

EXB-8205 & EXB-8505 8mm Tape Drives

standard and eXtended-Length configurations

Product Specification

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Revision History

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000	September 1992
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510504-002

Changes and Enhancements to This Manual

This revision (510504-002) of the *EXB-8205 and EXB-8505 Product Specification for Standard and eXtended Length (XL) Configurations* replaces the *EXB-8205 8mm Cartridge Tape Subsystem Product Specification* (510703) and the *EXB-8505 8mm Cartridge Tape Subsystem Product Specification* (510504). This manual includes the following changes and enhancements:

- The manual has been reorganized for easier reference. Chapters 1 through 3 include a general description of the tape drives, tape drive functions, and related products; chapter 4 includes requirements for installation, operation, and maintenance; chapter 5 includes SCSI specifications; and chapters 6 and 7 include functional specifications and compliance with safety and regulatory standards.
- Information about the EXABYTE[®] EXB-8205 and EXB-8505 has been consolidated into one manual. Information about the “eXtended Length” (XL) configurations of these tape drives has also been included.
- In the Related Products section, a description of the EXB-210 8mm Library has been included. Information about extended length media, including the Recognition System stripe on 160m XL EXATAPE[™] data cartridges has been added. Exabyte cleaning cartridge information has also been updated.
- Detailed information about the relationship between physical track structures and logical data formats has been added to the Physical Format section.

Product Warranty Caution

The EXB-8205, EXB-8205XL, EXB-8505, and EXB-8505XL 8mm Cartridge Tape Subsystems are 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 EXB-8205, EXB-8205XL, EXB-8505, and EXB-8505XL 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 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 EXB-8205, EXB-8205XL, EXB-8505, or EXB-8505XL 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 following EXABYTE® 8mm Cartridge Tape Subsystems (tape drives):

- EXB-8205
- EXB-8205XL (extended length)
- EXB-8505
- EXB-8505XL (extended length)

Intended Audience

This manual is for engineering, purchasing, or marketing personnel who want to evaluate the EXB-8205, EXB-8205XL, EXB-8505, and EXB-8505XL to determine the feasibility of integrating them into product lines.

How This Manual is Organized

This manual contains the following chapters:

- **Chapter 1** describes the features of the tape drives, including compatibility with other Exabyte 8mm Cartridge Tape Subsystems, data compression, tape capacity, and custom EEPROM options. This chapter also describes the physical features of the tape drives, including mechanical and electrical components.
- **Chapter 2** describes the physical and logical recording formats used by the tape drives, including the implementation of helical-scan recording technology.
- **Chapter 3** describes the functional features of the tape drives, including how they perform read and write operations.
- **Chapter 4** lists the requirements for installing, operating, maintaining, and shipping the tape drives.
- **Chapter 5** describes how the tape drives implement 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.

This product specification contains a glossary and an index.

Related Publications

The following publications list additional, related information.

EXB-8205 and EXB-8505 8mm Cartridge Tape Subsystems

For information about installing, operating, and maintaining the EXB-8205, EXB-8205XL, EXB-8505, and EXB-8505XL, and for information about implementing SCSI commands, refer to the following publications:

- EXB-8205 and EXB-8505 8mm Cartridge Tape Subsystems SCSI Reference for Standard and eXtended Length Configurations, 510503
- EXB-8205 and EXB-8505 8mm Cartridge Tape Subsystems Integration and Optimization for Standard and eXtended Length Configurations, 510505
- EXB-8205 and EXB-8505 8mm Cartridge Tape Subsystems Installation and Operation for Standard and eXtended Length Configurations, 302967

Libraries and Enclosures

For information about libraries and enclosures currently available for the EXB-8205, EXB-8205XL, EXB-8505, and EXB-8505XL, refer to the following publications:

- EXB-210 8mm Library Product Specification, 510807
- Mini Tabletop 8mm Cartridge Tape Subsystem Product Specification, 520154

Standards

For information about the standards used for the tape drives, refer to the following publications:

- 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 special conventions to highlight notes, important information, and cautions. These conventions are explained below.

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

Read the information in *CAUTION* boxes to learn ways to avoid damaging the equipment.

Notes:

1

Features

This chapter provides an overview of the EXB-8205, EXB-8205XL, EXB-8505, and EXB-8505XL, including:

- Features
- Physical description
- Related products

Features

The EXB-8205, EXB-8205XL, EXB-8505, and EXB-8505XL are enhanced 8mm digital helical-scan cartridge tape subsystems (tape drives). The tape drives are packaged in the industry standard 5.25-inch half-high form factor, which allows for ease of integration across a multitude of platforms.

Featuring an integral Small Computer System Interface (SCSI) controller (either single-ended or differential configuration), these tape drives are the easily integrated solution to your journaling, archiving, data interchange, software distribution, imaging, data acquisition, and backup/restore needs.

Note: This specification applies to the EXB-8205, EXB-8205XL, EXB-8505, and EXB-8505XL. However, most of the illustrations in this manual show the EXB-8505.

In their compressed modes, the EXB-8205 can store up to 5 GBytes and the EXB-8505 can store up to 10 GBytes on a single 112m data cartridge, assuming an average compression ratio of 2:1.

The eXtended-Length (XL) configurations of these tape drives provide additional capacity by supporting EXATAPE™ 160m XL 8mm Data Cartridges. Assuming an average compression ratio of 2:1, the EXB-8505XL can store up to 14 GBytes of data on a single 160m XL data cartridge. Assuming the same compression ratio, the EXB-8205XL can store up to 7 GBytes on a single data cartridge.

For more information on EXATAPE data cartridge capacity, see page 1-8. For more information on EXATAPE data cartridges, see page 1-20.

► **Important** EXATAPE 160m XL 8mm Data Cartridges are only supported by the extended length tape drives (EXB-8205XL and EXB-8505XL). The standard tape drives (EXB-8205 and EXB-8505) cannot write on or read from 160m XL data cartridges and will automatically eject them.

As shown in Figure 1-1, the four tape drive models look identical, except for minor differences in the LEDs and the unload button.

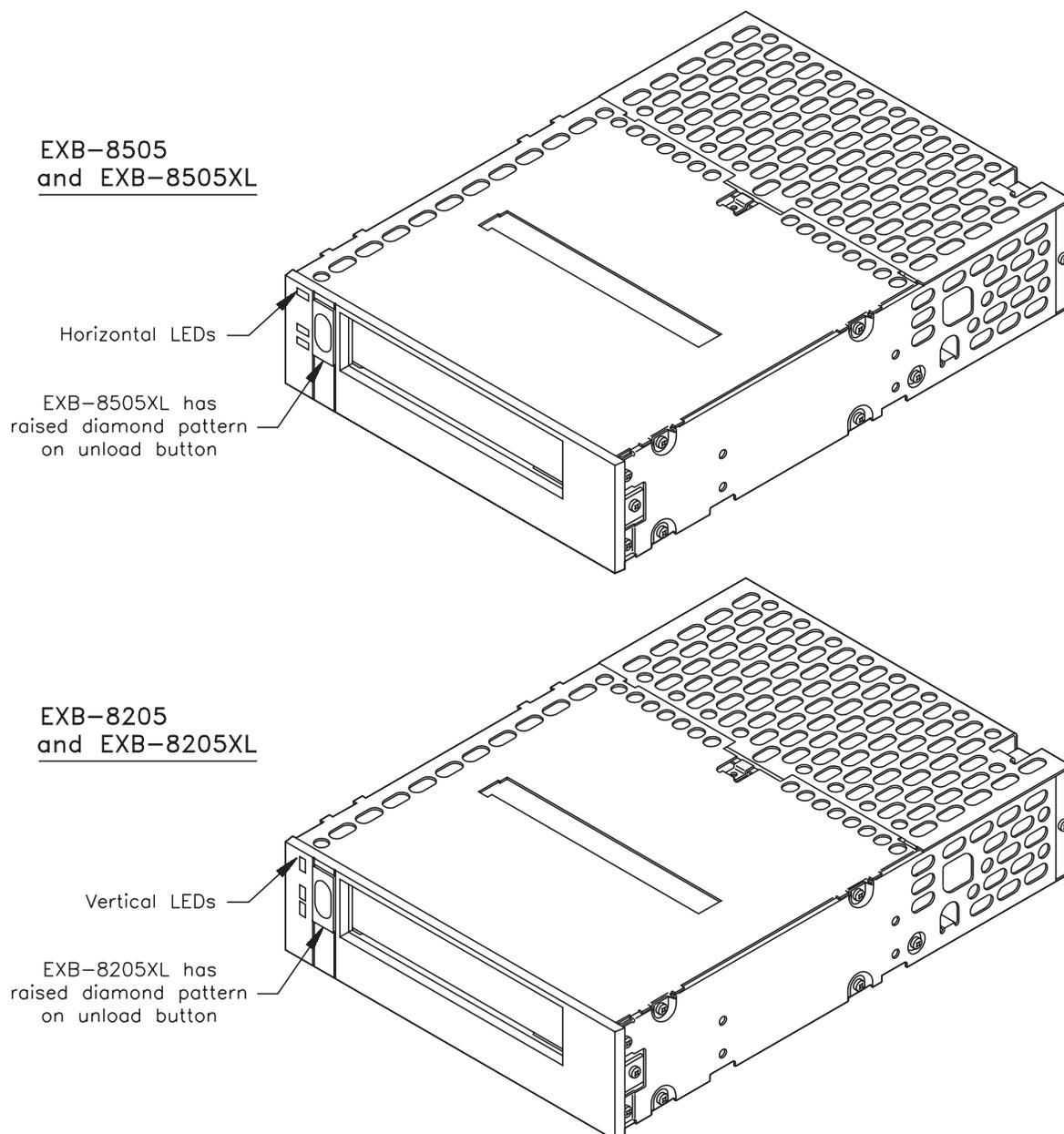


Figure 1-1 Comparison of the four tape drives

The EXB-8205XL and EXB-8505XL are fully compatible with the EXB-8205 and EXB-8505; each extended length tape drive supports all of the tape sizes and data formats supported by the corresponding standard tape drive. You can distinguish an extended length tape drive from a standard tape drive by checking the unload button. The extended length tape drives have a raised diamond pattern on the unload button.

Table 1-1 compares the features of the tape drives.

Table 1-1 Comparison of tape drive features

	EXB-8505 and EXB-8505XL	EXB-8205 and EXB-8205XL
Form factor	Half-high 5.25 inches	
Data formats supported	8200, 8200c, 8500, 8500c	8200, 8200c
Buffer size	1.0 MByte	
Data transfer rate*	1.0 MByte per second	500 KBytes per second
Search speed	75X normal (8500c, 8500, and 8200c formats) 10X normal (8200 format)	75X normal (8200c format) 10X normal (8200 format)
Synchronous data transfer	yes	
Time-to-clean LED indication	yes	
Compression	yes	

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

Read/Write Compatibility with Other Tape Drives

The EXB-8205, EXB-8205XL, EXB-8505, and EXB-8505XL can read data cartridges written by other Exabyte 8mm tape drives, including the EXB-8200, the EXB-8200SX, the EXB-8500, and the EXB-8500c. They can also write on data cartridges that are intended for use with these other tape drives.

Supported Formats

The EXB-8505 and EXB-8505XL read and write data in four logical formats:

- 8200
- 8200c (compressed)
- 8500
- 8500c (compressed)

The EXB-8205 and EXB-8205XL read and write data in two logical formats:

- 8200
- 8200c (compressed)

Table 1-2 shows the read and write compatibility of the four logical data formats with the tape drives. Table 1-3 compares these data formats.

Table 1-2 Read/write compatibility of Exabyte 8mm tape drives

A tape written in this format...	Can be read and written by an ...			
	EXB-8205	EXB-8205 XL	EXB-8505	EXB-8505 XL
8200	✓	✓	✓	✓
8200c	✓	✓	✓	✓
8500			✓	✓
8500c			✓	✓

Table 1-3 Data format features

	8200 format	8200c format*	8500 format (EXB-8505 and EXB-8505XL)	8500c format* (EXB-8505 and EXB-8505XL)
Maximum sustained data transfer rate	262 KBytes/sec	500 KBytes/sec		1.0 MByte/sec
Maximum capacity on 112m tape	2.5 GBytes	5.0 GBytes		10.0 GBytes
Maximum capacity on 160m XL tape (XL configurations only)	3.5 GBytes	7.0 GBytes		14.0 GBytes
Track structure	Helical scan: One write head writes a single data track with a -10° azimuth.		Helical scan: Two write heads write two overlapping data tracks. Track 1 = $+20^\circ$ azimuth. Track 2 = -10° azimuth.	
Supports partitions	no			yes
Supports setmarks	no			yes
Long filemarks	270 tracks (2,160 KBytes)		6 tracks (48 KBytes)	
Short filemarks	23 tracks (184 KBytes)	one 1-KByte physical block		
Setmarks	no			yes—6 tracks (48 KBytes)
EOD mark	no	yes—849 tracks	yes—602 tracks	
Search fields	no	yes		
Logical block packing	no	yes		

*Assumes a data compression ratio of 2:1.

Determining the Tape Format

When writing data to tape, the tape drive does one of the following:

- If the tape is positioned at the logical beginning of tape (LBOT), the tape drive writes data in the default format or whatever format you select with the SCSI MODE SELECT (15h) command. (The tape drive allows only one format on any one tape.)
- 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.

When reading a data cartridge, the tape drive automatically determines the tape's format.

Data Compression

When the tape drive compresses data, it uses the established Improved Data Recording Capability (IDRC) algorithm. Licensed from IBM, this algorithm is the *de facto* standard in mainframe environments. The tape drives also use the Exabyte Compression Integrity Check™ feature to ensure that data is accurately compressed and decompressed into the original form sent by the initiator.

The compression algorithm is completely contained in an Exabyte proprietary integrated circuit. The tape drive invokes the compression algorithm intelligently, constantly monitoring the compression ratio to determine whether compressing the data will actually decrease the size of the data set. The tape drive sends compressed data to tape only when it benefits the user's storage capacity and throughput.

Although the actual data compression ratio depends on the type of data, the EXB-8205, EXB-8205XL, EXB-8505, and EXB-8505XL achieve an average compression ratio of 2:1.

For detailed information about how the tape drives compress data, see Chapter 3.

Custom EEPROM Options

When the tape drive is manufactured, a number of operating features and default values are programmed in the electronically erasable programmable read-only memory (EEPROM). These operating features and default values, called *EEPROM options*, include such items as MODE SELECT power-on default values, command set options, hardware operation options, and SCSI configuration options.

When you order a tape drive, you can contact an Exabyte account manager to select which, if any, EEPROM settings you want to change from their standard settings. Using this information, Exabyte can create a customized EEPROM image that meets your integration and application development needs. Once your designated EEPROM structure is released, each tape drive you purchase will be factory-configured to your specifications.

Note: You can use the CTS Monitor program to change some of the tape drive's EEPROM option settings. For more information about these options, refer to the documentation for the CTS Monitor program.

Storage Capacity

Table 1-4 lists the approximate storage capacities of 8mm data cartridges written in the four logical formats. For more information on EXATAPE 8mm data cartridges, see page 1-20.

Table 1-4 Approximate capacities of EXATAPE data cartridges

Length of EXATAPE	Approximate Capacity to LEOT ^a in MBytes			
	8500c compressed format ^b (EXB-8505 and EXB-8505XL)	8500 format (EXB-8505 and EXB-8505XL)	8200c compressed format ^b	8200 format
15m	1,176	588	588	294
54m	4,697	2,348	2,348	1,174
112m	9,888	4,944	4,698	2,349
160m XL ^c	14,000	7,000	7,000	3,500

^a Logical end of tape.

^b These columns assume an average compression ratio of 2:1 (on average, each compressed 1,024-byte physical block represents 2,048 bytes of user data).

^c EXATAPE 160m XL extended length media is compatible with the EXB-8205XL and EXB-8505XL only.

Physical Description

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

- External features
- Size and weight
- Internal components

Front Panel Controls and Indicators

Figure 1-2 shows the controls and indicators on the front panel of the tape drive.

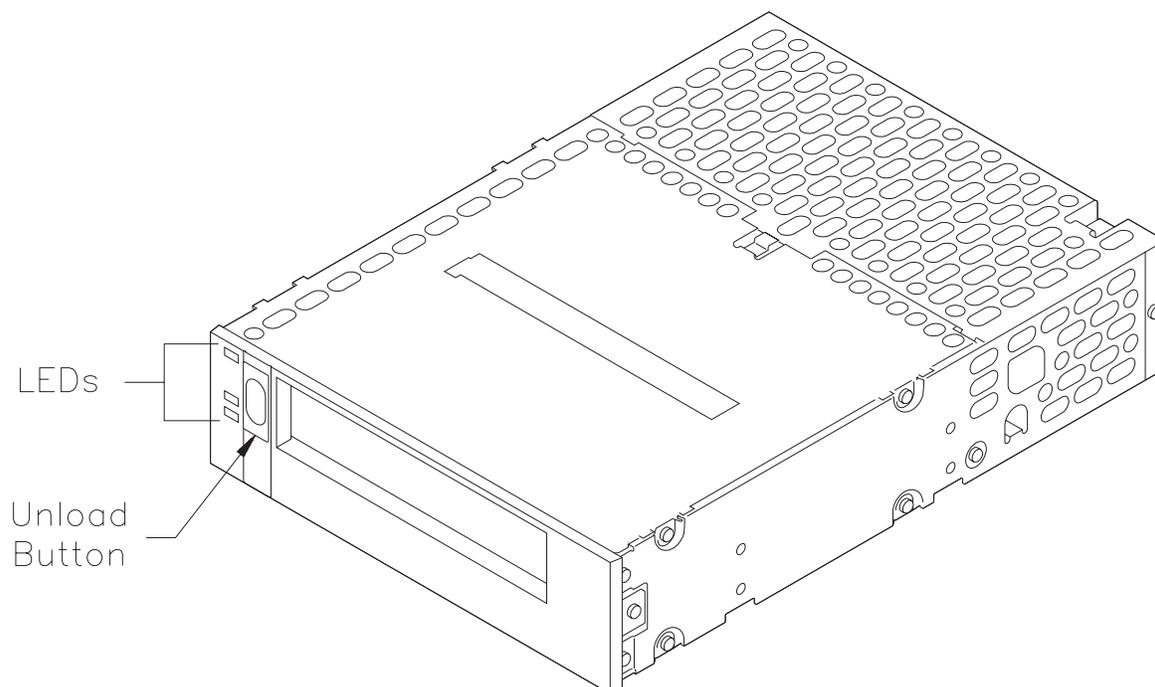


Figure 1-2 Front panel

Door and Bezel

Standard colors for the door and bezel include black, pearl white, pebble gray, platinum, and gray. Exabyte can provide custom colors at an additional cost. (Contact your account manager for more information.)

