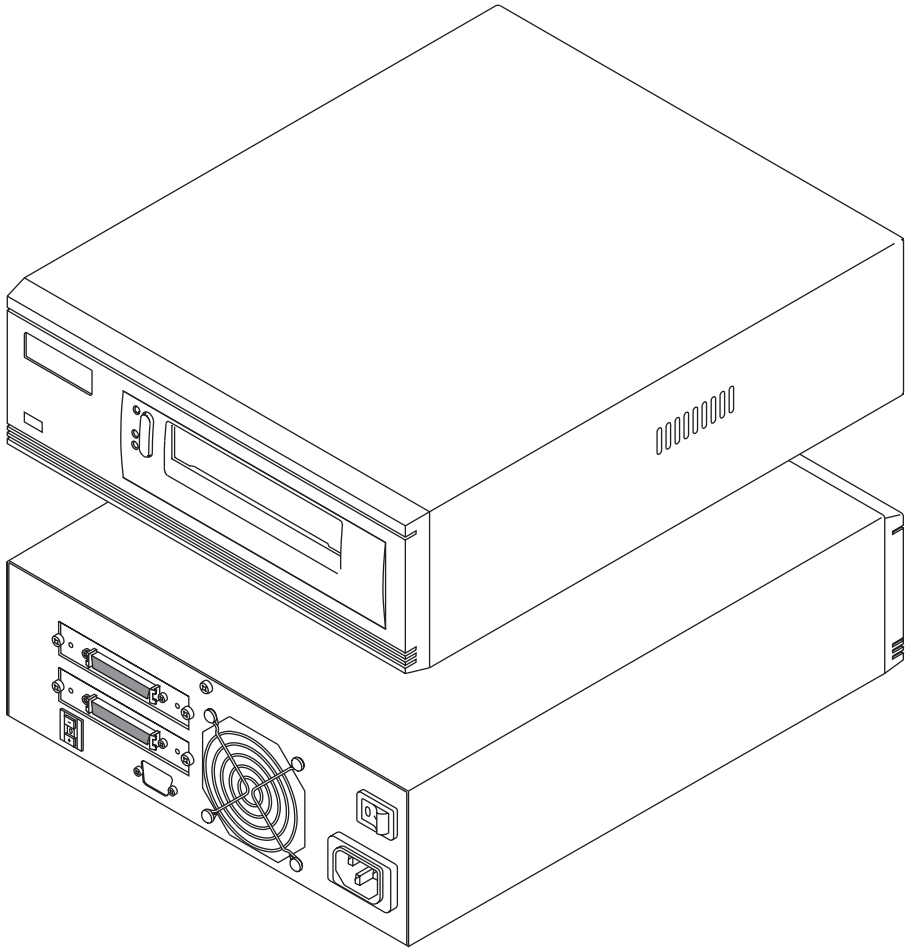

Figure A-1 Tabletop tape drive

Physical Features

This section describes the following physical features of the tabletop tape drive:

- Front panel components
- Back panel components
- Dimensions and weight

Front Panel Components

Figure A-2 shows the main components of the tabletop tape drive's front panel.

