Quantum.

LTO-3 Half-Height Tape Drive

LTO-3

81-81683-02 A01

Quantum LTO-3 Half-Height Tape Drive User's Guide, P/N 81-81683-02 A01, May 2007.
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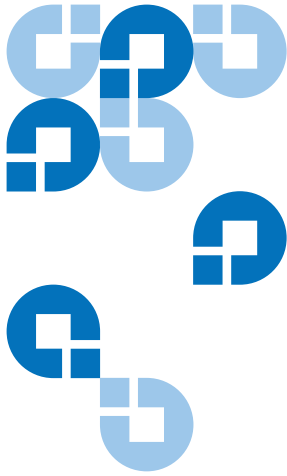
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Preface

Audience

This guide is written for users of the Quantum LTO-3 Half-Height Tape Drive.

Purpose

This guide provides information about the LTO-3 Half-Height Tape Drive including:

- Installing the drive
- Basic drive operations
- Maintenance
- Specifications
- Troubleshooting

Document Organization

This guide is organized as follows:

- Chapter 1, Introduction, provides an overview of LTO and Ultrium technologies, and summarizes the drive's key features.
- Chapter 2, Installation Procedures, describes handling precautions, unpacking tips, and installation instructions.
- Chapter 3, UNIX Configuration Procedures, describes the configuration settings for UNIX systems.

- [Chapter 4, Operation](#), describes the operation and maintenance of the drive.

- [Chapter 5, Theory](#), describes the theory of operation behind the drive, including the technology used in various drive components.

- [Chapter 6, Specifications](#), provides drive and cartridge specifications.

- [Chapter 7, Troubleshooting Guide](#) provides troubleshooting procedures you can follow if you encounter a problem with your drive.

- [Appendix A, Installation Checklists](#), provides abbreviated quick-start checklists for users who are already familiar with the installation procedures.

- [Appendix B, Disposal of Electrical & Electronic Equipment](#), provides instructions for proper disposal of unwanted electrical and electronic equipment.

- [Appendix C, Regulatory Compliances](#), identifies drive compliance with safety and EMC regulations.

This guide also has an index.

Notational Conventions

This guide uses the following conventions:

> **Note:** Notes emphasize important information related to the main topic.

> **Tech Tip:** Tech Tips provide technical information which may be helpful in performing the procedure.

> **Caution:** Cautions indicate potential hazards to equipment and are included to prevent damage to equipment.

> **Warning:** Warnings indicate potential hazards to personal safety and are included to prevent injury.

Related Documents

The following subsection identifies the primary documents that are related to the LTO-3 Half-Height Tape Drive.

Standards Conformance

The Small Computer System Interface is described in standards that include several versions and a number of individual documents. The original Small Computer System Interface Standard, X3.131-1986, is referred to as SCSI-1. SCSI-1 was revised, resulting in the Small Computer System Interface – 2 (X3.131-1994), referred to as SCSI-2. The set of SCSI-3 standards are collectively referred to as SCSI-3. The applicable ANSI standards are as follows:

- INCITS Technical Committee T10 (SCSI Storage Interfaces) Standards:

  - SCSI Architecture Model – 2 (SAM-2) INCITS 366-2003

  - SCSI Architecture Model – 3 (SAM-3) INCITS 402-2005

  - SCSI Architecture Model – 4 (SAM-4) in development

  - Automation/Drive Interface – Commands (ADC) INCITS 403-2005

  - Automation/Drive Interface Commands (ADC-2) in development

  - Automation/Drive Interface – Transport Protocol (ADT) INCITS 406-2005

  - Automation/Drive Interface – Transport Protocol – 2 (ADT-2) in development

  - Fibre Channel Protocol for SCSI (FCP) INCITS 269-1996

  - Fibre Channel Protocol for SCSI, Second Version - 2 (FCP-2) INCITS 350-2003

  - Fibre Channel Protocol for SCSI, Third Version - 3 (FCP-3) INCITS 416-2006

  - Fibre Channel Protocol for SCSI, Fourth Version - 4 (FCP-3) in development

  - SCSI-3 Medium Changer Commands (SMC) INCITS 314-1998

  - SCSI Media Changer Commands – 2 (SMC-2) INCITS 382-2004

  - SCSI Media Changer Commands – 3 (SMC-3) in development

  - SCSI Parallel Interface – 3 (SPI-3) INCITS 336-2000

  - SCSI Parallel Interface-4 (SPI-4) INCITS 362-2002

- SCSI Parallel Interface-5 (SPI-5) INCITS 367-2003
- SCSI-3 Primary Commands (SPC) INCITS 301-1997
- SCSI Primary Commands – 2 (SPC-2) INCITS 351-2001
- SCSI Primary Commands – 3 (SPC-3) INCITS 408-2005
- SCSI Primary Commands – 4 (SPC-4) in development
- SCSI-3 Stream Commands (SSC) INCITS 335-2000
- SCSI Stream Commands – 2 (SSC-2) INCITS 380-2003
- SCSI Stream Commands – 3 (SSC-3) in development
- Serial Attached SCSI – (SAS) INCITS 376-2003
- Serial Attached SCSI – 1.1 (SAS-1.1) INCITS 417-2006
- Serial Attached SCSI – 2 (SAS-2) in development
- INCITS Technical Committee T11 (Device Level Interfaces) Standards
  - Fibre Channel Arbitrated Loop (FC-AL-2) Amendment 1 INCITS 332.1999/AM1-2003Fibre Channel Generic Services-4 (FC-GS-4) INCITS 387-2004
  - Fibre Channel Generic Services-5 (FC-GS-5) in development
  - Fibre Channel Generic Services-6 (FC-GS-6) in development
  - Fibre Channel - Link Services (FC-LS) in development

> **Note:** The term "SCSI" is used wherever it is not necessary to distinguish between the versions of SCSI.

Contacts

Quantum company contacts are listed below.

Quantum Corporate Headquarters

To order documentation on the LTO-3 Half-Height Tape Drive or other products contact:

Quantum Corporation
P.O. Box 57100
Irvine, CA 92619-7100
(949) 856-7800
(800) 284-5101

Technical Publications

To comment on existing documentation send e-mail to:

doc-comments@quantum.com

Quantum Home Page

Visit the Quantum home page at:

http://www.quantum.com

Customer Support

Quantum Global Services provides 24-hour support that can be reached at:

North/South America:	(949) 725-2100 or (800) 284-5101
Asia/Pacific Rim:	(International Code) + 61 7 3839 0988
Europe/Middle East/Africa:	(International Code) + 44 (0) 1256 848748

Send faxes for Global Services to:

North/South America:	(949) 725-2176
Asia/Pacific Rim:	(International Code) + 61 7 3839 0955
Europe/Middle East/Africa:	(International Code) + 44 (0) 1256 848777

Send e-mail for Global Services to:

Asia/Pacific Rim:	apachelp@quantum.com
Europe/Middle East/Africa:	eurohelp@quantum.com

Visit our website:

www.quantum.com/support

Introduction

This chapter provides an introductory overview of the Quantum LTO-3 Half-Height Tape Drive. Topics include:

- [Overview](#)
- [Drive Models](#)
- [Features](#)

Overview

The Quantum LTO-3 Half-Height Tape Drive is a high-performance 16-channel tape drive that complies with the LTO interchange specifications. The drive is suited for mid-range to high-end servers, mainframe systems, and tape library automation systems.

The LTO-3 Half-Height Tape Drive uses Ultrium data cartridges. Its capacity is maximized using intelligent data compression. The drive has a native capacity of 400 Gbytes (800 Gbytes assuming 2:1 data compression).

The LTO-3 Half-Height Tape Drive has a 5¼-inch half-height form factor with automatic electromechanical cartridge soft load. It is available in two models:

- Internal
- Tabletop

Drive Models

Internal

The internal model (see figure 1) is a 5¼-inch drive that you can install inside the drive bay of a:

- Computer workstation or server system
- Quantum rackmount drive enclosure

Tabletop

The tabletop model is a 5¼-inch drive that is already mounted inside a stand-alone external drive enclosure with a built-in power supply.

Figure 1 Internal LTO-3 Half-Height Tape Drive

Features

Table 1 describes the key performance features and capabilities of the LTO-3 Half-Height Tape Drive.

Table 1   Performance Features and Capabilities

Feature	Description
Cartridge memory	Stores pertinent information about the media to enable fast cartridge loading
Chassis	Shock damped and isolated
Data buffering	128 Mbytes for high performance
Head positioner	Patented proprietary mechanism for increased data integrity
Intelligent data compression	Analyzes compression factors before recording to maximize performance and capacity
Interfaces	Either parallel Small Computer System Interface (SCSI) or serial-attached SCSI (SAS)
LSI circuitry	Custom designed for fast, efficient data processing
Native data transfer rate	Up to 68 Mbytes per second
Read channel	Third generation for increased maturity and data integrity
RISC processors	Provide fast, efficient data processing
SmartVerify	Includes two levels of ECC for extra data safety and error protection
Supported platforms	A wide variety of Windows and UNIX systems
TapeAlert	Monitors and reports drive performance

Feature	Description
Tape picking	Enhanced implementation for increased reliability
Variable-speed transfer	Variable speeds for matching with the host to: • Optimize data transfers • Shorten backup times • Increase reliability
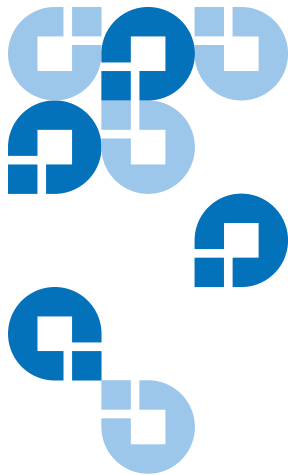
Installation Procedures

This chapter provides detailed installation instructions for both the internal and tabletop models of the Quantum LTO-3 Half-Height Tape Drive, including:

- Before Installing the LTO-3 Half-Height Tape Drive, which includes:
    - Handling Precautions and Installation Guidelines
    - Preinstallation Requirements on page 7
    - Unpacking and Inspecting the Drive on page 8
- Detailed procedures for:
    - Installing the Internal LTO-3 Half-Height Tape Drive on page 9
    - Installing the Tabletop LTO-3 Half-Height Tape Drive on page 17
    - Installing the LTO Driver Software on page 25, optional/when required
    - Registering the LTO-3 Half-Height Tape Drive on page 25

Optionally, experienced users who are familiar with installing the LTO-3 Half-Height Tape Drive can refer to the quick-start checklists in appendix A on page 85 of this guide. Each checklist provides abbreviated installation instructions, with references to the corresponding detailed procedures in this chapter.

