
TZ87 Series Cartridge Tape Subsystem Owner's Manual

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NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

Any changes or modifications made to this equipment may void the user's authority to operate this equipment.

The TZ87 shielded interconnect cable as supplied with the unit may not be substituted, nor altered or modified in any way.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

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Preface

Purpose

This manual introduces the TZ87 cartridge tape subsystems and describes the operating procedures the owner or operator needs to be aware of. Also included are suggestions for using the product in the OpenVMS and ULTRIX operating system environments.

Intended Audience

This manual is intended for the TZ87 subsystem owner.

Chapter 1

"About the TZ87 Cartridge Tape Subsystem" briefly describes the TZ87 cartridge tape subsystems. This chapter also describes the CompacTape III and CleaningTape III cartridges, and lists supplies and related documents.

Chapter 2

"Tape Drive Operation" shows the indicators and controls on the TZ87 subsystem and explains their use. This chapter provides a step-by-step explanation of how to operate and clean a TZ87 tape drive.

Chapter 3

"Solving Problems" explains how to identify and resolve problems with your subsystem. This chapter provides symptoms and lists the most likely causes of problems.

Appendix A

"TZ87 Subsystem Specifications" provides a specification listing for the TZ87.

Appendix B

"Standard VMS Commands" describes how to use standard VMS operating system commands with your TZ87 cartridge tape subsystem for optimum operating efficiency.

Appendix C

"Using the TZ87 with the ULTRIX Operating System" describes how to add the TZ87 subsystem to your ULTRIX operating system, how to get maximum capacity and performance from the TZ87 subsystem, and using various ULTRIX commands to save information on the TZ87 subsystem.

Appendix D

"Digital Services" lists the services Digital Equipment Corporation provides to its customers.

About the TZ87 Cartridge Tape Subsystem

1.1 In This Chapter

This chapter gives an overview of the TZ87 cartridge tape subsystem.

Chapter 1 includes the following topics:

Topic	Page
TZ87 Cartridge Tape Subsystem	1-1
Data Tape	1-4
Cartridge Compatibility	1-5
Cleaning Tape	1-7
Supplies	1-8
Related Documents	1-9

1.2 TZ87 Cartridge Tape Subsystem

1.2.1 TZ87 Description

The TZ87 product is a streaming tape drive that can store up to 10.0 GB of data, without compression, and 20 GB of data, with compression, assuming a 2:1 compression ratio on a CompacTape III cartridge.

The TZ87 series of cartridge tape subsystems are used primarily for data backup, for data archiving, and for loading software onto computer systems.

The TZ87 comes embedded in a system enclosure or in a tabletop enclosure with its own power supply. The TZ87 product uses the SCSI bus.

About the TZ87 Cartridge Tape Subsystem

1.2 TZ87 Cartridge Tape Subsystem

1.2.2 Basic Components

The TZ87 subsystem consists of the TZ87 tape drive which has an integrated SCSI controller module.

The TZ87 subsystem connects to the computer system through a SCSI bus attached to the controller module, which is responsible for processing SCSI commands and for initiating operations on the tape drive.

Depending on your host system configuration, the SCSI controller module comes as one of the following two options:

This controller option. . .	For this SCSI cable. . .
Single-ended	6-meter (19-foot), maximum length, single-ended cable (ANSI SCSI standard). This maximum length includes cabling inside cabinets and enclosures.
Differential	Longer differential SCSI cables with better noise immunity, up to a maximum cumulative length of 25 meters (81 feet).

1.2.3 VMS Support

The TZ87 is supported by various VMS versions with certain restrictions (Table 1-1):

About the TZ87 Cartridge Tape Subsystem

1.2 TZ87 Cartridge Tape Subsystem

Table 1-1 TZ87 VMS Restrictions

VMS Version	Restrictions ¹
<5.3	X
5.3	1,2
5.4	1,2
5.4-1	1,2
5.4-2	1,2
5.4-3	2
5.5	2
5.5-1	2
5.5-2	2

¹KEY

X = Not Supported

1 = VMS SHOW DEVICE command indicates "generic SCSI tape" and ERROR LOGGING indicates "GENERIC MK SUBSYSTEM." This has little impact on most applications.

2 = Writing Compactape III TK85 and TK86 media format is supported by the front panel, but is not supported from the command line interface since operating system support of density selection is not available.

1.2.4 Performance Consideration

The VMS backup performance rate achieved with your TZ87 subsystem can depend on a number of considerations, including your system processor. For example:

- Connecting directly to an embedded bus adapter on such systems as the VAXstation 4000-60, -90, MicroVAX 3100-30, -40, -80, DEC 3000-400, -500 and DEC 4000-6x0 provides optimum performance.
- Connecting to a MicroVAX/VAXserver 3xxx (Q-bus) system with a KZQSA adapter can reduce the rate of performance but does not limit the drive's high capacity of data storage.
- Other factors that can determine the performance of the TZ87 subsystem include: operating system configuration, backup user account configuration tuning, the backup utility used, the options selected on the backup utility, file system throughput, file fragmentation, block size, compression (on /off), data type (if compression is enabled), the amount of CPU memory

About the TZ87 Cartridge Tape Subsystem

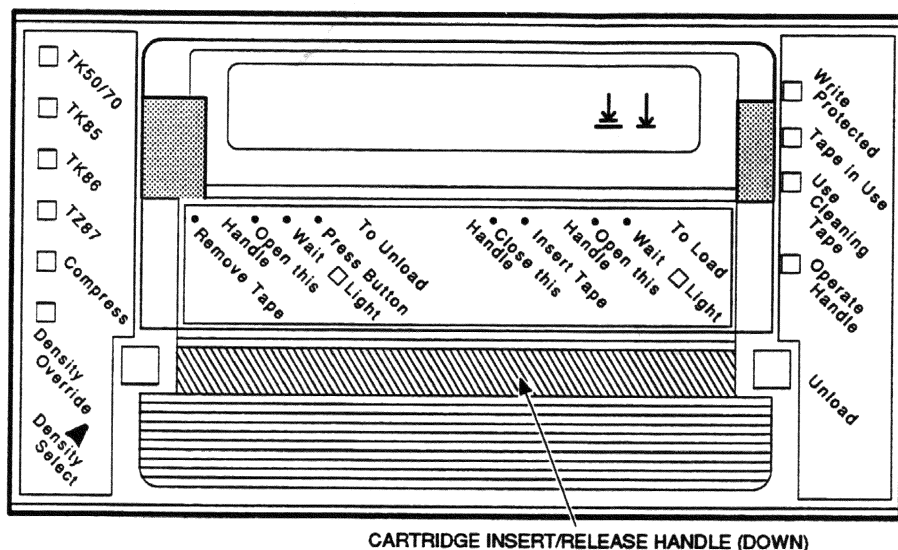
1.2 TZ87 Cartridge Tape Subsystem

available, and I/O channel bandwidth. See Appendices B and C for more information on some of these considerations.

1.2.5 TZ87 Front Panel

Figure 1-1 shows the front panel of the TZ87 cartridge tape subsystem:

Figure 1-1 Front Panel



ZKO-1217-27-DG

1.3 Data Tape

1.3.1 CompacTape III Description

The CompacTape III is a 4-1/8-inch square, dark gray, plastic cartridge containing 1200 feet of 1/2-inch magnetic, metal particle (MP) tape.

1.3.2 Cartridge Packaging

Your CompacTape III is supplied with a:

- Set of slide-in labels for cartridges
- Cartridge handling information sheet

1.3.3 Reading and Writing Data

The TZ87 tape drive writes 64 pairs of tracks—128 tracks total—on the CompacTape III. The drive reads and writes data in a two-track parallel, serpentine fashion, traveling the entire length of tape on two tracks (at about 110 inches per second). The drive then steps the head and reverses tape direction and continues to read/write on the next two tracks.

1.3.4 Write-Protecting Data

The CompacTape III cartridge has a write-protect switch to prevent accidental erasure of data (see Section 1.3.5). When the switch is moved to the left and the small orange rectangle is visible, data cannot be written to the tape. Beneath the orange rectangle is an arrow over two lines on the write-protect switch. The arrow over the two lines symbolizes data cannot be written to the tape.

On the right side of the write-protect switch is another symbol, an arrow over one line. The symbol indicates if the write-protect switch is moved to the right, data can be written to the tape.

1.3.5 CompacTape III Diagram

Figure 1-2 shows the CompacTape III cartridge and its write-protect switch.

1.4 Cartridge Compatibility

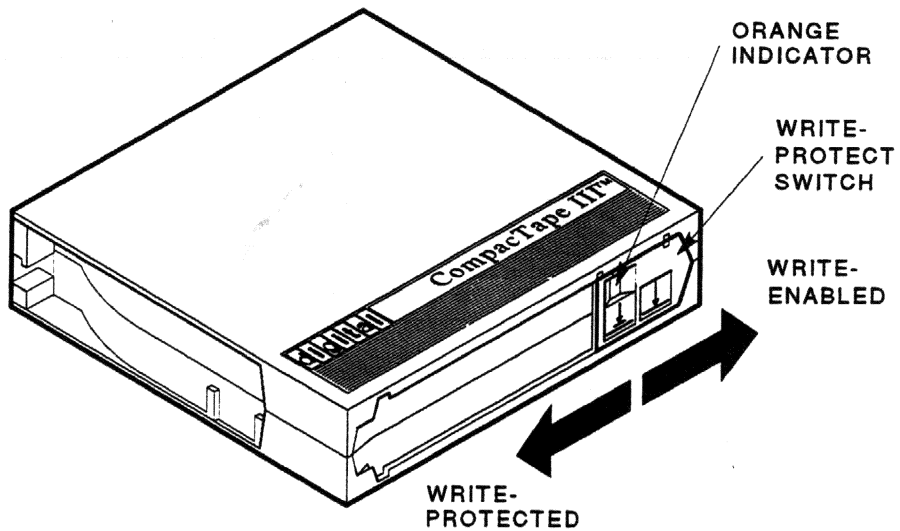
1.4.1 Comparison of Read/Write Ability

The following table shows cartridge compatibility with the TZ87 tape drive:

About the TZ87 Cartridge Tape Subsystem

1.4 Cartridge Compatibility

Figure 1-2 CompacTape III Cartridge



SHR_X1020C_89

About the TZ87 Cartridge Tape Subsystem

1.4 Cartridge Compatibility

Cartridge Type/Format (Capacity)	Read/Write Ability in the TZ87
CompacTape/TK50 (95 MBF)	Read only
CompacTape II/TK70 (296 MBF Mode)	Read only
CompacTape III/TK85 (2.6 GBF Mode)	Read/write in 85 Mode ¹
CompacTape III/TK86 (6.0 GBF Mode)	Read/write in 86 Mode ¹
CompacTape III/TZ87 (10.0 GBF, 20.0 GBF assumes 2:1 compression)	Read/write in 87 Mode ¹
CompacTape III/Blank	Read/write in 85 ² , 86 ² , or 87 Mode, as selected

¹Recording format can be changed to that of 85, 86, or 87 mode on a write from BOT

²Read/write, backward compatible with drive of selected density

1.5 Cleaning Tape

1.5.1 CleaningTape III Description

The CleaningTape III is a 4-1/8-inch square, light yellow, plastic cartridge containing 1200 feet of 1/2-inch cleaning tape. See Table 2-7 for information on using the CleaningTape III.