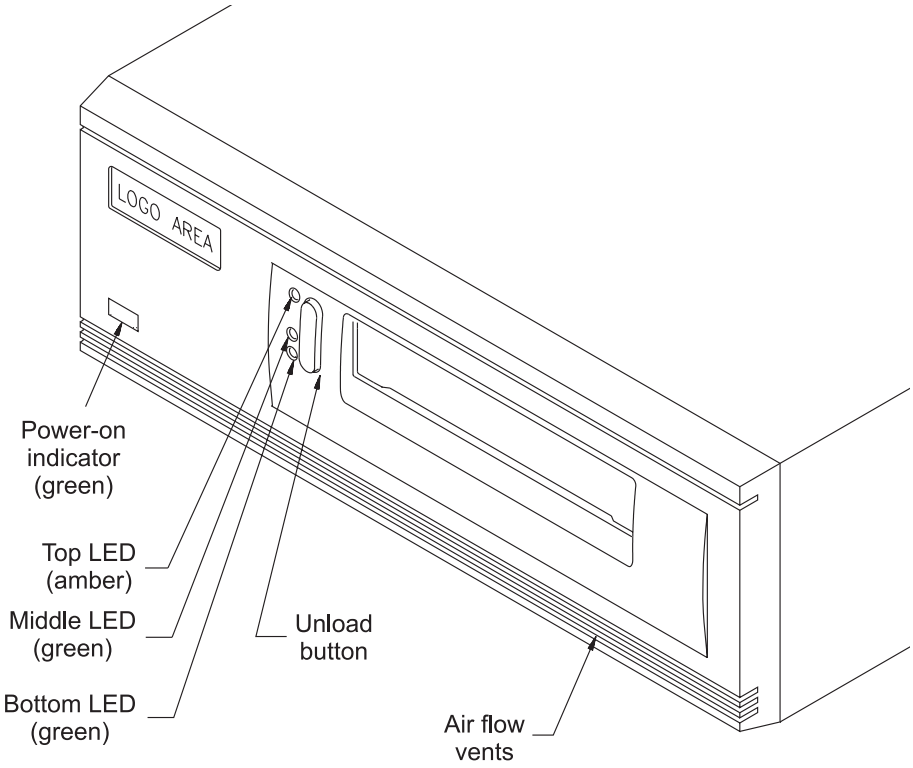

Figure A-2 Front panel of the tabletop tape drive

Logo Area

The tabletop tape drive provides a recessed area in the upper left corner of the faceplate for a company logo. Figure A-5 shows the location and dimensions of the logo area. The standard tabletop tape drive does not include a logo label. For custom label information, contact your Exabyte account manager.

Power-On Indicator

When you turn on the tabletop tape drive's power, the green power-on indicator on the lower left corner of the faceplate lights up. When power is off or disconnected, the indicator turns off.

Color

The standard enclosure, including the faceplate and door of the tape drive, is pearl white. For custom color information, contact your Exabyte account manager.

Unload Button and LEDs

The operation of the tape drive's unload button and the statuses indicated by the LEDs are described on page 4-12.

Back Panel Components

Figure A-3 shows the main components of the tabletop tape drive's back panel.