Before Installing the LTO-3 Half-Height Tape Drive

Handling Precautions and Installation Guidelines

Always observe the following precautions and guidelines when handling and installing LTO-3 Half-Height Tape Drives:

- Internal, at all times
- Tabletop, when removed from its free-standing enclosure

Handling Precautions	
	• Internal drives have exposed components that are sensitive to static electricity. To reduce the possibility of damage from static discharge, the drives are packaged in a protective antistatic bag. Do not remove the drive from the antistatic bag until you are ready to install it.
	• Wear an ESD-preventive grounding wrist strap or observe similar ESD precautions when working with the drive. Be sure the wrist strap makes good skin contact. Do not remove the wrist strap until you finish working with the drive. Also, avoid contact between the drive, other equipment, and clothing. The wrist strap only protects the equipment from ESD voltages on the body; ESD voltages on clothing can still cause damage.
	• Before removing the drive from the antistatic bag, touch a grounded metal surface to discharge any static electricity buildup from your body.

(continued)

Handling Precautions (continued)	• Handle the drive by its sides rather than by the top cover to reduce the risk of dropping the drive or damaging it during installation. • Either lay the drive on a nonconductive surface or put it back inside the protective antistatic bag to reduce the chance of damage from static discharge
Installation Guidelines	• LTO-3 Half-Height Tape Drives with the parallel SCSI interface are low voltage differential (LVD) SCSI devices. Install LVD drives only in LVD environments. Do not mix LVD and HVD devices on the same parallel SCSI bus. • Due to the high speed of the LTO-3 Half-Height Tape Drive, do not connect more than one LTO-3 drive to the same channel on a host SCSI adapter.

Preinstallation Requirements

Before installing the LTO-3 Half-Height Tape Drive, make sure you have:

• A host bus adapter (HBA) installed and properly configured in the host computer:

  • Parallel SCSI HBA for a parallel SCSI drive

  • Serial SCSI HBA for a SAS drive

• Interface components:

  • For a parallel SCSI drive, either internal or tabletop, a 68-pin parallel SCSI cable and terminator

  • For a SAS drive, either:

    • 7-pin 1x SATA style interface cable for an internal drive

    • 26-pin SFF-8088 mini-SAS style interface cable for a tabletop drive

- Backup application software that supports the tape drive. For a list of the backup software applications that have been tested with the LTO-3 Half-Height Tape Drive, please visit our website at:

    www.quantum.com/support

Unpacking and Inspecting the Drive

Although each LTO-3 Half-Height Tape Drive is inspected and carefully packaged at the factory, damage can occur:

- In shipment
- When being unpacked

Observe the handling precautions listed in Handling Precautions and Installation Guidelines and carefully unpack and inspect the LTO-3 Half-Height Tape Drive as follows:

1 Visually inspect the shipping container and notify your carrier immediately of any damage.

2 Place the shipping container on a flat, clean, stable surface and carefully remove the contents.

3 Visually inspect the LTO-3 Half-Height Tape Drive and notify your Quantum representative immediately of any damage.

4 Always save the shipping container and packing materials for any future reshipment.

Installing the Internal LTO-3 Half-Height Tape Drive

To install the internal LTO-3 Half-Height Tape Drive, complete the following procedures in the order presented:

1 Depending on the interface configuration of the drive:

IF the drive interface is . . .	THEN . . .
parallel Small Computer System Interface (SCSI),	proceed to <u>Configuring the Internal Parallel SCSI Tape Drive</u> in the following subsection to configure the parallel SCSI ID and bus terminator power.
serial-attached SCSI (SAS),	there is no need to configure the SCSI ID or bus termination, as SAS is a point-to-point architecture. Skip to <u>Mounting the Internal Tape Drive</u> on page 13

2 <u>Connecting the Internal Drive Interface and DC Power Cables</u> on page 15.

3 <u>Restarting the Internal Tape Drive System</u> on page 17

4 <u>Installing the LTO Driver Software</u> on page 25, if required.

5 <u>Registering the LTO-3 Half-Height Tape Drive</u> on page 25.

Configuring the Internal Parallel SCSI Tape Drive

The factory-set default configuration of the internal parallel SCSI LTO-3 Half-Height Tape Drive is:

- SCSI ID: 6

- Terminator power: enabled

IF the default parallel SCSI ID configuration is . . .	THEN you can . . .
compatible with your system SCSI bus,	skip the following subsection and proceed to Configuring the Internal Parallel SCSI Terminator Power on page 12.
already assigned to another device,	change the configuration of either the other device, or the LTO-3 Half-Height Tape Drive, as described in the following subsection.

Configuring the Internal Drive Parallel SCSI ID

Each device on the parallel SCSI bus must have its own unique SCSI ID. Use SCSI configuration jumper pins 1–2, 3–4, 5–6, and 7–8 on the drive back panel to change the SCSI ID of the LTO-3 Half-Height Tape Drive (see figure 2 and table 2).

> **Note:** Parallel SCSI controllers and host adapters generally use ID 7. In some systems, the boot drive uses ID 0 or ID 1. Avoid configuring the LTO-3 Half-Height Tape Drive to these SCSI IDs.

If you are installing the internal LTO-3 Half-Height Tape Drive in a UNIX operating system environment, see Finding Existing SCSI Devices and Controllers on page 28 and refer to the appropriate subsection in chapter 3 to identify the installed parallel SCSI devices and controllers:

- Configuring Sun UNIX Environments on page 27

- Configuring IBM AIX UNIX Environments on page 30

- Configuring Linux UNIX Environments on page 32

- Configuring HP-UX UNIX Environments on page 33

Figure 2 Internal Parallel SCSI
ID Configuration Jumper Pins

SCSI ID configuration jumper pins
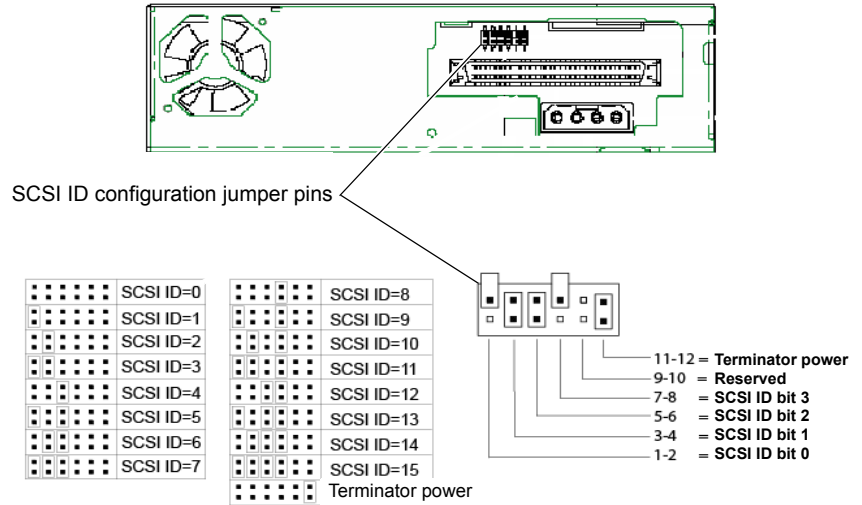
Table 2 Internal SCSI ID
Configuration Jumper Pin
Settings

	Jumper Pins			
SCSI ID	**1–2**	**3–4**	**5–6**	**7–8**
0	Open	Open	Open	Open
1	Shunted	Open	Open	Open
2	Open	Shunted	Open	Open
3	Shunted	Shunted	Open	Open
4	Open	Open	Shunted	Open
5	Shunted	Open	Shunted	Open
6 (default)	Open	Shunted	Shunted	Open
7	Shunted	Shunted	Shunted	Open
8	Open	Open	Open	Shunted
9	Shunted	Open	Open	Shunted

SCSI ID	Jumper Pins			
	1–2	3–4	5–6	7–8
10	Open	Shunted	Open	Shunted
11	Shunted	Shunted	Open	Shunted
12	Open	Open	Shunted	Shunted
13	Shunted	Open	Shunted	Shunted
14	Open	Shunted	Shunted	Shunted
15	Shunted	Shunted	Shunted	Shunted

Configuring the Internal Parallel SCSI Terminator Power

By default, terminator power is enabled on the internal parallel SCSI LTO-3 Half-Height Tape Drive. If you use this default setting, then the last device at the end of the parallel SCSI bus must have either:

• A parallel SCSI bus terminator

• Terminator power enabled

See figure 3 for examples of internal parallel SCSI bus termination.

To disable terminator power, remove the jumper across pins 11 and 12 (see figure 2).

> **Note:** The internal parallel SCSI LTO-3 Half-Height Tape Drive does not provide SCSI termination. The last device at the end of the parallel SCSI bus chain must have a SCSI bus terminator.