1.5.2 Cartridge Packaging

Your CleaningTape III is supplied with a:

- Slide-in label that has 20 boxes, each for marking a check after cartridge use (see Section 1.5.3)
- Cartridge handling information sheet

1.5.3 Cartridge Expiration

You can use the CleaningTape III cartridge approximately 20 times before it expires. The word *expire* does not pertain to an expiration date. *Expire* means no unused cleaning area is left on the tape.

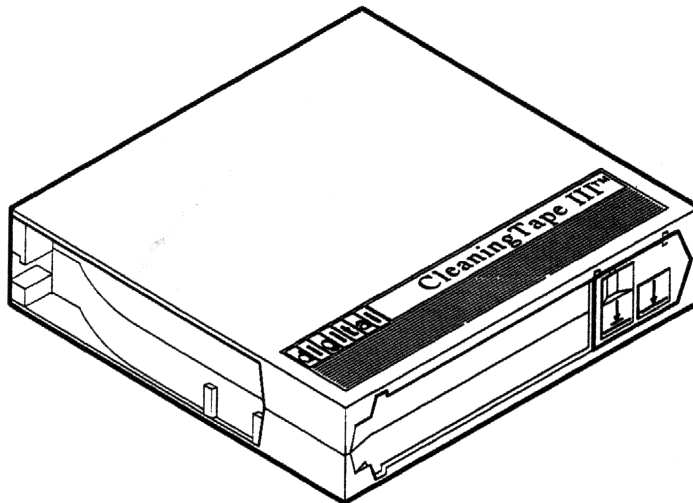
To record the number of uses, mark a check in one box on the cartridge label after each cleaning. After the final use, discard the cleaning tape cartridge.

Figure 1-3 shows the CleaningTape III:

About the TZ87 Cartridge Tape Subsystem

1.6 Supplies

Figure 1–3 CleaningTape III Cartridge



SHR_X1020E_89

1.6 Supplies

1.6.1 Cartridges Provided

One CompacTape III cartridge and one CleaningTape III cartridge ship with the TZ87 subsystem.

1.6.2 How To Order

You can order additional cartridges by contacting your Digital sales representative or by calling Digital's DECdirect ordering service at 1-800-DIGITAL.

The following table lists cartridges with order numbers for the TZ87 subsystem:

Order Number	Description
TK85-HC	CleaningTape III Cartridge.
TK85K-01	CompacTape III Cartridge.
TK85K-07	CompacTape III data cartridge (quantity, 7)
TK85K-A0	CompacTape III data cartridge (quantity, 1008)

1.7 Related Documents

1.7.1 For More Information

The following documents provide more information on the TZ87 products and how to best utilize their capabilities:

Order Number	Title
AA-Z407B-TE	<i>VAX/VMS Backup Utility Reference Manual</i>
AI-Y506B-TE	<i>Guide to VAX/VMS Disk and Magnetic Tape Operations</i>
AA-Z424A-TE	<i>VAX/VMS Mount Utility Reference Manual</i>
EK-OTZ87-OM	<i>TZ87 Cartridge Tape Subsystem Owner's Manual</i>
EK-OTZ87-RC	<i>TZ87 Tape Drive Operator's Reference Card</i>

Tape Drive Operation

2.1 In This Chapter

Chapter 2 includes the following main topics and sections:

Topic	Section
Before You Install	Section 2.2
Overview of the Front Panel	Section 2.3
Description of Controls and Indicators	Section 2.4
Description of the Tape Cartridge	Section 2.5
Loading a Cartridge	Section 2.6
Using the CleaningTape III	Section 2.7
Unloading a Cartridge	Section 2.8
Preserving Cartridges	Section 2.9

2.2 Before You Install

You must perform the following procedures before you are ready to install the TZ87 subsystem.

2.2.1 Disabling Parity Checking

If your host system does not generate SCSI Bus parity, you must disable parity checking in the TZ87 subsystem by adding a jumper to the SCSI ID connector on the left side of the TZ87 drive-controller board (Figure 2-1).

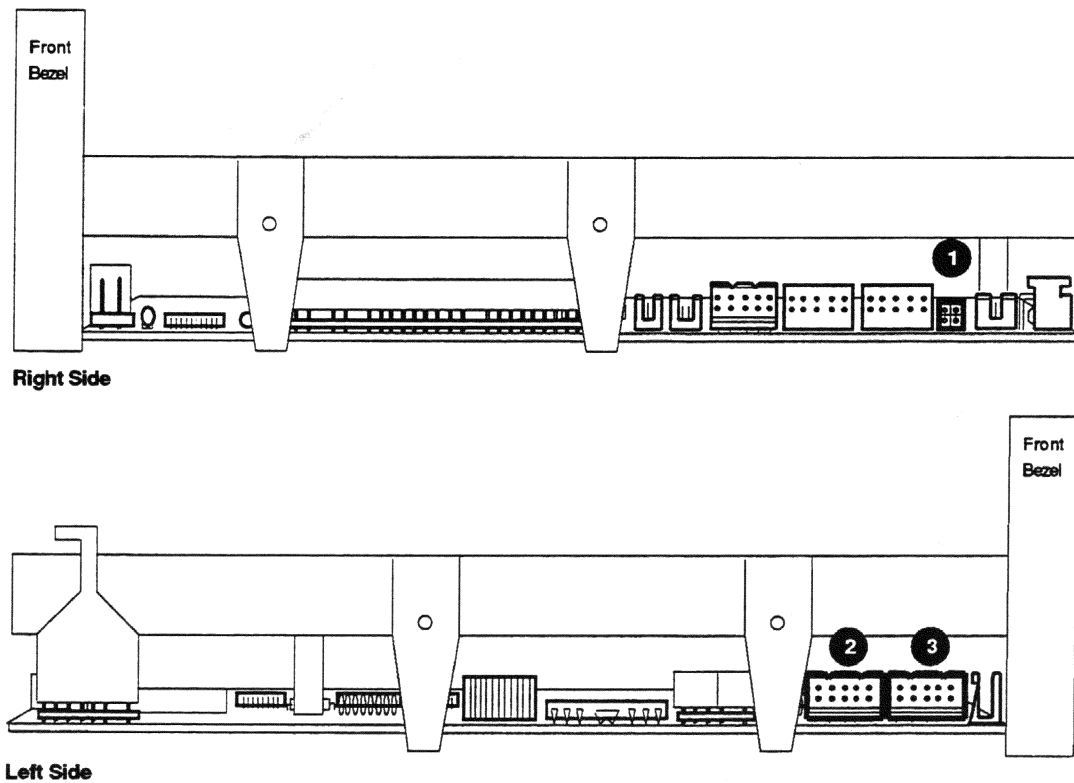
Tape Drive Operation

2.2 Before You Install

To disable parity:

1. Use Figure 2-1, Number ❷, to locate the SCSI ID connector on the drive.

Figure 2-1 TZ87 Drive Connectors

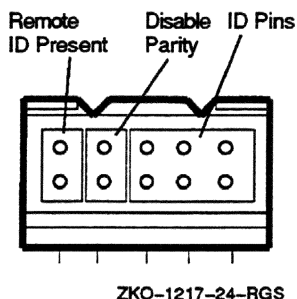


ZKO-1217-17-RGS

- ❶ TRM PWR/TRM ENB Connector
- ❷ SCSI ID Connector
- ❸ Loader Connector

Figure 2-2 shows what the pins on the SCSI ID connector represent.

Figure 2-2 SCSI ID Connector Pins



NOTE

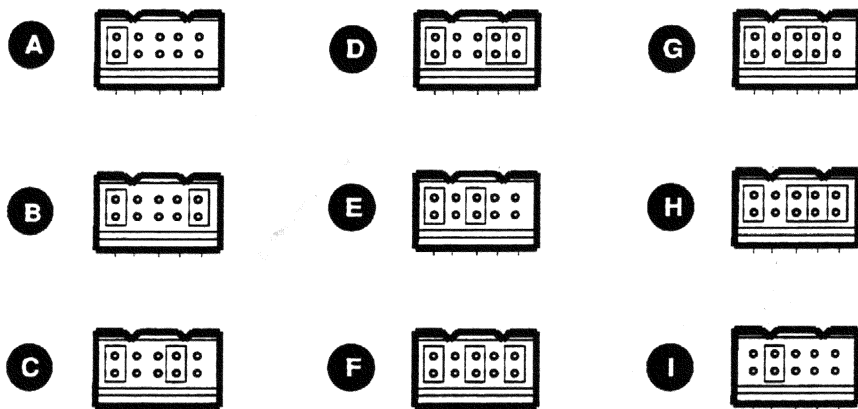
A jumper must always be placed on the Remote ID Present position (Figure 2-2) for the host to recognize any ID selection on this connector. The default ID is factory set at 5.

2. Place the jumper in the disable parity check position, as shown in Letter I, Figure 2-3.

Tape Drive Operation

2.2 Before You Install

Figure 2-3 Jumper Positions



ZKO-1217-19-RGS

A. SCSI ID 0

D. SCSI ID 3

G. SCSI ID 6

B. SCSI ID 1

E. SCSI ID 4

H. SCSI ID 7

C. SCSI ID 2

F. SCSI ID 5

I. Disable parity checking. The jumper goes in this position with any SCSI ID you choose.

2.2.2 Changing the SCSI ID

The drive is shipped with SCSI ID 5. You can change the SCSI ID by adding jumpers to the drive's SCSI connector (Figure 2-1).

