Eagle TR-3

Product Specification

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Revision History

Revision	Date
000	February 1996

Exabyte Corporation
1685 38th Street
Boulder, Colorado 80301

316198-000

Product Warranty Caution

The EXABYTE® Eagle™ TR-3 Minicartridge Tape Drive is warranted to be free from defects in materials, parts, and workmanship and will conform to the current product specification upon delivery. **For the specific details of your warranty, refer to your sales contract or contact the company from which the tape drive was purchased.**

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

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

CAUTION

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

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

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

Contents

About This Specification

This product specification describes the functional, performance, and environmental specifications for the EXABYTE® Eagle™ TR-3 Minicartridge Tape Drive.

Intended Audience

This specification is for engineering, purchasing, or marketing personnel who want to evaluate the tape drive to determine the feasibility of integrating it into a product line.

Related Publications

The following publications list additional, related information.

Eagle TR-3 Minicartridge Tape Drive

- *Eagle TR-3 Minicartridge Tape Drive Installation*, 316199
- *Eagle TR-3 Minicartridge Tape Drive Operation*, 316747
- *Configuring Windows 95 for the Exabyte Accelerator Card*, 315941

Standards

- QIC-80 – *Flexible-Disk-Controller-Compatible Recording Format for Information Interchange*
- QIC-107 – *Basic Drive Interface for Flexible-Disk-Controller Compatible ¼-Inch (6.35 mm) Minicartridge Tape Drives*
- QIC-113 – *Host Interchange Format*
- QIC-117 – *Common Command Set Interface Specification for Flexible Disk Controller Based Mini Data Cartridge Tape Drives*
- QIC-3010-MC **–** *Serial Recorded Magnetic Tape Minicartridge for Information Interchange*
- QIC-3020-MC – *Serial Recorded Magnetic Tape Minicartridge for Information Interchange*
- QIC-162 — *900 Oe, 750-foot Midsized Magnetic Tape Cartridge*

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.

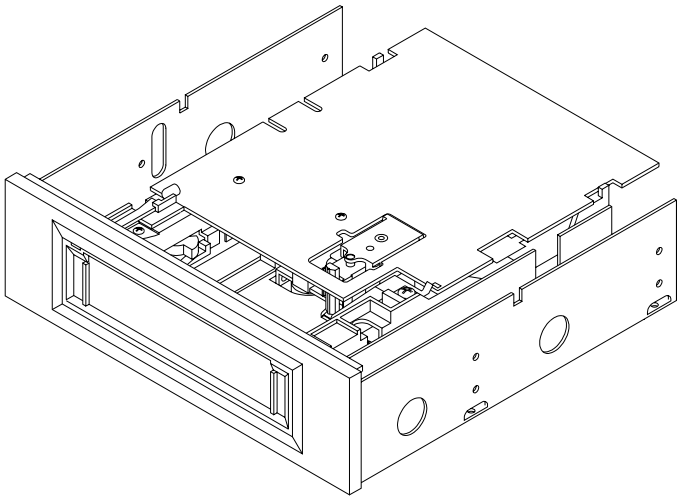
Important Read the information in *Important* boxes to learn crucial information about the topic or procedure being discussed.

CAUTION

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

1 Features and Physical Description

This chapter provides an overview of the EXABYTE® Eagle™ TR-3 Minicartridge Tape Drive (shown below).



The Eagle TR-3 is a minicartridge tape drive that interfaces directly with a floppy controller in a computer. When used with backup software, this tape drive is ideally suited for system backup and restore tasks in a desktop PC environment. The Eagle TR-3 can store up to 4.2 gigabytes of data on a single minicartridge (depending on the cartridge type and assuming a software data compression ratio of 2:1).

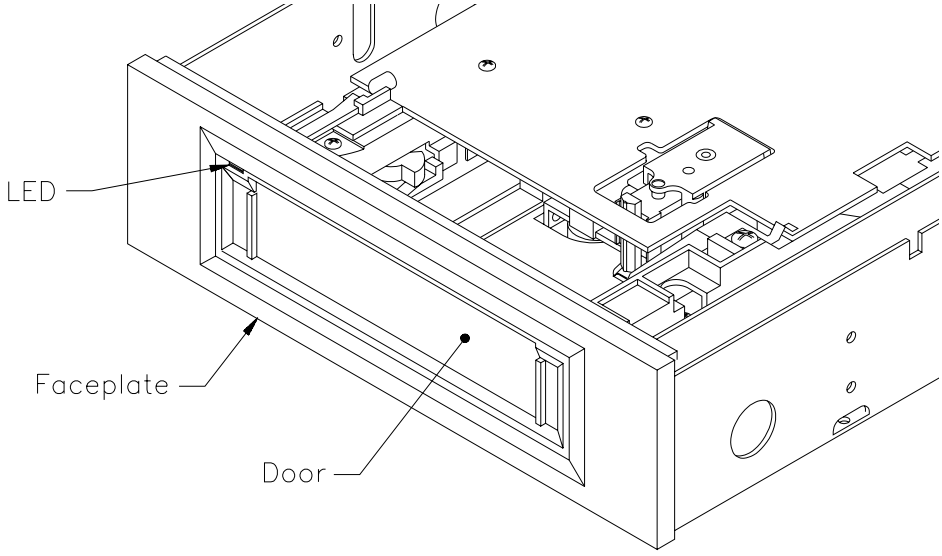
To increase the Eagle TR-3's data transfer rate, you can connect the tape drive to the Exabyte Accelerator card. With this card installed in your computer, the Eagle TR-3 can accept data at twice the speed of most floppy controller cards.

Physical Description

This section describes the physical features of the tape drive.

Front Panel Components

The figure shows the faceplate, door, and LED on the front panel.



Faceplate

The front panel contains a snap-on faceplate, which conforms to a 5.25-inch, half-high form factor or a 3.5-inch, one-inch form factor.

Door

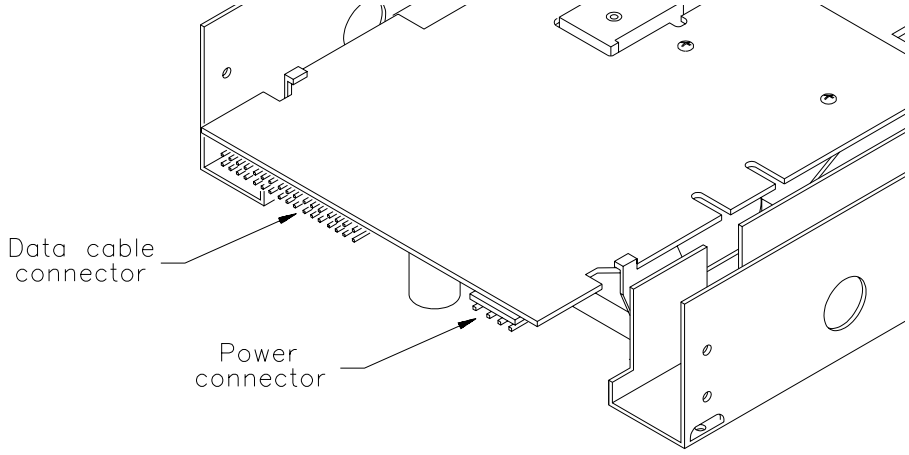
The front door is designed to minimize dust accumulation when a minicartridge is not inserted. When a minicartridge is inserted, the door folds back and the minicartridge protrudes slightly from the faceplate.

LED

The tape drive contains one LED, which indicates that the tape drive is selected for activity.

Rear Components

The rear of the tape drive contains the power connector and the data cable connector.



Data Cable Connector

The tape drive contains a 34-pin connector for communication with the floppy controller. See Chapter 3 for more information.