Figure 3   Internal Parallel SCSI
Bus Termination Examples

SCSI terminator

SCSI device
(termination
enabled)

Tape drive
(no termination)

Tape drive
(no termination)

SCSI device
(termination
disabled)

SCSI terminator

SCSI controller
(termination
enabled)

SCSI controller
(termination
enabled)
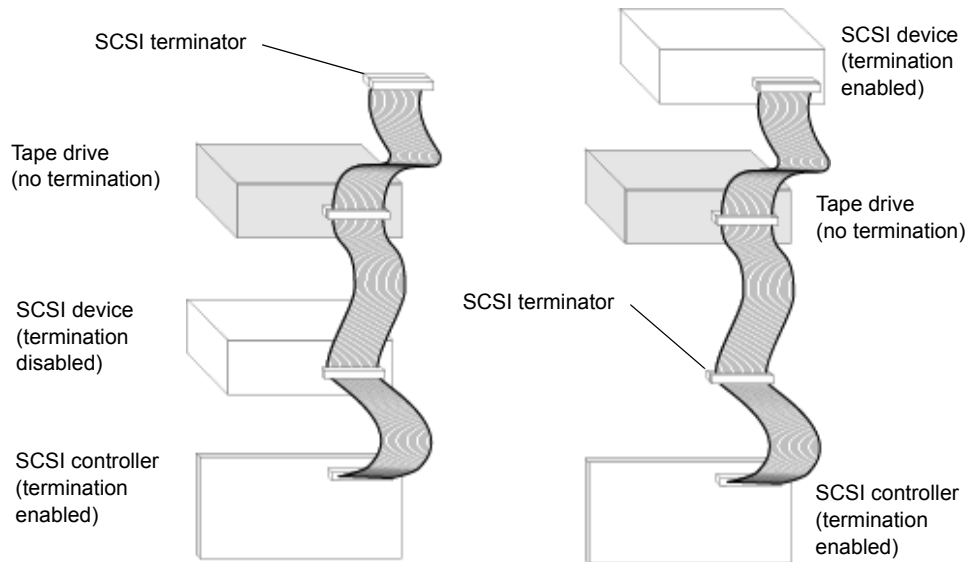
**Mounting the Internal
Tape Drive**

You can mount the internal LTO-3 Half-Height Tape Drive either
horizontally or vertically, but not upside down (see figure 4).

IF you mount the drive . . .	THEN the . . .
horizontally,	base of the drive must be within 15 degrees of horizontal.
vertically,	side of the drive should be within 5 degrees of horizontal.

Figure 4 Acceptable Mounting
Orientation

YES   YES   YES   NO
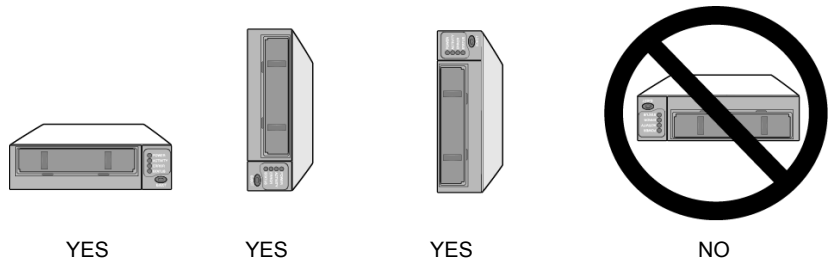
Mount the drive in a 5.25-inch, half-height drive bay as follows:

1 As required:

   a Save and close your open files and terminate all running
   applications.

   b Shut down the workstation or server system.

   c Disconnect the system AC power cord from the facility AC
   power receptacle.

2 Remove the cover from the workstation or server system.

> **Note:** See your computer manufacturer's instructions for the
> proper procedures to remove the cover.

3 Select an available 5.25-inch half-height bay and, if required, remove
the bay cover.

4 Position the drive in the bay and align either the upper or lower
mounting holes—whichever is appropriate—with the holes in the
chassis (see figure 5).

5 Secure the drive using two M3.0 X 4 metric screws on each side.

> **Caution:** Using screws longer than 4 mm can damage the drive.
> *Do not* use screws longer than 4 mm to secure the
> internal LTO-3 Half-Height Tape Drive.

After mounting the internal LTO-3 Half-Height Tape Drive, proceed to
Connecting the Internal Drive Interface and DC Power Cables in the
following subsection.

Figure 5 Internal Tape Drive
Mounting Holes

Upper mounting holes

Lower mounting holes
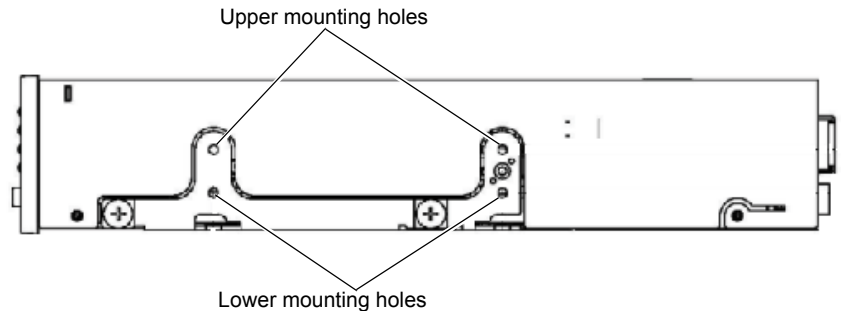
**Connecting the Internal
Drive Interface and DC
Power Cables**

As shown in figure 6 and figure 7, the rear panels of the internal LTO-3
Half-Height Tape Drives have connectors for:

- Either a 68-pin parallel SCSI or a 7-pin 1x SATA style interface cable

- A serial library interface cable

- The internal drive DC power cable

Connect the interface and DC power cables to the internal drive as
follows:

1 Verify that the system is shut down and the AC power cord is
disconnected from the facility AC power receptacle.

2 Depending on the interface configuration of your internal drive:

a For the parallel SCSI internal drive:

- Attach the internal parallel SCSI interface cable to the 68-pin
parallel SCSI connector on the back of the drive.

Caution:	The LTO-3 Half-Height Tape Drive with the parallel SCSI interface is a low voltage differential (LVD) SCSI device. Install it only in LVD environments. Plugging an LVD drive into a high voltage differential (HVD) bus makes the entire bus nonfunctional and may permanently damage the drive or other SCSI devices on the bus.

- See the internal parallel SCSI bus termination examples in <u>figure 3</u> on page 13 to check/verify the system SCSI bus configuration and install a 68-pin LVD SCSI bus terminator as required.

b For the SAS internal drive, attach the internal SAS interface cable to the 7-pin 1x SATA style SAS connector on the back of the drive.

Figure 6 Internal SCSI Drive Interface and DC Power Connectors

Serial library port

68-pin parallel SCSI connector
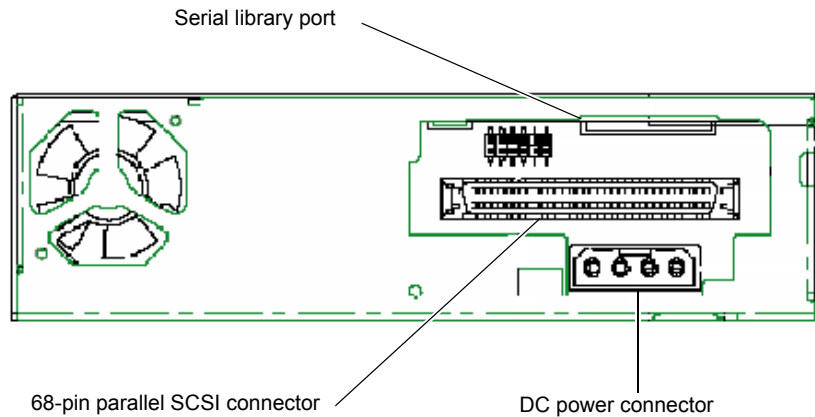
DC power connector

Figure 7 Internal SAS Drive Interface and DC Power Connectors

Serial library port

DC power connector

7-pin 1x SATA style SAS connector
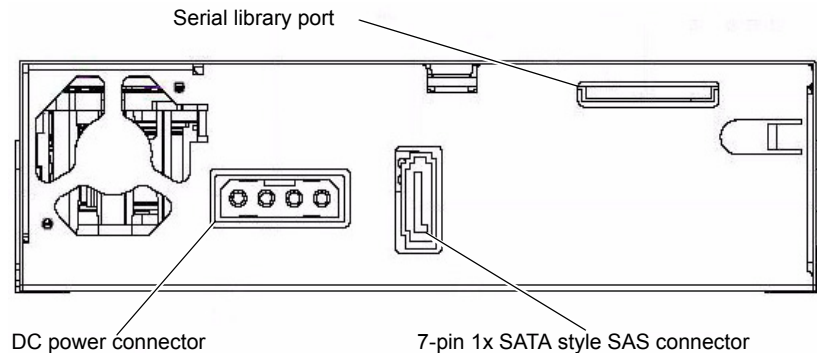
3 If you are installing the internal LTO-3 Half-Height Tape Drive in a tape library system, connect the RS-422 serial interface cable to the serial library port on the back of the drive. (The serial library port is not used on workstation or server systems.)

4 Connect the internal drive DC power cable to the DC power connector on the back of the drive.

5 Reinstall the system cover.

6 Reconnect the system AC power cord to the facility AC power receptacle.

After connecting the interface and DC power cables, proceed to Restarting the Internal Tape Drive System in the following subsection.

Restarting the Internal Tape Drive System

After connecting the internal drive interface and DC power cables:

1 Restart the workstation or server system.

2 Refer to the operating procedures in chapter 4 to verify that the internal LTO-3 Half-Height Tape Drive comes on and completes the Power On Self Test (POST) functions.

3 As required, proceed to either:

- Installing the LTO Driver Software on page 25

- Registering the LTO-3 Half-Height Tape Drive on page 25

Installing the Tabletop LTO-3 Half-Height Tape Drive

The tabletop LTO-3 Half-Height Tape Drive is a compact external drive that connects to the host computer through an external parallel SCSI port or an external serial-attached SCSI (SAS) port.

Do not attempt to install the LTO-3 Half-Height Tape Drive until you have reviewed Handling Precautions and Installation Guidelines on page 6.

To install the tabletop LTO-3 Half-Height Tape Drive, complete the following procedures in the order presented:

1 Depending on the interface configuration of the drive:

IF the drive interface is . . .	THEN . . .
parallel Small Computer System Interface (SCSI),	proceed to <u>Configuring the Tabletop Parallel SCSI Tape Drive</u> in the following subsection to configure the SCSI ID.
serial-attached SCSI (SAS),	there is no need to configure the SCSI ID, as SAS is a point-to-point architecture. Skip to <u>Connecting the Tabletop Drive Interface and AC Power Cables</u> on page 21.

2 <u>Connecting the Tabletop Drive Interface and AC Power Cables</u> on page 21.

3 <u>Restarting the Tabletop Drive System</u> on page 24.

4 <u>Installing the LTO Driver Software</u> on page 25, if required.