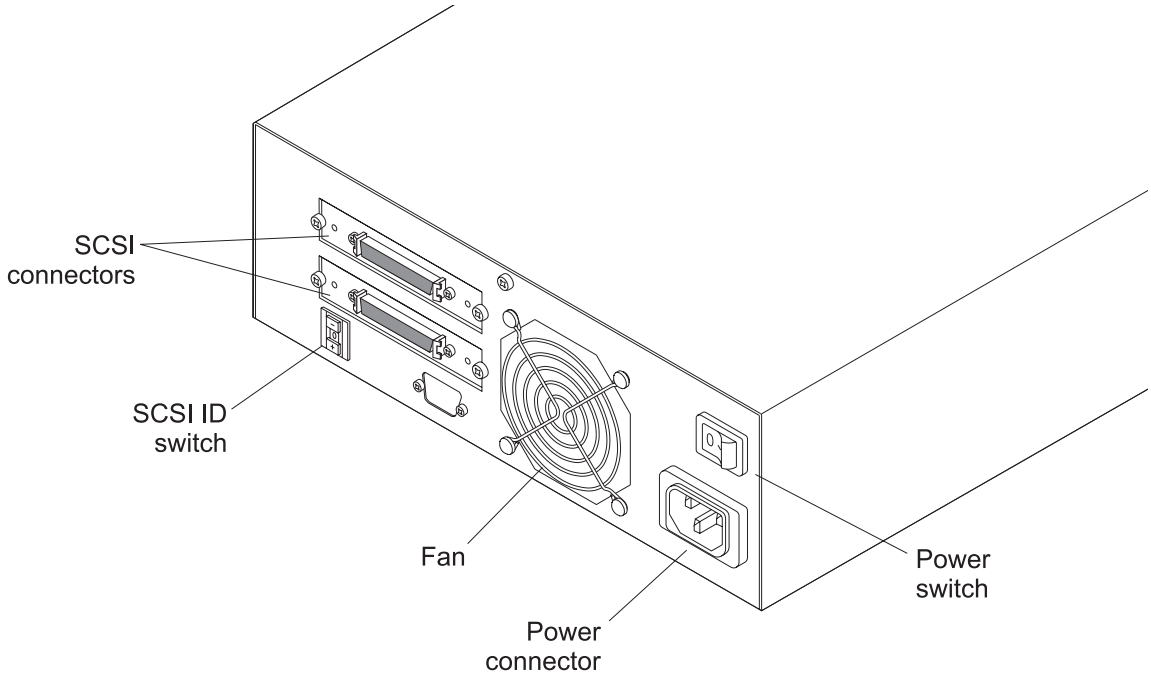

Figure A-3 Back panel of the tabletop tape drive

SCSI ID Switch

The SCSI ID switch is an incremental switch that enables you to set the address of the tape drive on the SCSI bus. The switch is recessed to prevent accidental selection. See page A-10 for information about setting the SCSI ID.

SCSI Connectors

Two 50-contact SCSI connectors enable you to connect the tape drive to a SCSI bus. See page A-11 for information about SCSI connection requirements.

Fan

The thermistor-controlled fan maintains the temperature of the tape drive to within 2° C of the ambient temperature. The fan also features locked rotor protection. If a foreign object becomes lodged in the fan, the fan motor automatically shuts off.

See page A-9 for information about how the fan controls air flow through the enclosure.

Power Connector

The power connector is the input for AC power to the tabletop tape drive's internal power supply. See page A-12 for requirements for connecting power to the tape drive. See page A-13 for power specifications.

Power Switch

The rocker switch on the upper right side of the back panel controls AC power to the tabletop tape drive's internal power supply.

Labels

The tabletop tape drive includes FCC and serial number labels. These labels provide component, serial number, and part number revision information. Figure A-4 shows the location of these labels.

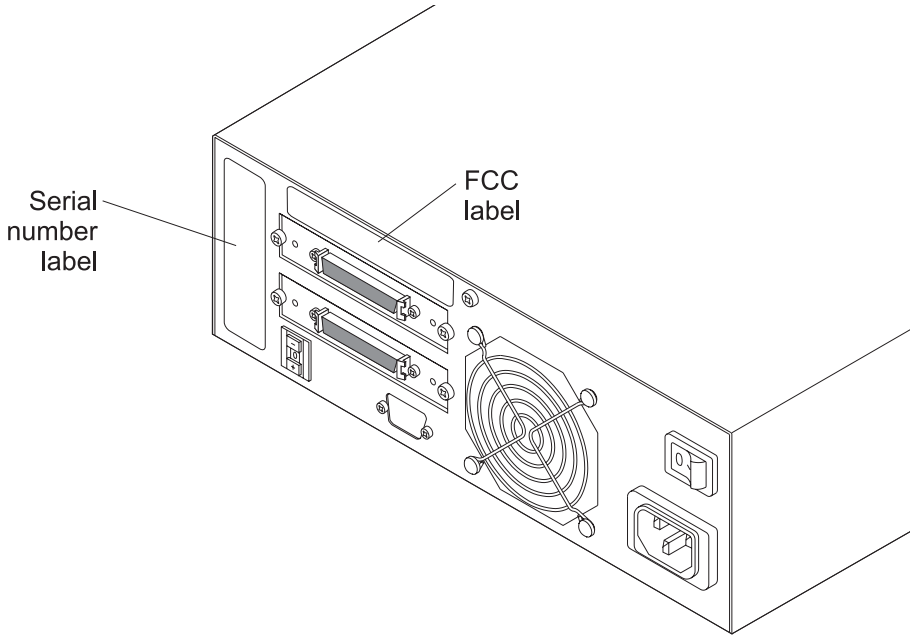

Figure A-4 Labels on the tabletop tape drive

Dimensions and Weight

The tabletop tape drive has the following dimensions and weight:

Table A-1 Dimensions and weight

Dimensions	3 inches high × 9 inches wide × 11 inches deep (76.2 mm × 228.6 mm × 279.4 mm)
Weight	8.4 pounds (3.8 kilograms)

Figure A-5 shows the dimensions of the tabletop tape drive.