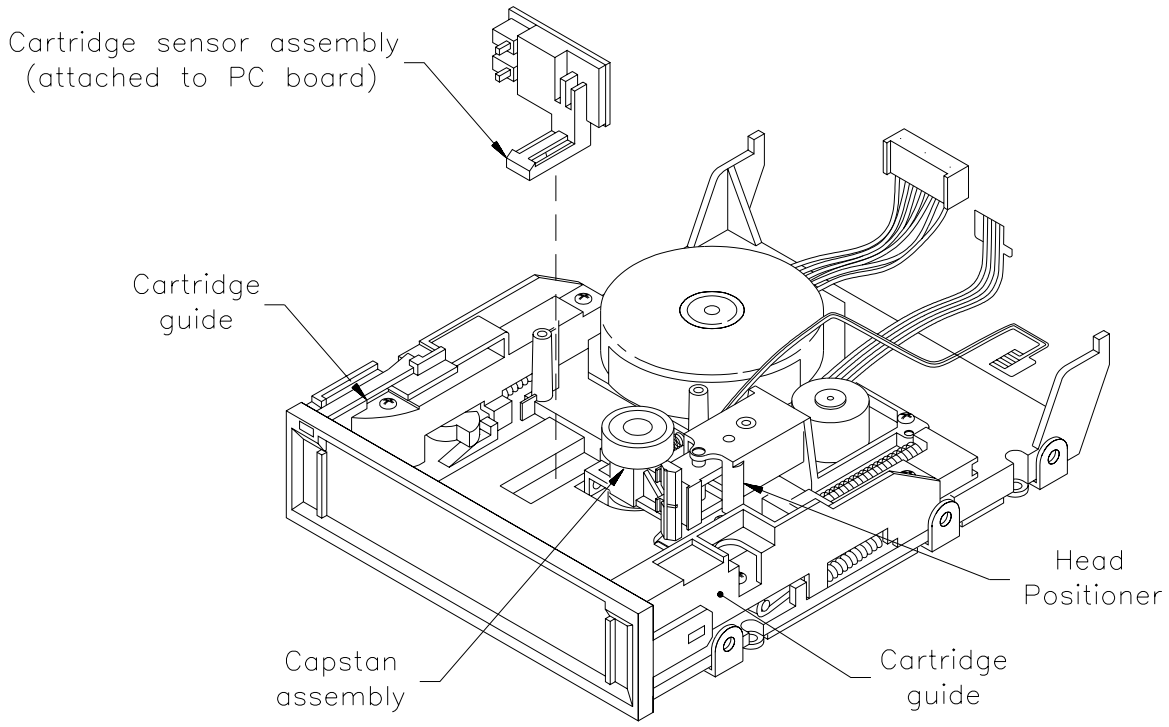
Power Connector

The tape drive includes a four-pin mini-power connector. See Chapter 3 for more information.

Platform Components

All the major mechanical components of the tape drive are attached to the platform, shown in the figure. The mechanical modules attached to the platform include:

- Cartridge guides
- Cartridge sensor assembly
- Capstan assembly
- Head positioner



Cartridge Guides

The cartridge guides securely locate the minicartridge per the three datum axes.

Cartridge Sensor Assembly

The cartridge sensor assembly consists of the following:

Tape hole sensors The tape hole sensors consist of an infrared emitter and detector. These sensors detect light projected through holes punched into each end of the tape. These holes indicate the tape type, the beginning of tape, and the end of tape.

Micro switches Two mechanical lever switches detect whether the minicartridge is present and whether the minicartridge is write protected.

Capstan Assembly

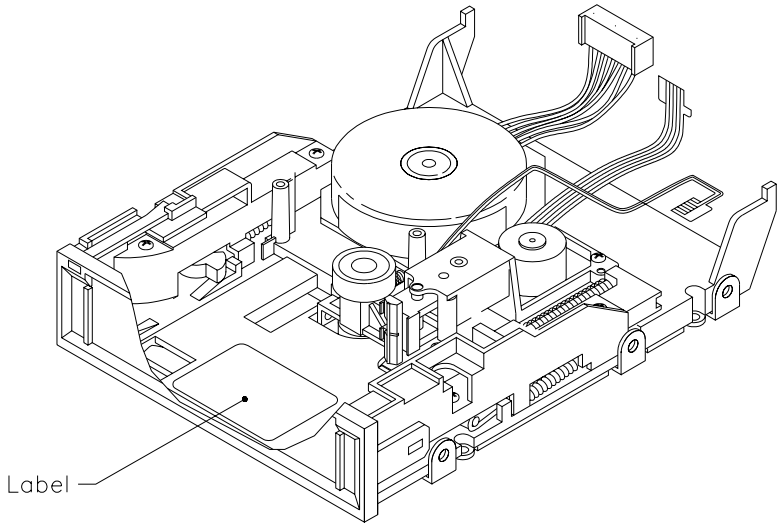
The pivoted capstan assembly provides stable tape motion inside the minicartridge. It is driven by a semi-elastic belt from a remote servo motor, which controls the tape speed.

Head Positioner

The head positioner assembly consists of a flex cable subassembly, a stepper motor, a head carrier, and a lead screw subassembly. These gear-driven components work together to position and move the head across the width of the tape in either direction.

Labels

The tape drive includes a standard configuration label and a product ID label, located inside the door on the front bezel. You can view these labels by pushing the door open with your finger.

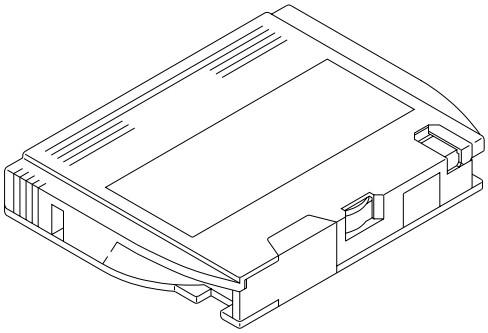


Minicartridges

The Eagle TR-3 can write data to any of the following minicartridges:

- MC3000XL
- Travan TR-2 and TR-3 (shown in the figure below)
- QIC-Wide
- QIC-EXtra 8mm and QIC-EXtra quarter-inch

You can purchase these cartridges already preformatted.



Note: With the appropriate software, the tape drive can read (but not write) TR-1, QIC-80, and QIC-40 formatted tapes.

The following table describes the maximum storage capacities for the minicartridges.

Maximum storage capacities for the minicartridges[a]		
Minicartridge	**Capacity (native)**	**Capacity (with compression)[b]**
QIC-EXtra 8mm	2.1 gigabytes	4.2 gigabytes
QIC EXtra quarter-inch	1.7 gigabytes	3.4 gigabytes
Travan TR-3	1.6 gigabytes	3.2 gigabytes
QIC Wide	833 megabytes	1.7 gigabytes
MC3000XL	680 megabytes	1.4 gigabytes

[a] Assumes that data is written in QIC-3020 format. When data is written in QIC-3010 format, the storage capacity is decreased by 50%.

[b] Assumes a 2:1 software compression ratio.

Refer to Chapter 3 for information about caring for and storing minicartridges.

2 Recording and Format Description

This chapter describes the following:

- QIC-3010 and QIC-3020 data formats
- Write and read operations
- Tape format
- Error detection and correction

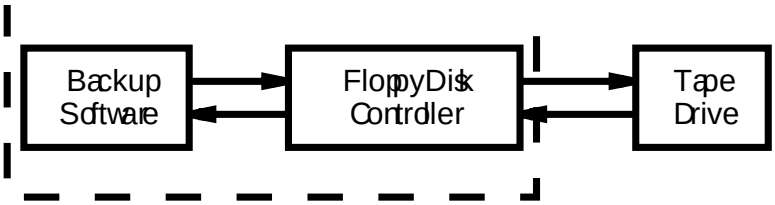
QIC-3010 and QIC-3020 Data Formats

The Eagle TR-3 can write data in either QIC-3010 or QIC-3020 data formats. The software automatically determines which format to write by detecting whether the minicartridge inserted in the tape drive is preformatted for either QIC-3010 or QIC-3020.

Note: When a 500-kilobit floppy controller is installed, the software can write data only in QIC-3010 format.

Write and Read Operations

The figure below provides a high-level overview of how the computer and tape drive communicate so the drive can write and read information.



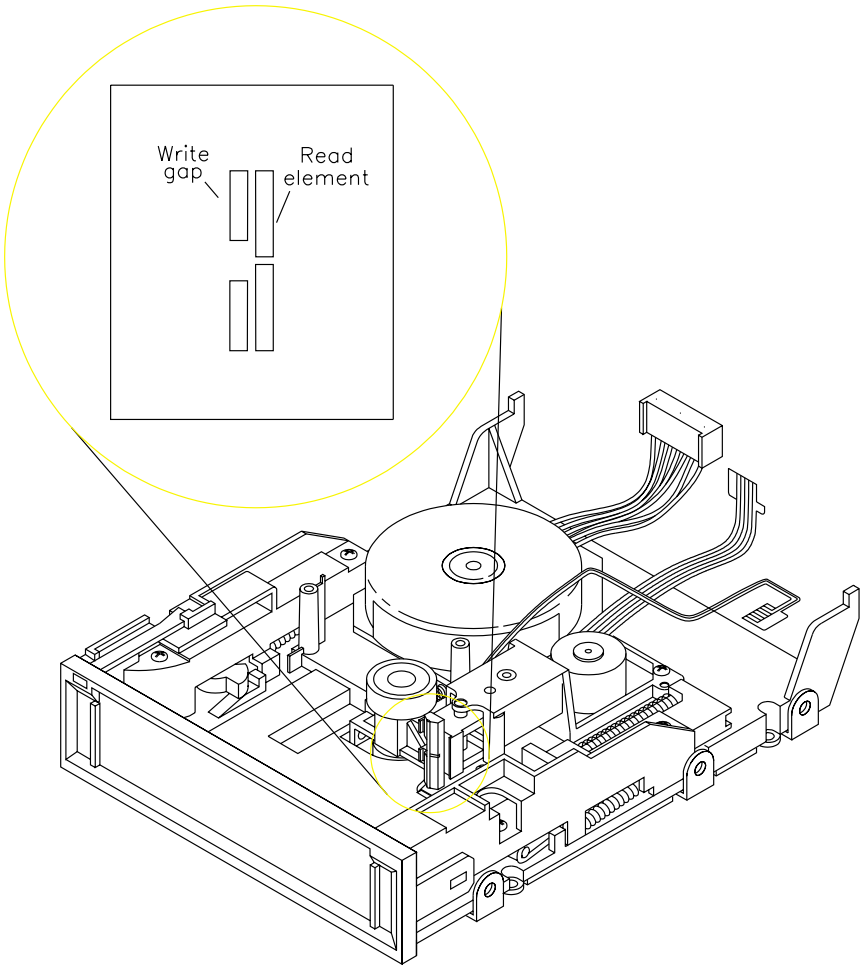
1. When your backup software issues a command to the tape drive, the command is sent to the floppy controller in the host computer.