5 <u>Registering the LTO-3 Half-Height Tape Drive</u> on page 25.

Configuring the Tabletop Parallel SCSI Tape Drive

The factory-set default configuration of the tabletop parallel SCSI LTO-3 Half-Height Tape Drive is:

- SCSI ID: 6

- Terminator power: enabled

IF the default parallel SCSI ID configuration is . . .	THEN you can . . .
compatible with your system SCSI bus,	skip the following subsection and proceed to Connecting the Tabletop Drive Interface and AC Power Cables on page 21.
already assigned to another device,	change the configuration of either the other device, or the LTO-3 Half-Height Tape Drive, as described in the following subsection.

Note: You cannot disable terminator power on a tabletop parallel SCSI drive.

Configuring the Tabletop Drive Parallel SCSI ID

Each device on the parallel SCSI bus must have its own unique SCSI ID. Use the push-button SCSI ID selector switch on the drive back panel to change the SCSI ID of the tabletop LTO-3 Half-Height Tape Drive (see figure 8).

Figure 8 Tabletop Parallel
SCSI ID Selector Switch
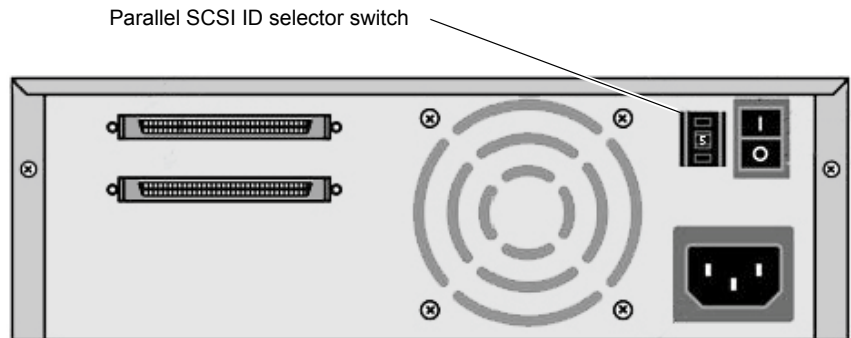
Parallel SCSI ID selector switch

> **Note:** Parallel SCSI controllers and host adapters generally use ID 7.
> In some systems, the boot drive uses ID 0 or ID 1. Avoid
> configuring the LTO-3 Half-Height Tape Drive to these SCSI
> IDs.

If you are installing the tabletop LTO-3 Half-Height Tape Drive in a
UNIX operating system environment, see Finding Existing SCSI Devices
and Controllers on page 27 and refer to the appropriate subsection in
chapter 3 to identify the installed parallel SCSI devices and controllers:

- Configuring Sun UNIX Environments on page 27

- Configuring IBM AIX UNIX Environments on page 30

- Configuring Linux UNIX Environments on page 32

- Configuring HP-UX UNIX Environments on page 33

After configuring the parallel SCSI ID, proceed to Connecting the
Tabletop Drive Interface and AC Power Cables in the following
subsection.

Connecting the Tabletop Drive Interface and AC Power Cables

As shown in and , the rear panels of the tabletop LTO-3 Half-Height Tape Drives have connectors for:

• Either a 68-pin parallel SCSI cable (two connectors), or a 26-pin SFF-8088 mini-SAS style interface cable

• The AC power cable

For the tabletop parallel SCSI drive, either SCSI connector can be used as a SCSI IN or SCSI OUT connection. This means you can use either connector to attach the drive to a host computer or to another parallel SCSI device.

Figure 9 Tabletop SCSI Interface and Power Cable Connectors

68-pin parallel SCSI connectors

AC power switch
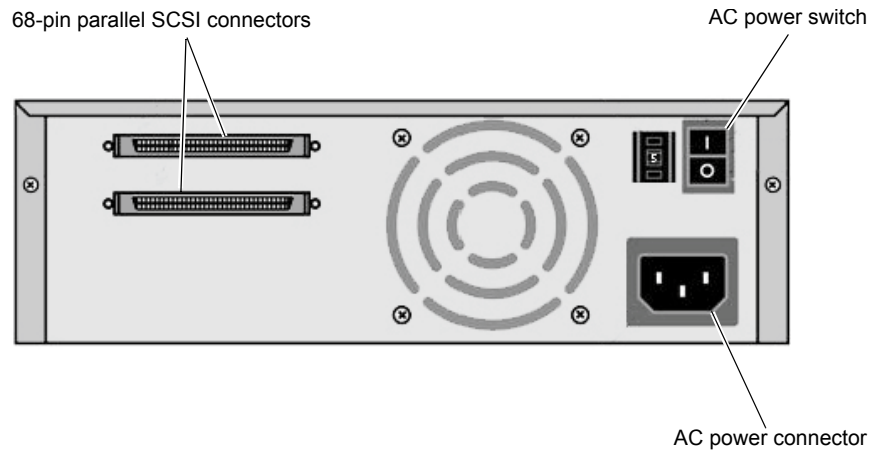
AC power connector

Figure 10 Tabletop SAS
Interface and Power Cable
Connectors

26-pin SFF-8088 mini-SAS connector

AC power switch
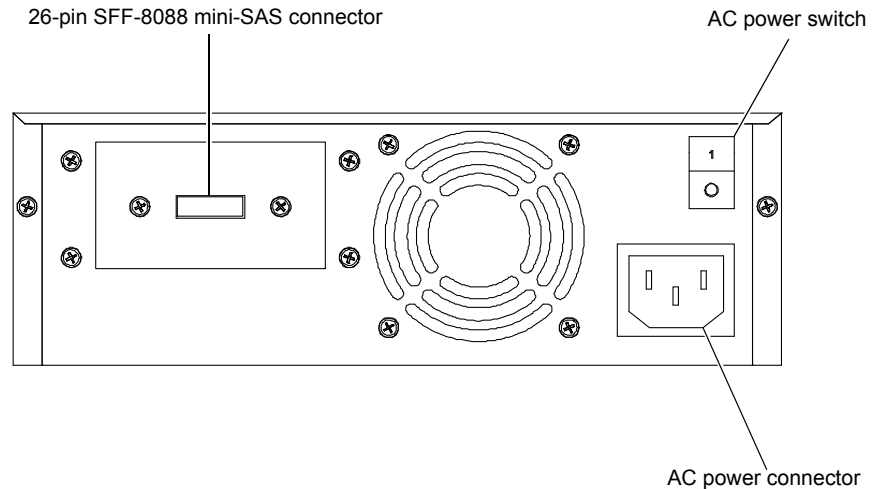
AC power connector

Connect the interface and AC power cables to the tabletop drive as
follows:

1 As required:

  a Save and close your open files and terminate all running
    applications.

  b Shut down the workstation or server system.

  c Disconnect the system AC power cord from the facility AC
    power receptacle.

2 Depending on the interface configuration of your tabletop drive:

  a For the parallel SCSI tabletop drive:

  • Attach the SCSI IN interface cable to one of the 68-pin
    parallel SCSI interface connectors on the back of the drive.

  • Attach either the SCSI OUT interface cable or a SCSI
    terminator to the other parallel SCSI interface connector on
    the back of the drive.

    If the tabletop LTO-3 Half-Height Tape Drive is the last or
    only device in a SCSI chain, you must install a 68-pin low
    voltage differential (LVD) terminating plug on the unused
    parallel SCSI connector.

See figure 11 for tabletop parallel SCSI bus termination examples.

> **Caution:** The LTO-3 Half-Height Tape Drive with the parallel SCSI interface is a low voltage differential (LVD) SCSI device. Install it only in LVD environments. Plugging an LVD drive into a high voltage differential (HVD) bus makes the entire bus nonfunctional and may permanently damage the drive or other SCSI devices on the bus.

   b For the SAS tabletop drive, attach the external SAS interface cable to the 26-pin SFF-8088 mini-SAS connector on the back of the drive.

3 Verify that the tabletop LTO-3 Half-Height Tape Drive AC power switch is set to the off position, and connect the AC power cord to the power connector on the back of the drive.

4 Connect the drive AC power cord to the facility AC power receptacle.

5 Reconnect the workstation or server system AC power cord to the facility AC power receptacle.

After connecting the tabletop drive interface and AC power cables, proceed to Restarting the Tabletop Drive System in the following subsection.

Figure 11 Tabletop Parallel
SCSI Bus Termination
Examples

SCSI terminators

External SCSI device

External tape drive

External tape drive

External SCSI
device

SCSI controller
(termination disabled)

SCSI controller
(termination
enabled)

Internal SCSI
device (termination
enabled
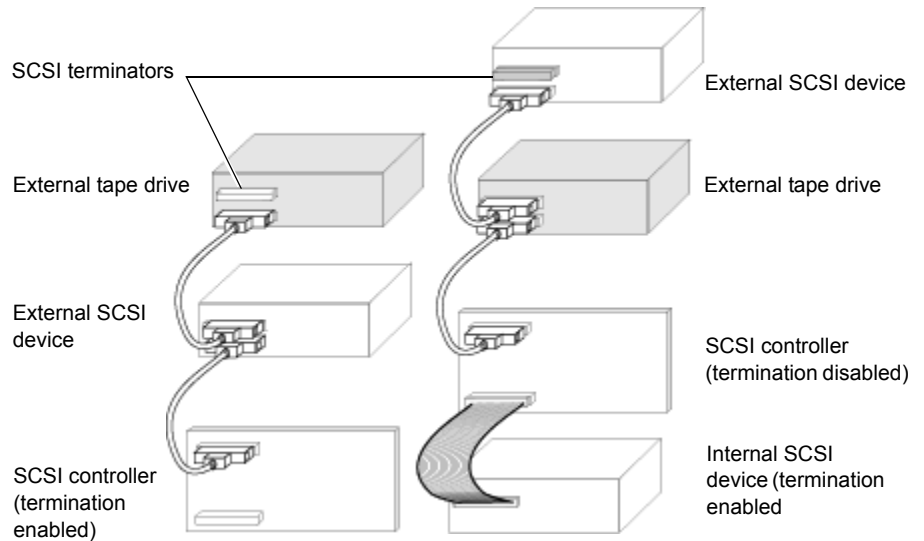
Example 1: SCSI termination in a system
that has only external SCSI devices.