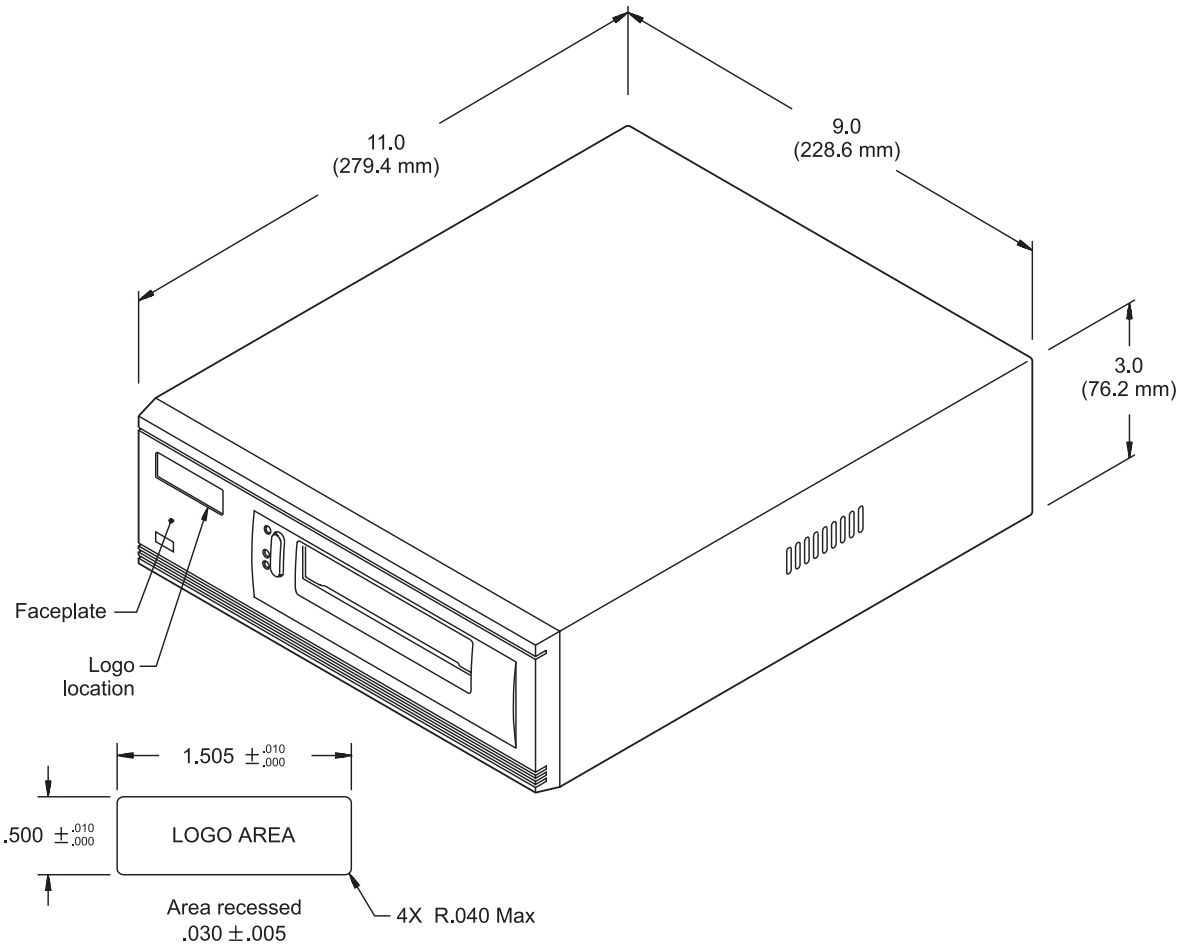

Figure A-5 Dimensions of the tabletop tape drive in inches (and mm)

Environmental Specifications

The environmental specifications for the internal tape drive (described in Chapter 6) apply to the tabletop tape drive as well. However, because the tabletop tape drive includes an enclosure, ambient temperature and humidity must be maintained at the levels described in this section to achieve the tape path requirements discussed on page 6-12.

To meet tape path temperature and humidity requirements, maintain the tabletop tape drive's ambient operating environment within the area defined by the dotted lines in Figure A-6. Table A-2 defines the points in the chart.