2. The floppy controller converts the backup software commands into QIC-117 commands that the tape drive can understand.

3. The floppy controller converts the QIC-117 commands into signals, and sends the signals over floppy bus control lines to the tape drive.

4. For write commands, the controller sends data to the tape drive's write gap on the head. For read commands, the controller retrieves data from the tape drive's read element.

The following figure shows a close-up view of the head, which contains one write gap and one thin-film Magneto-Resistive read element.



Data Recording

During write operations, the Eagle TR-3 records parallel tracks of data on a formatted tape, as follows:

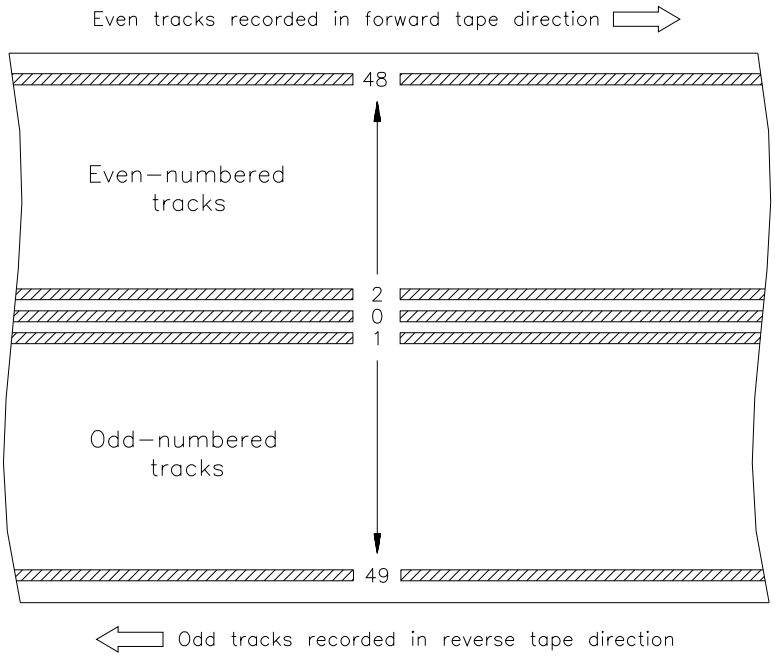
1. The write gap writes the first track, track 0, along approximately the center line of the tape until the drive's sensors detect the tape holes at the end of tape.

2. The head moves down to the next position and the write gap writes track 1 in the reverse direction.

3. The head moves up to the next position and the write gap writes track 2 in the forward direction.

4. The head continues writing data in a serpentine pattern (odd tracks in the reverse direction and even tracks in the forward direction) until there is no more data or it reaches the end.

The figure depicts how tracks are arranged on the tape.



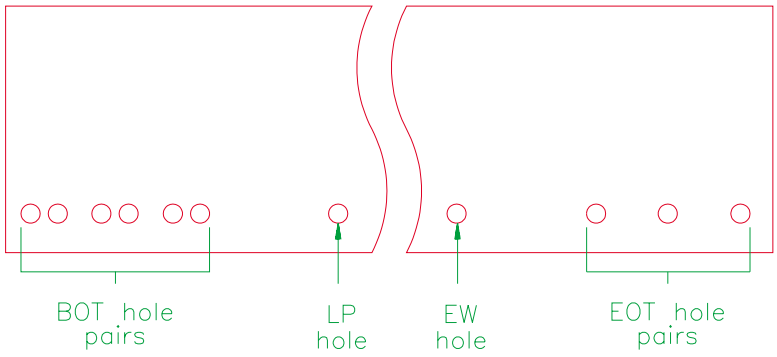
The tape drive records 50 tracks of data on the TR-3, QIC-Wide, and QIC-EXtra 8mm minicartridges. For the MC3000XL and QIC-EXtra quarter-inch minicartridge, it records 40 tracks.

Tape Format

This section describes the physical and logical tape formats.

Physical Tape Format

The figure shows the physical tape markers.

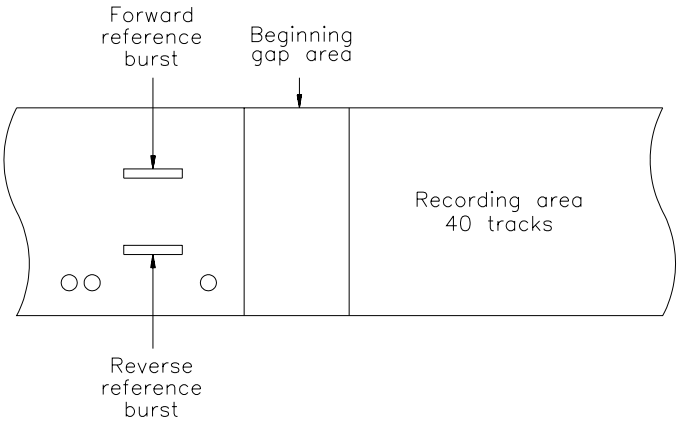


The physical tape markers include:

- **Beginning of tape (BOT)**. Several pairs of holes indicate the physical beginning of tape.
- **Load point (LP)**. This single hole is located after the last pair of BOT holes to indicate the beginning area where data can be written.
- **Early warning (EW)**. This single hole is located before the first EOT hole to indicate that the tape has almost reached the end of the recording area.
- **End of tape (EOT)**. Three EOT holes indicate that the tape has almost reached its physical end.

Logical Tape Format

The figure shows the logical tape areas.



Logical tape areas include:

- **Reference burst**. During a format operation, a forward and a reverse reference burst are recorded between the innermost BOT hole and before the LP hole. The tape drive uses these reference burst signals to properly align the head along the tape when it writes and reads data.

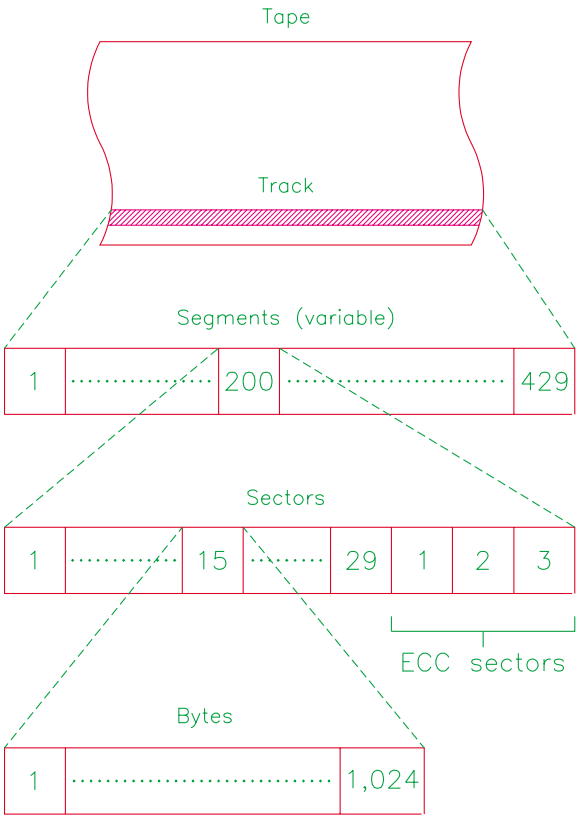
- **Beginning gap**. For even tracks, the beginning gap is an area of erased tape between the LP hole and the recording area. For odd tracks, the beginning gap is between the EW hole and the recording area.

- **Recording area**. The recording area contains up to 40 parallel tracks of data for MC3000XL and QIC-EXtra quarter-inch minicartridges and 50 tracks of data for TR-3, QIC-Wide, and QIC-EXtra 8mm minicartridges. As shown in the figure on the next page, each track is divided into segments (a varied amount, depending on the tape format and length, as described in the following table); each segment is divided into 29 data sectors and 3 ECC sectors; each sector is 1,024 bytes.

Minicartridge	Minimum segments per track[a]
MC3000XL	573 segments
QIC-Wide	
TR-3	1,074 segments
QIC-EXtra	1,432 segments

[a] These are approximate values.

The figure shows the segments, sectors, and bytes in a data track.



Error Detection and Correction

The host computer provides extensive error correction capabilities to allow accurate recovery of data in the presence of media defects, noise, and worn or damaged media. By using the Read-Solomon error correction code (ECC) and a cyclic redundancy check (CRC) calculated by the host computer, the tape drive offers a correctable error rate of one in 1.6×10^7 bits read and a non-recoverable error rate that is better than one in 10^{14} bits read.