Unload Button

The unload button is the only operator control on the tape drive. Pushing this button starts the unload procedure. On the EXB-8205 and EXB-8505, the unload button is smooth and has an oval-shaped indentation. On the EXB-8205XL and EXB-8505XL, the unload button has a diamond texture.

See Chapter 4 for more information about loading and unloading cartridges.

LEDs

The tape drive contains three LEDs on the front panel. Various combinations of these LEDs (either on, off, or flashing) indicate the status of the tape drive operations. See Chapter 4 for more information about the LED functions.

Labels

All Exabyte products are required to include standard process, configuration, and agency labels. Figure 1-3 shows the location and content of these labels on the top cover of the tape drive.

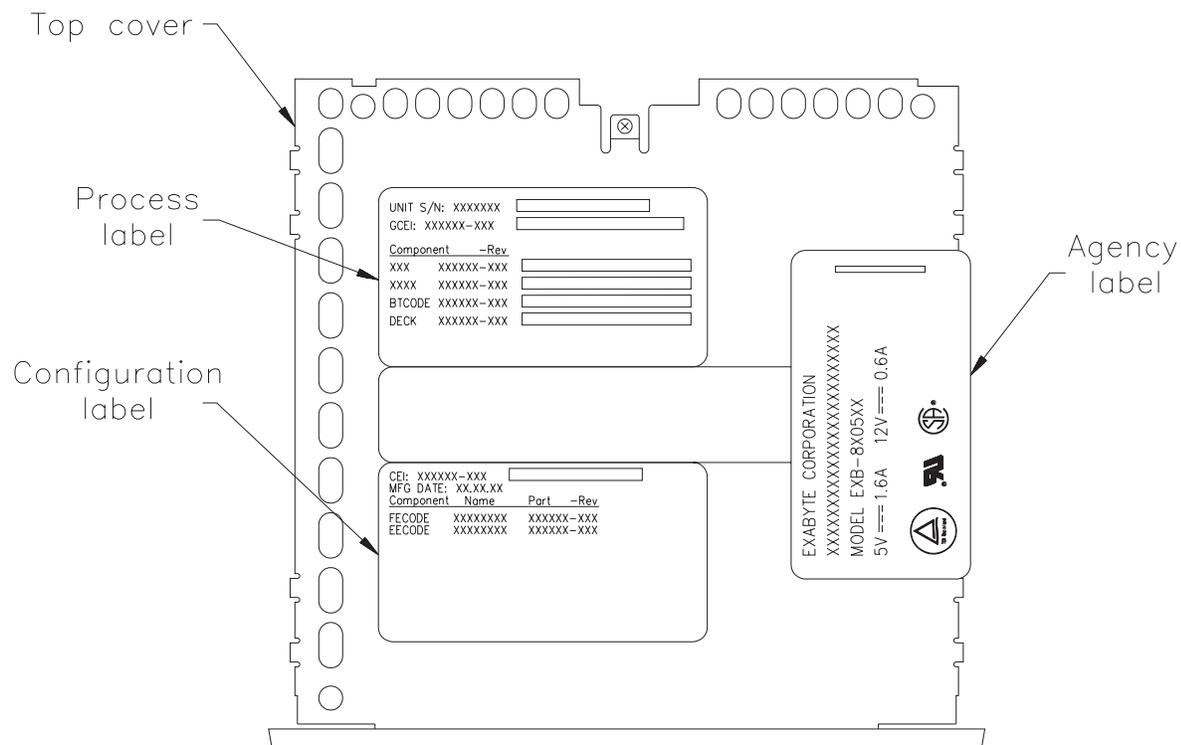


Figure 1-3 Label location and content

Back Panel Components

Figure 1-4 shows the back panel of a single-ended tape drive. The differential tape drives look similar except that there are no SCSI terminator R-packs (resistor terminators).

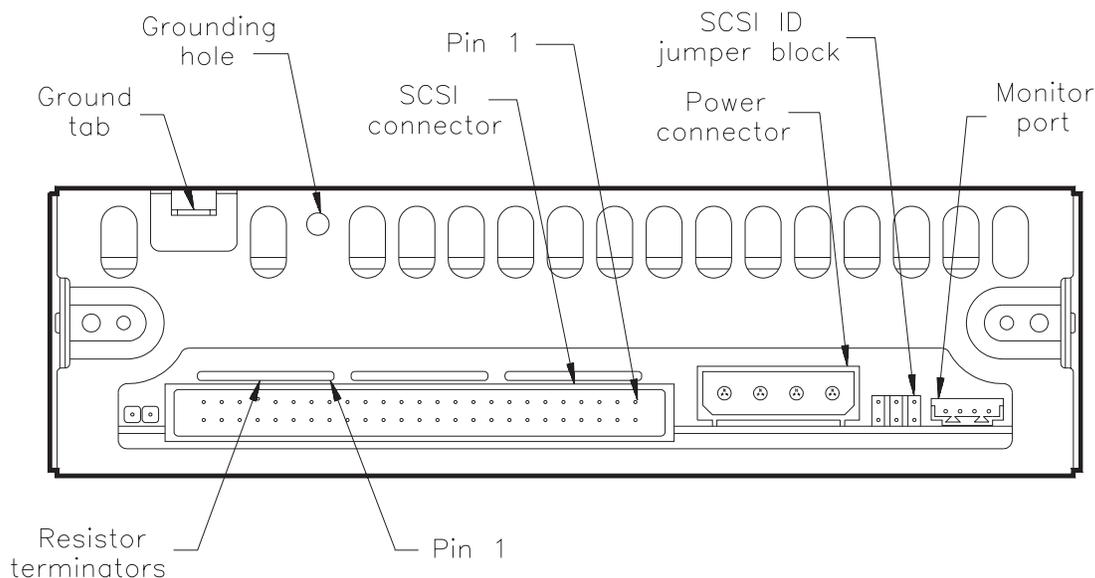


Figure 1-4 Back panel (single-ended configuration)

Ground Tab and Grounding Hole

The tape drive includes a ground tab and grounding hole to use if you want additional chassis grounding. See Chapter 6 for more information.

SCSI Connector

The 50-pin SCSI connector on the tape drive allows you to connect the tape drive to the SCSI bus. Pin 1 is the first pin on the right side of the top row.

See Chapter 5 for more information about connecting the tape drive to the SCSI bus.

Power Connector

The 4-pin power connector on the tape drive is compatible with the power connector used for standard 5.25-inch half-high devices. See Chapter 6 for more information.

SCSI ID Jumper Block

The SCSI ID jumper block on the tape drive enables you to set the SCSI ID either by using a remote switch or by installing jumpers. See Chapter 4 for more information about setting the SCSI ID.

Monitor Port

Using the Monitor port, you can change some of the tape drive's configuration options, download code updates, and perform diagnostic procedures on the tape drive.

To use the Monitor port, you will need the Exabyte CTS Monitor program and an IBM AT[®], XT[™], or compatible system with a serial port.

If your tape drive has a 3-pin Monitor port, you will need the following cables and connectors:

- A 3-pin to RJ-11 modular phone plug cable (Exabyte part number 303772)
- An RJ-11 to 9-pin level shifter (Exabyte part number 301001)
- A 9-pin to 25-pin adapter cable (if your computer system has a 25-pin serial port)

If your tape drive has a 4-pin Monitor port, you will need the following cables and connectors:

- A 4-pin to 25-pin connector cable (Exabyte part number 727005)
- A 25-pin to 9-pin adapter cable (if your computer system has a 9-pin serial port)

Resistor Terminators (single-ended configuration only)

The single-ended configuration of the EXB-8205 or EXB-8505 includes three single inline package (SIP) resistor terminators (R-packs) that you can use if the tape drive is the terminating device for the SCSI bus. You can remove these terminators if the tape drive does not terminate the bus or if you want to use external terminators. The first pin is on the right end of the terminator.

Note: The differential configuration of the tape drive does not include internal terminators and must be terminated externally.

Internal Components of the Tape Drive

This section describes the internal components of the tape drive, including the tape transport mechanism, the rotating drum assembly, and each of the four main cards.

Figure 1-5 shows the internal components of the EXB-8505 and EXB-8505XL. The EXB-8205 and EXB-8205XL have a VUA card instead of the SUA card shown below.

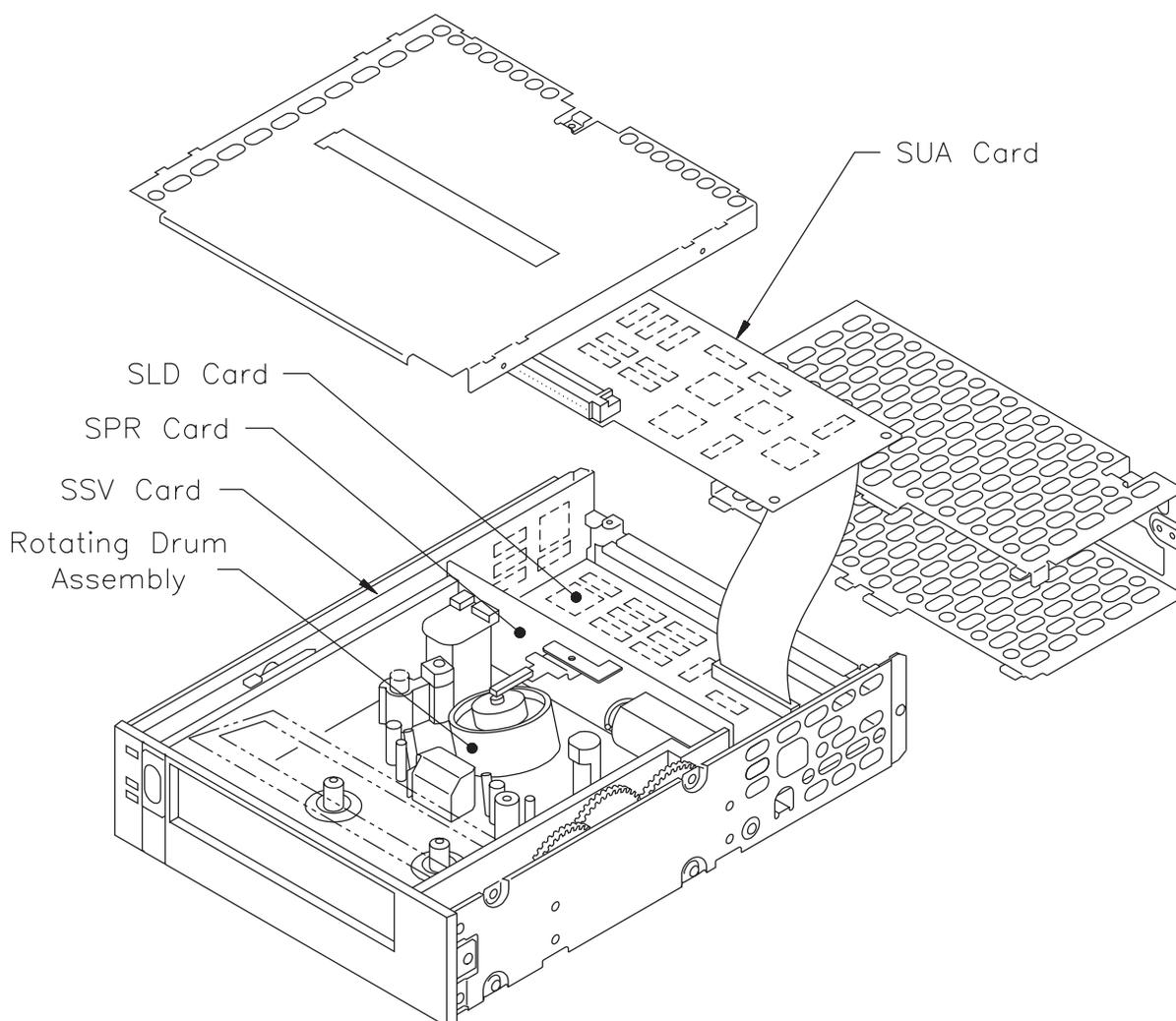


Figure 1-5 Internal components (EXB-8505 shown)

Tape Transport Mechanism

The 8mm tape transport mechanism is manufactured by Sony to Exabyte specifications. It is compatible with 8mm data cartridges that meet the ECMA-145 standard.

Rotating Drum Assembly

The rotating drum assembly in the EXB-8205 and EXB-8205XL has one write head, one read head, and one servo head. The rotating drum assembly in the EXB-8505 and EXB-8505XL 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 on the EXB-8505 and EXB-8505XL drum assembly.

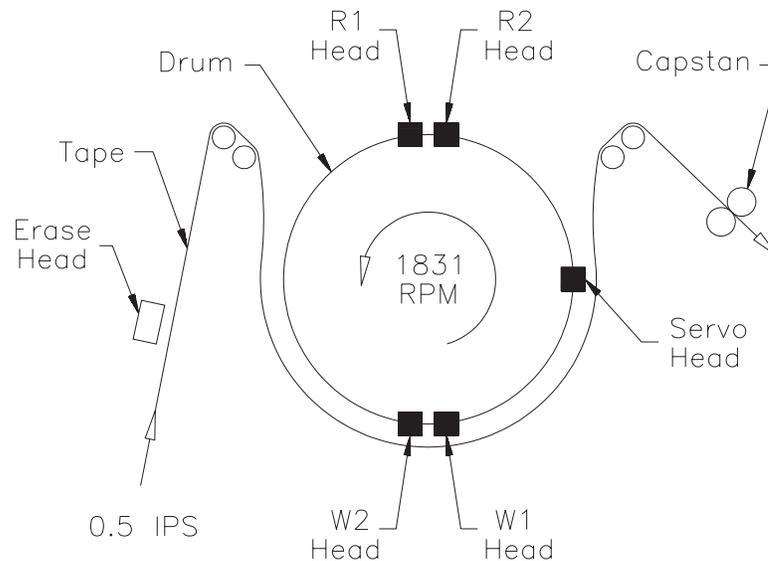


Figure 1-6 Location of the read heads and write heads (EXB-8505)

In the EXB-8505 and EXB-8505XL, 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.

The drum rotates constantly at 1831 rpm in the default format (8500c format for the EXB-8505 and EXB-8505XL; 8200c format for the EXB-8205 and EXB-8205XL). This speed of rotation results in a nominal effective head-to-tape speed of approximately 150.5 inches per second (3.8 meters per second). Approximate tape movement is 0.5 inches per second (11.1 millimeters per second). Forces acting on the tape and various component mechanisms are correspondingly low, resulting in long life for both the media and tape transport mechanism.

Note: In 8200 format, the drum rotates at 1923 rpm.

Servo Card (SSV)

The Servo (SSV) card contains the tape drive's servo circuits, including two digital LSIs and one analog LSI, a dedicated 6303-compatible microprocessor, and a 64-KByte FEPRM.

The Servo card controls all the mechanics of the tape drive, such as the following:

- Tape transport mechanism
- Adjustment of tape velocity based on track-embedded servo information
- Drum, reel, and capstan servos
- Circuits that control the reel motor, the load motor, the drum and capstan motors, and the front load motor
- Sensor interface circuits for the drum, reel, 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

Preamp and Upper Analog Cards

A Preamp card (SPR card) contains preamplifier, motor, and write driver circuitry.

The Upper Analog card (SUA card in the EXB-8505 and EXB-8505XL; VUA card in the EXB-8205 and EXB-8205XL) contains analog filters, equalization, and clock-detect circuitry.

Together, the preamp and upper analog cards comprise the 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.

Lower Digital (SLD) Card

The Lower Digital (SLD) card contains the data processor, error correction code, buffer memory, and control circuitry. The tape drive's data buffer includes 1 MByte of dynamic random access memory (DRAM).

The SLD card controls communication between the tape drive and the SCSI bus, and can be either of the following:

- SLDS (single-ended SCSI)
- SLDD (differential SCSI)

The SLD card contains a 8051-compatible microprocessor, which implements the controller function. The controller function includes the following activities:

- 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-megabyte buffer

Size and Weight

Designed to meet industry-standard 5.25-inch half-high form factor mounting requirements, the tape drive is 1.62 inches high \times 5.75 inches wide \times 8.00 inches deep (41.2 \times 146.0 \times 203.2 mm) and weigh 2.6 pounds (1.2 kilograms). Figure 1-7 shows the external dimensions of the tape drive.

For information about mounting requirements, see Chapter 4.

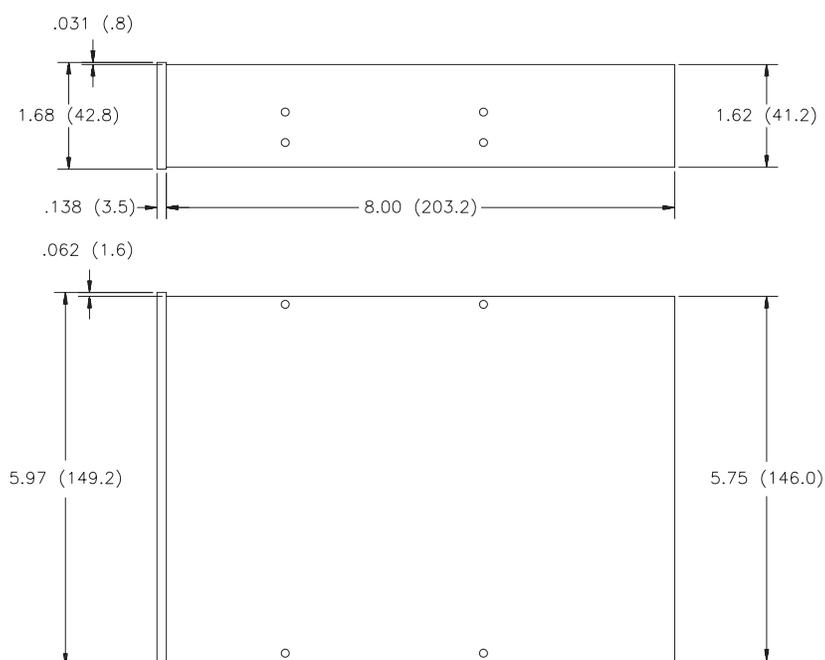


Figure 1-7 External dimensions in inches (and millimeters)

Related Products

This section describes products related to the tape drives.