To change the SCSI ID:

1. Use Figure 2-1, Number ②, to locate the SCSI ID connector on the drive.
2. Choose a SCSI ID from 0 to 7.
3. Use Figure 2-1 to see where to place the jumpers for the ID you choose. For example, if you chose SCSI ID 1, place the jumpers in the same positions as those in Letter B.

2.2.3 Setting the TRM ENB/TRM PWR Jumpers

Note

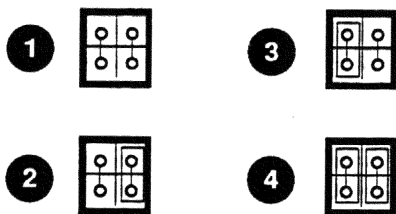
The Small Computer System Interface (SCSI) bus must be terminated at both ends of the bus, and at least one device must supply terminator power.

The TZ87 controller module has active terminators. You can configure the TZ87 drive to supply termination power and termination on the bus.

To supply terminator power and provide termination for the SCSI bus:

1. Use Figure 2-1, Number ❶, to locate the TRM PWR/TRM ENB connector on the drive.
2. Place jumpers in the positions shown in Figure 2-4, Number ❹.

Figure 2-4 Jumper Settings for TRM PWR/TRM ENB Connector



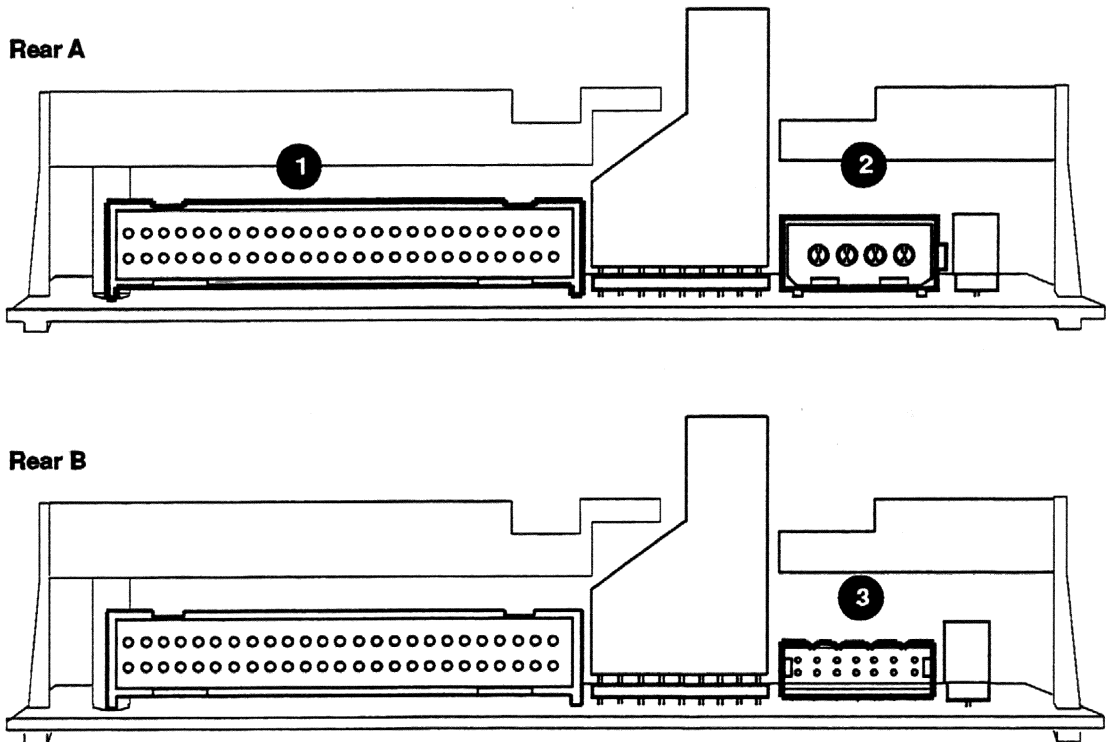
ZKO-1217-18-RGS

-
- | | |
|---|--|
| ❶ No Term Power/Disable
Active Termination | ❸ Term Power/Disable
Active Termination |
| ❷ No Term Power/Enable
Active Termination | ❹ Term Power/Enable
Active Termination |
-

2.2.4 Locating the SCSI and Power Connectors

To install the TZ87 drive, note the location of the rear connectors (Figure 2-5).

Figure 2-5 TZ87 Drive Rear Connectors



ZKO-1217-16-RGS

① SCSI Connector

② Power Connector

**③ Power Connector
(StorageWorks Option)**

Tape Drive Operation

2.2 Before You Install

2.2.5 Selecting Density

This section describes the drive's density select features.

CAUTION

If you reuse a prerecorded tape and write from beginning of tape (BOT), all prerecorded data is lost. This includes density changes, since they only occur when writing from BOT.

2.2.6 How to Select Density at the Front Panel

To select density with the TZ87:

1. Insert the tape into the drive. The yellow Tape in Use indicator blinks while the tape loads and calibrates.
2. After calibration completes, the yellow Tape in Use indicator remains lit.
3. Press the Density Select switch once to enter the density select mode. The Density Override indicator and the indicator of the tape's actual density lights.
4. Press the Density Select switch again to toggle through the different density options. Stop when you reach the selected density. The selected density indicator blinks and the tape's actual density indicator remains steady.
5. After the tape is written to in the selected format, the selected density indicator lights steadily, and the previous density indicator shuts off.

2.2.6.1 Density Select Example

If you have installed a tape with a prerecorded TK85 density and you use the density selection button to select TZ87 density, you should observe the following:

- The TK85 indicator remains lit, indicating that the density selection of the current tape has not changed yet
- The TZ87 indicator blinks, indicating that a density change is pending
- The density override indicator is lit, indicating that a density selection has been made from the front panel

When a write from BOT occurs, you will observe the following:

- The TK85 indicator goes off,

- The TZ87 indicator becomes steady
- The density override indicator remains lit

2.2.7 Density Selection Rules

Density selection occurs according to the following rules:

READ WRITE APPEND

The density selected will reflect the density of the tape already in the drive.

WRITE from BOT

The density selected may occur via:

- Use of the front panel Density Select button. Using the Density Select button always overrides a selection.
- Programmable host commands at the operating system.
- However, if neither condition 1 or 2 exists, the density selected is the native default, TZ87 mode, (compression enabled).

Caution

Regardless of the operating conditions, a write from BOT destroys existing data on the tape.

Note

You can use the drive's control panel at various times, not just after loading a tape. Density selection will be inactive until a write command is issued (at BOT). The controller remembers the density selection state until you do one of the following:

- Change the density selection.
 - Unload the tape.
-

Tape Drive Operation

2.2 Before You Install

Table 2-1 Results of Density Selection

If . . .	Then . . .
You did not use the density select button	The indicators show the actual density when the tape is reading and writing. The drive density indicators light steadily and the density override indicator is off.
You used the density select button, and if the actual tape density is the same as the density you selected	The indicator for both the actual density and density override indicators are lit. For example, if the actual tape density is TZ87 and the selected tape density is TZ87, then the indicator next to TZ87 lights.
You used the density select button, and if the actual tape density differs from the density selected:	<ol style="list-style-type: none">1. The density override indicator lights steadily.2. The indicator next to the actual density lights steadily.3. The indicator next to the requested density blinks. <p>For example if the actual tape density is TZ87 and the selected density is TK86, the TZ87 indicator lights steadily, the TK86 indicator blinks, and the density override indicator remains steady. After writing begins, the TZ87 indicator turns off, the TK86 indicator lights steadily and the density override indicator lights steadily.</p>

2.3 Overview of the Front Panel

The TZ87 has the following indicators and controls for operating the subsystem (Figure 2-6):

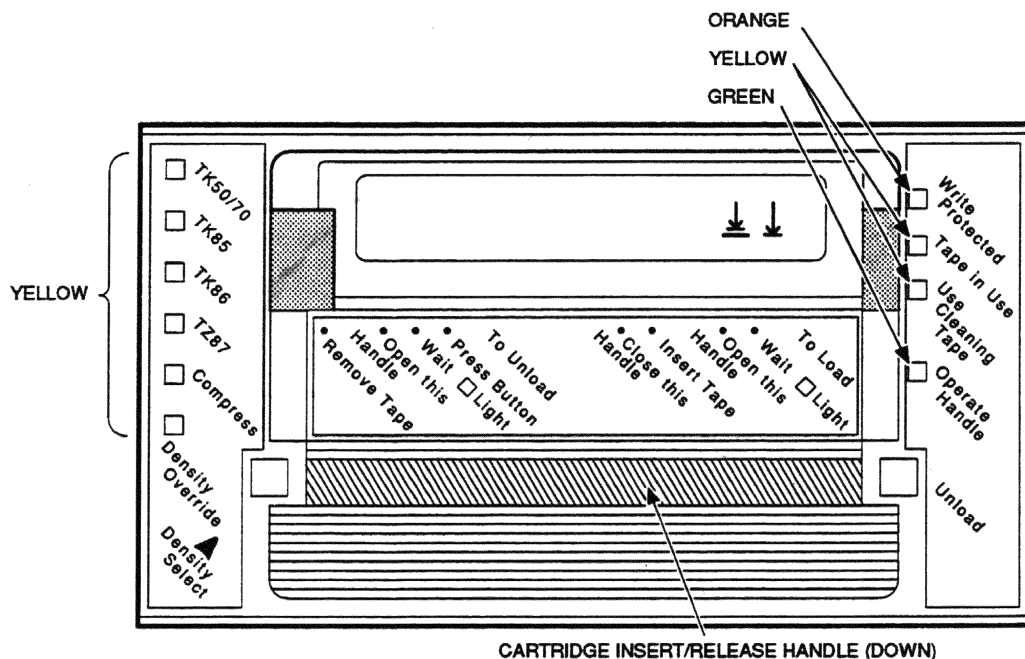
Indicators (Left Side of Drive)	Indicators (Right Side of Drive)
Density indicator(s) (TK50/70, TK85,TK86,or TZ87)	Write Protected
	Tape in Use
	Use Cleaning Tape
Compression indicator	Operate Handle
Density Override indicator	Beeper (audible) not visible
Density Select button	Unload button

Figure 2-6 shows the TZ87 product front panel indicators and controls.