The host integrates three ECC sectors in each data segment sent to the tape drive. In addition, the host computer's CRC algorithm can detect errors (but not necessarily correct them) in each data sector.

3 Installation and Operation

This chapter describes the requirements for installing and operating the Eagle TR-3. It also describes preventive maintenance.

Installing the Tape Drive

Installing the tape drive involves the following steps:

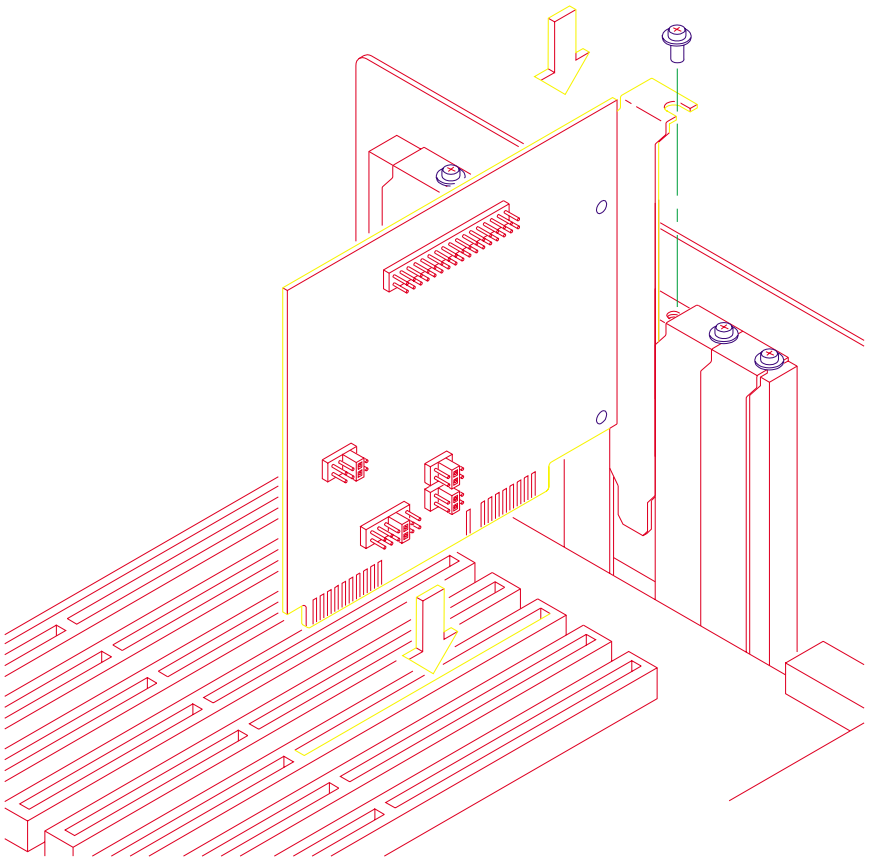
1. Installing the Exabyte Accelerator card (recommended)
2. Connecting the power cable
3. Connecting the data cable
4. Mounting the tape drive

For step-by-step instructions, refer to *Eagle TR-3 Minicartridge Tape Drive Installation*.

Installing the Exabyte Accelerator Card

To increase the tape drive's data transfer rate, install the Exabyte Accelerator card in the computer and connect it to the tape drive. This accelerator card transfers data at 2 megabits per second — twice the speed of most floppy controller cards.

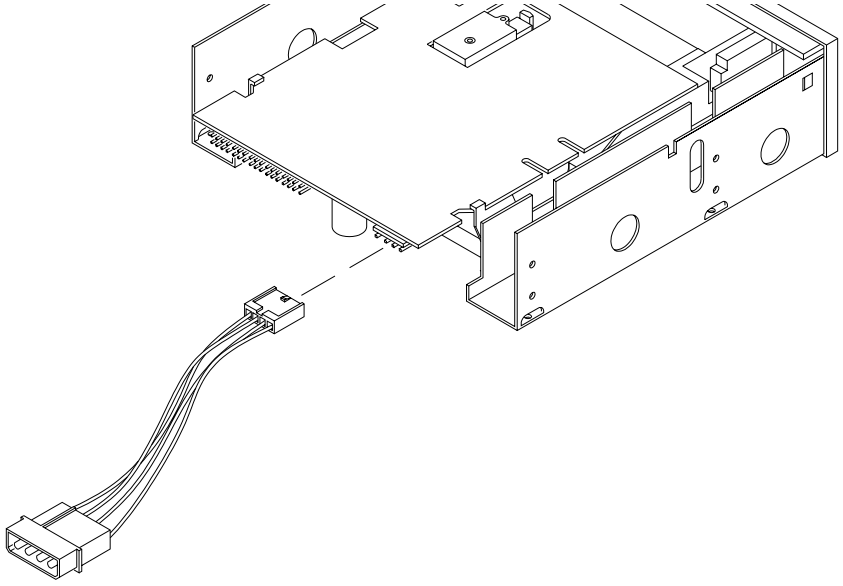
The accelerator card can be installed in an available expansion slot in your computer, as shown below.



Connecting the Power Cable

To provide the tape drive with power, connect an available power lead from the computer's power supply. The power lead must be a cable with a plastic 4-pin connector.

The tape drive includes a 4-pin mini-power connector and a power adapter cable, as shown below.

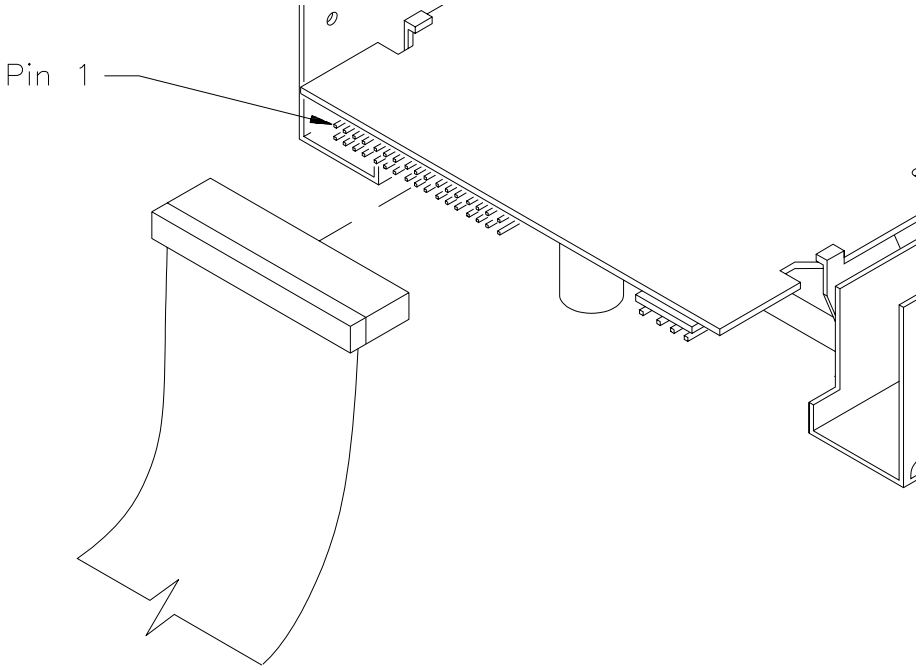


The following table lists the pin assignments for the power connector. The pins are numbered from left to right.

Pin number	Assignment
1	12 VDC
2	12 VDC return
3	5 VDC return
4	5 VDC

Connecting the Data Cable

The tape drive uses a standard 34-pin connector for connecting the data cable between the tape drive and the floppy controller. For connection to a card edge connector cable system, you can order a 34-pin converter plug. When using this optional converter plug, use a mating connector AMP 111111-3 or equivalent.



The data cable used to connect the tape drive and the floppy controller complies with the specifications listed in the table below.

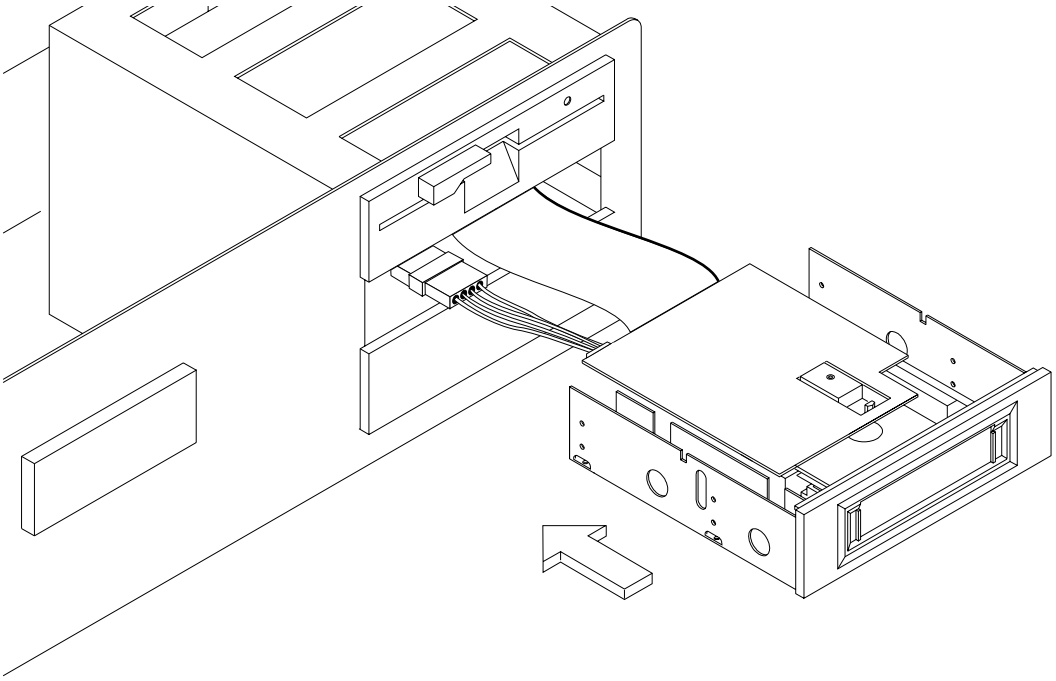
Data cable specifications	+
Type:	34-conductor, AWG #28 ribbon cable that complies with QIC-107
Maximum length:	Six feet
Connector:	Male AMP 746288-8 or equivalent
Maximum connectors:	Five maximum mating connectors for daisy chain installation

The table below provides the pin assignments for the data cable connector.