Integration with Other Exabyte Products

You can purchase the tape drive separately or already integrated with one of the following Exabyte products:

- EXB-210 8mm Library
- Mini Tabletop Cartridge Tape Subsystem

EXB-210 8mm Library

The EXB-210 is an 8mm data cartridge library that contains one or two half-high 8mm tape drives, a ten-cartridge magazine, one fixed cartridge slot, and a robotic handler. The robotic handler moves the 8mm cartridges between the cartridge storage locations and the tape drives, greatly reducing the need for manual intervention.

Figure 1-8 shows vertical (stand-alone) and horizontal (rack-mount) models of the EXB-210.

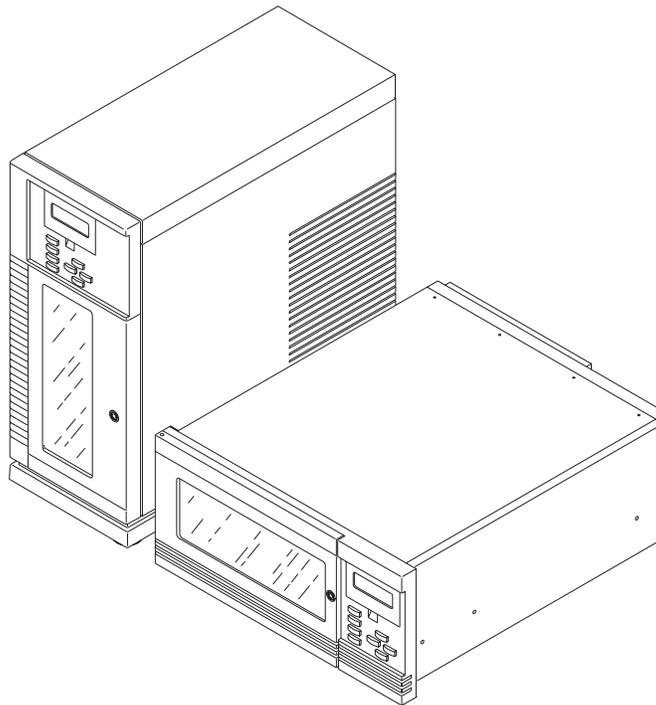


Figure 1-8 EXB-210 8mm Library

Designed as an easily integrated data management solution, the EXB-210 provides automated data storage in a SCSI-2 environment. Operating with an EXB-8505XL and assuming a data compression ratio of 2:1, the EXB-210 can store up to 154 GBytes on eleven 160m XL data cartridges.

For more information about the EXB-210, refer to the *EXB-210 8mm Library Product Specification*.

Mini Tabletop Cartridge Tape Subsystem

The Mini Tabletop Cartridge Tape Subsystem (Mini Tabletop CTS) is an 8mm tape drive enclosure, which includes a power supply, thermistor-controlled fan, SCSI connectors, and Monitor port.

Figure 1-9 shows vertical, horizontal, front, and back views of the Mini Tabletop CTS.

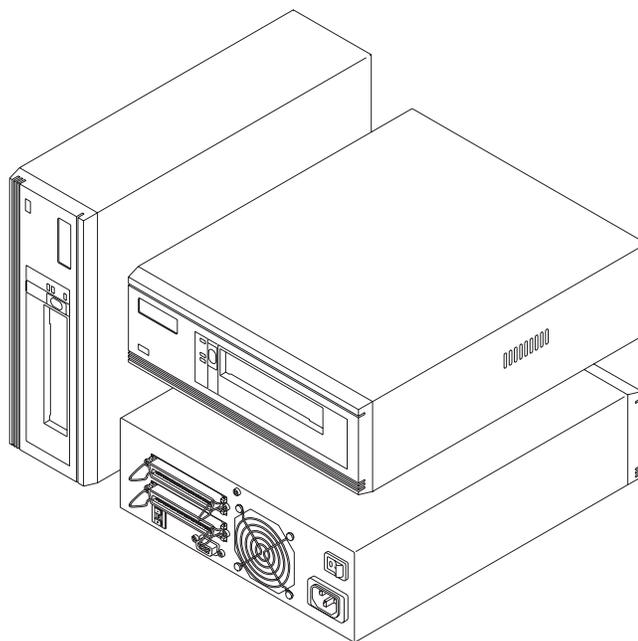


Figure 1-9 Mini Tabletop CTSs with EXB-8505s installed

The Mini Tabletop CTS is lightweight and completely enclosed. It has an internal, self-switching universal power supply, which allows continuous operation during limited power interruptions or surges. The Mini Tabletop CTS also offers maximum EMI/RFI shielding.

A remote SCSI ID switch and two SCSI connectors on the enclosure provide multiple options in a daisy-chained environment.

For more information about the Mini Tabletop CTS, refer to the *Mini Tabletop Cartridge Tape Subsystem Product Specification*.

EXATAPE™ Data Cartridges

The tape drives use data-quality removable, rewriteable 8mm metal-particle 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 products, including the EXB-8205, EXB-8205XL, EXB-8505, and EXB-8505XL. EXATAPE media meets specifications that are the most stringent in the industry.

Unlike media available from other manufacturers, EXATAPE media is specifically controlled for use in a data storage environment and offers reliability, extended durability, and long-term archivability. In addition, exclusive use of EXATAPE media with Exabyte 8mm tape drives has been shown to prolong head and tape life.

Table 1-5 shows EXATAPE data cartridge compatibility with Exabyte half-high and full-high drives.

Table 1-5 EXATAPE media compatibility with 8mm tape drives

EXATAPE Length	Thickness	Compatible 8mm Tape Drives			
		EXB-8200 and EXB-8200SX	EXB-8500 and EXB-8500c	EXB-8205 and EXB-8505	EXB-8205XL and EXB-8505XL
15m	13 μm	✓	✓	✓	✓
54m	13 μm	✓	✓	✓	✓
112m	10 μm	✓	✓	✓	✓
160m XL	7.7 μm	Do not use	Do not use	Automatically ejects	✓

► **Important** EXATAPE 160m XL media is compatible with the EXB-8205XL and EXB-8505XL only. The EXB-8205 and EXB-8505 will automatically eject these data cartridges.

Although Exabyte full-high 8mm tape drives will accept EXATAPE 160m XL data cartridges, they are not compatible and should not be used together.

EXATAPE 160m XL data cartridges offer the same reliability and performance as all other EXATAPE data cartridges.

All EXATAPE 160m XL data cartridges contain a single Recognition System stripe located on the tape leader for media identification. The EXB-8205XL and EXB-8505XL are capable of detecting this stripe, which they use to distinguish data-quality metal-particle media, such as EXATAPE, from other 160m media.

To maintain data integrity, the EXB-8205XL and EXB-8505XL automatically eject 160m data cartridges or equivalent length video cartridges that are not equipped with the Recognition System stripe. By rejecting potentially inferior media, the extended length tape drives ensure greater data reliability and protect the read and write heads from unnecessary wear.

Exabyte Cleaning Cartridges

Use an Exabyte 8mm Cleaning Cartridge to clean the tape drive. The Exabyte 8mm Cleaning Cartridge contains a shed-free fabric tape that traps and removes debris from tape drive heads and tape paths. By using this cleaning cartridge on a regular basis, you maintain data integrity and improve reliability of the tape drive.

Exabyte 8mm Cleaning Cartridges come in two sizes: 3c and 12c. Used in a half-high tape drive, the 3c cartridge offers up to 9 cleaning passes, and the 12c cartridge can offer as many as 36 cleaning passes. Details on the cleaning intervals are given in Chapter 4.

Note: If you are using these cleaning cartridges with Exabyte full-high 8mm tape drives, you will get fewer cleaning passes per cartridge. Because full-high tape drives have a longer tape path, more material is required for each cleaning.

CAUTION

The Exabyte 8mm Cleaning Cartridge (or an Exabyte-approved cleaning cartridge) is the only authorized method for cleaning the tape drive. Other 8mm cleaning kits can leave fragments in the tape path or on the heads. If you use any other type of cleaning material, you will void the tape drive warranty.

2

Recording Format

This chapter describes the recording formats used by the EXB-8205, EXB-8205XL, EXB-8505, and EXB-8505XL. It includes information about the following:

- Helical-scan recording
- Physical format of the recorded tape
- Logical format of the recorded tape

Helical-Scan Recording

To increase the amount of data that can be recorded on the tape, the tape drive implements advanced helical-scan recording technology. Helical-scan recorders write very narrow tracks at an acute angle to the edge of the tape, as shown in Figure 2-1. This recording method creates a track length that is several times longer than the width of the tape. Tracks can be accurately positioned by the geometry of the tape path to precise minimal tolerances, resulting in a very high number of tracks per inch.

The combination of the helical wrap of the tape around the drum, the rotation of the head/drum assembly, and the linear motion of the tape causes the heads to trace a track across the tape that is 2.47 inches (62.7 millimeters) long, at an acute angle of approximately 5 degrees to the bottom edge of the tape.

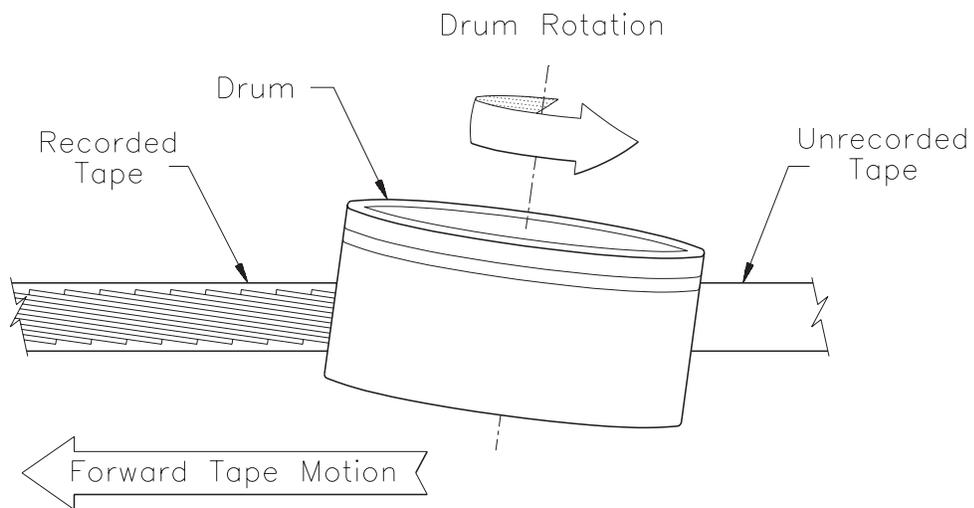


Figure 2-1 Helical-scan recording

Physical Format

This section defines the physical track structure of the tape, including the types of physical track structures, physical blocks, search fields, and servo areas.

Physical Track Structure

The EXB-8205 and EXB-8205XL can write data to tape in two types of physical track structures: 8200 and 8200c. The EXB-8505 and EXB-8505XL can write data to tape in three types of physical track structures: 8500/8500c, 8200c, and 8200. These track structures are described below. Figure 2-2 shows the relationship between the three physical track structures and the four logical data formats.

- **In 8500/8500c track structure**, the tape drive writes two overlapping tracks to the tape for each revolution of the drum. Each track contains data blocks, servo areas (track 2 only), clock sync areas, and search fields. 8500/8500c track structure is also called *dual-azimuth track structure*.

Note: 8500 and 8500c physical track structures are identical. Using the compressed logical format (8500c), the EXB-8505 and EXB-8505XL compress data before storing it in physical blocks. Using the uncompressed logical format (8500), the tape drives do not compress data.

- **In 8200c track structure**, the tape drive writes a single track to the tape for each revolution of the drum. Like 8500/8500c tracks, each track contains data blocks, servo areas, clock sync areas, and search fields. 8200c track structure is also called *single-azimuth compressed track structure*.
- **In 8200 track structure**, the tape drive writes a single track to tape for each revolution of the drum. Each track contains data blocks and one servo area for accurate positioning of the tape. 8200 track structure is also called *single-azimuth uncompressed track structure*.

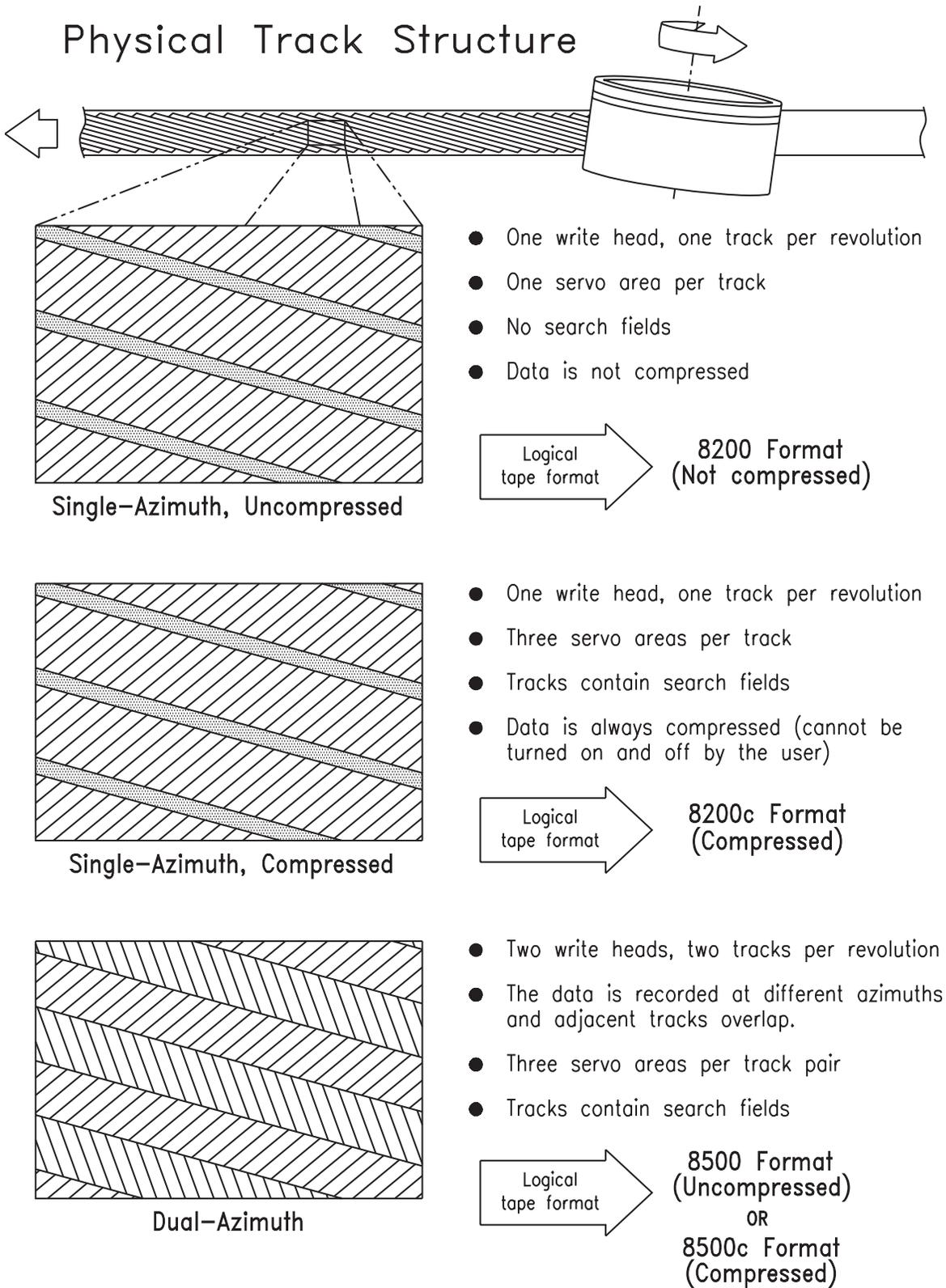


Figure 2-2 Relationship of 8mm physical track structures to logical data formats

8500/8500c Physical Track Structure

In 8500/8500c format, an EXB-8505 or EXB-8505XL uses the W1 and W2 heads to write two partially overlapping physical tracks on the tape for each revolution of its head/drum assembly. The width of each track is 15.5 μm . During a read operation, the tape drive uses the R1 and R2 heads to read the two tracks.

Figure 2-3 shows the physical track structure on a tape written in 8500 and 8500c format.

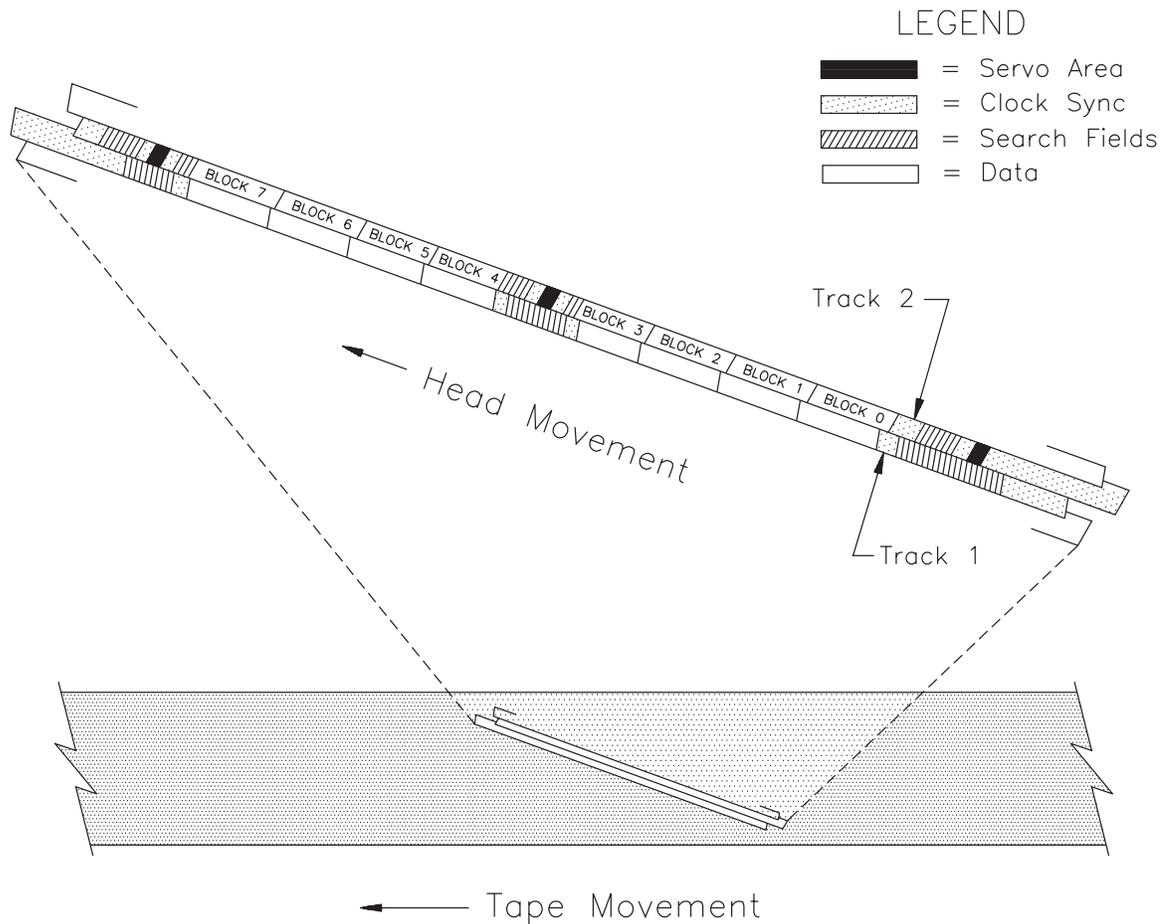


Figure 2-3 Physical track structure for 8500 and 8500c format

Figure 2-4 shows the position of the EXB-8505 and EXB-8505XL'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 and 8500c format tapes.