Example 2: SCSI termination in a system that
has both internal and external SCSI devices.

**Restarting the Tabletop
Drive System**

After connecting the tabletop drive interface and AC power cables:

1 Set the tabletop LTO-3 Half-Height Tape Drive power switch to the
   on position.

2 Restart the workstation or server system.

3 Refer to the operating procedures in chapter 3 to verify that the
   tabletop LTO-3 Half-Height Tape Drive comes on and completes the
   Power On Self Test (POST) functions.

As required, proceed to either:

• Installing the LTO Driver Software

• Registering the LTO-3 Half-Height Tape Drive

Installing the LTO Driver Software

If you intend to use the LTO-3 Half-Height Tape Drive with the Microsoft® native backup applet on a Windows 2000, Windows Server® 2003, Windows XP®, or Windows Vista operating system, install the appropriate version of the LTO driver software. (See the Downloads page for LTO-3 drivers under Standalone Tape Drives on the Quantum support website at www.quantum.com/support.)

> **Note:** The LTO driver software is not necessary with commercial backup application software.

Registering the LTO-3 Half-Height Tape Drive

After installing the LTO-3 Half-Height Tape Drive, be sure to register it via the Quantum website at:

www.quantum.com/registration

Registering the drive ensures that you will receive the latest technical information about the drive, as well as other product, service, and support information.
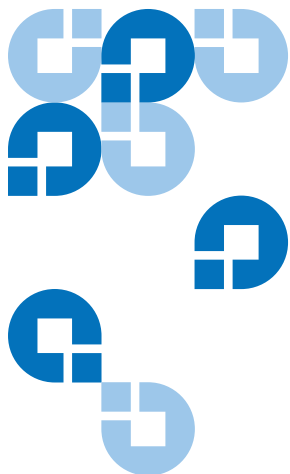
UNIX Configuration Procedures

This chapter describes how to configure various UNIX systems to recognize and obtain optimal performance from the LTO-3 Half-Height Tape Drive.

The topics covered in this chapter are:

A Word About SCSI Controllers

The LTO-3 Half-Height Tape Drive transfers data natively at 68 Mbytes per second, with 2:1 compression of the data. It supports the SCSI Ultra 160 specification and can transfer data at burst rates of up to 320 Mbytes per second. To achieve maximum drive performance, always choose high-performance disk drives for your system, as well as high-performance SCSI controllers.

Table 3 lists the recommended types of SCSI controllers, in order of most preferred (top) to least preferred (bottom).

Table 3   Recommended SCSI Controllers

Controller Type	Maximum Transfer Rate
Ultra 320 SCSI	320 Mbytes per second, most preferred
Ultra 3 SCSI	160 Mbytes per second
Wide Ultra2 SCSI	80 Mbytes per second, compatible

For definitions of the terms used above, please refer to SCSI Trade Association web site:

www.scsita.org/aboutscsi/index01.html

Finding Existing SCSI Devices and Controllers

Each SCSI device attached to a host must have a unique SCSI address. The first step in configuring the UNIX environment is to determine the addresses of all SCSI devices to verify that each has a unique address.

Note: SCSI ID 7 is almost always dedicated to the SCSI controller. Never configure the LTO-3 Half-Height Tape Drive for ID 7 unless you are absolutely sure that the controller is not assigned ID 7.

Configuring Sun UNIX Environments

This subsection provides procedures for configuring the following Sun UNIX operating system environments:

- Solaris 2.4, 2.5 and 2.6
- Solaris 7, 8, 9 and 10

Finding Existing SCSI Devices and Controllers

Use the **modinfo** and **dmesg** commands to identify the installed SCSI devices and controllers.

For example, the command **dmesg | egrep target | sort | uniq** can find all SCSI controllers and devices. The output may look similar to:

```
sd32   at   ithps0:   target2   lun0
sd34   at   ithps0:   target4   lun0
st21   at   ithps1:   target0   lun0
st22   at   ithps1:   target1   lun0
```

In this example, the LTO-3 Half-Height Tape Drive can be set for SCSI ID 2 through 6 and attached to controller ithps1. (This particular controller also supports SCSI addresses 8 through 15.)

Note: You might be able to view the main pages of three types of SCSI controllers for Sun Sparc systems:
- esp
- glm
- isp

Do not attach the LTO-3 Half-Height Tape Drive to esp type controllers. They are not fast enough and will produce very slow backup operations.

In this case, the Ultra Wide glm type controller would be the minimum acceptable device.

The best controllers for the LTO-3 Half-Height Tape Drive are Ultra3 SCSI-capable devices with a minimum data transfer rate of 160 Mbytes per second.

Configuring the UNIX Environment

Procedure

1 Add the following lines to the **st.conf** file in the **/kernel/drv** directory.

```
tape-config-list=
"SEAGATE ULTRIUM06242-XXX", "Seagate LTO 1", "SEAGATE_LTO1",
"CERTANCE ULTRIUM 2", "Seagate LTO 2", "Certance_LTO2",
"CERTANCE ULTRIUM 3", "Seagate LTO 3", "Certance_LTO3",
"QUANTUM ULTRIUM 3", "Quantum LTO 3","Quantum_LTO3",

# THE LAST ENTRY IN THIS SECTION MUST END WITH A SEMICOLON
```

SEAGATE_LTO1 = 1,0x3b,0,0x1d639,4,0x00,0x00,0x00,0x00,1;
Certance_LTO2 = 1,0x3b,0,0x1d639,4,0x00,0x00,0x00,0x00,1;
Certance_LTO3 = 1,0x3b,0,0x1d639,4,0x00,0x00,0x00,0x00,1;
Quantum_LTO3 = 1,0x3b,0,0x1d639,4,0x00,0x00,0x00,0x00,1;

The value 0x1d639 equates to the way the LTO-3 Half-Height Tape
Drive is configured to operate in the Solaris environment. This value
enables the LTO-3 Half-Height Tape Drive to support:

- Variable-length records (variable-length block size), not limited
  to 64 Kbytes

- Long time outs (5 times longer than normal) for long erase
  functions (Attempting to erase the entire tape is not
  recommended.)

- End of data detection

- Backspace over:

  - Files (same as **mt bsf** command to backspace over file marks)

  - Records (same as **mt bsr** command to backspace over
    individual tape blocks)

- Unloadable device drivers

- Buffered write operations

- Mode Select Page 10h operations to enable/disable data
  compression

2 After modifying the **st.conf** file, use the **boot-r** command to restart the
system and reconfigure the kernel.

  a If you are replacing a tape device with the same SCSI ID, you
      might want to delete the st devices from the **/dev/rmt** directory.
      (This is recommended.)

  b When using commands that require a blocking factor, such as **tar**
      or **ufsdump**, the preferred factor is:

    - 128 (optimal)

    - 64 (minimal)

   c When using commands that require tape density and size settings, the tape:

- Density is 124,000 bpi

- Length is 1800 feet

Note, however, that the **ufsdump** and **ufsrestore** commands are preferred, as they automatically detect end-of-tape without the need for tape density and length settings.

   d When writing data to tape, use the **c** option to enable data compression. For example, **tar cf /dev/rmt/0c** causes the tape drive to compress the data before writing to tape.

Configuring IBM AIX UNIX Environments

This subsection provides procedures for configuring IBM AIX Version 4.1*x* and later UNIX operating system environments.

Finding Existing SCSI Controllers and Devices

Use the **lsdev–Cs scsi** command to identify the installed SCSI devices and controllers.

Note the existing SCSI device IDs and verify that the SCSI ID for the LTO-3 Half-Height Tape Drive does not conflict with the other IDs shown by the **lsdev** command.

Configuring the UNIX Environment

Procedure

Use the **Other SCSI Tape Drive** option of the SMIT utility to configure AIX:

1 Enter SMIT at the Tape Drive menu by typing **smit tape**.

2 Select **Add a tape Drive**.

3 Use the **Other SCSI Tape Drive** option to specify the type of tape drive you will be adding.

4 Select **Parent SCSI Adapter** from the available list to display the **Add a tape Drive "Entry Fields"**.

5 Change the following standard options to maximize drive performance and functionality:

   a Set the **Connection Address with the Drives Target and Lun** (always use **Lun 0**). In the list, the target device is the first number and the Lun is the second. For example, if the drive is ID 5, choose 5,0.

   b Set the **BLOCK** size to **0**.

   c Set **Use DEVICE BUFFERS during writes** to **yes**.

   d Set **RETURN error on tape change or reset** to **no**.

   e Set **Use EXTENDED file marks** to **yes**.

   f Set **RESERVE/RELEASE support** to **yes**.

   g Set **BLOCK SIZE for variable length support (Num.)** to **0**.

   h Set **Density 1** to **0**.

6 Leave the **Set delay. . .** and **Set timeout. . . lines** at the default value.

7 Click **OK** to install the drive in the system database and create the devices. There is no need to restart the system.

8 Exit SMIT.

9 Subsequently:

   a Use the AIX commands **backup** and **restore** to transfer data to and from the LTO-3 Half-Height Tape Drive. They transfer data much more quickly than other commands such as **tar** and **cpio**. However, for:

     • **cpio**, use a blocking factor of 128

     • **tar**, use the N option and a factor of 128

> **Note:** Some older systems with poor video controllers might experience a degradation in performance when using the **v** option, which prints the path names on the standard console during the backup. Unless there is a real need to see the filenames as they are backed up, do not use the **v** option.

   b For commands that use density and tape size settings, the tape:

   - Density is 124,000 bpi

   - Length is 1800 feet

Configuring Linux UNIX Environments

This subsection provides procedures for configuring Linux UNIX operating system environments.

Finding Existing SCSI Controllers and Devices

Use the following command to list the current SCSI controllers:

dmesg | grep SCSI

This command produces output similar to:

(scsi0)<Adaptec AHA-294XX Ultra2 SCSI host
adapter> found at PCI 0/16/0

Use the following command to find existing SCSI devices:

cat /proc/scsi/scsi

This command produces output similar to:

Host: scsi0 Channel: 0 Id:6 Lun:00
Vendor: Quantum Model: ULTRIUM 3 Rev: 1897
Type: Sequential-Access ANSI SCSI revision 04

Use the output of these two commands to determine which SCSI target ID numbers are available. In this example, a tape drive is attached at target ID 6.