Data cable connector pin assignments				
Pin No.	**Name**	**Description**	**Direction**	
			to drive	**to controller**
2	/LSD	Not used by drive.	n/a	+
4	/INU			^
6	/DS4			^
8	/IDX	Index Pulse. Initiates and terminates transfer of controller data during a format operation.		✔
10	/DS1	Not used by drive.	✔	
12	/DS2	Drive Select 1. Selects drive with address 1.	✔	
14	/DS3	Drive Select 2. Selects drive with address 2.	✔	
16	/MOT	Not used by drive.	n/a	+
18	/DIR			^
20	/STP	Step. Sends commands to drive.	✔	
22	/WD	Write Data. Sends a pulse per flux transition for MFM encoded data to be recorded on tape.	✔	
24	/WG	Write Gate. Indicates data is to be recorded on tape.	✔	
26	/TK0	Track 00. Transfers drive status to controller.		✔
28	/WP	Write Protect. Transfers write-protect status to controller.		✔
30	/RD	Read Data. Sends data from tape.		✔
32	/SS	Not used by drive.	n/a	+
34	/DC			^
1 — 33 (all odd pins)		Ground.		+

Mounting the Tape Drive

You can mount the tape drive inside a computer system or other enclosure in either a vertical or horizontal position. The figure below shows how to mount the 5.25-inch form factor drive in a horizontal position.



The tape drive is shipped with mounting hardware that extends it to a 5.25-inch, half-high form factor. If you want to use the tape drive in a 3.5-inch, one-inch form factor, remove the mounting hardware.

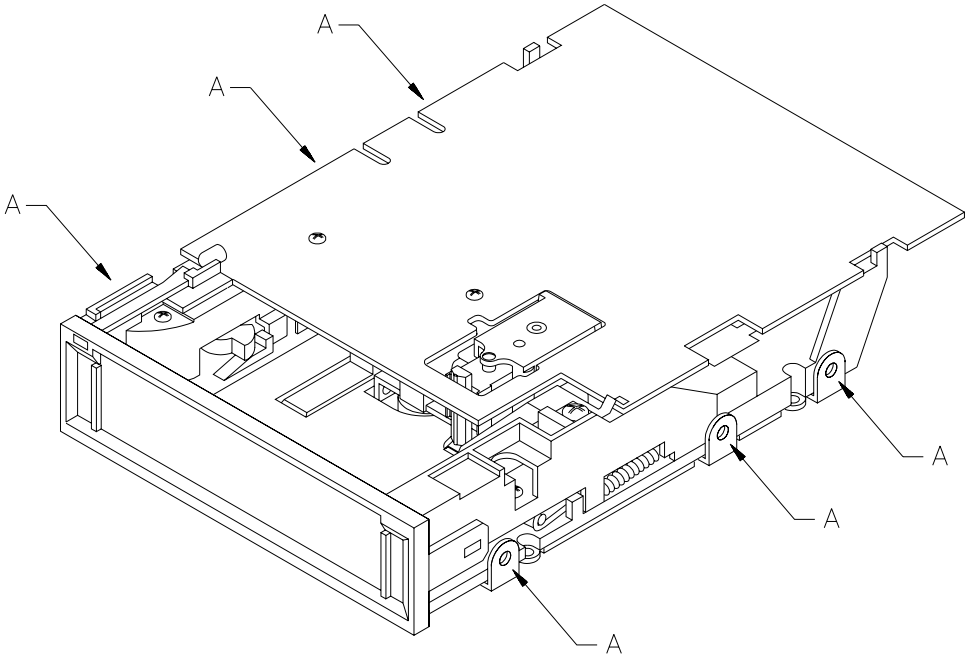
Note: Depending on your computer, you may need additional mounting rails on the tape drive before installing it in the computer bay.

Mounting Hole Locations

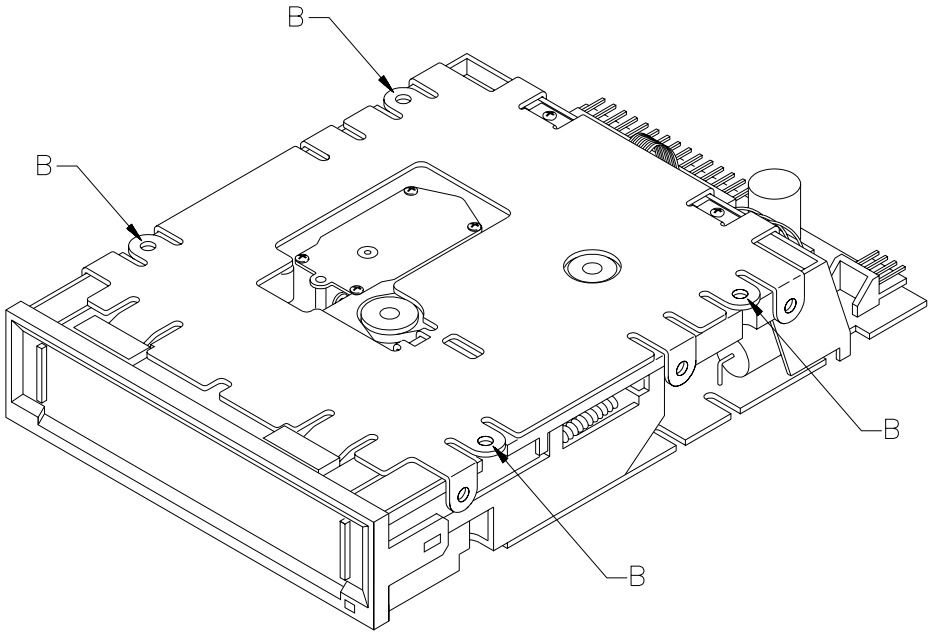
The following figures show the mounting hole locations for the tape drive. When mounting the drive, use the four mounting holes on the sides (shown as “A”) or the three mounting holes on the bottom (shown as “B”).

When mounting the drive from the bottom, you must use 0.020-inch washers to space the drive from the mounting surface. This ensures adequate air circulation.

Side mounting holes:

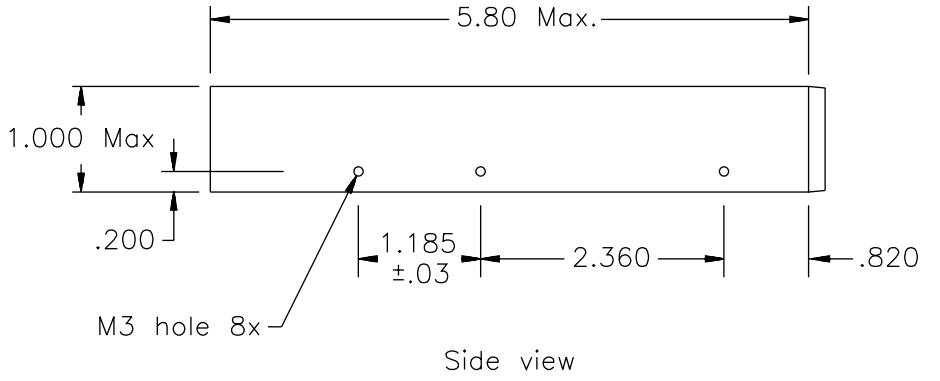


Bottom mounting holes:

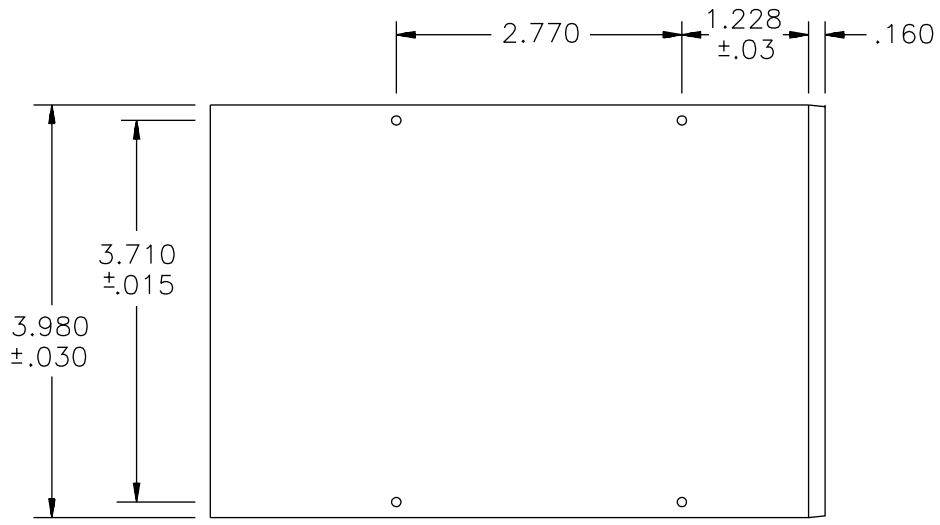


Mounting Hole Dimensions

The mounting holes on the tape drive are designed to accommodate #6-32 ’ ⅜-inch screws and are 0.220 inches deep (minimum).