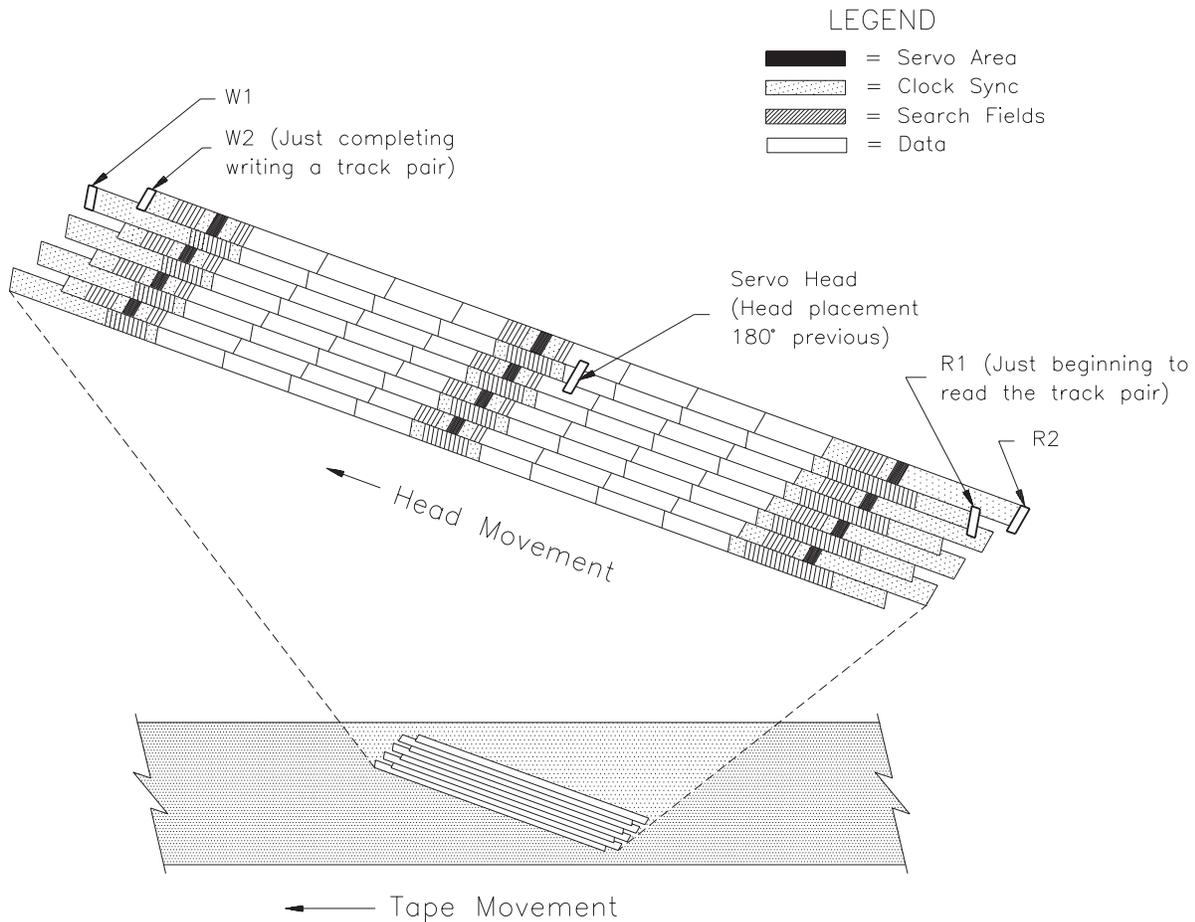


Figure 2-4 Position of the tape drive's heads relative to the tracks (8500/8500c format)

8200c and 8200 Physical Track Structure

In 8200c and 8200 formats, the tape drive writes one physical track on the tape for each revolution of the head/drum assembly. The width of the track is 25 μm . During a read operation, the tape drive reads a single track. The EXB-8505 and EXB-8505XL use the W2 write head and R2 read head for these operations.

Figure 2-5 shows the physical track structure on a tape written in 8200c format. Figure 2-6 shows the physical track structure on a tape written in 8200 format.

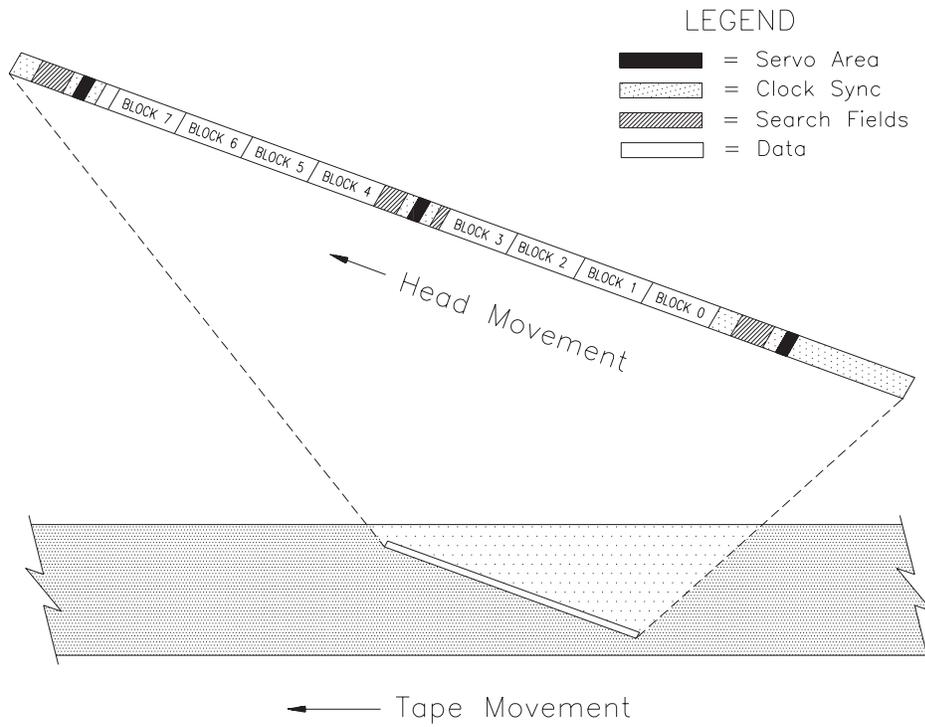


Figure 2-5 Physical track structure for 8200c track format

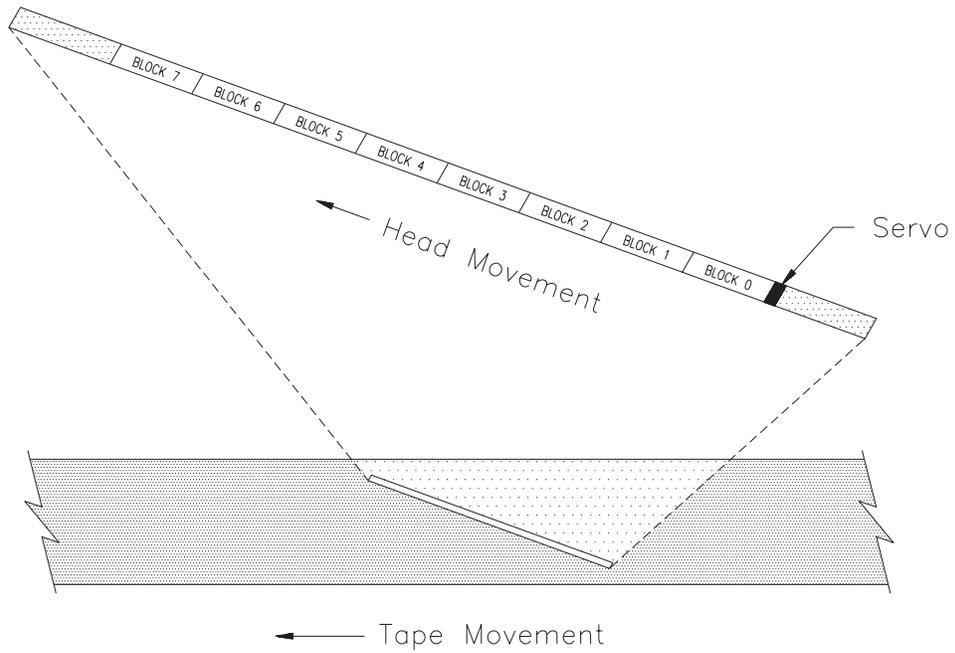


Figure 2-6 Physical track structure for 8200 track format

Figure 2-7 shows the position of the tape drive's write head, read head, and servo head relative to the tracks as the heads pass across the tape when the tape drive is reading and writing 8200c format tapes. (For the EXB-8505 and EXB-8505XL, the W2 write head and R2 read head positions are shown.)

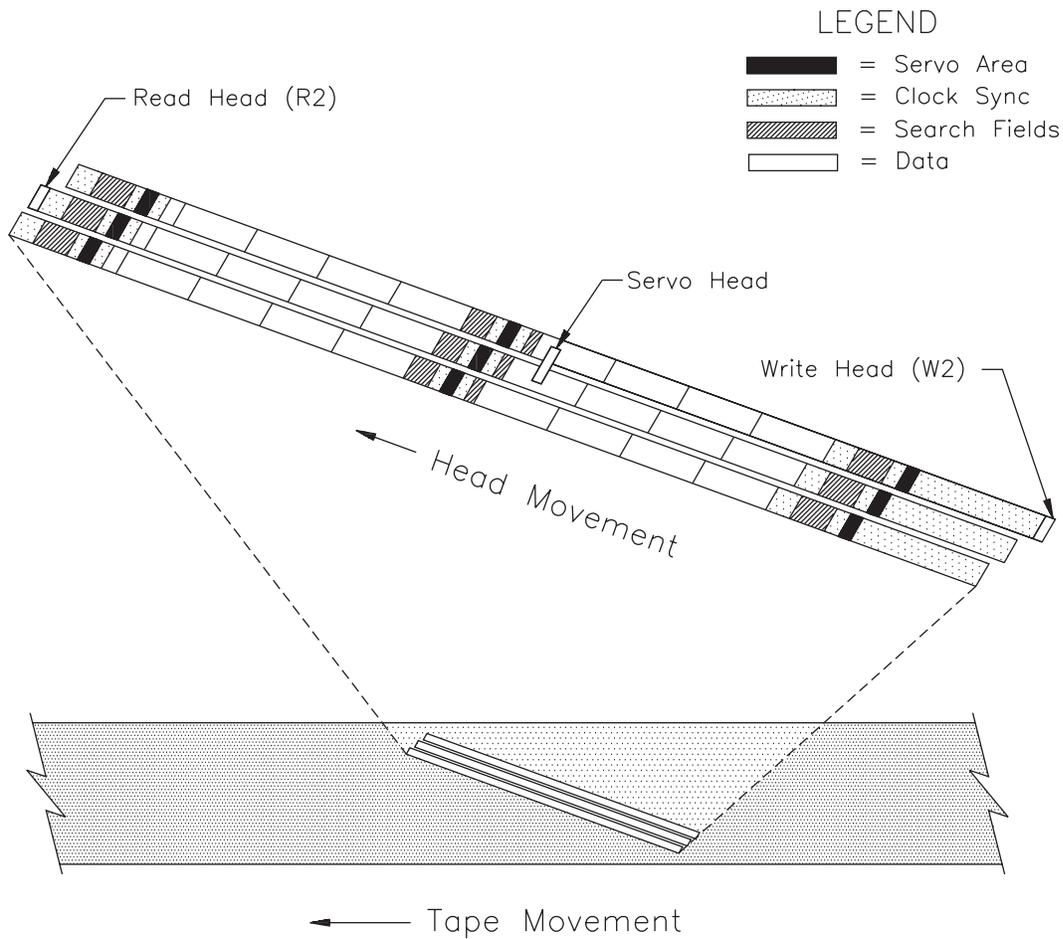


Figure 2-7 Position of the tape drive's heads relative to the tracks (8200c format)

Physical Blocks

For all three physical track formats, each physical track contains eight physical blocks. A physical block can contain user data or other information. As shown in Figure 2-8, a physical block containing user data includes the following information:

- 2 bytes of cyclic redundancy check (CRC) data
- 400 bytes of error correction code (ECC) data
- 1,024 bytes of uncompressed user data or 2,048 of compressed user data (assuming a 2:1 compression efficiency)
- 14 bytes of header information

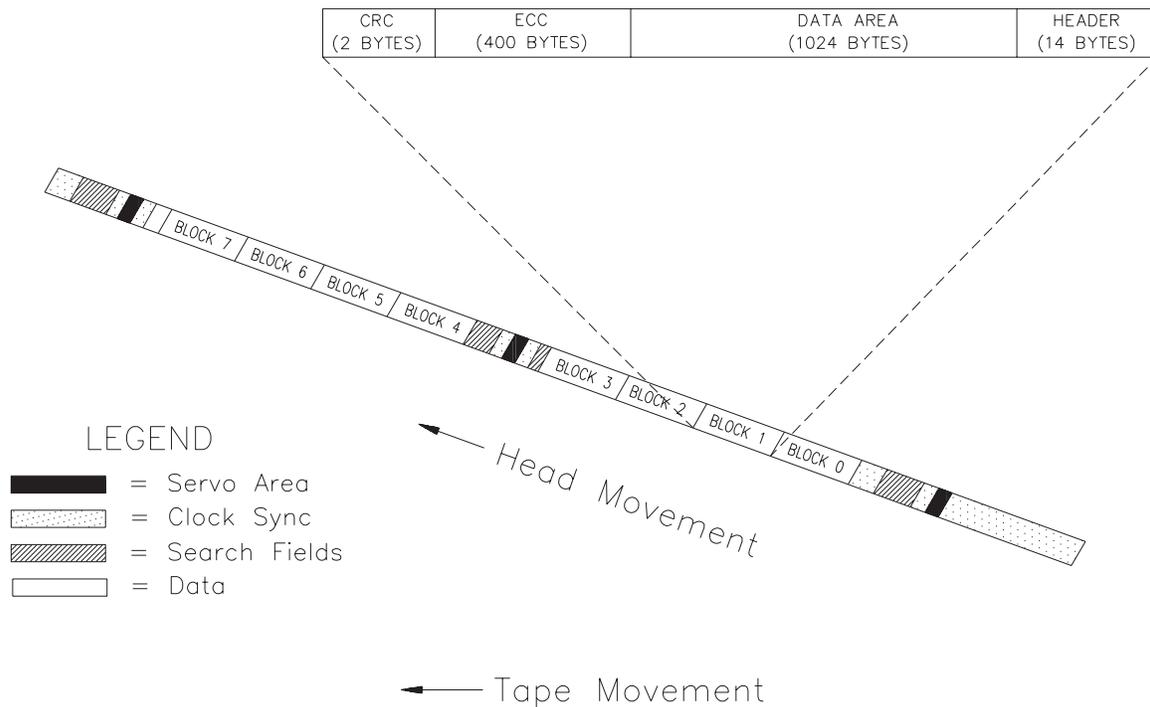


Figure 2-8 Physical block format for all logical formats (8200c or 8500/8500c physical track structure shown)

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

Search Fields

For 8500/8500c and 8200c track structures, each track contains *search fields* used for high-speed search. (Figure 2-8 shows where search fields are located in a track.) The search fields are the only areas of the tape that are read during a high-speed search. The search field data contains information for locating files and blocks and detecting the end-of-data (EOD) mark during high-speed searches.

Note: Tapes written in 8200 format are SCSI-1 compatible and do not contain search fields. For this reason, 8200 format tapes do not support high-speed search. In addition, the EXB-8205, EXB-8205XL, EXB-8505, and EXB-8505XL do not support the EXB-8200SX high-speed search feature.

Servo Areas

For all three physical track structures, each track contains *servo areas* that the tape drive uses to read tapes written by other tape drives. Each servo area contains a signal that the servo head detects and uses to control linear tape velocity. This track-following servo process results in accurate positioning of the track under the read head.

The servo scheme is based on the geometry of the track positions. Each servo area consists of one servo data signal burst surrounded by an erase (margin) signal. The tape drive places servo areas in the following locations, based on physical track format:

- In 8200 format, the tape drive places a servo area at the beginning of each track (as shown in Figure 2-6).
- In 8200c format, the tape drive places a servo area at the beginning, middle, and end of every track (as shown in Figure 2-7).
- In 8500/8500c format, the tape drive places a servo area at the beginning, middle, and end of every other track (as shown in Figure 2-4).

Note: Refer to the *EXB-8200 8mm Cartridge Tape Subsystem Product Specification* for information about track-following servo for 8200 format.

Recording Parameters

Table 2-1 shows the recording parameters for the EXB-8205, EXB-8205XL, EXB-8505, and EXB-8505XL. The table includes the parameters for tape drives writing and reading data in three physical formats.