Tape Drive Operation

2.3 Overview of the Front Panel

Figure 2-6 TZ87 Indicators



ZKO-1217-28-DG

2.4 Description of Controls and Indicators

Section 2.4 includes the following sections:

Topic	Section
Beeper	Section 2.4.1
Unload Button	Section 2.4.2
Cartridge Insert/Release Handle	Section 2.4.3
Running Power-on Self-test	Section 2.4.4

2.4.1 Beeper

A momentary beeper sounds when you can operate the cartridge insert/release handle. When you hear the beep, the green light is on.

2.4.2 Unload Button

The Unload button rewinds the tape and unloads the tape from the drive back into the cartridge. The tape must be completely rewound and unloaded into the cartridge before you remove the cartridge from the drive. Depending on tape position, an unload operation may take from 10 seconds to 2 minutes.

The unload button is used primarily when the user wants to unload the tape. When the user pushes the unload button, the TZ87 flushes any buffered write data to the media before beginning the unload sequence.

If the drive is in error state (all four front panel lights flashing), pushing the unload button causes the drive to reset and unload the tape if possible.

2.4.3 Cartridge Insert/Release Handle

Operate the cartridge insert/release handle to load a cartridge or to eject a cartridge only when the Operate Handle indicator is on, and after the momentary beep sounds. The handle lifts to the open position and lowers to the closed position. See Section 2.6 and Section 2.8 for the operating procedures.

2.4.4 Running Power-on Self-test

When the subsystem is powered up, the drive performs the power-on self-test (POST). The sequence of events is:

Stage	What Happens
1	The lights on the right front panel turn on sequentially, from top to bottom. All lights stay on for a few seconds.
2	All lights on the left front panel turn on at the same time for about three seconds and then turn off.
3	The green Operate Handle, the orange Write Protected, and the yellow Use Cleaning Tape lights turn off. The yellow Tape in Use light blinks while the tape drive initializes.
4	After initialization, the drive is in one of the following four states:

Tape Drive Operation

2.4 Description of Controls and Indicators

If...	Then...
a. No cartridge is present	<ol style="list-style-type: none"> 1. The yellow Tape in Use light turns off 2. The green Operate Handle light turns on 3. The handle is unlatched 4. The drive beeps momentarily <p>You can now raise the handle and insert a cartridge.</p>
b. A cartridge is present and the handle is down	The drive loads the cartridge. When the yellow Tape in Use light stops blinking and stays on, the light of the tape's actual density lights. For example, if the actual tape density is TK85, then the light turns on next to the TK85 label. When Density Override blinks, you can now select a density. The drive is ready for use. (See Selecting Density Section 2.2.5.)
c. A cartridge is present, but the handle is up (not recommended)	The yellow Tape in Use light turns off. The green Operate Handle light flashes. When you lower the handle, the cartridge loads.
d. The drive detects an error condition	Then all right or left side lights blink repeatedly. You may try to unload the tape and reinitialize the drive by pressing the Unload button or turn drive power off and then on again. The right or left side lights stop blinking and the drive tries to reinitialize. The lights turn on steadily again and go off if the test succeeds.

POST completes in about 13 seconds and the subsystem responds normally to all commands. However, it might take longer for the media to become ready. After a bus reset, the tape drive responds within a bus selection timeout period.

Use Table 2-2 and Table 2-3 to determine the drive's operating condition:

Table 2-2 Right Front Panel

Label	Color	State	Operating Condition
Write Protected	Orange	On Off	Tape is write-protected. Tape is write-enabled.
Tape in Use	Yellow	Blinking On	Tape is moving. Tape is loaded; ready for use.

(continued on next page)

Tape Drive Operation

2.4 Description of Controls and Indicators

Table 2-2 (Cont.) Right Front Panel

Label	Color	State	Operating Condition
Use Cleaning Tape	Yellow	On	Drive head needs cleaning, or the current data cartridge is bad (Section 2.7).
		Remains on after you unload the cleaning tape	Cleaning tape attempted to clean the drive head, but the tape expired, so cleaning was not done.
		After cleaning, turns on again when you reload the data cartridge	Problem data cartridge. Try another cartridge.
		Off	Cleaning is complete, or cleaning is unnecessary.
Operate Handle	Green	On	Okay to operate the cartridge/insert release handle.
		Off	Do not operate the cartridge insert/release handle.
All left side or right side front panel indicators	-	On	Power-on self-test is starting.
		Blinking	An error has occurred. Press the Unload button or turn drive power off and then on again to clear the error.

Tape Drive Operation

2.4 Description of Controls and Indicators

Table 2-3 Left Front Panel

Label	Color	State	Operating Condition
TK50/70	Yellow	On	Indicates tape is recorded in TK50 or TK70 format.
TK85	Yellow	On	Indicates tape is recorded in TK85 format.
		Blinking	Indicates tape is recorded in another density. You selected this density for a write from BOT.
TK86	Yellow	On	Indicates tape is recorded in TK86 format.
		Blinking	Indicates tape is recorded in another density. You selected this density for a write from BOT.
TZ87	Yellow	On (default)	Indicates tape is recorded in TZ87 format.
		Blinking	Indicates tape is recorded in another density. You selected this density for a write from BOT.
Compress	Yellow	On	Compression mode enabled. (Compression can be done in TZ87 density only.)
		Off	Compression mode disabled.
Density Override	Yellow	On	A density selection has been set from the drive's front panel.
		Off (default)	Density selection is under host control or automatic.
		Blinking	You are in density selection mode

2.5 Description of the Tape Cartridge

The tape cartridge is a 4-1/8 inch, gray, plastic cartridge containing 1200 feet of 1/2 inch magnetic metal particle tape.

The medium is a half-inch cartridge or ANSI-compatible equivalent. It is written and read using the interchange format as proposed in the applicable pending ANSI X3B5 project.

2.5.1 Cartridge Write-Protect Switch

The tape cartridge has a **write-protect switch** to prevent accidental erasure of data. Before loading the tape cartridge into the drive, position the write-protect switch on the front of the cartridge (Figure 2-7). The switch can move to the:

- **Left**, so the cartridge is **write-protected**
- **Right**, so the cartridge is **write-enabled**

When you slide the switch to the left, the small orange rectangle is visible. This means data cannot be written to the tape. The arrow (beneath the orange rectangle and over the two lines on the write-protect switch) lets you know that data cannot be written to the tape.

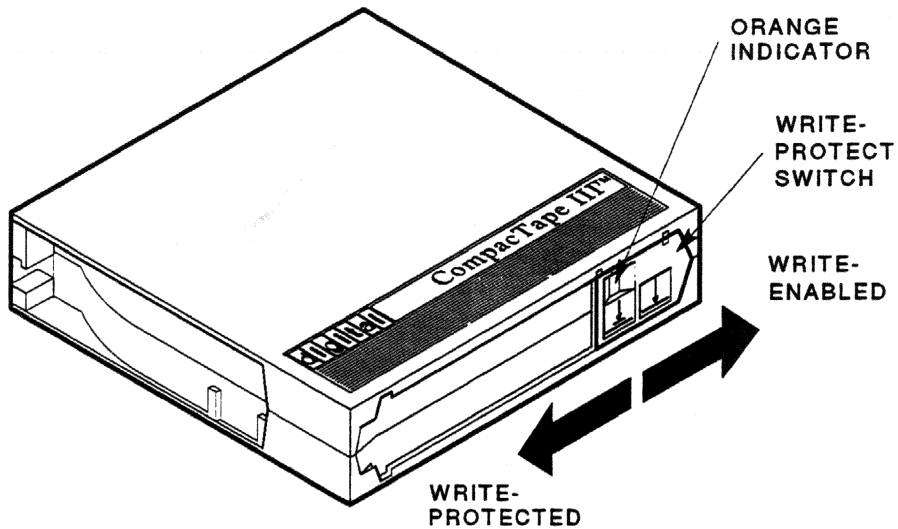
On the right side of the write-protect switch is another symbol: an arrow over one line. This symbol indicates that if you slide the write-protect switch to the right, data can be written to the tape.

Figure 2-7 shows the write-protect switch on the tape cartridge:

Tape Drive Operation

2.5 Description of the Tape Cartridge

Figure 2-7 Tape Cartridge



SHR_X1020C_89

2.5.2 Data Protection

If you move the cartridge write-protect switch to the left, the drive turns on the write protect LED immediately. However, if the drive is writing to the tape, the write protect does not take effect until the write is completed.

Table 2-4 describes what happens to data protection when you move the write-protect switch before loading the cartridge:

Table 2-4 Before Loading the Cartridge

If you move the write-protect switch. . .	Then. . .
To the left, the tape is write-protected, with the orange indicator showing	You cannot write data to the tape.
To the right, the tape is write-enabled	You can write data to the tape (if it is not software write-protected).

Table 2-5 describes what happens to data protection when you move the write-protect switch during operation:

Table 2-5 After Loading the Cartridge and Operating

If you move the write-protect switch. . .	Then. . .
From the write-protected position to the write-enabled position	The tape becomes write-enabled after a variable amount of time (on order of seconds).
From the write-enabled position to the write-protected position	The tape becomes write-protected after a variable amount of time (on order of seconds).

2.6 Loading a Cartridge

The directions for loading a cartridge into and unloading a cartridge from the drive are printed on the front of the drive.

The following are more detailed steps for loading a cartridge (Figure 2-8):

1. When the green light is on steadily, pull the cartridge insert/release handle open.
2. Insert the cartridge.
3. Push the cartridge into the drive.
4. Push the handle closed.