The widely available distributions of Linux automatically install the proper SCSI and tape device drivers. If you executed the **cat** command to find existing SCSI devices, you have ensured that the SCSI driver for your controller is installed.

Use the following command to view currently loaded modules:

execute

Verify that one of the entries is st.

Use the following command to view the st device number for your attached tape drive:

dmesg | grep tape

This command produces output similar to:

Detected SCSI tape st0 and scsi0 . . .

Configuring the UNIX Environment

Procedure

1 Use the **mt** command options to configure the UNIX environment.

2 Use the **stsetoptions** command from within the **mt** command to set up a default configuration.

   See the man page for **mt** for details.

3 Subsequently:

   a Do not use the **erase** command.

   b Do not use commands that partition the tape. Partitioning is not supported in the LTO format.

   c For commands that use density and tape size settings, the tape:

   • Density is 124,000 bpi

   • Length is 1800 feet

   d For commands that use a blocking factor, use a factor of 128.

Configuring HP-UX UNIX Environments

This subsection provides procedures for configuring HP-UX Version 11.0 UNIX operating system environments.

Finding Existing SCSI Controllers and Devices

Use the following command to list the current SCSI controllers and devices:

can ioscan–f.

Configuring the UNIX Environment

Procedure

1 Log in as superuser and issue the command:

ioscan –C tape –f

This command produces output similar to:

Class I H/WPath Driver S/WState H/Wtype Description
Tape 7 8/12.6.0 stape Claimed Device QUANTUM ULTRIUM 3

2 From the root directory and as superuser, issue the command:

/sbin/insf –C tape

3 Issue the command:

**/sbin/mksf –d stape –H x/x.x.x –I y –c 1
–n –u /dev/rmt/zcnb**

Where:
- *x* is the data under **H/WPath** from the ioscan
- *y* is the data under I from the ioscan
- *z* is the tape device identifier number

> **Note:**   You can execute an **ls** command for the **/dev/rmt** directory
> to choose:
> - An identifier number that has not already been used
> - A unique device name such as **cnb** to more easily
>   remember which device name will enable data
>   compression during write

4 Refer to the man pages for **mksf** to review settings for **rewind**, **no
rewind, Berkeley mode**, and **AT&T mode**.

5 After executing the **insf** and **mksf** commands, use the following command to check the installation:

ioscan –fn | grep –C tape

This command produces an output that shows the hardware and device addressing and the device name assigned to the LTO-3 Half-Height Tape Drive.
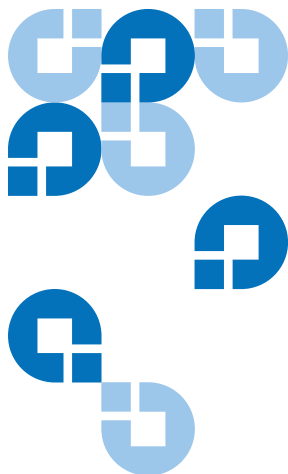
Chapter 4
Operation

This chapter describes how to operate the LTO-3 Half-Height Tape Drive.

Topics covered in this chapter are:

-
-
-
-

Understanding the Front Panel Display

As shown in figure 12, the LTO-3 Half-Height Tape Drive front panel display has four LED indicators that reflect the operating condition of the drive:

The green POWER LED is on whenever power is applied to the drive.

The green ACTIVITY LED, the orange ERROR LED, and the amber STATUS LED are either on steady or blinking at different rates in various combinations to indicate the various drive conditions as shown in table 4.

Figure 12 Front Panel Display
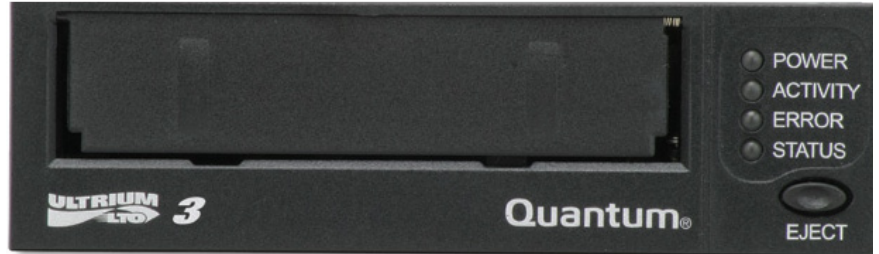
In <u>table 4</u>:

This indication . . .	Signifies that the LED is . . .
On	illuminated continuously in a steady state.
Slow	blinking on and off at a rate of one cycle per second.
Fast	blinking on and off at a rate of four cycles per second.

Table 4   Front Panel Display LED Blink Codes

Drive Condition	Activity LED (Green)	Error LED (Orange)	Status LED (Amber)
Cleaning Request			On
Cleaning cartridge present	On		On
Cleaning cartridge at EOT	On		Fast
Cleaning failure or media error		Fast	Fast
Hardware error		Fast	
Manual intervention required		On	
Microcode download	Fast	Slow	Fast

Drive Condition	Activity LED (Green)	Error LED (Orange)	Status LED (Amber)
Microcode download error	Fast	Fast	Fast
Positioning – loading, unloading, rewinding, spacing, or locating	Slow		
Power On Self Test (POST) in progress	Slow	Slow	Slow
Power On Self Test (POST) failure		Fast	On
Servo initialization	Slow		Slow
Tape Active – writing, reading, or verifying	Slow		

Using LTO Tape Cartridges

Loading a Tape Cartridge

To load an Ultrium tape cartridge into the LTO-3 Half-Height Tape Drive, gently insert the cartridge into the slot and then either:

- Push the cartridge further into the drive until the drive senses the cartridge and automatically completes the load operation.

- Use a library or host command to complete the load operation.

Unloading a Tape Cartridge

To unload an Ultrium tape cartridge from the LTO-3 Half-Height Tape Drive, either:

• Use a library or host command to unload the tape.

• Press the Eject button on the front panel of the drive.

> **Caution:** After you press the Eject button, several minutes can elapse before the drive ejects the cartridge. Do not power down the tape drive or the host computer until the drive has completely ejected the cartridge.

Write Protecting a Tape Cartridge

Ultrium tape cartridges have a sliding write-protect switch at the right-rear corner as shown in figure 13.

Sliding the write-protect switch toward the . . .	Enables data to be . . .
center of the cartridge (the Locked position),	read from the cartridge, but not written to it. (This is the write-protected position.)
corner of the cartridge (the Unlocked position),	both read from and written to the cartridge. (This is the write-enabled position.)

Figure 13 Ultrium Tape Cartridge Write-Protect Switch
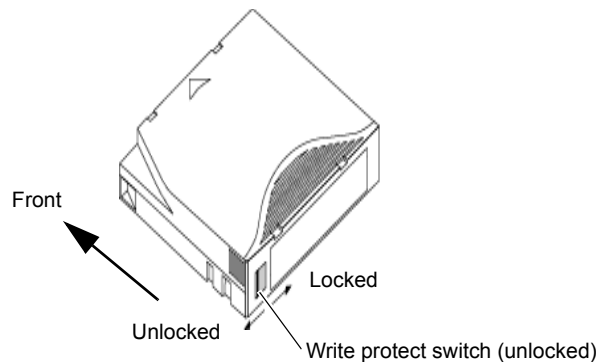
Tape Cartridge Care and Maintenance

Observe the following precautions to protect the data on your Ultrium tape cartridges:

Always:	• Remove the cartridge from the drive when not in use and store it in its protective case.
	• Avoid dropping the cartridge. This can damage components inside the cartridge, possibly rendering the tape unusable. If you drop a tape cartridge, open the cartridge door and make sure that the leader pin is in the correct position.
	• Re-tension a dropped cartridge before using.
	• Keep the cartridge away from:
	• Direct sunlight and heat sources, such as radiators, heaters, or warm air ducts.
	• Sources of electromagnetic fields, such as telephones, computer monitors, dictation equipment, mechanical or printing calculators, motors, magnetic tools, and bulk erasers.
Do not:	• Expose the cartridge to dirt, dust or moisture.
	• Touch the tape media within the cartridge.
	• Bulk erase Ultrium tape cartridges. LTO tape cartridges have prewritten servo patterns that cannot be reformatted by the tape drive. A bulk erase operation would make them unusable.
	• Use tape cartridges outside the specified operating conditions: 10° C to 40° C, 20% to 80% relative humidity.
	If a tape cartridge has been exposed to conditions outside the specified range, recondition the tape before using in the operating environment by exposing it to the operating environment for a time equal to or greater than the time it was outside the operating environment, up to a maximum of 24 hours. Then re-tension the tape to stabilize the tape pack for better performance.

Cleaning the Tape Drive

Excessive tape debris or other material can accumulate on the tape heads if the drive is:

- Used with non-approved media
- Operated in a hot, dusty environment

When this happens, the drive can experience excessive errors while reading or writing, and illuminate the amber Status LED continuously during operation. This means that the drive needs to be cleaned.

The LTO cleaning cartridge has the same dimensions as the tape cartridge and contains an LTO Cartridge Memory (LTO-CM), but is loaded with cleaning media instead of recording media. Always keep the LTO cleaning cartridge in its protective case when not in use.

Procedure

To clean the LTO-3 Half-Height Tape Drive:

1 Load an LTO cleaning cartridge into the tape drive.

2 Observe that both the Status and Activity LEDs are on steady during the cleaning process.

> **Note:** If the LTO-3 Half-Height Tape Drive does not recognize the cartridge as an LTO cleaning cartridge, the drive stops the cleaning process and ejects the cartridge.

3 After the cleaning process completes, depending on the drive configuration, either:

    a The drive automatically ejects the LTO cleaning cartridge, or

    b You must press the Eject button to eject the LTO cleaning cartridge.

4 Write the date on the cartridge label for future reference.

Each time you use the LTO cleaning cartridge, the cleaning media advances to a new, unused section. After approximately 50 cleanings, all of the media will be used up and the LTO-3 Half-Height Tape Drive:

- Turns on the green Activity LED
- Fast flashes the amber Status LED
- Ejects the LTO cleaning cartridge

Always discard used-up LTO cleaning cartridges.