Table 2-1 Recording parameters

Parameter	Tape drives reading and writing in this physical format:		
	8500/8500c ^a	8200c	8200
Tape width	8.00 mm (0.315 in)	8.00 mm (0.315 in)	8.00 mm (0.315 in)
Track length (data + servo)^b	62.651 mm (2.47 in.)	62.651 mm (2.47 in)	71.628 mm (2.82 in)
Tracks per revolution^c	2	1	1
Track pitch	15.5 μm (0.000610 in)	31.0 μm (0.001221 in)	31.0 μm (0.001221 in)
Track width	15.5 μm (0.000610 in)	25.0 μm (0.000984 in)	25.0 μm . (0.000984 in)
Track density	64.506 trk/mm (1638.455 trk/in)	32.253 trk/mm (819.226 trk/in)	32.254 trk/mm (819.253 trk/in)
Areal recording density	144.23 Mfc/mm ² (93.052 Mfc/in²)	72.115 Mfc/mm ² (46.526 Mfc/in²)	68.68 Mfc/mm ² (44.312 Mfc/in²)
Drum speed	1831.055 rpm	1831.055 rpm	1922.607 rpm
Tape speed	11.079 mm/sec (0.436 ips)	11.079 mm/sec (0.436 ips)	11.633 mm/sec (0.458 ips)
Track angle	4.9 degrees	4.9 degrees	4.9 degrees
Wrap angle	221 degrees	221 degrees	221 degrees

a EXB-8505 and EXB-8505XL only.

b In 8200c and 8500/8500c formats, servo information is embedded in three places along the length of the track.
In 8200 format, servo information is embedded at the beginning of the track.

c Tracks per revolution is the number of tracks written or read for each revolution of the rotating drum assembly.

Logical Format

The following sections describe the logical characteristics of the information recorded on the tape. The logical tape format consists of the logical beginning of tape (LBOT) mark, followed by any number of tracks up to the limit for the data cartridge. These tracks can include logical blocks of data, gap blocks and gap bytes, filemarks, setmarks, and end-of-data information.

Supported Logical Formats

The EXB-8205 and EXB-8205XL can write user data in the following logical tape formats:

- 8200c (compressed)
- 8200

The EXB-8505 and EXB-8505XL can write user data in any of the following logical tape formats:

- 8500c (compressed)
- 8500
- 8200c (compressed)
- 8200

See Figure 2-2 for information about the correspondence between logical tape formats and physical formats.

Logical Blocks

A *logical block* contains user data that is transferred from the host to the tape drive. 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 KBytes.

For information about setting the logical block size, refer to the *EXB-8205 and EXB-8505 SCSI Reference*.

Logical Block Compression

When writing data in 8500c and 8200c formats, the tape drive compresses logical blocks of user data before placing them in the physical blocks. Thus, each physical block contains a compressed representation of the original user data. Assuming that the compression algorithm allows user data to be compressed an average of two times, each physical block written by the tape drive in compressed format can contain, on average, the compressed equivalent of 2,048 bytes of user data.

Note: The actual compression ratio achieved by the tape drive in 8500c and 8200c formats depends on the type of data to be compressed.

For more information about compression, refer to Chapter 3.

Logical Block Packing

To optimize tape capacity when writing tapes in 8200c, 8500, or 8500c formats, the tape drive packs logical blocks of user data into physical blocks. Each 1,024-byte physical block on tape can contain multiple logical blocks (for example, two 512-byte uncompressed logical blocks can be written in one physical block). To prevent losing data capacity when small logical block sizes are used, the tape drive can begin writing a logical block in one physical block and end in a subsequent physical block.

Note: In 8200 format, logical blocks are not packed. Only one or part of one logical block can be written in each physical block.

Figure 2-9 shows three examples of how logical blocks can be written into one 1,024-byte physical block.

In 8200 format, each physical block contains one header and one logical block. In 8200c, 8500, and 8500c formats, 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.

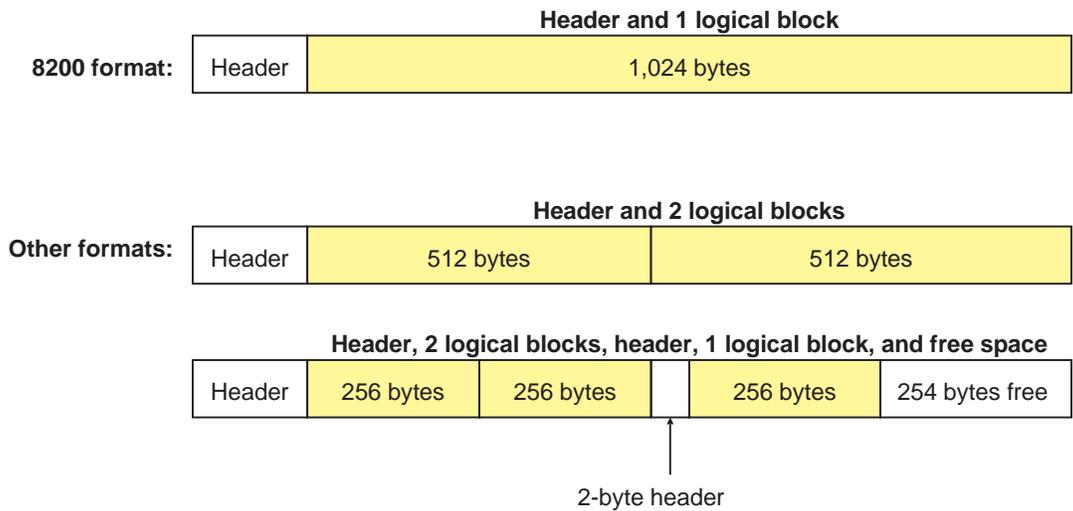


Figure 2-9 Logical block packing (one physical block)

Gap Bytes

A *gap byte* is a byte containing undefined data that the tape drive uses to fill empty space in a physical block. The tape drive may automatically write gap bytes in the following cases:

- At the end of a write operation.
- Before writing a filemark.
- Before writing a setmark (EXB-8505 or EXB-8505XL only).
- When it is physically impossible to start the next logical block in the physical block because less than three bytes are available. (This is because the two-byte header and at least one data byte must be present in the first physical block before the logical block can spill over to a second physical block.)

Figure 2-10 shows how gap bytes can be used to fill empty space at the end of a physical block. Gap bytes cannot be accessed by any SCSI command.

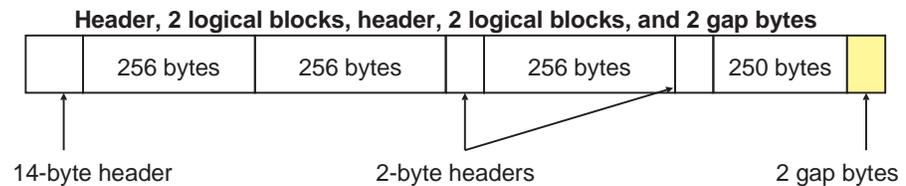


Figure 2-10 Gap bytes (one physical block)

Gap Blocks and Gap Tracks

A *gap block* is a physical block containing 1,024 gap bytes. A gap track is a physical track containing eight gap blocks. When the tape drive stops at the end of a write operation, it writes at least one gap track following the last track containing data blocks. In 8200 or 8200c format, the tape drive writes one gap track. In 8500 or 8500c format, it can write two gap tracks.

The gap track provides the track orientation required to append data. When a subsequent write operation begins, the controller repositions the tape and records the data on a track adjacent to the gap track.

Figure 2-11 shows two tracks, one with seven data blocks and one gap block, and one with a gap track. Gap blocks cannot be accessed by any SCSI command.

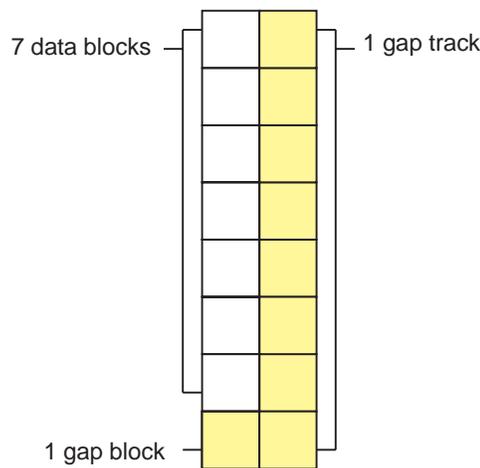


Figure 2-11 One gap block and one gap track in two physical tracks

Filemarks

Filemarks enable the initiator to locate particular blocks of data on the tape quickly during a high-speed search. By using a SPACE filemark (11h) command, the initiator can position the tape to the data marked by filemarks at up to 75 times the normal tape speed (or up to 10 times the normal tape speed when reading an 8200 format tape).

Depending on the format, the tape drive can write either a long or short filemark. Table 2-2 shows the type and size of filemarks for each format type.

Table 2-2 Type and size of filemarks for each format

Tape format	Type and size of filemarks	
	Long filemark (KBytes)	Short filemark (KBytes)
8500 or 8500c	48	1
8200	2,160	184
8200c	2,160	1

Long Filemarks

A long filemark in either 8500 or 8500c format consists of six tracks of information:

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

A long filemark in 8200c or 8200 format consists of the following:

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

The information in the filemark physical 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 blocks before the filemark to ensure that all data has been written to tape correctly or to complete tracks that are not completely filled with data blocks.

Short Filemarks

In 8500, 8500c, and 8200c formats, a short filemark consists of a single, 1-KByte physical block. This block contains information identifying the filemark's number and location on the tape.

In 8200 format, a short filemark consists of 21 tracks of information.

Setmarks (EXB-8505 and EXB-8505XL only)

When the EXB-8505 or EXB-8505XL is writing in 8500c format, you can issue a WRITE FILEMARKS (10h) command to write one or more setmarks to 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 KBytes long and consists of the following:

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

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

End of Data (EOD)

When writing tapes in 8500, 8500c, or 8200c format, the tape drive writes an end-of-data (EOD) mark after the last data written to tape. In 8500 and 8500c formats, the EOD mark consists of one or more gap tracks, erase gaps, and 600 tracks of end-of-data blocks. In 8200c format, the EOD mark consists of 249 erase gap tracks and 600 tracks of end-of-data blocks.

These tracks are used when the initiator issues a SPACE (11h) command to locate the last data written to tape. The tape drive overwrites the EOD mark when it writes additional data to tape.

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

Track and Block Counts

The number of tracks and physical blocks on the tape depend on the following markers:

- **Physical beginning of tape (PBOT).** PBOT is located at the point on the tape where the translucent leader material is attached to the media. This position is detected by an optical sensor in the tape transport mechanism.
- **Logical beginning of tape (LBOT).** When you issue a write operation at the beginning of tape, the tape drive automatically records LBOT at approximately 29 inches (74 cm) from PBOT. The LBOT area includes tracks of LBOT information, which are used to indicate the LBOT's location, to calibrate the servo system and to indicate whether the tape was written in uncompressed or compressed format. The data contained in the LBOT blocks cannot be altered or accessed by the user.
- **Logical end of tape (LEOT).** LEOT is determined by the number of recorded tracks that occur after LBOT. For this purpose, lengths of erased segments are converted into an equivalent number of tracks.
- **Physical end of tape (PEOT).** PEOT is located at the point on the tape where the translucent trailer material is attached to the media. This position is detected by an optical sensor in the tape transport mechanism.

The number of tracks between LBOT and LEOT depends on the type and length of tape. Table 2-3 and Table 2-4 list the following information for tapes written in various formats:

- The number of tracks and 1,024-byte physical blocks between LBOT and LEOT
- The approximate number of tracks and 1,024-byte physical blocks that occur between LEOT and PEOT

Table 2-3 Track and physical block counts for 8200 and 8200c formats

EXATAPE Size	LBOT to LEOT				LEOT to PEOT*			
	Number of tracks		Number of blocks		Number of tracks		Number of blocks	
	Hex	Decimal	Hex	Decimal	Hex	Decimal	Hex	Decimal
15m	8C44h	35,908	46220h	287,264	11A9h	4,521	8D48h	36,168
54m	22FF2h	143,346	117F90h	1,146,768	114Eh	4,430	8A70h	35,440
112m	46000h	286,720	230000h	2,293,760	45B0h	17,840	22D8h	142,720
160m XL	696F9h	431,865	34B7C8h	3,454,920	19B0h	6,576	CD84h	52,612

*Track and block counts from LEOT to PEOT are approximate.

Table 2-4 Track and physical block counts for 8500 and 8500c formats

EXATAPE Size	LBOT to LEOT				LEOT to PEOT*			
	Number of tracks		Number of blocks		Number of tracks		Number of blocks	
	Hex	Decimal	Hex	Decimal	Hex	Decimal	Hex	Decimal
15m	11888h	71,816	8C440h	574,528	954h	2,388	4AA0h	19,104
54m	45FE4h	286,692	22FF20h	2,293,536	229Eh	8,862	114F0h	70,896
112m	93568h	603,496	49AB40h	4,827,968	22A2h	8,866	11510h	70,928
160m XL	D2DF2h	863,730	696F90h	6,909,840	3361h	13,153	19B08h	105,224

*Track and block counts from LEOT to PEOT are approximate.

3

Functional Description

This chapter describes the functional features of the EXB-8205, EXB-8205XL, EXB-8505, and EXB-8505XL, including write and read operations.

Write Operations

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

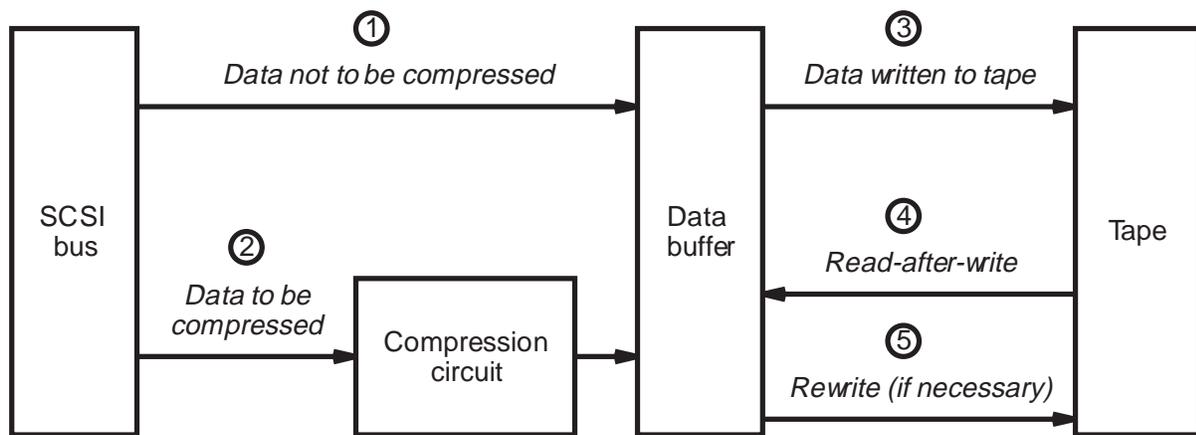


Figure 3-1 Data flow during a write operation

Data Flow and Data Compression

The data-flow process during a write operation is outlined below. (The steps below 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 (8200 or 8500) for the tape, the data goes directly from the SCSI bus to the tape drive's 1-MByte DRAM data buffer. (Data transfers between the SCSI bus and the buffer occur asynchronously or synchronously.)
- ② If you select compressed format (8200c or 8500c) for the tape, the tape drive looks at the currently active MODE SELECT parameters to see if data compression has been turned on.

Note: If you select 8200c format, data compression is always on; you cannot turn it off.

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 written to tape 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 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, $2 \div 1,024 \times 100\%$).

Data Compression Monitoring

The tape drive constantly monitors the compression ratio to determine whether compressing the data will actually decrease the size of the data set. When a logical block expands (as it might, for example, when it has already been compressed by the initiator), the tape drive automatically switches to uncompressed format. It remains in this format until it encounters a compressible logical block. Then, it switches back to the compressed format.

Streaming and Start/Stop Modes

The data buffer enables the tape drive to operate as either a streaming tape device or as a start/stop tape device. When the tape drive transfers data to the 1-MByte data buffer, the data buffer's formatter performs the following tasks:

- Formats logical user data blocks into physical blocks
- Appends tag, address, and index information to each data block

The mode of operation (streaming or start/stop) depends on the rate that data can be transferred between the initiator and the tape drive, as follows:

- **The tape drive operates in streaming mode** if the initiator can sustain a minimum of:
 - 1 MByte per second for 8500c format (EXB-8505 and EXB-8505XL only)
 - 500 Bytes per second for 8500 format (EXB-8505 and EXB-8505XL only)
 - 500 KBytes per second for 8200c format
 - 262.5 KBytes per second for 8200 format

Note: These values assume a 2:1 compression ratio for 8500c and 8200c formats.

- **The tape drive operates in start/stop mode** if the initiator cannot sustain these minimum transfer rates; starting and stopping occur automatically.

Thresholds During a Write Operation

In start/stop mode, the motion threshold controls the starting and stopping of tape motion. In streaming mode, the reconnect threshold controls the rate of disconnects and reconnects between the tape drive and the initiator. The values of both of these thresholds can be changed with a MODE SELECT command.

Motion Threshold

In a start/stop write operation, the initiator-to-buffer transfer speed is slower than the buffer-to-tape transfer speed. In this mode of operation, the motion threshold value represents the minimum amount of data that must be in the tape drive's 1-MByte DRAM data buffer before tape motion will start. When the initiator sends data to the tape drive, the tape drive waits until the buffer reaches the motion threshold to begin writing. Then it writes data to tape until the buffer is empty.

The buffer allows the tape drive to operate with fewer starts and stops, reducing wear on the tape and the tape drive.

Reconnect Threshold

In a streaming write operation, the initiator-to-buffer transfer rate is equal to or greater than the buffer-to-tape transfer rate. In this mode of operation, the tape drive writes data to tape continually. When the buffer becomes full, the tape drive disconnects from the initiator, and the initiator is free to perform other tasks.

For the tape drive to continue streaming, the initiator must begin sending data again before the buffer is empty. The reconnect threshold value represents the minimum amount of free space that must be in the tape drive's 1-MByte buffer before the tape drive will reconnect to the initiator to accept additional data. When the reconnect threshold value is exceeded, the tape drive reconnects to the initiator and data transfer resumes until the buffer is full.

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

Figure 3-2 provides a high-level overview of the tape drive's flow of data during a read operation.