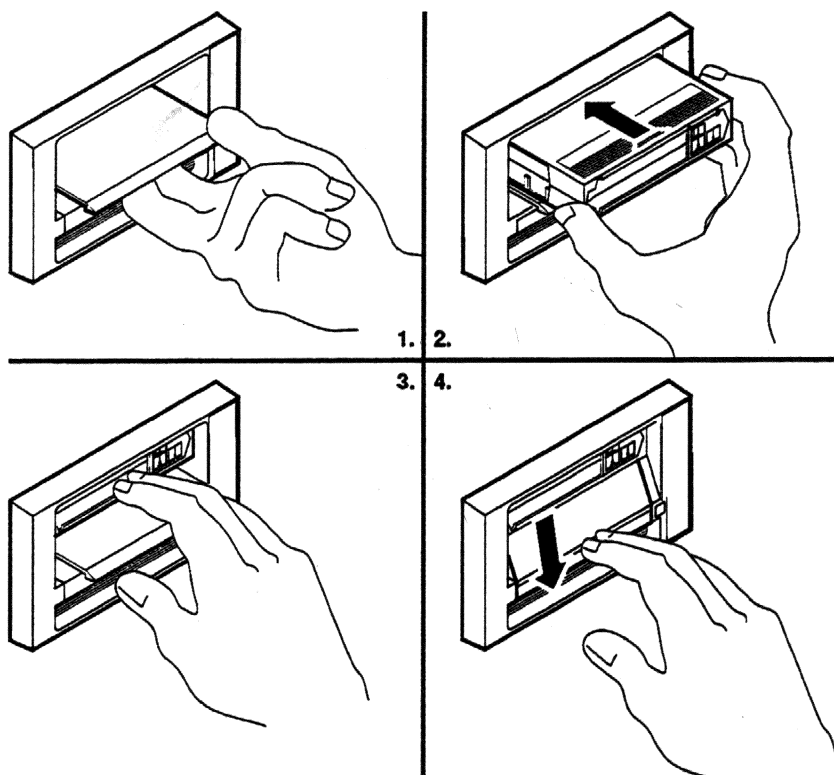
The green light turns off and the yellow light blinks to show the tape is loading. When the tape is at the beginning-of-tape (BOT) marker, the yellow light turns on steadily. The tape is now ready for use.

Tape Drive Operation

2.6 Loading a Cartridge

Figure 2-8 shows how to load a cartridge into the drive:

Figure 2-8 Cartridge Loading



ZKO-1217-10-DG

2.6.1 Tape in Use

Whenever the yellow Tape in Use light is on steadily, the tape is ready to use. When the tape is being read, written, or rewound, the yellow Tape in Use light blinks.

Use Table 2-6 to determine what is happening during cartridge use:

Table 2-6 What is Happening During Cartridge Use (Right Side Lights)

If. . .	It means. . .
The yellow Tape in Use light is on steadily	A cartridge is loaded, but the tape is not moving. This condition can mean that no application is communicating with the controller, or that the application is communicating but is not delivering commands for tape motion.
The yellow Tape in Use light blinks irregularly	A read or write is in progress.
The yellow Tape in Use light blinks regularly	The tape is loading, unloading, or rewinding.
The green Operate Handle light turns on and the beeper sounds	The tape is unloaded.
All four lights blink	An error has occurred during operation.

2.7 Using the Tape Cleaning Cartridge

Use Table 2-7 to determine when to use the cleaning cartridge.

Table 2-7 When to Use the Cleaning Cartridge

If...	It means...	And you should...
1. The Use Cleaning Tape indicator turns on (Figure 2-6)	The drive head needs cleaning or the tape is bad (see item 3 in table).	Use the cleaning cartridge. Follow the instructions in Section 2.6 for loading a cartridge into the drive. When cleaning is complete, the beeper sounds for you to remove the cleaning cartridge.
2. A particular cartridge causes the Use Cleaning Tape indicator to turn on frequently		Back up this data on another cartridge, and then discard the old cartridge. A damaged cartridge may cause unnecessary use of the cleaning cartridge.
3. The Use Cleaning Tape indicator turns on after you clean the drive head and reload your data cartridge	Your data cartridge may be causing the problem	Try another data cartridge.
4. The Use Cleaning Tape indicator is on after you load the cleaning cartridge	Cleaning has not been done and the cartridge is expired	Replace the cleaning cartridge.

NOTE

The cleaning cartridge expires after approximately 20 uses.

2.8 Unloading a Cartridge

To unload a cartridge from the drive (Figure 2-9):

1. Press the Unload button (or issue the appropriate system software command). The yellow Tape in Use indicator blinks as the tape rewinds.
2. When the green light turns on (the beeper also sounds), pull the cartridge insert/release handle open to eject the cartridge.
3. Remove the cartridge.

4. Push the handle closed.

CAUTIONS

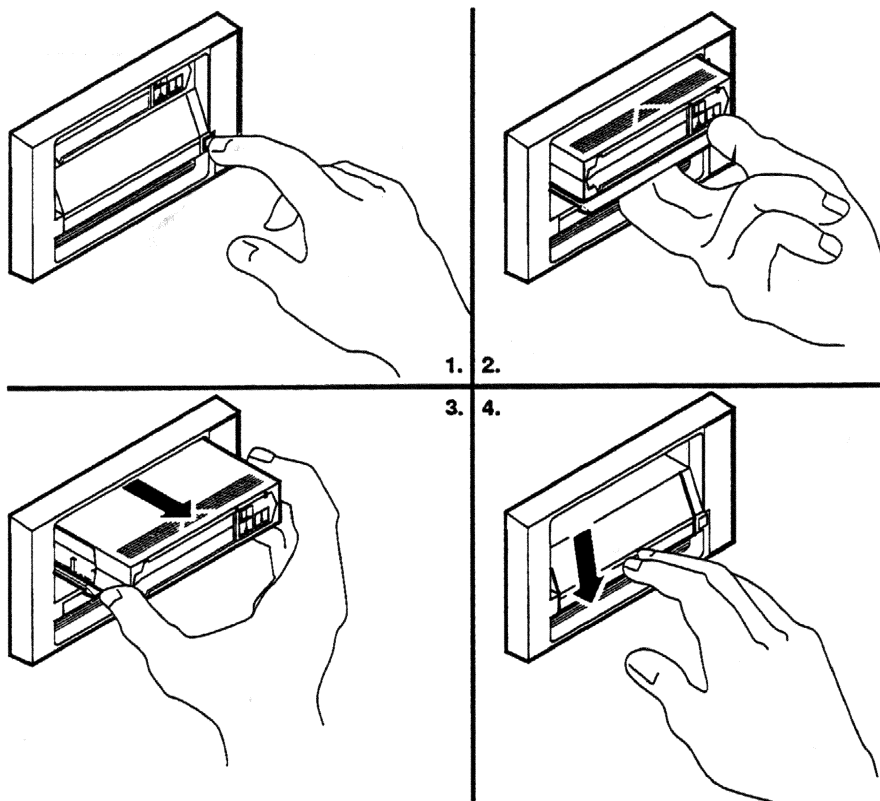
Remove a cartridge from the drive before turning off host system power. Failure to remove a cartridge can result in cartridge and drive damage.

When you remove the cartridge from the drive, return the cartridge to its plastic case to prolong the cartridge life.

Tape Drive Operation

2.8 Unloading a Cartridge

Figure 2-9 Unloading a Cartridge



ZKO-1217-09-DG

2.9 Preserving Cartridges

For longer life of recorded or unrecorded cartridges, store cartridges in a clean environment with the following conditions:

- Do not drop or bang the cartridge. Doing so can displace the tape leader, making the cartridge unusable and possibly damaging the drive.
- Keep tape cartridges out of direct sunlight and away from heaters and other heat sources.
- Store tape cartridges in temperatures between 10°C and 40°C (50°F to 104°F). For longer cartridge life, always store the cartridge in its plastic container and in room environment conditions of 72°F \pm 7°F (22°C \pm 4°C).
- If the tape cartridge has been exposed to heat or cold extremes, stabilize the cartridge at room temperature for the same amount of time it was exposed—up to 24 hours.
- Do not place cartridges near electromagnetic interference sources, such as terminals, motors, video, or X-ray equipment. Data on the tape can be altered.
- Store tape cartridges in a dust-free environment where the relative humidity is between 20% and 80%. For longer cartridge life, store the cartridge at 40% \pm 20% relative humidity.
- Place an identification label only in the slide-in slot on the front of the cartridge.
- Do not adhere labels to the cartridge anywhere except in the slide-in slot.

Solving Problems

3.1 In This Chapter

3.1.1 Introduction

This chapter describes what to do if you have drive or tape problems.

3.1.2 Contents

Chapter 3 describes the following topics:

Topic	Page
Common Errors	3-1
Inspections	3-3

3.2 Common Errors

3.2.1 Avoiding Basic Problems

You can avoid some errors by following these guidelines:

- Use the correct cartridge type. See Chapter 1.
- Care for your cartridges according to the guidelines in Chapter 2.
- Make sure the cartridge leader and the drive leader are in their correct positions. See Section 3.3 in this chapter.
- Unload the cartridge before powering down the system.

Solving Problems

3.2 Common Errors

3.2.2 Error Influences

If an error does occur during subsystem operation, you may be able to correct the error yourself. Factors influencing errors include:

- Defective media
- Dirty drive head
- Operator or user errors
- Incorrect backup commands

Use the following table to interpret error symptoms, determine their causes, and take corrective action:

Symptom	Probable Cause	Possible Correction
Failure to mount or read /write with new or used cartridge	Bad cartridge	Retry with another cartridge.
	Dirty drive head	Use CleaningTape III.
VMS INITIALIZE command fails with parity error	Tape calibration failed	Use the CleaningTapeIII, or try another cartridge.
Green light is on and tape does not move (yellow light stays on, does not blink)	Cartridge load error	Inspect the cartridge for a mispositioned leader (see Section 3.3.2 in this chapter). Replace the cartridge if its leader is mispositioned. Inspect the drive for a damaged, misplaced, or unhooked leader (see Section 3.3.4 in this chapter). Call Digital Services if the drive leader is not in the correct location.
All right- or left-side lights are blinking	Drive failed self-test or detected a hard error during operation	Try to clear the error by pressing the Unload button or turn power off and then on again. If the error does not clear (the tape does not rewind and unload and the lights blink), you have a hardware failure. Call Digital Services.

3.3 Inspections

3.3.1 Checking the Cartridge Leader

Before you use a tape cartridge, be sure the tape leader is in the same position as the one in Section 3.3.2. Lift the door lock with your thumb and open the small door to expose the leader.