Side view



Bottom view

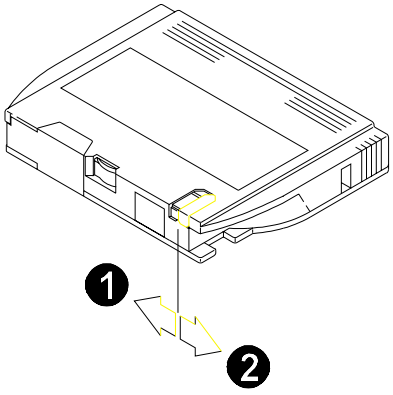
Operating the Tape Drive

Basic tape drive operations include:

- Setting the record tab on the minicartridge
- Loading and unloading minicartridges
- Formatting a minicartridge
- Resetting the tape drive

Setting the Record Tab

The minicartridge includes a record tab to prevent you from unintentionally writing to the tape. Before inserting a minicartridge in the tape drive, ensure that the record tab is positioned correctly for the desired operation (either write-protected or write-enabled), as shown in the figure.



1 Write-protect
2 Write-enable

Loading and Unloading Minicartridges

To load a minicartridge into the tape drive, insert it into the drive door and press firmly until the minicartridge locks into place. Once the minicartridge is inserted, the tape drive rewinds the tape, positions it at the load point, and scans for the reference bursts. The tape drive is then ready to process commands.

Before removing a minicartridge, be sure that the tape drive is idle (the LED is off) and the tape is rewound to the beginning. Remove the minicartridge by pulling it out of the slot.

CAUTION

If you do not rewind the tape before removing the cartridge, the tape drive terminates any command in progress.

Formatting a Minicartridge

You can use the application software to format a minicartridge; however, formatting can take up to 6 hours, depending on the tape format specified and the controller speed. Exabyte strongly recommends that you purchase preformatted minicartridges.

Note: Contact Exabyte to purchase minicartridges already preformatted for the QIC-3020 format.

Resetting the Tape Drive

Occasionally, the tape drive may experience an error that can only be cleared by resetting the tape drive. You can reset the tape drive by either of the following methods:

- Powering the tape drive (or host computer) off and back on again
- Issuing the QIC-117 Soft Reset command

Preventive Maintenance

This section provides some preventive maintenance guidelines for the Eagle TR-3 and the minicartridges.

Note: The tape drive has no user serviceable adjustments or maintenance procedures. All service or repairs must be performed by Exabyte Corporation or authorized service personnel.

Cleaning the Recording Head

Under normal operating conditions, the tape drive's recording head does not require cleaning. However, if you see any performance degradation or if the backup application indicates a higher than expected number of corrections, you can clean the recording head with either of the following:

- Exabyte Cleaning Cartridge (available from your dealer or Exabyte Express)
- Lint-free, chlorine-free swab and 95% isopropyl alcohol (available from a consumer electronics store)

Retensioning a Minicartridge

Retensioning (running the tape from end to end) ensures that the tape is wound at an even tension so that data can be transferred reliably to and from tape. Ideally, you should retension the tape before every backup. Retensioning is especially important when:

- A new minicartridge is first loaded
- One section of the minicartridge has been used frequently
- The minicartridge is exposed to temperature changes of 16°C (30°F) or more
- The minicartridge has been transported or mailed
- The minicartridge has been stored for a year or more
- The minicartridge has been dropped

To retension a minicartridge, insert the cartridge into the tape drive and use the software's retensioning option. (Refer to your software manual for further instructions.) If your software does not provide a retensioning option, use available options to wind the tape from one end to the other and back.

Caring for Minicartridges

To maximize the shelf life of your tapes and ensure data integrity, follow these guidelines when storing minicartridges:

- Place a label or other reference information on the cartridge's plastic cover. **Do not place labels on the metal bottom of the minicartridge.** You may want to label the minicartridge to indicate the backup date and the recording format (QIC-3010 or QIC-3020).
- Store minicartridges with the record tab in the write-protect position. See page 3-9.
- Keep minicartridges in their protective boxes when not in use.
- Do not open the minicartridge's access door or touch the tape.
- Store minicartridges in a cool, non-magnetic environment. Follow the minicartridge manufacturer's specifications for storage temperature and other environmental requirements. Do not allow the temperature and humidity in the storage environment to fluctuate.
- Keep the storage location as free of airborne particulates (for example: smoke, toner, or paper dust) as possible.
- Store minicartridges as soon as possible after you have written data to them. Immediate storage helps avoid many of the conditions that can damage tapes, such as temperature and humidity fluctuation, particulate contamination, and excessive handling.
- Periodically retension the tape. See page 3-11.
- Do not drop the minicartridge.

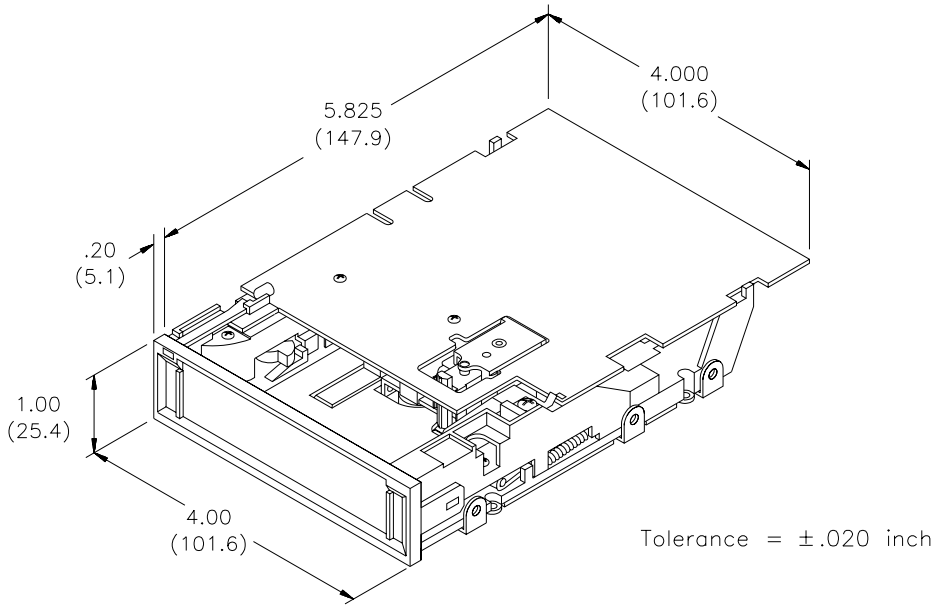
4 Specifications

This chapter describes specifications for the tape drive's physical features, performance, reliability, power, operating environment, and shipping. It also describes safety and regulatory agency standards, and the QIC-117 command set.

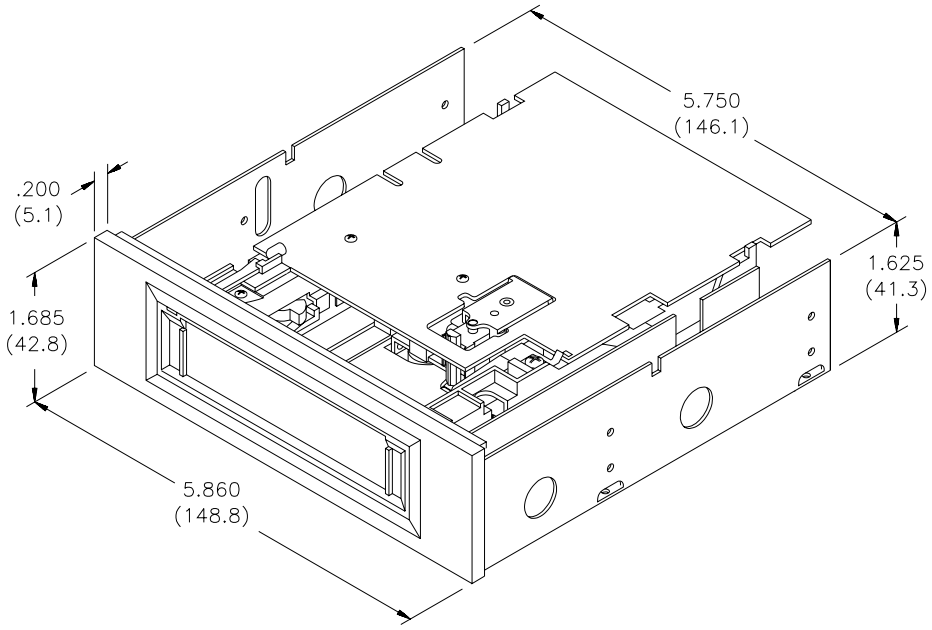
Physical Specifications

Size

The figure below shows the dimensions of the tape drive in its 3.5-inch form factor in inches (and millimeters).