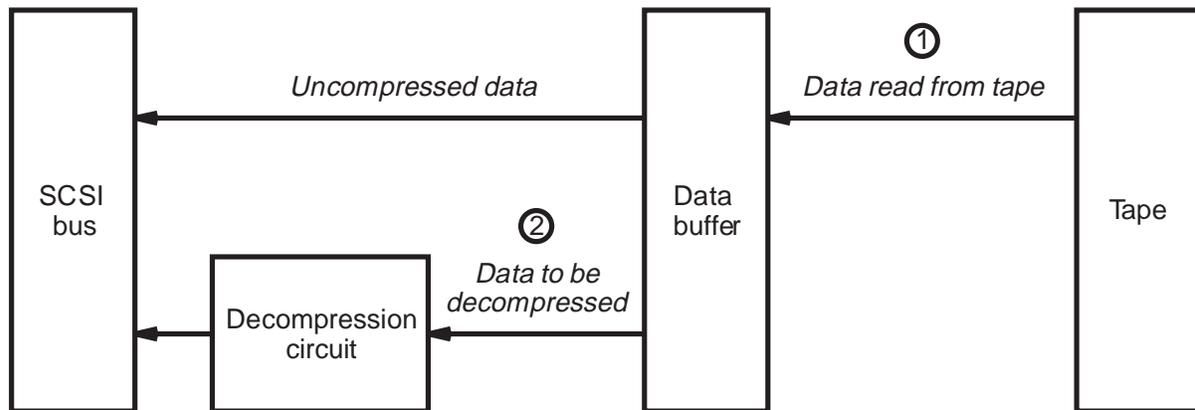


Figure 3-2 Data flow during a read operation

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, which was appended when the data was written, is again verified. This final integrity check assures that all block reconstruction and decompression was successful.

Thresholds During a Read Operation

The motion threshold controls the starting and stopping of tape motion. The reconnect threshold controls the rate of disconnects and reconnects between the tape drive and the initiator.

Motion Threshold

In a start/stop read operation, the tape-to-buffer transfer speed is faster than the buffer-to-initiator transfer speed. In this mode of operation, the motion threshold value represents the minimum amount of free space that must be in the tape drive's 1-MByte buffer before tape motion will start and data will be read from the tape to the buffer. The read-from-tape operation continues until the buffer is full and tape motion stops. Tape motion does not restart until the amount of free space in the buffer once again exceeds the motion threshold value.

Reconnect Threshold

In a streaming read operation, the tape-to-buffer transfer rate is equal to or less than the buffer-to-initiator transfer rate. In this mode of operation, the tape drive reads data from tape continually. When the buffer becomes empty, the tape drive disconnects from the initiator, and the initiator is free to perform other tasks.

For the tape drive to continue streaming, the initiator must begin to accept data again before the buffer is full. The reconnect threshold value represents the minimum amount of data that must be in the tape drive's 1-MByte buffer before the tape drive will reconnect to the initiator to transfer data from the buffer. When the reconnect threshold value is exceeded, the tape drive reconnects to the initiator and data transfer resumes. The data transfer to the initiator continues until the buffer is empty.

4

Requirements for Use

This chapter specifies the requirements for installing, operating, maintaining, and shipping the EXB-8205, EXB-8205XL, EXB-8505, and EXB-8505XL. This chapter includes the following sections:

- Installation requirements
- Operation
- Preventive maintenance
- Loading new microcode
- Shipping requirements

Installation Requirements

Installing 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

This section describes the requirements for installing the tape drive. For step-by-step instructions for completing installation tasks, refer to *EXB-8205 and EXB-8505 Installation and Operation*.

Requirements for 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 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 (see Figure 4-1).
- 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.

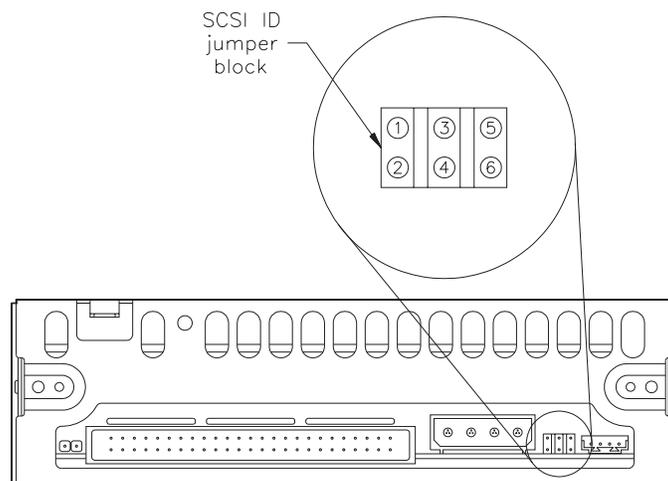


Figure 4-1 SCSI ID jumper block on the back panel (single-ended configuration)

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

For detailed instructions for setting the SCSI ID, including the pin assignments for the SCSI ID jumper block, refer to *EXB-8205 and EXB-8505 Installation and Operation*.

Requirements for Mounting the Tape Drive

The main housing 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 of the device. This ensures that the tape drive can be adequately cooled.

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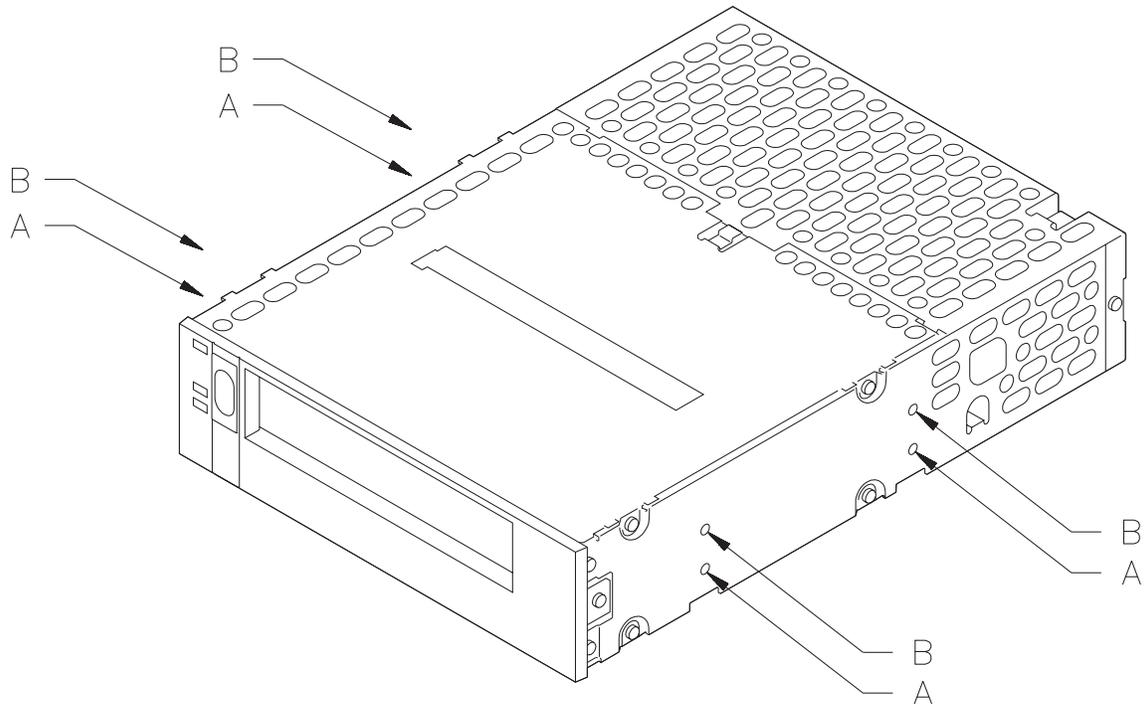


Figure 4-2 Mounting holes on the sides

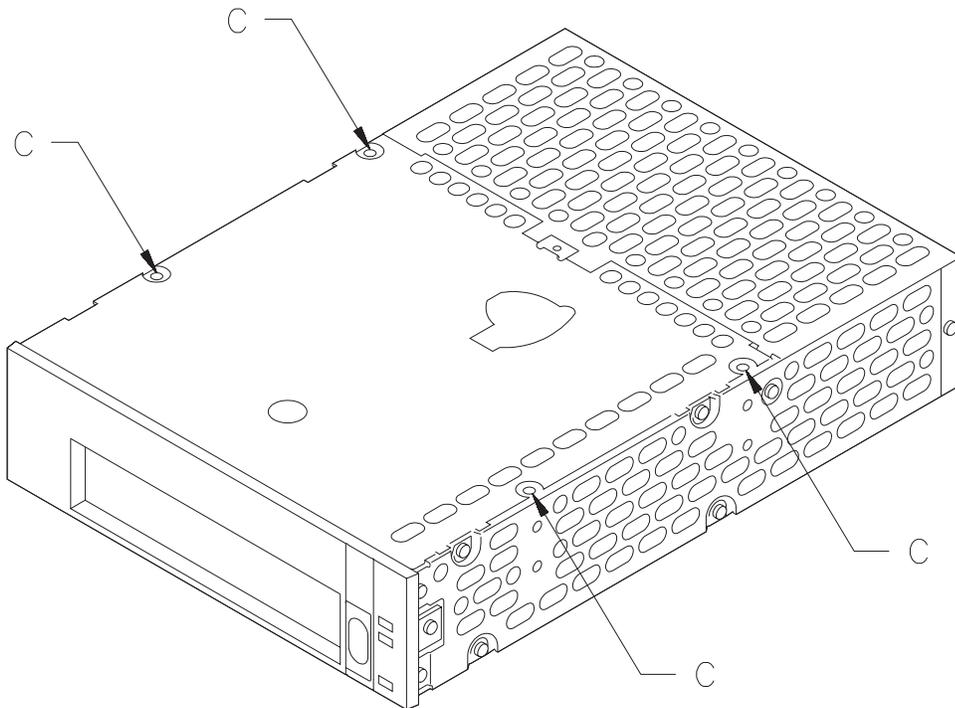


Figure 4-3 Mounting holes on the bottom

The mounting holes accommodate $M3 \times 0.5 \times 6$ 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 tape drive's mounting holes.

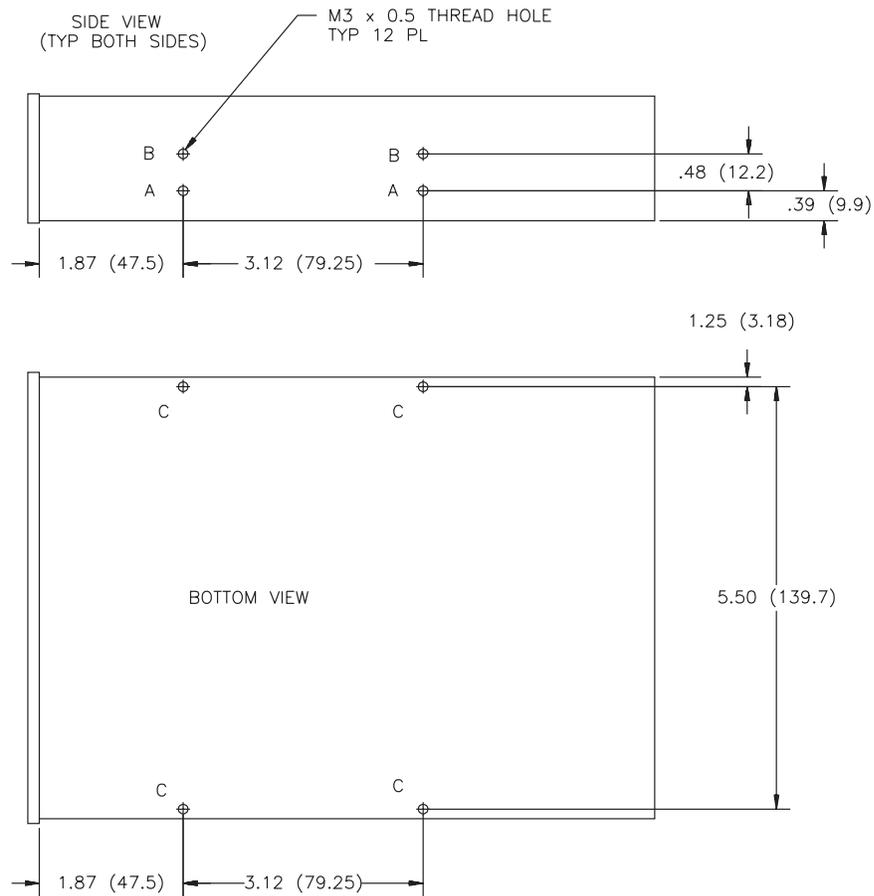


Figure 4-4 Mounting hole dimensions in inches (and millimeters)

Requirements for SCSI Bus Termination

If the tape drive is the last device on the SCSI bus, it must be terminated. As described in this section, the termination requirements for the tape drive depend on whether it uses a single-ended or differential SCSI configuration.

Terminators for Single-Ended Configuration

The single-ended SCSI configuration includes three single in-line package (SIP) resistor terminators (R-packs). They can be left in place if the tape drive terminates the SCSI bus or removed if the tape drive does not terminate the SCSI bus or if external termination is used.

If necessary, the single-ended tape drive can be terminated externally. To ensure that the tape drive performs to specification, Exabyte recommends a Methode Electronics, Inc. dataMate® DM103-02-0 single-ended external terminator.

Terminators for Differential Configuration

The differential SCSI configuration of the tape drive does not include internal terminators. If a differential tape drive terminates the SCSI bus, it must be terminated externally. To ensure that the tape drive performs to specification, Exabyte recommends a Methode Electronics, Inc. dataMate DM103-01-0 differential external terminator.

Requirements for Connecting a SCSI Cable

The cable for connecting the tape drive to the SCSI bus is not provided with the tape drive. You must provide a cable that complies with the appropriate safety and regulatory agency requirements. To comply with FCC, Canadian DOC, and VDE limits, the tape drive requires shielded cables when the cables are external to the mounting enclosure.

Impedance

Ideally, to match the cable terminators, the 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 \pm 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 cables used on the same bus have the same impedances.

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.

Primary Conductor

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

SCSI Cable Connector Requirements

The SCSI connector is located at the back of the tape drive, as shown in Figure 4-5. The connector is a 50-pin male ribbon cable connector. The stub length within the tape drive is less than 50 mm.

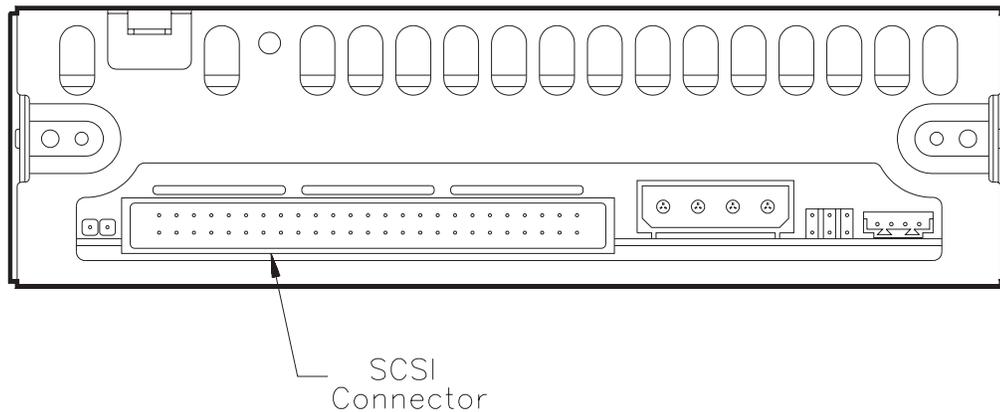


Figure 4-5 SCSI connector location on the back panel

To connect the 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 Connector pin assignments for differential tape drives

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 Connector pin assignments for single-ended tape drives

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.

Operation

This section provides general information about operating the tape drive. For more detailed instructions, refer to *EXB-8205 and EXB-8505 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.

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.

The EXB-8205 and EXB-8505 have a smooth unload button. The EXB-8205XL and EXB-8505XL have a diamond-textured unload button.

Device States

Figure 4-6 shows the orientation of the green, amber, and dual green/amber LEDs on the front panel of the EXB-8505 and EXB-8505XL. Figure 4-7 shows the orientation of the LEDs on the front panel of the EXB-8205 and EXB-8205XL. The three LEDs are status indicators.

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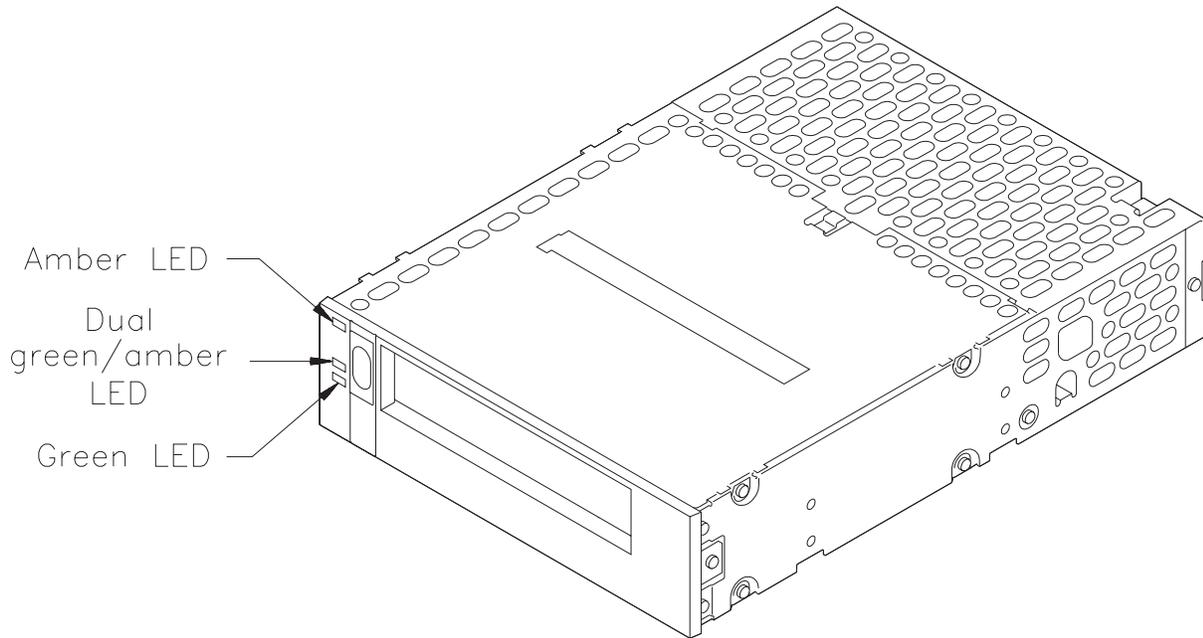


Figure 4-6 LEDs on the faceplate of the EXB-8505 and EXB-8505XL

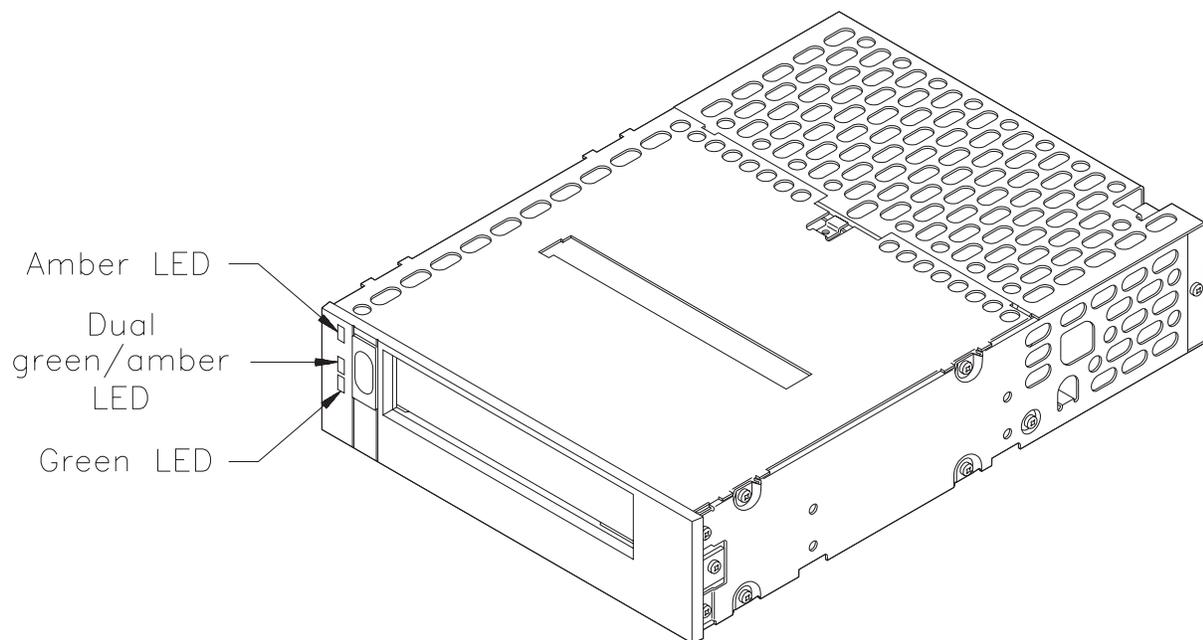


Figure 4-7 LEDs on the faceplate of the EXB-8205 and EXB-8205XL

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

- When the top (amber) LED is on or flashing, the tape drive either has an error or needs to be cleaned.
- When the middle LED is on or flashing, SCSI bus activity is occurring. The middle LED can be green or amber, as follows:
 - When this LED is amber, the tape loaded in the tape drive is in compressed format (8500c or 8200c).
 - When this LED is green, the tape loaded in the tape drive is in uncompressed format (8500 or 8200).
- When the bottom (green) LED is on or flashing, tape motion is occurring.