CAUTIONS

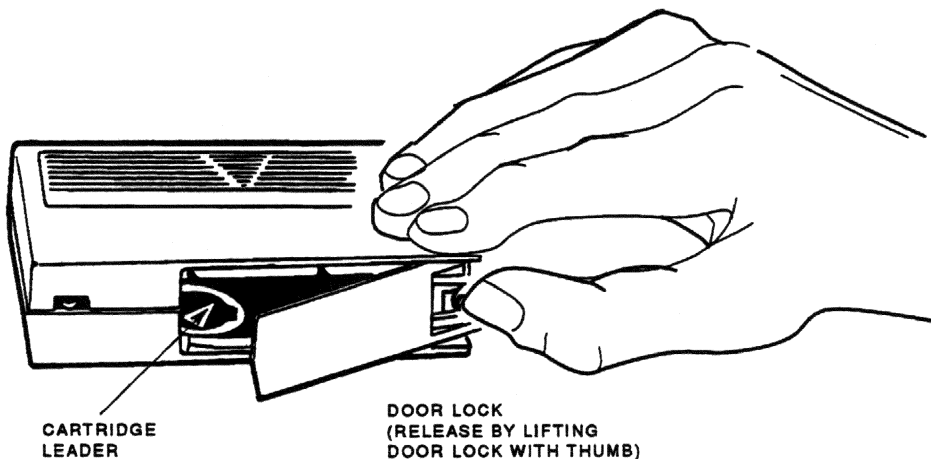
Do not touch the exposed magnetic tape.

If the tape leader is not in the correct position, do not try to fix it. Use another cartridge instead.

3.3.2 Diagram of Cartridge Leader

Figure 3-1 shows the correct position of the cartridge leader:

Figure 3-1 Cartridge Leader



SHR-0002-86
SHR_X1027_89_CPG

Solving Problems

3.3 Inspections

3.3.3 Checking the Drive Leader

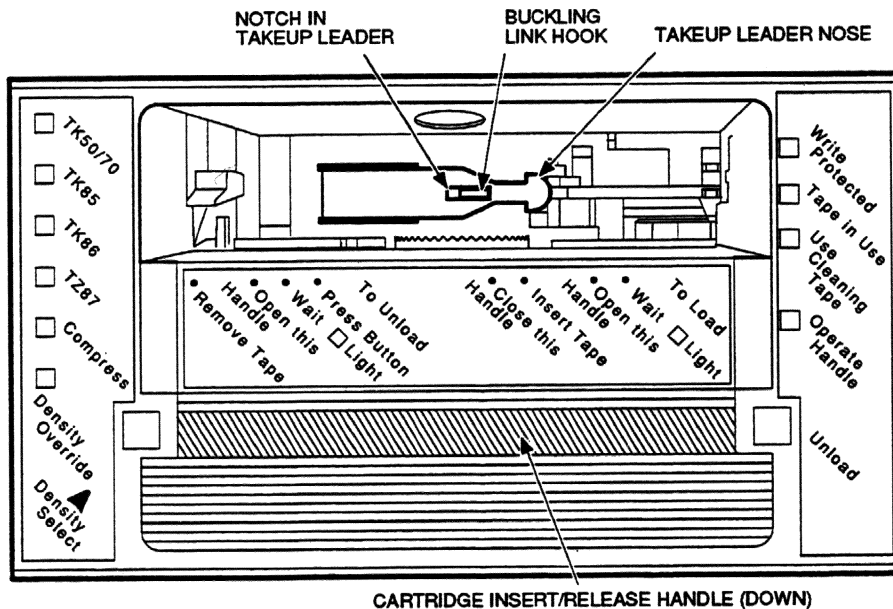
To examine the drive takeup leader, tilt the cartridge receiver door on the front of the drive. Look inside to see that the drive leader is connected to the buckling linkhook. The hook should be engaged in the leader slot (Section 3.3.4).

If the leader is unhooked, misplaced, or damaged, call Digital Services. Do not try to fix the leader.

3.3.4 Diagrams of Drive Leader

Figure 3-2 shows the location of the leader inside the drive:

Figure 3-2 Diagram of Drive Leader

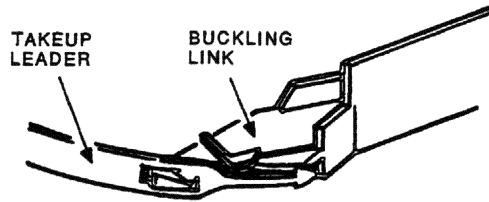


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Figure 3-3 shows the correct and incorrect locations of the drive leader:

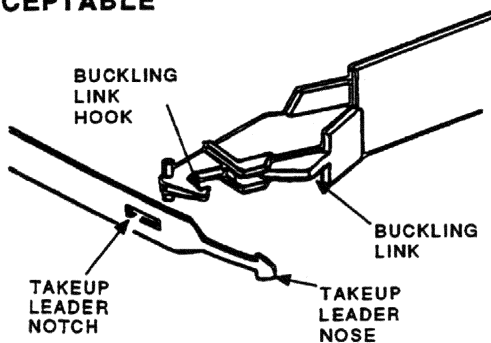
Figure 3-3 Correct and Incorrect Positions of the Drive Leader

ACCEPTABLE

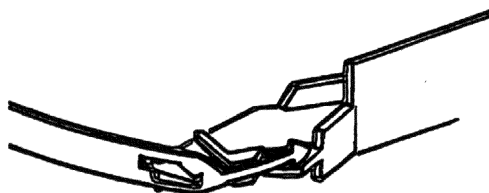


**CORRECT
LOCATION
OF TAKEUP
LEADER NOSE
IN FRONT
OF LINK**

NOT ACCEPTABLE



**LEADER
UNHOOKED**



**TAKEUP
LEADER NOSE
DISPLACED
ABOVE
LINK**

ZKO-1217-31-DG

TZ87 Subsystem Specifications

A.1 Mode of Operation

When the TZ87 subsystem operates in noncompressed mode it has a maximum transfer rate of 1.25 Mbytes/s. In compressed mode the maximum transfer rate is 2.5 Mbytes/s write and 3 Mbytes/s read.

A.2 Media

The specified media for the TZ87 subsystem is 1/2-inch (12.7 mm) unformatted magnetic tape with the following characteristics:

- Track density = 0.003 inches per track
- Bit density = 62,500 bits/in
- Number of tracks = 128
- Tape speed = 110 in/s read/write, 150 in/s rewind/spacing
- Track format = Two-track parallel, serpentine recording
- Cartridge capacity = up to 10 GB (uncompressed), 20 GB (compressed), assuming a 2:1 compression ratio

A.3 Power Consumption

The TZ87 subsystem consumes 22.1 W maximum, peak power (start/stop) 32 W. It has the following power requirements:

- 12 V operating (write/read) 0.8 A, maximum (start/stop) 1.5 A
- +5 V operating (write/read) 2.5 A, maximum (start/stop) 2.8 A

TZ87 Subsystem Specifications

A.4 Transfer Rates

A.4 Transfer Rates

The following transfer rates apply to this product.

Transfer rate raw native = 1.72 Megabytes/second

Transfer rate user native = 1.25 Megabytes

Transfer rate compressed* = 2.50 Megabytes/second maximum write; 3.00 Megabytes/second maximum read

*Compression ratio is data dependent

Standard VMS Commands

B.1 Using the Subsystem Efficiently

B.1.1 Introduction

This section identifies guidelines you should follow to use the TZ87 subsystem effectively with your host application. To maximize the subsystem's efficiency, you must use certain qualifiers with the MOUNT and BACKUP commands. This appendix describes those qualifiers and their appropriate values.

B.1.2 Guidelines

For efficient operation of the TZ87 subsystem:

- Choose a large block size when mounting a tape; 65534 is recommended.
- Use the /MEDIA_FORMAT=COMPACTION to enable data compaction, unless the files being written to tape contain data that has already been compressed (for example, by using a software utility).
- Do not use the COPY command to save more than 9999 files onto the tape.

B.2 Tape Commands

B.2.1 Introduction

The TZ87 cartridge tape subsystem uses the standard magnetic tape commands that can be invoked under VMS operating system, version 5.4-2 or later. This section discusses the following VMS commands used to operate the TZ87.

Standard VMS Commands

B.2 Tape Commands

For this command. . .	See page. . .
ALLOCATE	B-2
INITIALIZE	B-2
MOUNT	B-3
BACKUP	B-3
COPY	B-4
DISMOUNT	B-4
DEALLOCATE	B-4

B.2.2 For More Information

This appendix is a reference only; it does not include all the details that may be involved in using VMS commands.

For more information about VMS commands and command files, see the *VAX/VMS Guide to Using Command Procedures* (AA-H782B-TE), *VAX/VMS Command Language User's Guide* (AA-DO23C-TE), or the *VMS System Manager's Guide*.

B.2.3 Using the ALLOCATE Command

The **ALLOCATE** command provides exclusive access to a device and optionally establishes a logical name for that device. Once you have allocated a device, other users cannot access that device until you explicitly **DEALLOCATE** it, or until you log out. Use the following format to allocate the TZ87 subsystem:

```
$ ALLOCATE device_name: [logical name]
```

For example, to allocate the TZ87 subsystem for your use and assign it to the logical name *TAPE1*, do the following:

```
$ ALLOCATE MIA0: TAPE1
```

B.2.4 Using the INITIALIZE Command

CAUTION

Be sure to use a scratch tape before initializing; otherwise, any data on the tape will be destroyed.

Use the **INITIALIZE** command to specify the device name, and write a volume name to the magnetic tape volume loaded into the TK87 tape drive. The tape must be write-enabled for the initializing operation. Use the following format:

```
$ INITIALIZE/MEDIA_FORMAT=COMPACTION device_name:  
[volume label]
```

As an example, to initialize the device *TAPE1* and assign the volume name *GMB001*, type the following:

```
$ INITIALIZE/MEDIA_FORMAT=COMPACTION MIA0: GMB001
```

For the initialization to succeed, the cartridge must not have been mounted (with the **MOUNT** command).

For detailed information regarding volume names and magnetic tape operations, see the *Guide to VAX/VMS Disk and Magnetic Tape Operations* (AA-M539A-TE).

B.2.5 Using the MOUNT Command

The **MOUNT** command lets you make a magnetic tape volume available for processing. It loads the tape with the protection set according to the write-protect switch on the cartridge. It can determine the maximum block size.