Note:	If the amber Status LED comes on continuously within 24 hours after a cleaning cycle, perform the cleaning procedure again. If, after three cleaning cycles in a 72-hour period, the amber Status LED comes on again, contact Quantum Technical Support.

Performing an Emergency Reset and Cartridge Eject

If the LTO-3 Half-Height Tape Drive stops communicating with the host computer, use the following procedure to reset the drive and eject a cartridge (if necessary).

Caution:	When you perform an emergency reset and cartridge eject, any data in the drive or host buffers will not be written to the tape and the tape record may not be correctly terminated with an end-of-data mark. If the end-of-data mark is not written to the tape, you will not be able to append any data to that tape unless you overwrite the existing data on the tape.

To perform an emergency reset, hold down the Eject button between 5 to 15 seconds, and then release it.

IF there is . . .	THEN the tape drive firmware . . .
no tape in the drive,	restarts the drive and begins the Power On Self Test function.
a tape in the drive,	ignores all outstanding SCSI commands, ejects the tape, restarts the drive, and begins the Power On Self Test function.

If the emergency reset procedure does not eject the cartridge from the drive, see
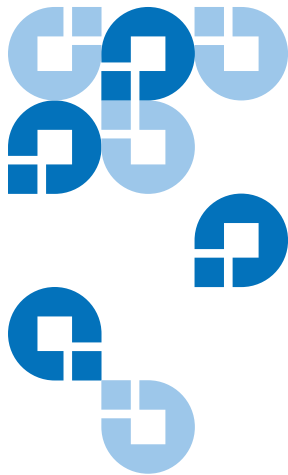
Chapter 5
Theory

This chapter describes operational theories used in the LTO-3 Half-Height Tape Drive.

The topics covered in this chapter are:

- [Track Layout](#)
- [Recording Method](#) on page 46
- [Data Buffer](#) on page 46
- [Data Integrity](#) on page 46
- [Data Compression](#) on page 48

Track Layout

With the LTO-3 Half-Height Tape Drive, there are 704 data tracks on the LTO tape, numbered 0 through 703. Data track 703 is the track closest to the bottom edge of the tape (the reference edge).

The area between adjacent servo bands is a data band. There are 4 data bands, each of which includes 176 data tracks. The data bands are numbered 2, 0, 1, 3. Data band 2 is closest to the bottom edge of the tape.

A track group is a set of tracks that is recorded concurrently. The sets of 11 data tracks in a data band are data sub-bands. There are 16 data sub-bands per data band. The data tracks are accessed in a serpentine manner.

A wrap is a track group recorded in the physical forward or physical reverse direction. The wraps are recorded in a serpentine fashion starting in data band 0. The tape contains 44 track groups, 22 written in the forward direction and 22 written in the reverse direction. Even-numbered wraps are recorded in the forward direction (BOT to EOT), and odd-numbered wraps are recorded in the reverse direction (EOT to BOT).

Figure 14 shows the layout of data on an LTO tape.

Figure 14 Layout of the Tracks on LTO Ultrium Tapes
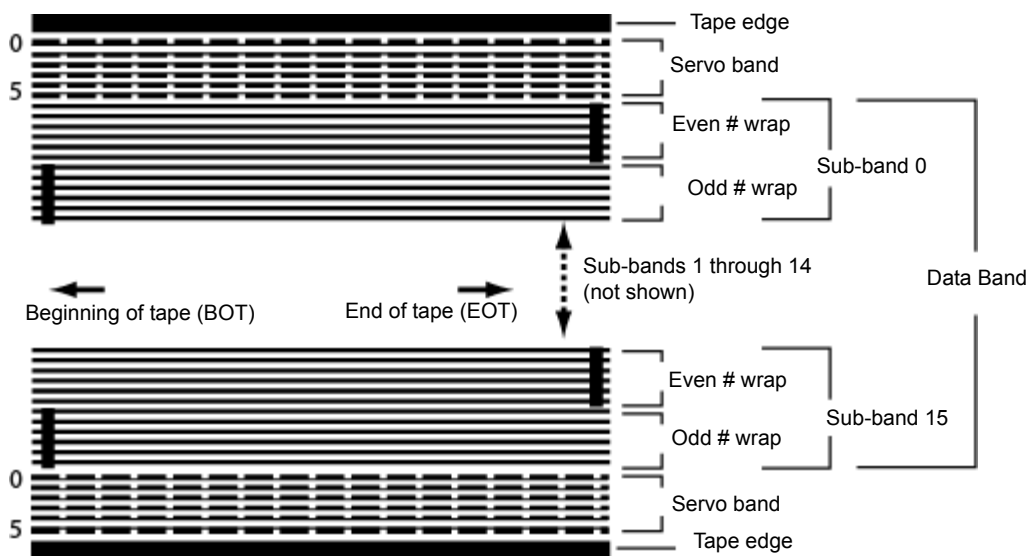
Recording Method

The LTO-3 Half-Height Tape Drive records data using write-equalized (0,13/11) Run Length Limited (RLL) code. RLL (0,13/11) Data bits are defined as follows:

- **ONE** is represented by a flux transition at the center of a bit-cell.

- **ZERO** is represented by no flux transition in the bit-cell.

Data Buffer

In its default configuration, the LTO-3 Half-Height Tape Drive has a 128-Mbyte buffer. The buffer controller has a burst transfer rate of 320 Mbytes/sec., and utilizes bank switching to achieve a maximum average bandwidth of nearly 240 Mbytes/sec. The high bandwidth is needed to support look-aside data compression in the case of compressible data being transferred from SCSI at 160 Mbytes/sec.

Data Integrity

The mechanical and electrical design of the drive ensures that drive performance does not degrade over time. Changes in head alignment, head wear, component drift, and other factors are minimized to ensure that data integrity and interchange capability are not compromised. The drive also incorporates adaptive Finite Impulse Response (FIR) filters that modify the equalization of each read channel dynamically to compensate for many of those changes.

The error rate of the LTO-3 Half-Height Tape Drive is less than 1 hard error in 10^{17} bits. The undetectable error rate is 1 in 10^{27} bits read.

Error-correction Code (ECC)

The use of Cyclic Redundancy Checking (CRC), two-level orthogonal Error Correction Coding (ECC) provides a very low probability of encountering a hard error. During the read process, ECC correction is performed on the fly without affecting tape streaming.

There are two levels of Error Correction Coding (ECC). These two levels are orthogonal — that is, an ECC codeword at one level intersects ECC codewords at the other level just once, which means there will be only one common symbol between them. The two levels are called C1 and C2.

C1 ECC

As data is written to memory from the data processing unit, the DMA/ECC interface generates C1 ECC bytes and writes them to memory.

As data is written to tape, the C1 ECC is checked and an interrupt generated if there is an error. The C1 ECC read from memory is the ECC that is written to tape.

When data is read from tape and stored into memory, C1 ECC is checked and:

- If the C1 ECC is good, the "Valid" bit for the codeword pair is set.

- Otherwise, a pointer to the invalid codeword pair is passed to the C1 ECC correction engine.

    - If the C1 ECC correction engine can correct the error, then the corrected bytes are written to memory, and the Valid bit is set.

    - Otherwise, the Valid bit is left cleared.

As data is read from memory to the data processor for decompression, the C1 ECC is again checked and an interrupt generated if it is not correct.

C2 ECC

C2 ECC involves three distinct operations:

1 **Encoding**: Generating C2 ECC bytes from data bytes (performed by ECC coprocessor hardware).

2 **Decoding**: Generating ECC syndromes from data and ECC bytes, testing for all-zeroes (performed by ECC coprocessor hardware).

3 Correction: Generating corrected data from syndromes.

The correction depends on the number and types of errors involved:

- For one known C1 codeword pair in error in a subdata set (C2 codeword), the operation is performed by the ECC coprocessor hardware.

- For two or more known C1 codeword pairs in error, the matrix is computed by firmware and the correction is performed by hardware.

- For one or more unknown C1 codeword pairs, syndromes are generated by hardware, error location is computed by firmware, the matrix is computed by firmware and the correction is performed by hardware.

Servo-tracking Faults

During a write operation, if the servo system detects an error that may result in adjacent data tracks being overwritten, the write operation is aborted. The write operation will not continue until the correct servo tracking is re-established.

Data Compression

Typical data streams of text, graphics, software code, or other forms of data contain repeated information of some sort, whether it is at the text level where you can readily recognize regular repetitions of a single word, or at the binary level where the repetitions are in bits or bytes. Although most data is unique and random, the binary level data exhibits patterns of various sizes that repeat with varying degrees of regularity.

Storage efficiency is increased if the redundancies or repetition in the data are removed before the data is recorded to tape. Data compression technology significantly reduces or eliminates redundancies in data before recording the information to tape. This increases the amount of data that can be stored on a finite medium and increases the overall storage efficiency of the system.

With data compression, the redundant information in a data stream is identified and represented by codewords or symbols that allow the same

data to be recorded in a fewer number of bits. These codewords or symbols point back to the original data string, using fewer characters to represent the strings. Because these smaller symbols are substituted for the longer strings of data, more data can be stored in the same physical space.

Some important benefits result from data compression in tape drives:

- The same amount of information can be stored on a smaller length of tape.

- More data can be stored on a given length of tape.

- Performance can more closely parallel to that of high-transfer-rate computers.

- More information can be transferred in the same time interval.

Data Compression Considerations

In an effective data-compression method, several factors are important:

- The amount of compression, which is measured by the compression ratio. This ratio compares the amount of uncompressed data to the amount of compressed data. It is obtained by dividing the size of the uncompressed data by the size of the compressed data.

- The speed with which data is compressed and decompressed relative to the host transfer rate.

- The types of data to be compressed.

- The data integrity of the compressed data.