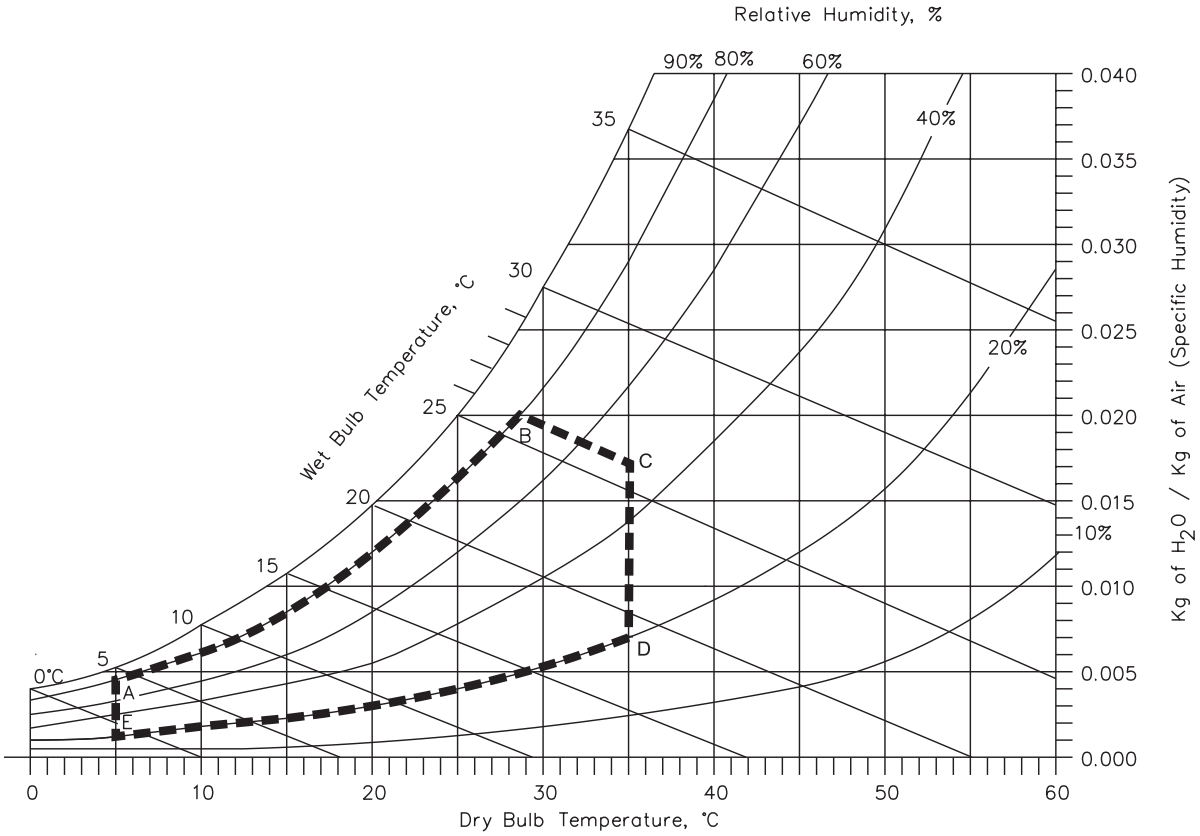

Figure A-6 Ambient operating environment for the tabletop tape drive

Table A-2 Temperature and humidity points for Figure A-6

Point	Temperature	Humidity
A	5°C	80%
B	29°C	80%
C	35°C	50%
D	35°C	20%
E	5°C	20%

Air Flow in the Tabletop Enclosure

A thermistor-controlled fan controls air flow through the tabletop enclosure. Air flows from the front of the enclosure to the rear through a specially designed series of vents built into the enclosure. To maintain the internal temperature within 2° C of ambient temperature, the thermistor increases or decreases air flow based on environmental temperature changes.

Figure A-7 shows the flow of air through the tabletop enclosure.

CAUTION

Do not cover the air flow vents on the right side of the tabletop tape drive (shown in Figure A-7). Covering these vents can cause the tape drive to overheat and damage equipment and the data cartridge.