Table 4-3 shows the various combinations of LEDs that may occur to indicate different operating states during tape drive operation.

Table 4-3 LED states during operation

	Tape Drive State										
	POST (1st part)	POST (to completion)	Failed POST	Ready—no tape loaded	Ready—tape loaded	Normal tape motion	High-speed tape motion	SCSI bus reset	Error	Time to clean	Cleaning tape loaded
Top LED (errors)	●	●	* fast	○	○	○	○	●	* slow	* fast	○
Middle LED (SCSI)^a	● (green)	* irregular	* irregular	* irregular	* irregular	* irregular	* irregular	* irregular	* irregular	* irregular	* irregular
Bottom LED (motion)	●	○ ^b	○	○	●	* slow	* fast	●	○	* fast	* slow

^a Green—EXB-8500 or EXB-8200 uncompressed format tape.
Amber—EXB-8500c or EXB-8200c compressed format tape.

^b If a tape is loaded, the bottom LED will flash slow and then fast during the second part of the power-on self-test.

Key for Table 4-3

●	○	*
The LED is on.	The LED is off.	The LED is flashing:
		* slow = 1 flash/second (0.94 Hz)
		* fast = 4 flashes/second (3.76 Hz)
		* irregular = Rate of flash varies with SCSI bus activity. If the tape drive is not connected to the bus, the LED will be off.

Note: Table 4-3 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. (For example, a fairly complex LED sequence occurs when you load new microcode from tape.)

Loading Data Cartridges

To load a tape into the tape drive, first set the write-protect switch on the EXATAPE data cartridge as required (either write protected or write enabled), then insert the data cartridge into the tape drive. Make sure you are using a data cartridge that is compatible with your tape drive. For information on tape drive and media compatibility, see Chapter 1.

► **Important** EXATAPE 160m XL media is compatible with the EXB-8205XL and EXB-8505XL only. The EXB-8205 and EXB-8505 will automatically eject these data cartridges. Do not use 160m XL data cartridges in Exabyte full-high tape drives.

When you insert a cartridge, the tape drive automatically loads the cartridge, unless the initiator has issued a MODE SELECT (15h) command to disable the autoloader function. Once the data cartridge is loaded, the tape drive presents ready status (bottom green LED on) and commands requiring loaded media will execute normally.

- Notes:**
- If you disabled the autoloader function, the tape drive does not present ready status until the initiator issues a LOAD (1Bh) command.
 - If you attempt to load a cartridge during a power-on self-test, the tape drive will eject the cartridge.
 - If you attempt to load a 160m data cartridge that is not equipped with an Exabyte Recognition System stripe into an EXB-8205XL or EXB-8505XL, the tape drive will eject the cartridge.

Refer to *EXB-8205 and EXB-8505 Installation and Operation* for instructions for setting the write-protect switch and loading data cartridges in the tape drive. Refer to the *EXB-8205 and EXB-8505 SCSI Reference* for information about the MODE SELECT and LOAD commands.

Load Time

The time required to load the data cartridge and position the tape to LBOT after the data cartridge is inserted is approximately 60 seconds. When loading a tape, the tape drive spaces forward from PBOT and determines the following:

- **The tape format.** The format will be either 8200, 8200c, 8500, 8500c, or unknown.
- **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 *EXB-8205 and EXB-8505 SCSI Reference*.

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 *EXB-8205 and EXB-8505 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 (except in 8200 format)
- 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.

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 *EXB-8205 and EXB-8505 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 by 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 μ sec (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 three minutes if the tape is positioned near the end of tape.

Using SCSI Commands

You can use SCSI commands to read, write, erase, and search for data. You can also copy microcode, inquire about tape drive status, set operating parameters, and perform diagnostic tests using SCSI commands.

For information on these commands and how to use them, see Chapter 5.

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 an Exabyte or Exabyte-approved 8mm cleaning cartridge.

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 will void the warranty on the tape drive.

For more information on Exabyte cleaning cartridges, see Chapter 1. For instructions for using the cleaning cartridge, refer to *EXB-8205 and EXB-8505 Installation and Operation*.

Determining When the Tape Drive Needs Cleaning

You should clean the tape drive's heads and tape path after **every 30 tape motion hours**. This cleaning frequency does not depend on the format in which you write and read data. However, if you are using the tape drive in a particularly dirty environment or if you operate it infrequently, you may want to clean it more often than every 30 tape motion hours. Cleaning the tape drive helps to ensure that it will perform according to its specifications.

Time-to-Clean LED Indication

The tape drive keeps track of tape motion hours internally. When 30 tape motion hours have elapsed, the top and bottom LEDs will flash rapidly and the middle LED will flash irregularly, depending on SCSI bus activity (see Table 4-3). For best results, clean the tape drive as soon as possible after the LEDs begin flashing.

REQUEST SENSE (03h) Command

If desired, you can issue a REQUEST SENSE (03h) command and look at the setting 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 New Microcode

To upgrade the microcode in the tape drive, you can:

- Use a microcode update tape that you obtain from Exabyte (no special software required)
- Create a microcode update tape from another tape drive using the Exabyte CTS Monitor program
- Use Exabyte microcode update diskettes with CTS Monitor
- Copy microcode from the Exabyte Technical Support bulletin board and load it in your tape drive using CTS Monitor

- Use the READ BUFFER command to copy the new code from a tape drive across the SCSI bus to an initiator. You can then use the WRITE BUFFER command to copy the code from the initiator to another tape drive.

For more information about the CTS Monitor program, refer to the CTS Monitor documentation. For more information about using SCSI commands, refer to the *EXB-8205 and EXB-8505 SCSI Reference*.

Shipping Requirements

This section describes the shipping requirements for the tape drive, including information about the shipping carton and a list of the environmental conditions needed for transporting the tape drive.

Shipping Cartons

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 4-4 shows shipping dimensions and weights for the tape drive.

Table 4-4 Single pack and multi-pack shipping dimensions and weights

Size	Dimensions	Weight
Single-pack	13.5 inches long × 10.75 inches wide × 8.5 inches high (34.3 × 27.3 × 21.6 cm)	1 CTS: 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 CTSs: 12 lbs (5.4 kg) 4 CTSs: 15 lbs (6.5 kg) 5 CTSs: 18 lbs (8.2 kg)

Both the single-pack and the multi-pack shipping cartons and internal 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 National Safe Transit Association (NSTA) Project 1A for packaged products weighing less than 100 pounds.

Note: 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.

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

Unpacking and Packing Instructions

Unpacking and packing instructions for the tape drive are included in *EXB-8205 and EXB-8505 8mm Cartridge Tape Subsystem Installation and Operation*.

To avoid damaging the tape drive, use the original shipping carton and packing materials (or replacement packaging obtained from the vendor) when repacking and shipping the tape drives. The shipping carton and packing materials are not intended to be used for shipping items other than an Exabyte half-high 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.

Data Transfer Rate

The maximum obtainable data transfer rates for the tape drive depend on what mode it is operating in. For information on data transfer rates, see Chapter 6.

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 SCSI messages supported by the EXB-8205, EXB-8205XL, EXB-8505, and EXB-8505XL.

Refer to the *EXB-8205 and EXB-8505 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		✓
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.

Note: Tapes written and read in 8200 format use the SCSI-1 command set. See the *EXB-8205 and EXB-8505 SCSI Reference* for more information.

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.
READ BLOCK LIMITS	05h	Requests that the tape drive return data identifying the maximum and minimum logical block lengths supported.

Command	OP Code	Description
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.
RECEIVE DIAGNOSTIC RESULTS	1Ch	Reports the results of the tests requested by a previous SEND DIAGNOSTIC command or to obtain a trace of SCSI and servo command activity for the tape drive.
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 used 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 (0Ah) command. The data can be written in any of the four supported logical tape formats (two formats for the EXB-8205 and EXB-8205XL), which are specified by the MODE SELECT (15h) command.

To write filemarks or setmarks (8500c format only), use the WRITE FILEMARKS (10h) command.

Reading Data

To transfer bytes or blocks of data from the tape drive to the initiator, use the READ (08h) 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 (19h) 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 (11h) or LOCATE (2Bh) commands. The tape drive moves the tape at its high-speed search speed, which is up to 75 times the nominal tape speed.

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 (3Ch) and the WRITE BUFFER (3Bh) 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.

Inquiring About Tape Drive Status

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

REQUEST SENSE (03h) Command

Use the REQUEST SENSE (03h) 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 (12h) Command

You can use the INQUIRY (12h) 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 (4Dh) and LOG SELECT (4Ch) Commands

You can use the LOG SENSE (4Dh) command to retrieve the tape drive's read and write error counters. You can use the LOG SELECT (4Ch) command to set threshold values for these counters.

Performing Diagnostic Tests

You can perform diagnostics to find out detailed information about tape drive operations. The SEND DIAGNOSTIC (1Dh) command allows you to run special diagnostic tests, including a drive dump. The RECEIVE DIAGNOSTIC RESULTS (1Ch) command allows you to obtain diagnostic results or a dump that provides you with information about the status of tape drive operations.

Setting Operating Parameters

To set operating parameters for the tape drive, use the MODE SELECT (15h) command. To find out how the parameters are set for the tape drive, use the MODE SENSE (1Ah) command.

6

Functional Specifications

This chapter includes functional specifications for the tape drive, including the following sections:

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

Performance Specifications

This section describes the performance specifications for the tape drive.

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.

Table 6-1 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.

Tape Speed

Table 6-2 lists the nominal tape speed at which data can be written and read by the tape drives.

Table 6-2 Nominal tape speed

Format	Speed	
	EXB-8205 and EXB-8205XL	EXB-8505 and EXB-8505XL
8500c	—	11.079 mm/sec (0.436 inch/sec)
8500	—	
8200c	11.079 mm/sec (0.436 inch/sec)	
8200	11.633 mm/sec (0.458 inch/sec)	

File-Search Tape Speed

Table 6-3 lists forward and backward file-search tape speeds for the tape drives. These high-speed search times occur when the initiator issues a LOCATE command (for tapes written in 8200c, 8500, or 8500c formats) or a SPACE command (for all formats).

Table 6-3 File-search tape speeds

Format	Forward Speed		Backward Speed	
	EXB-8205 and EXB-8205XL	EXB-8505 and EXB-8505XL	EXB-8205 and EXB-8205XL	EXB-8505 and EXB-8505XL
8500c	—	831 mm/sec max (32.7 inch/sec)	—	831 mm/sec max (32.7 inch/sec)
8500	—		—	
8200c	831 mm/sec max (32.7 inch/sec)		831 mm/sec max (32.7 inch/sec)	
8200	116 mm/sec (4.58 inch/sec)		87.25 mm/sec (3.45 inch/sec)	

8500, 8500c, and 8200c Formats

If the tape is written in 8500, 8500c, or 8200c formats, the tape drive can perform forward and backward file-search operations at up to 75 times the nominal tape speed.

8200 Format

If the tape is written in 8200 format, the tape drive can perform forward file-search operations at 10 times the nominal tape speed and backward file-search operations at 7.5 times the nominal tape speed.

Rewind Tape Speed

Table 6-4 lists maximum rewind times for the tape drives for four sizes of EXATAPE 8mm data cartridges. 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 you issue a REWIND command.
- The drum has not stopped rotating.
- Tape tension has not been released.

Table 6-4 Typical rewind times

Size of EXATAPE ^a	Length m (ft)	Typical rewind time (seconds)
15m	15 (49)	50
54m	54 (177)	100
112m	112 (367)	170
160m XL ^b	160 (524)	240

^a EXATAPE data cartridges are recommended for use with all Exabyte products and are available for purchase from Exabyte Corporation.

^b 160m XL media is intended for use in the EXB-8205XL and EXB-8505XL only.

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.

Drum Rotation Period

Table 6-5 shows the drum rotation period for the tape drives reading and writing tapes in all formats.

Table 6-5 Drum rotation periods

Format	Drum rotation period	Nominal effective head-to-tape speed
8500c*	32.77 msec (1831.055 rpm)	3.824 m/sec (150.548 inch/sec)
8500*		
8200c		
8200	31.21 msec (1922.607 rpm)	4.015 m/sec (158.075 inch/sec)

*EXB-8505 and EXB-8505XL only

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.

Data Transfer Rate

The maximum obtainable data transfer rates for the tape drive depend on what mode it is operating in. Table 6-6 shows the data transfer rates for each of the four formats.

Table 6-6 Data transfer rates

Type of transfer	Rate achieved for these formats . . .			
	8500c ^a	8500 ^a	8200c	8200
Sustained transfer rate	up to 1 MBytes/sec ^b	up to 500 KBytes/sec	up to 500 KBytes/sec ^b	up to 262.5 KBytes/sec
Synchronous burst	up to 5.0 MBytes/sec			
Asynchronous burst	up to 2.5 MBytes/sec			

^a EXB-8505 and EXB-8505XL only

^b Assumes a 2:1 compression ratio

- Notes:**
- When compression is enabled, the tape drive can increase the sustained transfer rate of 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.

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 reliability specifications for the tape drive.

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 mean time between failures (MTBF) value for the EXB-8205, EXB-8205XL, EXB-8505, and EXB-8505XL is 160,000 power-on hours.

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:

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

- The tape drives are tested at the following ambient temperature and relative humidity:
 - 23° C ± 2° C
 - 50% relative humidity ± 10% (non-condensing)
- The tape drives are 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 Standard ECMA-145.
- Environmental conditions for the tape drive and the 8mm data cartridges must be maintained as specified in the “Environmental Specifications” section of this chapter.
- The tape drive must be cleaned with an Exabyte or an Exabyte-approved cleaning cartridge using the recommended cleaning procedure. Refer to *EXB-8205 and EXB-8505 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:

- No recorded data will be lost as a result of power loss while the tape drive is reading data.
- 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 one error per total number of bits transferred to the host.

Conditions for Data Reliability

The conditions under which the specifications for data reliability apply are as follows:

- The EXATAPE data cartridges used must comply with Standard ISO/IEC 12246.
- 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 the “Environmental Specifications” section of this chapter.
- The tape drive must be cleaned with an Exabyte or Exabyte-approved 8mm cleaning cartridge using the recommended cleaning procedure. Refer to *EXB-8205 and EXB-8505 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. If, however, the tape drive cannot rewrite the data block correctly after a maximum of 11 rewrite attempts (12 write attempts total), 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: 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. If, however, the tape drive cannot reread the data block correctly after one reread attempt at normal speed and one reread attempt at slow speed, 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: 1.0×10^{-17}

Power Specifications

This section lists the power specifications for the tape drive.

Voltages

The tape drive operates from standard +5 VDC and +12 VDC supply voltages, as specified in Table 6-7. All specified voltages are DC; no external AC power is used by the tape drive. The tape drive does not provide any overvoltage or overcurrent protection.

Table 6-7 Power specifications for standard voltages

Power specification	+5 Volts	+12 Volts
Nominal tolerance: Ripple and Noise ^a (60Hz to 20 MHz)	± 5% 125 mVpp max	
Operating current: Nominal ^b SLDS card ^c SLDD card ^c Peak ^d SLDS card SLDD card	1.7A 2.1A 2.8A 3.2A	0.6A 0.6A 1.6A 1.6A
Operating power consumption: SLDS card SLDD card	14.5 watts 16.5 watts	
Power consumption when idle: SLDS card SLDD card	13.0 watts 14.5 watts	

^a The ripple voltage is included in the total voltage tolerance.

^b Nominal current occurs during streaming write or read operation.

^c The SLDS card is the single-ended card; the SLDD card is the differential card.

^d 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).

Power Connector

The power connector used in the tape drive is compatible with the power connector used for standard 5.25-inch, half-high devices. Figure 6-1 shows the location of the power connector on the rear of the tape drive and the pin assignments.