The figure below shows the dimensions of the tape drive's 5.25-inch mounting extension hardware in inches (and millimeters).



Weight

Weight of the tape drive	
3.5-inch form factor:	0.9 pounds (0.4 kg)
5.25-inch form factor:	1.3 pounds (0.6 kg)

Performance Specifications

The tables below list the basic performance and recording specifications for the Eagle TR-3.

Maximum data transfer rates*		
with this type of floppy controller ...	**without software compression**	**with software compression (assumes a 2:1 ratio)**
Exabyte Accelerator card	10 MB/minute	20 MB/minute
1-megabit controller	5 MB/minute	10 MB/minute
500-kilobit controller	2.5 MB/minute	5 MB/minute

*These are approximate values. The actual data transfer rate depends on your system.

Recording specifications		
Specification	**QIC-3010 format**	**QIC-3020 format**
Tape speed	22.6 IPS[a] with 500 Kbits/sec. transfer rate	22.6 IPS with 1 Mbit/sec. transfer rate
	45.2 IPS with 1 Mbit/sec. transfer rate	45.2 IPS with 2 Mbits/sec. transfer rate
Flux density	22,125 FRPI[b]	44,250 FRPI[b]
Recording density	22,125 BPI[c]	44,250 BPI[c]
Areal density	3.54 MB/sq. inch	7.1 MB/sq. inch
Rewind/search speed	90 IPS[a]	
Data tracks	50 tracks: (TR-3, QIC-Wide, QIC-EXtra 8mm) 40 tracks: (MC3000XL, QIC-EXtra quarter-inch)	

[a] Inches per second.

[b] Flux reversals per inch.

[c] Bits per inch.

Reliability Specifications

Reliability specifications include equipment reliability (mean time between failures) and data reliability.

Reliability specifications	
Mean time between failures:	151,000 power-on hours (10% duty cycle)
Life of the head:	Greater than 3,000 tape motion hours
Data reliability: correctable errors	Less than 1 bit in 1.6×10^7 bits read
Data reliability: uncorrectable errors	Less than 1 bit in 10^{14} bits read

Mean Time Between Failures (MTBF)

The mean time between failures (MTBF) value 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.

MTBF Conditions

The MTBF value is determined under the following conditions:

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

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

- The tape drive operates in accordance with the specifications listed in this chapter.
- The minicartridges used comply with the QIC-162 standard.

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 the tape drive
- 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 drives
- 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 Reliability

Data reliability is specified as a bit error rate in units of one error per total number of bits transferred to the host.

Conditions for Data Reliability

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

- The minicartridges used must comply with the QIC-162 standard.
- Minicartridges 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 minicartridges must be maintained as specified on page 4-8.

Restrictions for Data Reliability

The following types of errors are excluded in the determination of data reliability:

- Errors caused by a failure of the tape drive
- Errors caused by faulty or damaged minicartridges 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 sectors other than sectors containing user data

Power Specifications

The following table provides the tape drive's voltage specifications.

Note: All voltages are measured at the tape drive's input power connector.

Voltage specifications					
Nominal voltage	**Voltage tolerance**	**Idle current[a]**	**Streaming current[a]**	**Peak current[b]**	**Voltage ripple**
+5 Volts	± 5%	0.6 amp	0.6 amp	0.8 amp	120 mVpp maximum
+12 Volts	± 10%	0.1 amp	0.7 amp	2.0 amp	120 mVpp maximum

[a] Current at nominal voltage.

[b] Not to exceed 200 ms.

The following table provides the tape drive's power consumption specifications.

Power consumption specifications	
Mode	**Power consumption**
Idle	< 3.2 watts
Streaming	< 12 watts

Environmental Specifications

Environmental specifications include the operating environment, acoustic noise, particulate contamination limits, shock, and vibration.

Operating Environment

The table below shows the environmental specifications.

Environmental specifications	
Operating temperature:	10°C to 45°C (50°F to 113°F)
Maximum rate of change	10°C per hour (18°F per hour)
Non-operating temperature:	
Storage	–22°C to 60°C (–8°F to 140°F)
Transportation	–30°C to 65°C (–22°F to 149°F)
Maximum rate of change	10°C per hour (18°F per hour)
Relative humidity:	
Operating	20% to 80% (non-condensing)
Storage	10% to 90% (non-condensing)
Transportation	5% to 95% (non-condensing) (packaged, maximum one-week)
Maximum dew point:	29°C (79°F)
Altitude:	
Operating	–1,000 to 15,000 feet (–305 to 4,572 meters)
Non-operating	–1,000 to 50,000 feet (–305 to 15,240 meters)
Magnetic field susceptibility:	≤ 5 gauss

Acoustic Noise Limits

The acoustic sound pressure of the tape drive and cartridge do not exceed 50 dBA (A-weighted) sum when the tape drive is operating at 45.2 inches per second.

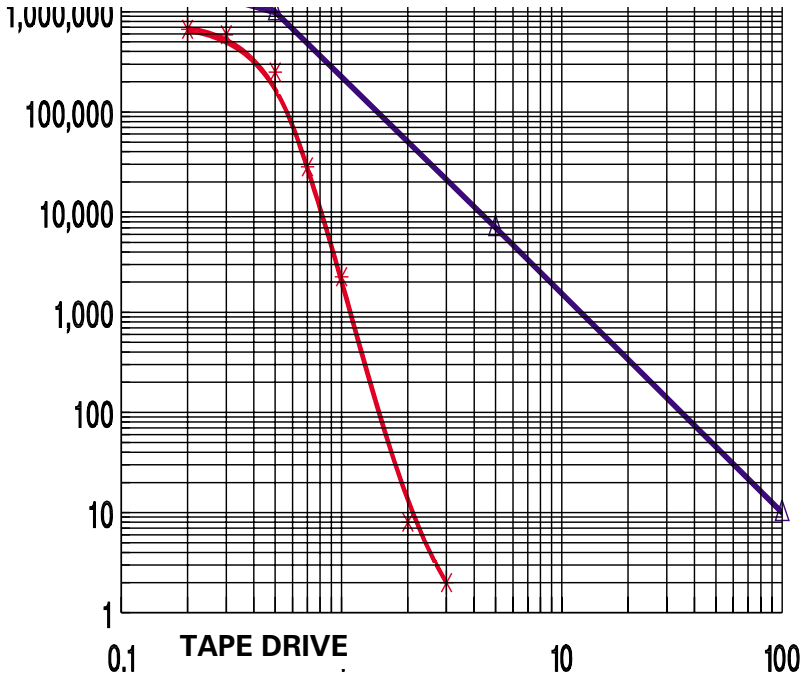
Particulate Contamination Limits

The ambient operating environment should not exceed the particulate counts shown below.

Particulate contamination specifications	+	
Particle size (microns)	**Number of particles [3] Particle size per cubic meter**	**Number of particles [3] Particle size per cubic foot**
0.1	8.8 x 107	2.5×10^6
0.5	3.5×10^7	1.0×10^6
5.0	2.5×10^5	7.0×10^3

The figure on the next page shows the particulate contamination profile of a typical office compared to the specifications for the tape drive. Contamination profiles of individual office areas vary.

Particulate contamination specification vs. typical office:



Shock and Vibration Specifications

The following tables list the shock and vibration specifications for the Eagle TR-3.

Shock specifications			
Operating	**Non operating[a]**	**Transportation[b]**	**Handling**
7 G for 6 ms[c]	50 G for 11 ms[d]	ISTA Project 1A	Drop and Topple per IEC 68-2-31

[a] The tape drive has been unpacked, but no power has been applied.

[b] The tape drive has not been unpacked.

[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 50 G were applied to each of the tape drive's six sides.

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 to 150 Hz	PSD = 0.0003 g^2/Hz
200 to 400 Hz	PSD = 0.00008 g^2/Hz
Random vibration[b] applied during non-operation[c] and transportation[d]	
1 Hz	PSD = 0.0003 g^2/Hz
3 Hz	PSD = 0.00055 g^2/Hz
12 to 100 Hz	PSD = 0.01 g^2/Hz
400 Hz	PSD = 0.000003 g^2/Hz
Transportation[d]	
ISTA Project 1A	
Swept sine applied during non-operation[e] and operation[f]	
5 to 400 to 5 Hz	

[a] A 0.75 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 no power has been applied.