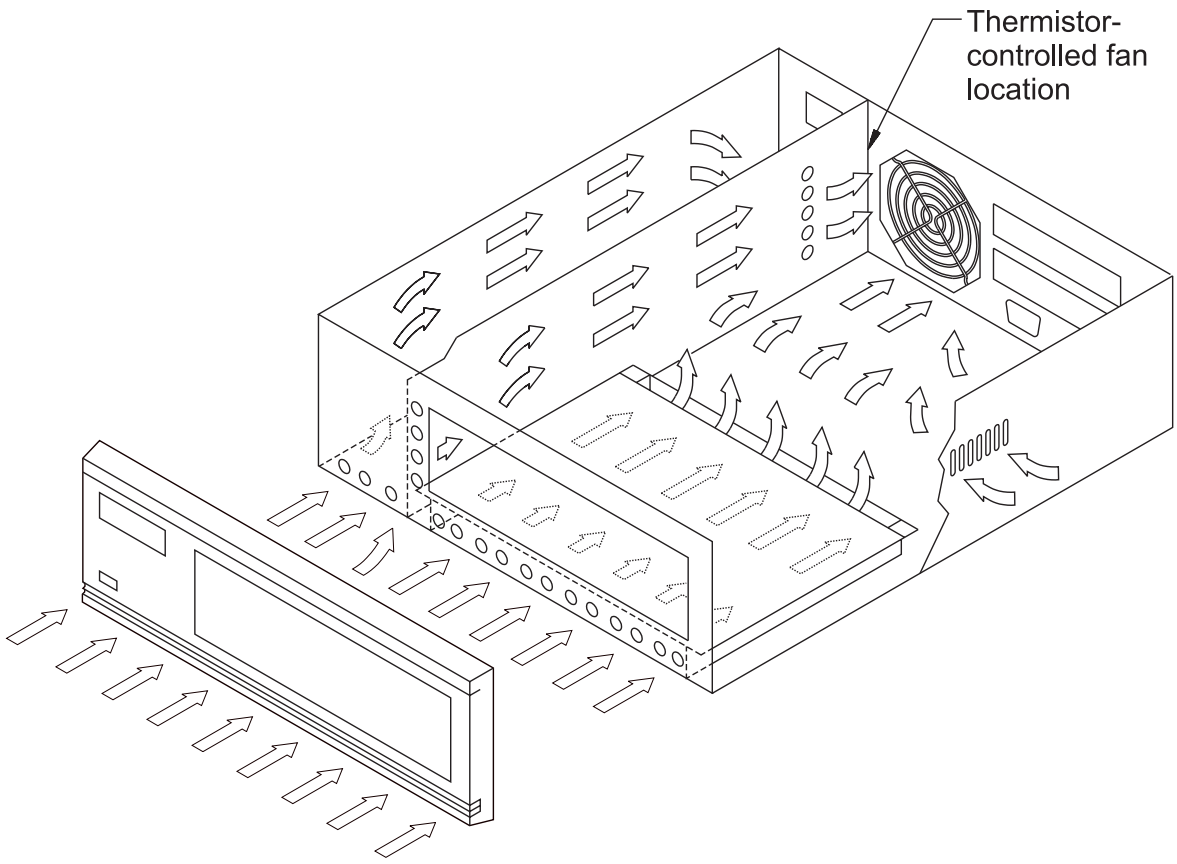

Figure A-7 Air flow through the tabletop enclosure

Installation Requirements

Installing the tabletop tape drive involves the following steps:

- Setting the SCSI ID
- Connecting SCSI cables
- Terminating the tabletop tape drive (if necessary)
- Connecting the tabletop tape drive to power
- Powering on the tabletop tape drive

This section describes the requirements for these steps. For detailed instructions for completing the installation tasks, refer to *Exabyte Eliant 820 Installation and Operation*.

Setting the SCSI ID

As shown in Figure A-8, you can use a pen or other fine-tipped instrument to change the SCSI ID switch on the back of the tabletop tape drive. You can select a SCSI ID from 0 to 7.