Use the following format to mount a tape on the TZ87 subsystem for use with the **BACKUP** utility:

```
$ MOUNT/FOREIGN/CACHE=TAPE DATA/BLOCKSIZE=65534/MEDIA_FORMAT=COMPACTION  
device_name: [volume label]  
             [logical name]
```

As an example, to make *TAPE1* available for processing, type the following:

```
$ MOUNT/FOREIGN/CACHE=TAPE DATA/BLOCKSIZE=65534/MEDIA_FORMAT=COMPACTION  
MIA0: GMB001 TAPE1
```

The screen displays a message:

```
%MOUNT-I-MOUNTED, GMB001 mounted on MIA0:
```

You must use the **/FOREIGN** qualifier when you are performing **BACKUP** commands. Do not use it when you are performing **COPY** commands.

B.2.6 Using the BACKUP Command

The **BACKUP** command provides protection against file volume corruption by creating backup copies.

The following is an example of using **BACKUP** to save files onto the tape.

```
$ BACKUP/BLOCKSIZE=65534/MEDIA_FORMAT=COMPACTION source:*. * tape:file.name
```

You can also back up lists of files and entire volumes.

See your system manuals before deciding on qualifiers for use with the **BACKUP** command. For detailed information about **BACKUP** and other VMS tape commands, see the *VAX/VMS Backup Utility Reference Manual* (AA-Z407B-TE).

Standard VMS Commands

B.2 Tape Commands

B.2.7 Using the COPY Command

Use the **COPY** command, with the TZ87 subsystem, to copy files from tape.

In the following example, the **MOUNT** command requests that the volume labeled *GMB001* be mounted on the drive at *MIA0* and assigns the logical name *TAPE1*.

The **COPY** command uses the logical name *TAPE1* for the input file specification. All files on *MIA0* are copied to the current default disk and directory. The files keep their original file names and file types.

```
$ MOUNT/BLOCKSIZE=65534/MEDIA_FORMAT=COMPACTION/CACHE=TAPE_DATA MIA0: GMB001 TAPE1:  
$ COPY TAPE1:*.* *.*
```

Note

Using the **COPY** command to move multiple files may not achieve optimum performance. Check with your system manager for more information.

B.2.8 Using the DISMOUNT Command

The **DISMOUNT** command cancels the previous **MOUNT** command, makes the unit unavailable for processing, and unloads the tape:

```
$ DISMOUNT logical_name or device_name:
```

B.2.9 Using the DEALLOCATE Command

The **DEALLOCATE** command cancels the previous **ALLOCATE** command and makes the unit available for other users. The following is an example of the command:

```
$ DEALLOCATE MIA0: or TAPE1
```

Using the TZ87 with the ULTRIX Operating System

C.1 Introduction

This appendix is intended for those using the TZ87 tape with the ULTRIX operating system.

This appendix includes:

- Adding the TZ87 drive to your ULTRIX system
- Tips on getting maximum capacity and performance
- Using the TZ87 drive for unattended backups
- Using various ULTRIX commands to save information on the TZ87 drive

C.2 Adding the TZ87 to the ULTRIX System

Before connecting the TZ87 drive to the SCSI bus:

1. Locate the SCSI ID switches at the rear of the TZ87 drive.
2. Ensure the SCSI ID (target ID) number for the TZ87 is unique. The recommended ID is 5. Use SCSI ID 5 only if no other device on the bus has SCSI ID 5.
3. Ensure all other devices on the SCSI bus have unique SCSI IDs.

C.2.1 Connecting the TZ87 to ULTRIX

To connect the TZ87 drive to the ULTRIX system:

1. Physically connect the TZ87 cable(s) to the ULTRIX system.
2. Ensure an entry for the TZ87 drive is specified in the ULTRIX system configuration file. If you have to modify your configuration file by adding an entry, then you must build a new kernel and reboot the system. This is explained in Section C.2.3 and Section C.2.4.

Using the TZ87 with the ULTRIX Operating System

C.2 Adding the TZ87 to the ULTRIX System

3. Create logical device names for your TZ87 drive, explained in Section C.2.5.

C.2.2 Checking the ULTRIX System Configuration File

Locate the ULTRIX system's configuration file. It should be in the `/usr/sys/conf` directory under the mips or VAX system subdirectory.

The configuration file name is the same as the system name and must contain an entry for the TZ87 drive.

If...	Then...
An entry does not exist,	You need to create an entry in the configuration file.
An entry already exists,	You do not need to change the configuration file.

C.2.3 Creating an Entry

An entry has the following format:

tape name at controller device#

An example entry for Bus 0, SCSI ID 5:

tape tz5 at sii0 drive 5

To create an entry in the configuration file:

1. Refer to Table C-1 to determine the name according to your SCSI target ID and your bus number. Usually, users have one bus, Bus 0. Find the name, listed under the Bus 0 or Bus 1 columns.

For example: the name for SCSI Target ID 5, Bus 0 is tz5.

Table C-1 Determining the Tape Name

SCSI Target ID	Bus 0	Bus 1
0	tz0	tz8
1	tz1	tz9
2	tz2	tz10
3	tz3	tz11

(continued on next page)

Using the TZ87 with the ULTRIX Operating System

C.2 Adding the TZ87 to the ULTRIX System

Table C-1 (Cont.) Determining the Tape Name

SCSI Target ID	Bus 0	Bus 1
4	tz4	tz12
5	tz5	tz13
6	tz6	tz14
7	tz7	tz15

2. Determine the name of the controller to which the TZ87 drive is connected.
3. Include the word tape, name, controller, and the device# in the entry.

C.2.4 Building the Kernel, Rebooting the System

If you added an entry to your configuration file, you must rebuild the kernel and reboot the system. Be sure to save the original kernel before rebooting the system.

For example:

```
$ /etc/doconfig                (this creates a new kernel)
$ mv /vmunix /vmunix.old      (save the old kernel)
$ mv new_kernel_name /vmunix  (move the new kernel to the root directory)
$ /etc/shutdown -r now        (reboot the system)
```

C.2.5 Creating Logical Device Names for the TZ87 Drive

Use the MAKEDEV command located in the /dev directory to create logical device names.

For example:

```
$ cd /dev
$ MAKEDEV tz5
```

Leads to some or all of the following logical device names:

```
/dev/nrmt0l
/dev/nrmt0h
/dev/rmt0l
/dev/rmt0h
/dev/rmt0m
/dev/nrmt0m
/dev/rmt0a
/dev/nrmt0a
```

- *mt* (in the middle of the logical name) means *magnetic tape* device.

Using the TZ87 with the ULTRIX Operating System

C.2 Adding the TZ87 to the ULTRIX System

- *nr* means *no rewind* when the utility completes. Use the no rewind option when more than one operation is being performed to the same tape.
- *r* means *rewind* when the utility completes.
- *0* is the logical unit number.
- *h* means *high* density (TZ87 density; compression enabled; ref. Section C.4).
- *m* means *medium* density (TZ87 density; compression disabled; ref. Section C.4).
- *l* means *low* density (TZ86 density; ref. Section C.4).
- *a* means *auxiliary* density (TZ85 density; ref. Section C.4).

NOTE

Since the TZ87 is a high density tape drive, be sure to use the logical device names including *h*. The only exception is if modifications are made to allow selection of TK85 density for writing via the low density device entry (Section C.4).

C.3 Getting Maximum Capacity and Performance

The TZ87 drive stores data at different capacities, depending on the drive format in which the TZ87 drive is writing. Use Table C-2 to see the capacity with each drive format.

Table C-2 Maximum Capacity

Drive Format	Data Amount Per Cartridge
TZ87, no compression	More than 10.0 GBF
TZ87, with compression	About 20.0 GBF, depending on the data being written
TZ86	6.0 GBF
TZ85	2.6 GBF

The TZ87 runs at maximum peak streaming rates of 1.25 MB/s in non-compression mode, 2.5 MB/s (write, depending on compression ratio and data) and 3.0 MB/s (read, depending on decompression ratio and data) in compression mode.

Using the TZ87 with the ULTRIX Operating System

C.3 Getting Maximum Capacity and Performance

This section explains how to maximize the functions of the TZ87 drive.

C.3.1 Getting Maximum Storage Capacity and Recommendations

The block size does not have much effect on capacity when the TZ87 drive is writing in TZ87 format, but a large (at least 16K bytes) block size is recommended for more efficient operation of the device, host, and I/O channel.

To get maximum storage capacity when writing in TK85 or TK86 format:

Use block sizes that are integral multiples of 4096 bytes, such as 4k, 8k, 12k, 16k, and so forth. It is **recommended** you use larger block sizes of 16k, 24k, or 32k when writing in TK85 or TK86 format. These larger block sizes:

- Allow more efficient data processing by the host and on the SCSI bus
- Maximize capacity

Some utilities and commands default to using block sizes that cause lower capacity and I/O rates. For example:

If you use...	Then you can fit ...
A 512 byte block size when writing in TK85 format (this is the dd command's default)	About 320 MB of data on the tape
A 512 byte block size when writing in TK86 format	About 750 MB of data on the tape
A 512 byte block size when writing in TZ87 format	About 10 GB (no compression) and 20 GB (with compression) of data on the tape
The recommended block sizes	<ul style="list-style-type: none">• 2.6 GB for TK85 format• 6.0 GB for TK86 format• 10.0 GB (no compression) for TZ87 format (not much effect)

Most utilities used for tape I/O let you select the block size through command line switches.

Note

If you are not using ULTRIX V4.2a or later, with the latest Common Access Method (CAM) software kit installed, you have a tape file length limit of 2.1 GB.

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C.3 Getting Maximum Capacity and Performance

With striping or disk array techniques or when running the tar command to back up multiple file systems, you need to note the 2.1 GB limit. Plan backups so that a tar or dump set does not exceed the 2.1 GB limit. However, you can store multiple save sets on the same cartridge.

C.3.2 Maximizing Performance

To handle bursts of data, the TZ87 drive has about 2 MB of cache memory. This minimizes repositioning and keeps I/O rates as high as the host can handle.

The TZ87 runs at maximum peak streaming rates of 1.25 MB/s in non-compression mode, 2.5 MB/s (write, depending on compression ratio and data) and 3.0 MB/s (read, depending on decompression ratio and data) in compression mode.

If a non-optimal block size is used, the possible average I/O rate is limited. When writing TK85 or TK86 format, the recommended block sizes are: 16k, 24k, or 32k. You can use larger block sizes of 36k, 40k, and so forth, but a performance increase is unlikely.