[d] The tape drive has not been unpacked.

[e] Three sweeps at one octave per minute are applied to each axis at 1.5 G (peak) input.

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

Shipping Specifications

The tape drive is sealed in a static protection bag and is shipped with either one drive per carton (single-pack) or three to five drives per carton (multi-pack). The table shows the dimensions and weights of these cartons.

Size	Dimensions	Weight
Single-pack	13.5 inches long 10.75 inches wide 6.12 inches high (34.3 x 27.3 x 15.5 cm)	**With one drive:** 2.3 lbs (1.0 kg)
Multi-pack	18.75 inches long 11.25 inches wide 9.5 inches high (47.6 x 28.6 x 24.1 cm)	**With three drives:** 4.3 lbs (2.0 kg) **With four drives:** 5.2 lbs (2.3 kg) **With five drives:** 6.1 lbs (2.8 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 International Safe Transit Association (ISTA) Project 1A for packaged products weighing less than 100 pounds.

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

Safety and Regulatory Agency Compliance

This section describes the Eagle TR-3's compliance with safety and regulatory agency standards.

Safety Agency Standards

The Eagle TR-3 is certified as a component to the following safety agency standards:

- UL1950, Third Edition, Information Technology Equipment, including Electrical Business Equipment.
- CSA-C22.2 No. 950-95, Third Edition, Safety of Information Technology Equipment, including Electrical Business Equipment.
- EN60950: 1992 + A1, A2 / IEC950: 1991 + A1, A2, Safety of Information Technology Equipment, including Electrical Business Equipment.

Radiated and Conducted Electromagnetic Interference (EMI)

When installed in a suitable EMI-shielded enclosure with proper grounding, the Eagle TR-3 can be expected to comply with the following EMI / EMC levels:

- FCC Rules and Regulations, Part 15 – Radio Frequency Devices: Subpart B, Unintentional Radiators Class B.

  Note: According to FCC regulations, changes or modifications to the Eagle TR-3 that are not expressly approved by Exabyte may void the user's authority to operate the unit.

- CISPR Publication 22, 1985, Class B.
- Canadian Department of Communications (DOC), Radio Interference Regulation, Digital Apparatus, Class B

Electrostatic Discharge (ESD)

The tape drive complies with IEC 801-2, Second Edition 1991-04, Electromagnetic compatibility for industrial-process measurement and control equipment. The tape drive can withstand electrostatic discharges at the following test voltage and performance criteria:

- Up to 8 kilovolts air-gap discharge applied to all non-metallic surfaces accessible during normal use.
- Up to 4 kilovolts direct discharge applied to metallic surfaces accessible during normal use.

In each case, there is no degradation or non-recoverable loss of function due to damage of equipment or firmware.

Radiated Emission Susceptibility (RES)

- IEC 801-3 First Edition 1984 Electromagnetic compatibility for industrial-process measurement and control equipment, Part 3: Radiated electromagnetic field requirements

The tape drive will continue to operate without error when subjected to electromagnetic energy of severity level 2 (3V / m).

Electrical Fast Transients (EFT)

- IEC 801-4 First Edition 1988 Electromagnetic compatibility for industrial-process measurement and control equipment, Part 4: Electrical fast transient / burst requirements

The tape drive will continue to operate without error when subjected to EFT of severity level 2 on the AC power ports of the host computer.

QIC-117 Command Set

The Eagle TR-3 uses the QIC-117 commands listed in the table.

Code	Command name	Description
1	Soft Reset	Resets the tape drive.
2	Report Next Bit	Causes the next bit in the sequence to be reported on the TRACK ZERO line.
3	Pause	Causes the tape drive to pause tape motion, move tape in the logical reverse direction three to four segments, then stop.
4	Microstep Pause	Performs the same functions as the Pause command, except adds a head micro-stepping algorithm, used in off-track recovery.
5	Alternate Command Time-Out	Sets the command time-out interval to 6.5 milliseconds. This time-out remains in effect until a soft reset or a power cycle.
6	Report Drive Status	Reports eight bits of drive status as follows: 0 – drive ready; 1 – error detected; 2 – cartridge present; 3 – cartridge write-protected; 4 – new cartridge; 5 – referenced; 6 – at BOT; 7 – at EOT.
7	Report Error Code	Sends the 8-bit error code and the 8-bit command code associated with the error.
8	Report Drive Configuration	Returns information about the tape drive's hardware configuration.
9	Report ROM Version	Reports the current version of ROM.
10	Logical Forward	Causes the tape to move toward logical EOT. This command terminates when an error is detected, when the tape reaches logical EOT, or when the tape drive receives a Stop, Pause, or Skip command. A read or write command can be issued any time after Logical Forward.
11	Physical Reverse	Causes the tape to rewind at high speed to physical BOT. This command terminates when an error is detected, when the tape reaches physical BOT, or when the tape drive receives a Stop, Pause, or Skip command.
12	Physical Forward	Causes the tape to fast forward toward physical EOT. This command terminates when an error is detected, when the tape reaches physical EOT, or when the drive receives a Stop, Pause, or Skip command.
13	Seek Head to Track	Positions the head on the tape track.
14	Seek Load Point	Moves the tape to BOT. The command then scans reference bursts to calibrate the head position and determine the compatibility mode of the format.
15	Enter Format Mode	Causes the drive to interpret and execute commands in format mode.

Code	Command name	Description
16	Write Reference Burst	Causes the drive to format the load point zone of the tape in accordance with the QIC-3010 or QIC-3020 specification.
17	Set Verify Mode	Places the drive in verify mode, which reduces read margins to a more stringent value.
18	Stop Tape	Causes tape motion to stop.
21	Micro-Step Head Up	These commands can be used by the host software to attempt recovery from suspected off-track conditions that may be causing excessive read and write errors.
22	Micro-Step Head Down	
23*	Soft Select	Selects the tape drive.
24*	Soft Deselect	Deselects a tape drive previously selected with Soft Select or Phantom Select.
25	Skip N Segments Reverse	Moves the tape in the logical reverse direction a given number of tape segments.
26	Skip N Segments Forward	Moves the tape in the logical forward direction a given number of tape segments.
27	Select Rate or Format	Selects the data transfer rate or tape format.
28	Enter Diag. Mode 1	Sets the drive in a diagnostic mode.
29	Enter Diag. Mode 2	
30	Enter Primary Mode	Sets the drive to primary mode.
32	Report Vendor ID	Allows the software to determine the tape drive manufacturer.
33	Report Tape Status	Returns eight bits of information about the type of tape currently in the tape drive and the tape format.
34	Skip N Segments Extended Reverse	Performs the same functions as the Skip N Segments Reverse command, except that it can be used to extend the skip distance.
35	Skip N Segments Extended Forward	Performs the same functions as Skip N Segments Extended Reverse, but operates with motion toward EOT.
36	Calibrate Tape Length	Causes the tape drive to determine the number of segments per track that are available on the tape, based on the current format set by a Select Format command.
37	Report Format Segments	Returns the number of segments per track that the drive will use.
38	Set N Format Segments	Sets the number of segments per track that the drive will use.
46*	Phantom Select	Performs the same function as Soft Select, but allows an address of 0 or 1.
47*	Phantom Deselect	Deselects a drive previously selected with a Phantom Select or Soft Select command.

* The tape drive supports both Soft and Phantom Select/Deselect modes.

Notes

Glossary

BOT Beginning of tape. The three pairs of holes in the tape that indicate the physical beginning of tape.

bpi Bits per inch.

byte Eight bits or one character.

C Celsius (Centigrade).

Canadian DOC Canadian Department of Communications.

CISPR International Special Committee on Radio Interference.

cm Centimeter (0.3937 inches).

CRC Cyclic redundancy check.

CSA Canadian Standards Association.

ECC Error correction code.

EOT End of tape. The three holes in the tape that indicate the physical end of tape.

EW Early warning. A hole in the tape that indicates that the tape is near the physical end.

F Fahrenheit.

FCC Federal Communications Commission.

FRPI Flux reversals per inch. A measurement of the flux density on the tape.

G Gravity. Acceleration due to gravity.

gap An area on the tape head that writes data.

Hz Hertz.

IEC International Electrotechnical Commission.

ISTA International Safe Transit Association.

IPS Inches per second.

Kbit Kilobit.

KB Kilobyte.

LED Light emitting diode.

LP Load point. The physical hole in the tape that indicates where the tape drive can begin writing data.

ma Milliamp.

Mbit Megabit.

MB Megabyte.

MFM Modified Frequency Modulation. A method of encoding data on quarter-inch tape.

MHz Megahertz.

mm Millimeter (0.03937 inches).

ms or msec Millisecond.

MTBF Mean time between failures.

ns Nanosecond.

Oersted A unit of measurement for coercivity.

PSD Power spectral density.

TUV Technischer Uberwachungs-Verein.

UL Underwriters Laboratories.

VAC Volts AC.

VDC Volts DC.

VDE Verband Deutscher Elektrotechniker. (German Association of Electrotechnical Engineers.)

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