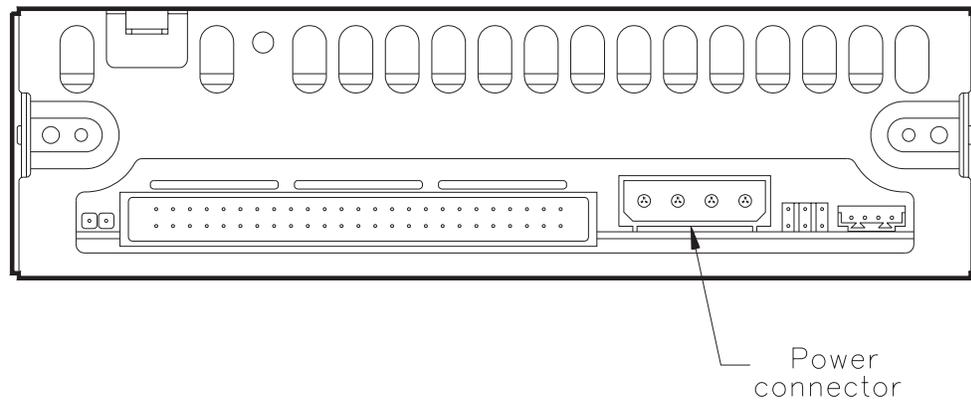


Figure 6-1 Power connector location on the back panel

Table 6-8 lists the pin assignments for the power connector.

Table 6-8 Power connector pin assignments

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

To connect the tape drive to a power cable, use an AMP 1-480424-0 series or equivalent female connector.

Grounding Hole and Ground Tab

The rear panel of the EXB-8205 and EXB-8505 includes a grounding hole and a ground tab, as shown in Figure 6-2. These can be used to provide additional chassis grounding if desired. The grounding hole uses an M3 0.5 6mm 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.

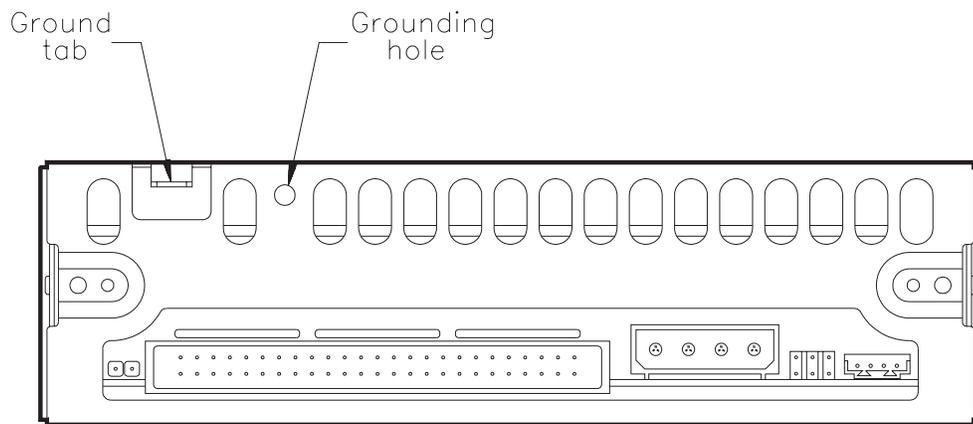


Figure 6-2 Chassis ground location on back panel

Environmental Specifications

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

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

Table 6-9 shows the overall environmental specifications for the tape drive.

Table 6-9 Environmental specifications

Specification	Operation ^b	Storage ^c or Not operating ^d	Transportation ^c
Temperature Range ^a	+5° C to +40° C (+41° F to +104° F)	−40° C to +60° C (−40° F to +140° F)	−40° C to +60° C (−40° F to +140° F)
Temperature Variation ^e	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)	1° C per minute; max 20° C per hour (2° F per minute; max 36° F per hour)
Relative Humidity ^e	20% to 80% Non-condensing	10% to 90% 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)

^a The temperature specifications assume that temperature measurements are made at the tape path.

^b All operating measurements include an EXATAPE data cartridge.

^c The tape drive has not been unpacked. Data cartridges are not packed with the tape drive.

^d The tape drive has been unpacked but is not operating. The data cartridge is not included.

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

Operating Environment

The psychrometric chart, Figure 6-3, shows the operating temperature and humidity ranges for the tape drive. The dotted line represents the operating environment.

Table 6-10 defines the temperature and humidity points shown in Figure 6-3.

Table 6-10 Temperature and humidity specifications

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

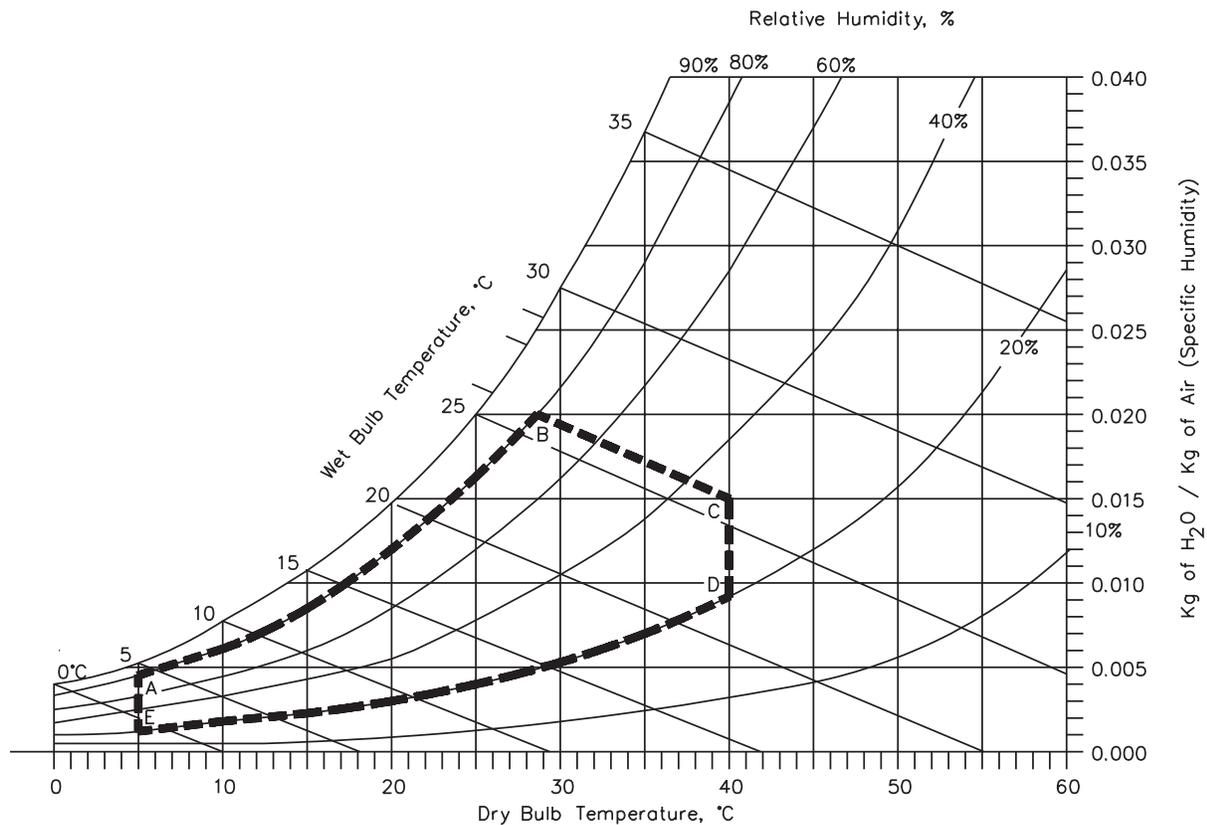


Figure 6-3 Temperature and humidity ranges for operation

Air Flow Requirements

Adequate air flow must be provided in the enclosure for the tape drive to dissipate heat resulting from approximately 15.0 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.

Particulate Contamination Limits

The ambient operating environment should not exceed the particulate counts shown in Table 6-11.

Table 6-11 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 6-4 shows the particulate contamination profile of a typical office compared to the specifications for the tape drive. Contamination profiles of individual office areas vary.

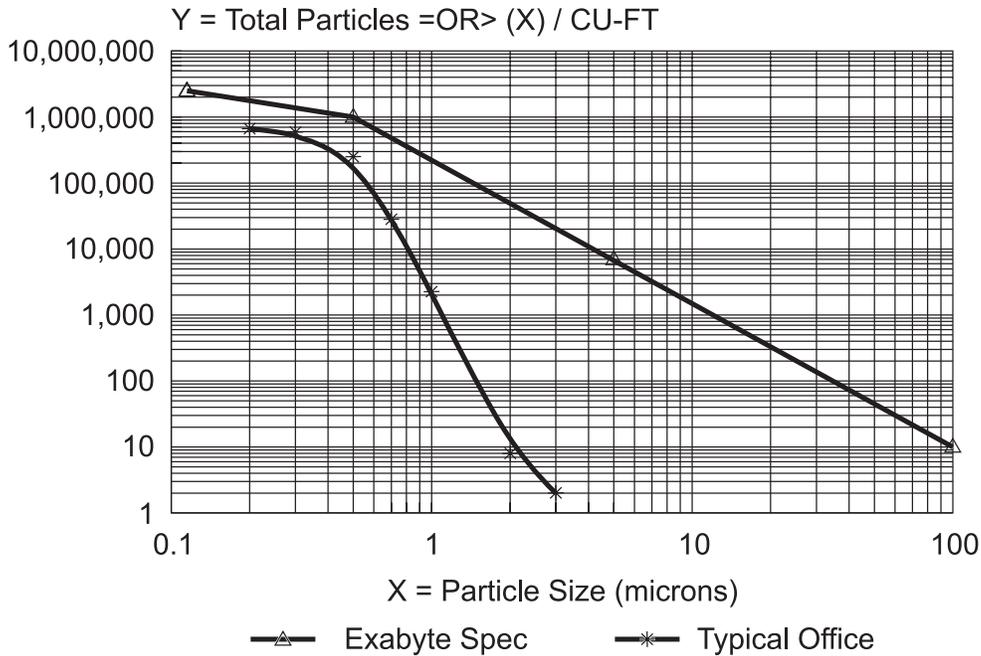


Figure 6-4 Particulate contamination specification vs. typical office

Shock Specifications

Table 6-12 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 6-12 Shock specifications

Operating	Storage ^a or Not Operating ^b	Transportation ^a
3 g for 5 ms ^c	45 g at a velocity change of 192 inch/sec ^d	NSTA Project 1A

^a The tape drive has not been unpacked.

^b The tape drive has been unpacked, but no power has been applied.

^c 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.

^d 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 6-13 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 6-13 Vibration specifications

Random vibration^a applied during operation	
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^c and storage^d	
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
Transportation^d	
NSTA Project 1A	

^a A 0.3 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 The tape drive has been unpacked, but is not operating.

^d The tape drive has not been unpacked.

Acoustic Noise

The overall, averaged A-weighted sound power levels (decibels) for the tape drive do not exceed the upper limits specified in Table 6-14.

Table 6-14 Acoustic noise limits

Operating mode	LWA*
The tape drive is powered on and idle.	40 dBA
The tape drive is fully operational and operating in streaming mode for a read or write operation.	45 dBA

*LWA is the average A-weighted sound power level over the following frequency range: 5 Hz to 12.5 KHz.

7

Safety and Regulatory Agency Compliance

This chapter describes the following:

- Safety agency standards
- Electrostatic discharge (ESD) standards
- Electromagnetic compatibility (EMC)
- Radiated susceptibility

Safety Agency Standards

When purchased from Exabyte Corporation, the tape drive is certified as a component by the following domestic and international product safety standards.

- UL Standard 1950, 1st Edition, Information Technology Equipment
- CAN/CSA Standard C22.2 No. 950-M89, Safety of Information Technology Equipment
- IEC 950/EN60950, Safety of Information Technology Equipment including Electrical Business Equipment (TUV)

Certification of the final product is the responsibility of the system integrator.

Electrostatic Discharge (ESD)

When properly installed with a shielded cabinet, shielded cables, and adequate grounding of the SCSI bus and the input power, the tape drive can withstand discharges of the following:

- Up to 10,000 volts applied to those points that are accessible during normal use without affecting the permanent read error rate or requiring operator intervention.
- Up to 15,000 volts applied to those points that are accessible during normal use without sustaining permanent damage. However, at this level of discharge, operator intervention may be required to reset the tape drive.

Note: No errors will occur or damage be caused to the tape drive when a cartridge charged to a maximum of 20,000 volts is inserted into the tape drive.

Electromagnetic Compatibility (EMC)

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

- FCC Rules, Part 15, Class B Computing Devices
- Canadian Department of Communications, Radio Interference Regulation for Digital Apparatus, Class B
- VDE Vfg 1046/1984, Class B
- CISPR Publication 22, 1985, Class B

Radiated Susceptibility

When properly installed with a shielded cabinet, shielded cables, and adequate grounding of the SCSI bus and the input power, the tape drive will continue to operate without error when subjected to electromagnetic energy of severity level 2 (3 volts/meter) as defined by IEC Publication 801-3.

Notes:

Glossary

- 8200 format** One of the data formats written and read by the EXB-8205, EXB-8205XL, EXB-8505, and EXB-8505XL. Tapes written in 8200 format can also be read by any EXB-8200, EXB-8200SX, EXB-8500, or EXB-8500c.
- 8200c format** One of the data formats written and read by the EXB-8205, EXB-8205XL, EXB-8505, and EXB-8505XL. Tapes written in 8200c format can also be read by an EXB-8500c.
- 8500 format** One of the data formats written and read by the EXB-8505 and EXB-8505XL. Tapes written in 8500 format can also be read by an EXB-8500 or EXB-8500c.
- 8500c format** One of the data formats written and read by the EXB-8505 and EXB-8505XL. Tapes written in 8500c format can also be read by an EXB-8500c.
- ANSI** American National Standards Institute.
- BOT** Beginning of tape.
- bus devices** Initiator or target devices connected to the SCSI bus.
- byte** Eight bits or one character.
- C** Celsius (Centigrade).
- Canadian DOC** Canadian Department of Communications.
- cm** Centimeter (0.3937 inches).
- connect** The establishment of communications between the initiator and the selected target.
- CRC** Cyclic redundancy check.
- CSA** Canadian Standards Association.
- CTS** Cartridge Tape Subsystem. Also referred to as a tape drive.

disconnect	The termination of communications between the initiator and the target. During a disconnect, the target releases control of the SCSI bus, allowing the bus to become free.
ECC	Error correction code.
ECMA	European Computer Manufacturers Association.
EEPROM	Electrically erasable programmable read only memory.
EPROM	Erasable programmable read only memory.
EOD	End of data.
EOT	End of tape.
EXATAPE	A data-grade, rewriteable data cartridge.
EXB-8200	The EXB-8200 8mm Cartridge Tape Subsystem. The EXB-8200 can store up to 2.5 gigabytes of data on a single EXATAPE 8mm data cartridge.
EXB-8200SX	The EXB-8200SX 8mm Cartridge Tape Subsystem. The EXB-8200SX is very similar to the EXB-8200 but offers a high-speed search capability.
EXB-8205	The EXB-8205 8mm Cartridge Tape Subsystem. The EXB-8205 is a half-high 8mm cartridge tape subsystem that can store 5 gigabytes of data on a single EXATAPE 112m 8mm data cartridge, assuming an average 2:1 compression ratio.
EXB-8205XL	The EXB-8205XL 8mm Cartridge Tape Subsystem. The EXB-8205XL is a half-high 8mm cartridge tape subsystem that can store 7 gigabytes of data on a single EXATAPE 160m XL 8mm data cartridge, assuming an average 2:1 compression ratio.
EXB-8500	The EXB-8500 8mm Cartridge Tape Subsystem. The EXB-8500 can store up to 5 gigabytes of data on a single EXATAPE 112m 8mm data cartridge.
EXB-8500c	The EXB-8500c 8mm Cartridge Tape Subsystem. The EXB-8500c is physically similar to the EXB-8500, but offers data compression as an option. Assuming an average compression ratio of 2:1, the EXB-8500c can store up to 10 gigabytes of data on a single EXATAPE 112m 8mm data cartridge.

- EXB-8505** The EXB-8505 8mm Cartridge Tape Subsystem. The EXB-8505 is a half-high 8mm cartridge tape subsystem that can store 10 gigabytes of data on a single EXATAPE 112m 8mm data cartridge, assuming an average 2:1 compression ratio.
- EXB-8505XL** The EXB-8505XL 8mm Cartridge Tape Subsystem. The EXB-8505XL is a half-high 8mm cartridge tape subsystem that can store 14 gigabytes of data on a single EXATAPE 160m XL 8mm data cartridge, assuming an average 2:1 compression ratio.
- F** Fahrenheit.
- FCC** Federal Communications Commission.
- FEPROM** Flash erasable programmable read only memory.
- GByte** Gigabyte.
- h** Hexadecimal (base 16) numbering system.
- host** The computer system that acts as the initiator of an operation.
- Hz** Hertz.
- ID** Identification.
- IDRC** Improved Data Recording Capability. The compression algorithm used by the EXB-8205, EXB-8205XL, EXB-8505, and EXB-8505XL (licensed from IBM).
- IEC** International Electrotechnical Commission.
- initiator** A host computer system that requests an operation to be performed by the target.
- ISO** International Standards Organization.
- KByte** Kilobyte.
- LBOT** Logical beginning of tape.
- LEOT** Logical end of tape.
- LUN** Logical unit number.
- MByte** Megabyte.
- MLCH** Machine level control history.

mm	Millimeter (0.03937 inches).
ms or msec	Millisecond.
ns	Nanosecond.
NSTA	National Safe Transit Association.
PBOT	Physical beginning of tape.
PEOT	Physical end of tape.
POST	Power-on self-test; the process that occurs when the tape drive performs its initial power-on diagnostics.
ready	The state of the tape drive when it is ready to process commands.
reconnect	The function that occurs when the target arbitrates and reconnects to an initiator after a disconnect.
SCSI	Small Computer System Interface.
SCSI address	An octal representation of the unique address (0-7) assigned to a SCSI device.
signal assertion	Driving a signal to the true state.
signal de-assertion	Driving a signal to the false state or biasing the signal by the cable terminators to the false state.
signal release	When a signal is not driven by a bus but is biased by the cable terminators to the false state.
status	Information sent from the target to the initiator upon completion of a command.
target	A bus device (usually a controller) that performs an operation requested by an initiator. The tape drive is a target.
XL	Extended length.
μm	Micrometer (0.00003937 inches).
μs or μsec	Microsecond.

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