Other factors that can limit performance:

- Data fragmentation on disks
- Oversubscribing the I/O channel bandwidth
- Processing speed and host CPU loads
- Memory size and availability

C.4 Selecting Density

You can select write density from the OCP panel of the TZ87 or from the ULTRIX host if the CAM software is installed and supports the TZ87 drive. If the CAM software is installed, but does not support the TZ87 drive, you can change the CAM software to support the drive by changing the:

- `/usr/sys/data/cam_data.c` file to recognize the TZ87
- `/usr/sys/h/devio.h` file to define the TZ87

NOTE

Recent releases of ULTRIX (v. 4.3) support the TZ87. If you have recent releases that support the TZ87, do not make the following changes.

Only experienced programmers should change the `cam_data.c` and the `devio.h` files. You must rebuild the kernel to add the changes. (See the configuration guidelines earlier in this appendix. Check the CAM software documentation for information about adding new devices.)

To allow density selection from the host, follow these steps:

1. Edit the `/usr/sys/h/devio.h` file to define the device name. Ensure that a copy of the original is preserved and can be restored if necessary.
 - a. Search for `DEV_TZ85`.
 - b. Make a copy of the definitions for `DEV_TZ85`
 - c. In the copy, change `DEV_TZ85` to `DEV_TZ87`
2. Edit the `/usr/sys/data/cam_data.c` file to define a density table for the TZ87 using the existing TZ85 density table as a template. Ensure that a copy of the original is preserved and can be restored if necessary.
 - a. Search for `tz85_dens`.
 - b. Make a copy of the `tz85_dens` table.
 - c. In the copy, change TZ85 references to TZ87.
 - d. In the copy, in the lines ending with `| DENS_BUF_VALID, ,` add `| DENS_COMPRESS_VALID` before the comma. This results in these lines ending with `| DENS_BUF_VALID | DENS_COMPRESS_VALID, .`
 - e. In the copy, change the density code to `0x18` in the `rmtxl` entry.

Using the TZ87 with the ULTRIX Operating System

C.4 Selecting Density

- f. In the copy, change the density code to 0x19 in the `rmtxm` entry.
- g. In the copy, leave the density code in the `rmtxa` alone.
- h. In the copy, change the density code to 0x19 in the `rmtxh` entry, and on the same line, change the compression code (labeled as such in the line above) from NULL to 0x01.
- i. In the copy, change all other density codes to 0x19.

This process allows device:

- `rmtxh` entries to select TZ87 density with compression enabled
 - `rmtxm` entries to select TZ87 density with compression disabled
 - `rmtxl` entries to select TK86 density
 - `rmtxa` entries to select TK85 density
3. Further edit the `/usr/sys/data/cam_data.c` file to use the TZ87 device name and density table that have just been defined to create a device description table for the TZ87.
 - a. Search further in the `cam_data.c` file for the next occurrence of "TZ85". This should locate the TZ85 device descriptor table.
 - b. Make a copy of the TZ85 device descriptor table.
 - c. In the copy, change TZ85 references to TZ87.
 - d. In the copy, change `&tz85_dens` to `&tz87_dens`.
 4. Save the current kernel (`/vmunix`).
 5. Build a new kernel. (This incorporates the changes made to the `devio.h` and `cam_data.c` files.)
 6. Reboot the system with the new kernel.

C.5 Using ULTRIX Tape Commands

This section describes ULTRIX commands used to operate the TZ87 drive.

The TZ87 drive uses standard magnetic tape commands to do backup and restore operations. The `tar` and `dump/restore` commands are used most often.

C.5.1 Using the tar Command

The **tar** command, which operates on files and directories, writes and reads tapes. The **tar** utility uses the specified block size or defaults to 10k byte block sizes. The default block size results in a 16% decrease of maximum capacity and I/O rates if using TK85 or TK86 densities.

Table C-3 lists the options you can use with the **tar** command.

Table C-3 Common tar Options

Option	Meaning
b	Block size in bytes (n) Block size in kilobytes (nk) nb = n x 512 bytes in a block
c	Create tape, writes from beginning
f	Tape device argument to follow
r	Append to the end of the tape
t	Table of contents of tape
u	Backup all new or modified files from last backup
v	Verbose
x	Extract from tape (read)

The following examples show command lines with the **tar** command to:

- Write a file to tape:

```
$ tar -cf /dev/rmt0h filename -b 64k
```

- Read a file from tape to your current directory:

```
$ tar -fx /dev/rmt1h filename
```

C.5.2 Using the dump Command

To use the **dump** command, you need system privileges. This command lets you write an entire file system to tape. Ensure that the current directory is not within the file system being backed up, except when backing up from the root directory.

The **dump** command uses 10k byte block sizes. A 16% reduction in capacity and I/O rates can result from using these block sizes if using TK85 or TK86 densities.

Using the TZ87 with the ULTRIX Operating System

C.5 Using ULTRIX Tape Commands

Table C-4 lists the options you can use with the **dump** command.

Table C-4 Common dump Options

Option	Meaning	Recommended Value
d	Tape density in bits per inch	62500
f	Tape device	
n	Notify all privileged accounts, the status of dump	
s	Size of tape in feet	150646 (uncompressed) 301292 (compressed)
u	Update the /etc/dumpdates file with the date	
0-9	Dump level	

The following examples show command lines with the **dump** command:

```
$ dump 0dsf 62500 301292 /dev/rmt0h /dev/rrz1a
$ dump unsf 62500 301292 /dev/rmt0h /usr/users
```

Dump level 0 is the highest and dumps the whole file system.

Dump level 9 is the lowest. All files, modified since the last dump of the same or lower dump level, are dumped.

C.5.3 Using the restore Command

The **restore** command reads a tape that is backed up with the **dump** command. The **restore** command can read a file, a directory, or the entire tape.

The **restore** command uses 10k byte block sizes. A 16% reduction in capacity and I/O rates can result from using these block sizes if using TK85 or TK86 densities.

Table C-5 lists the options you can use with the **restore** command.

Table C-5 Common restore Options

Option	Meaning
f	Tape device
r	Read everything from tape
i	Interactive
v	Verbose
x	Extract

The following example shows a command line with the **restore** command:

Using the TZ87 with the ULTRIX Operating System

C.5 Using ULTRIX Tape Commands

```
$ restore -xvf filename
```

C.5.4 Using the dd Command

Use the **dd** command to perform a device-to-device copy. The copy is done by file or by image, depending on the specification of the input or output device files.

Disks have two types of device files, image and block:

- If the disk image file (/dev/rxxxx) is used, performance is faster.
- If the disk block file (/dev/rxxx) is used, it is easier to retrieve a single file later.

The **dd** command uses the specified block size, or if none is given, a default of 512 bytes. When writing in TK85 or TK86 formats, an 87% reduction in capacity and performance can result from using the default block size. It is important to specify a more optimal block size.

The default block size does not affect capacity when writing in the TZ87 format.

Table C-6 lists the options you can use with the **dd** command.

Table C-6 Common dd Options

Option	Meaning	Recommended Value
if	Input file	
of	Output file	
bs	Input and output block size (bytes)	32768
ibs	Input block size (bytes)	32768 for tape
obs	Output block size (bytes)	32768 for tape

The following examples show command lines with the **dd** command to:

- Write to tape with the block device file:

```
$ dd if=/dev/rz1a of=/dev/rmt1h bs=32768
```
- Write to tape with the image device file:

```
$ dd if=/dev/rrz1a of=/dev/rmt1h bs=32768
```
- Read a tape:

```
$ dd if=/dev/rmt1h of=/dev/rz1a ibs=32768
```

Using the TZ87 with the ULTRIX Operating System

C.5 Using ULTRIX Tape Commands

C.5.5 Using the ltf Command

Use the **ltf** command to write and read ANSI tapes. This command operates on files and directories and uses the specified block size. Otherwise, the command defaults to 2048 byte blocks. This block size results in a 50% decrease of capacity and I/O rates when writing in TK85 or TK86 formats.

Table C-7 lists the options you can use with the **ltf** command.

Table C-7 Common ltf Options

Option	Meaning
B	Specify a block size to use
c	Create tape, writes from beginning
f	Tape device argument to follow
u	Back up all new or modified files from last backup
t	Table of contents of tape
v	Verbose
x	Extract from tape (read)

The following examples show command lines with the **ltf** command to:

- Write a file to tape:

```
$ ltf -cf /dev/rmt0h filename -B 16k
```
- Read a file from tape to your current directory:

```
$ ltf -fx /dev/rmt1h filename
```

C.5.6 Using the mt Command

The **mt** (magnetic tape) command allows you to give certain commands to the tape drive.

Table C-8 lists the options you can use with the **mt** command.

Table C-8 Common mt Options

Option	Meaning
eof	Write file mark(s)
bsf	Backward space file(s)
bsr	Backward space record(s)
fsf	Forward space file(s)
fsr	Forward space record(s)
offline	Unload the tape
rewind	Rewind to the beginning of medium
status	Obtain information from the drive

The following examples show command lines with the **mt** command to:

- Get the status of a drive:

```
$ mt -f /dev/rmt0h status
```
- Rewind the default drive:

```
$ mt rewind
```
- Write two file marks to the default drive:

```
$ mt eof 2
```

C.5.7 Using the cpio Command

The **cpio** command allows you to save files and directories on tape and other media and retrieve these files.

Table C-9 lists the options you can use with the **cpio** command.

Table C-9 Common cpio Options

Option	Meaning
c	Write or read header information in ASCII character form
d	Create directories as needed
i	Copy in
o	Copy out
t	Table of contents of tape
v	Verbose

The following examples show command lines with the **cpio** command to:

- Write to tape all files and subdirectories from your current directory:

Using the TZ87 with the ULTRIX Operating System

C.5 Using ULTRIX Tape Commands

```
$ find . -print | cpio -ocv > /dev/rmt0h
```

- List all files and subdirectories that are on the tape:

```
$ cpio -ictv < /dev/rmt0h
```

- Retrieve all files and subdirectories from the tape:

```
$ cpio -icdv < /dev/rmt0h
```

- Retrieve selective files from the tape:

```
$ cpio -icv < 'filename' < /dev/rmt0h
```

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Digital Services

D.1 Service Plans

D.1.5 Carry-In Service

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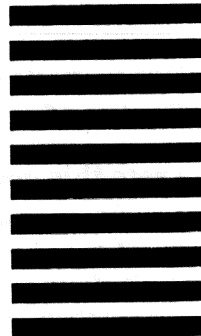
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