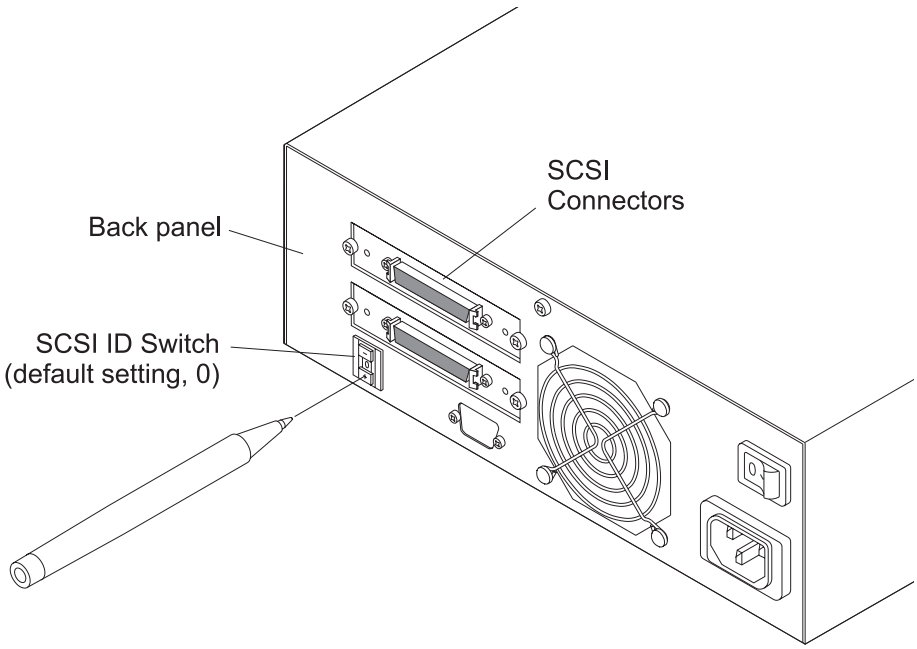

Figure A-8 SCSI ID switch for the tabletop tape drive

Connecting SCSI Cables

The tabletop tape drive does not include a SCSI cable. Select a cable that meets the specifications listed in Table A-3.

Table A-3 Specifications for the SCSI cable

Standard construction	50 conductors (25 twisted pairs with drain wire and shield)
Primary conductors	Insulated per UL Style 1589
Gauge	# 30 AWG minimum stranded (7/38) annealed
Insulation	Polypropylene (80°C) 0.010 inch nominal
Shielding	80% minimum tinned copper braid over aluminum/mylar foil
Outer jacket	Insulated per UL Style 2919
Recommended Impedance	100 Ohms ±10% @ 1.5 MHz

Each tabletop tape drive attached to the SCSI bus uses 0.4 meters (1.31 feet) of the total allowable bus length internally. You must add this amount for each tabletop tape drive to the length of cable used on the bus to determine the total length. See page 4-6 for SCSI bus length restrictions.

SCSI Connectors

The SCSI connectors on the back of the tabletop tape drive are 50-pin, high-density, female ribbon cable connectors. Use shielded, 50-pin, high-density, male ribbon cable connectors (AMP No. 750681-1) to connect cables to the tabletop tape drive.

Pin assignments for the differential SCSI connector are shown on page 4-7. Pin assignments for the single-ended SCSI connector are shown on page 4-8.

Terminating the Tabletop Tape Drive

If the tabletop tape drive is the last device on the SCSI bus, attach an external terminator to the SCSI connector not used by a SCSI cable. Use one of the following terminators:

- **For a single-ended configuration,** Exabyte recommends an AMP 869546-1 single-ended external terminator.
- **For a differential configuration,** Exabyte recommends an AMP 869545-1 differential external terminator.

Connecting the Tabletop Tape Drive to Power

The tabletop tape drive's AC power connector is a standard IEC type CEE-22 male connector. The tape drive includes a 120 VAC three-conductor power cord for use in the United States and Canada. The three-conductor, 18AWG, SVT or SJT type AC power cord has a molded NEMA 5-15P male connector on one end and a molded IEC type CEE-22 female connector on the other end. The power cord is UL Listed and CSA Certified.

You must supply power cords for other input voltages or when using the tabletop tape drive outside of the US and Canada, as follows.

220 VAC Power Cord for the US and Canada

A 220 VAC power for the tabletop tape drive must meet the following requirements:

- The power cord must have a NEMA 6-15P male connector on one end.
- The power cord must have an IEC type CEE-22 female connector on the other end.
- The cordage used must be an SVT or SJT type, three conductor, 18 AWG minimum.
- The power cord must comply with local electrical code.

International 220 VAC Power Cord

An international 220 VAC power cord for the tabletop tape drive must meet the following requirements:

- The power cord must have an attachment plug of the proper type, rating, and safety approval for the intended country.
- The power cord must have an IEC type CEE-22 female connector on one end.
- The cordage must be adequately rated and harmonized to CENELEC publication HD-21.

Powering On the Tabletop Tape Drive

When you turn on the power switch on the back of the tabletop tape drive, the power-on indicator on the front panel turns green, the fan begins to rotate, and the tape drive performs its power-on self-test. Refer to page 4-13 for information about the LED sequence that is displayed during the power-on self-test.

Power Specifications

The tabletop tape drive uses an internal switching power supply and can operate from 100 to 240 VAC, with a frequency of 50 or 60 Hz, without manual intervention. The power supply automatically adjusts for changes in voltage and frequency within the specified range. An AC line filter minimizes interference. Table A-4 lists the general specifications for the power supply.

Table A-4 Power supply specifications for the tabletop tape drive

Type	30 watts switching
Efficiency	60% minimum
Input voltage	100 to 240 VAC @ 1 Amp maximum (autoswitching input selection—no user selection required)
Frequency	50 or 60 Hz ± 5% (autoswitching input selection—no user selection required)
Switching frequency	> 30 KHz

The tabletop tape drive continues to operate when the AC power experiences intermittent operations, voltage surges, or voltage spikes. Table A-5 shows the acceptable AC power characteristics.

Table A-5 AC power characteristics for the tabletop tape drive

Intermittent operation	100% line dropout for 1/2 cycle at nominal line voltage. 50% line reduction for 1 1/2 cycles at nominal line voltage. 20% line reduction for 2 1/2 cycles at nominal line voltage.
Line discontinuities	
Voltage surges	500 volts at nominal line voltage. Pulse Width: 100 ns Rise Time: 5 ns Repetition Rate: 1 Hz Common and differential mode, positive and negative polarity.
Voltage spikes	1 to 5 KV at nominal line voltage. Pulse Width: 1 µs Rise Time: 25 ns Repetition Rate: 1 Hz Common and differential mode, positive and negative polarity.

Power consumption specifications are shown in Table A-6.

Table A-6 AC power consumption

Average current	0.265 amps
Maximum current	0.340 amps

Reliability Specifications

Mean Time Between Failures (MTBF)

The predicted MTBF value for the tape drive in an Exabyte tabletop enclosure (including the power supply, fan, and cables) is 115,000 hours. This value is based on a 10% duty cycle.

Mean Time to Repair

If the enclosed tape drive is treated as a field replaceable unit (FRU), the mean time to repair the tabletop tape drive (remove and replace the enclosed tape drive) is less than 15 minutes.

Shipping Requirements

When shipped, the tabletop tape drive is sealed in a static protection bag and is shipped with one unit per carton.

The shipping cartons and internal packing materials are designed so that the enclosed tabletop tape drive does not receive a shock greater than 45 g when the carton is dropped on any surface, corner, or edge from the following height:

- 36 inches (91.4 cm) at a velocity change of 167 inches per second (424 cm/sec)

The shipping carton passes the tests described in the International Safe Transit Association (ISTA) Project 1A and 2A for packaged products weighing less than 100 pounds.

Table A-7 lists the shipping carton's dimensions and weight.

Table A-7 Dimensions and weight of shipping carton for the tabletop tape drive

Dimensions	17 3/4 inches long × 16 1/4 inches wide × 10 3/4 inches high (45 cm × 41 cm × 27 cm)
Weight (fully packed)	12.4 pounds (5.6 kilograms)

The tabletop tape drive's packing materials are unbleached, reusable, recyclable, and environmentally safe. The materials contain no chlorofluorocarbons (CFCs) or heavy metals.

When repacking and shipping the tabletop tape drive, use the original shipping carton and packing materials (or replacement packaging obtained from the vendor) to avoid damaging the tape drive. The shipping carton and packing materials are not intended to be used for shipping items other than a tabletop tape drive.

Packing instructions for the tabletop tape drive are included in *Exabyte Eliant 820 Installation and Operation*. See page 6-12 for information about the environmental requirements for shipping the tabletop tape drive.

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