The amount of compression possible in a data stream depends on factors such as:

- Data pattern

- Compression algorithm

- Pattern repetition length

- Pattern repetition frequency

- Object size (block of information to be compressed)

- Starting pattern chosen

The transfer rate depends on factors such as:

- Compression ratio
- Drive buffer size
- Host computer input/output (I/O) speed
- Effective disc speeds of the host computer
- Record lengths that the host computer transmits

Data compression algorithms can be tailored to provide maximum compression for specific types of data. Because varying types of data are encountered in normal day-to-day operating circumstances, however, an effective data compression method for a tape drive must serve various data types. Additionally, the data compression method must adapt to different data types, automatically providing optimum handling for all types of data.

Intelligent Data Compression

The compressed capacity of the tape is maximized through the use of intelligent data compression. The intelligent data compression hardware determines the compressibility of each record. If the size of the record is larger after a compression attempt than the native (uncompressed) size, then the record is written in its native form.

The intelligent data compression utilizes two compression schemes:

- Scheme-1 is a LZ1-based compression scheme using a history buffer to achieve data compression.
- Scheme-2 is a pass-through compression scheme designed to pass uncompressible data through with minimal expansion.

There are three specific requirements for compliance with the LTO specification.

- The output data stream must be decompressible following LTO rules to create the input sequence of records and file marks perfectly.
- An LTO compressed data stream may not contain any of the eight reserved control symbols.
- While control symbols allow switching to Scheme 2, this should never be used by operational software because this capability is only for diagnostic and testing purposes.

Software data compression should never be used because the built-in intelligent data compression of the LTO-3 Half-Height Tape Drive is much more efficient than software data compression.

The LTO-3 Half-Height Tape Drive uses a derivative of ALDC-2 lossless data compression that includes additional control codes for intelligent data compression.
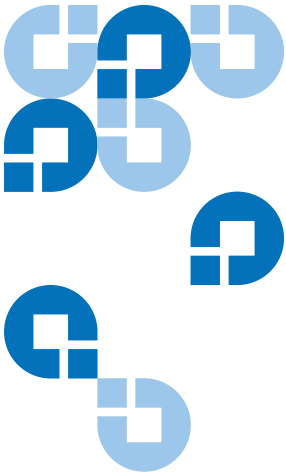
Chapter 6
Specifications

This chapter provides technical specifications for the LTO-3 Half-Height Tape Drive.

The topics covered in this chapter are:

Physical Specifications

Table 5 lists the physical specifications of the LTO-3 Half-Height Tape Drive, which is shown in figure 15.

Table 5   Physical Specifications

Specification	Internal Drive		Tabletop Drive
	Without Bezel	**With Bezel**	
Height	1.63 inches (41.3 mm)	1.70 inches (43.1 mm)	2.60 inches 66.2 mm)
Width	5.76 inches (146.30)	5.87 inches (149.10 mm)	8.35 inches (212.13 mm)
Length	8.56 inches (217.50 mm) (Max. to end of connector)	8.76 inches (222.57 mm) (Max. to end of connector)	10.73 inches (272.49 mm)
Weight	3.66 lbs. (1.66 kg)	3.72 lbs. (1.69) kg)	8.00 lb. (3.63 kg)

Figure 15 LTO-3 Half-Height
Tape Drive Dimensions

149.1

43.1

60.2
TO CARTRIDGE CENTER
FROM SIDE MOUNTING SURFACE

26.1
TO CARTRIDGE CENTER
FROM BOTTOM MOUNTING SURFACE

18.50

5.00

11.80

47.90

79.20

10.00

218.50

222.57
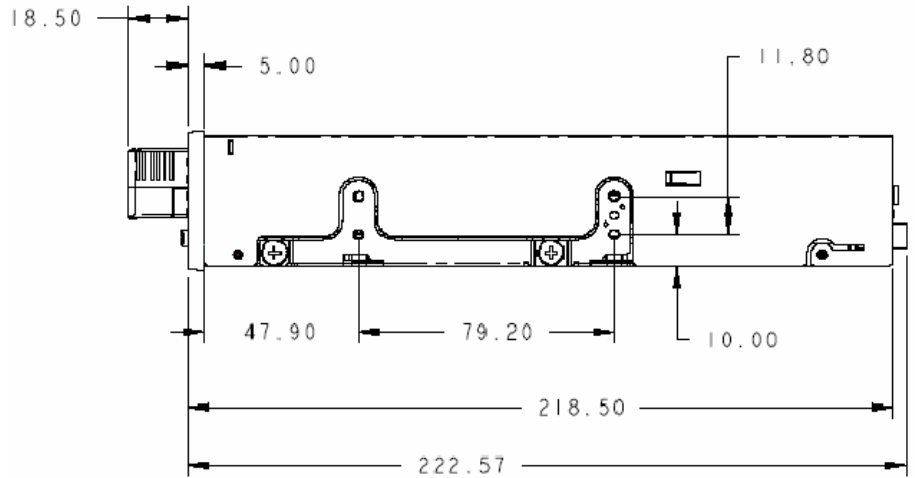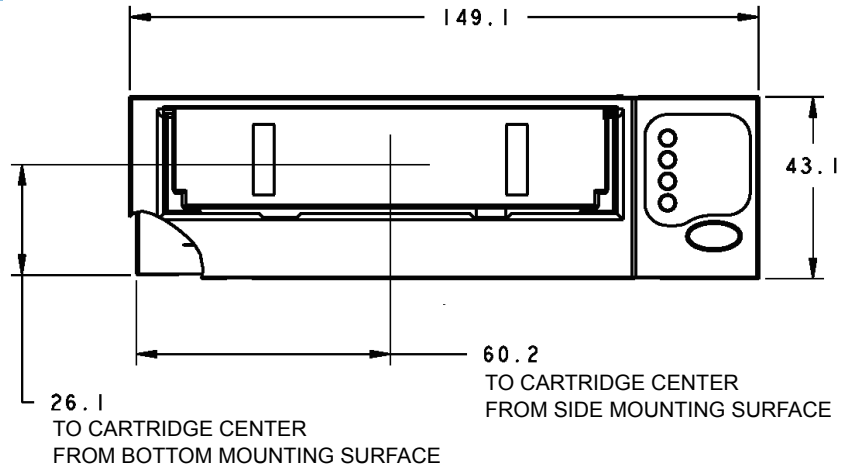
Power Specifications

The tabletop LTO-3 Half-Height Tape Drive has a built-in 90-260 VAC (47-63 Hz) automatic switching power supply.

Maximum voltage and power specifications for the internal LTO-3 Half-Height Tape Drive is listed in table 6. Specifications are the same as those for other SCSI drives unless otherwise noted.

Table 6   Voltage and Current Specifications

Specification	+12 VDC	+5 VDC
DC Voltage Tolerance	12.00 ± 10%	5.00 ± 5%
Non-operating max voltage	14 Volts peak	7 Volts peak
Max operating current Continuous: Peak:	 0.8 amps RMS 2.3 amps RMS (1 sec max)	 4.1 amps max RMS* 4.1 amps max RMS*
Standby current (max)	0.45 amps RMS	1.50 amps RMS*
Ripple (peak-to-peak)	$\leq$ 100 mV	$\leq$ 100 mV

* RMS parameters measured at the power connector using a true RMS digital meter.

Table 7   Power Dissipation

Power Specification	Dissipation
Max Standby Power	12.5 watts RMS*
Max Continuous Operating Power	31 watts RMS*

Power Specification	Dissipation
Max Peak Operating Power	36 watts RMS (1 sec max)

* RMS parameters measured at the power connector using a true RMS digital meter.

Drive Performance Specifications

Table 8 lists the performance specifications of the LTO-3 Half-Height Tape Drive.

Table 8   Drive Performance Specifications

Specification	Value
Average data access time (650-m tape) from BOW (beginning of wrap)	60 seconds
Average rewind time (650-m tape)	$\geq$ 51 seconds
Max rewind time (650-m tape)	$\leq$ 120 seconds
Capacity LTO Ultrium 3 (680 m)	400 Gbytes (native)
Cartridge unload time	25 seconds
Error recovery	Read-after-write Reed Solomon ECC (2 levels)
Flux density	10249 cells per mm

Specification	Value
Head configuration	2 bumps 16 thin-film write heads per bump 16 MR read heads per bump 2 MR servo heads per bump
Maximum data access time (650-m tape) from BOW	120 seconds
Maximum rewind time (650-m tape)	$\leq$ 115 seconds
Recording density	5,120 RLL-encoded ONEs per mm
Recording format	Ultrium 16-channel (U-316)
Recording method	0, 13/11 RLL
Recording undetectable errors	Less than 1 in 10^{27} data bits
Recording unrecoverable errors	Less than 1 in 10^{17} data bits
Synchronous transfer rate (burst)	160 Mbytes per sec max
Tape drive type	LTO (Ultrium)
Tape speed	Up to 4.53 meters per second
Track density	70 tracks per mm
Transfer rate (sustained)	68 Mbytes/second (max, native)

Environmental Requirements

Table 9 lists the environmental specifications of the LTO-3 Half-Height Tape Drive.

Table 9   Environmental Requirements

Specification	Operational	Nonoperational
Acoustic level idling (A-wt sum)	52 dBA maximum 5.0 LwA Bels	—
Acoustic level operational (A-wt sum)	57 dBA maximum 5.5 LwA Bels	—
Airflow requirements	Internal: 9 CFM (front to back)	N/A
Altitude	max 10,000 feet MSL (at 25°C)	40,000 feet (power off)
Humidity gradient	10% per hour	10% per hour
Relative humidity	20% to 80% non-condensing	10% to 95% non-condensing
Shock (1/2 sine wave)	10 Gs peak, 11 msec	40 Gs peak, 11 msec
Temperature	+50° to +104°F (+10° to + 40°C)	–40° to +149°F (–40° to + 66°C)
Thermal gradient	11°C per hour (10-40°C)	11°C per hour (10-40°C)
Vibration (sweep test)	0.005 inches DA (5-43 Hz) 0.50 G peak (43–1000 Hz) sweep rate 5-1000Hz; 1.0 octave per minute	0.1 inches (5-–15Hz) 1.0 G (15–500 Hz) 1.0 octave per minute

Injected Noise Specifications

The internal drive operates without degradation of error rates with 100 mV of noise injected between the chassis and 0 V at the power connector at any frequency between 45 Hz and 20 MHz.

Reliability Specifications

The LTO-3 Half-Height Tape Drive is designed for maximum reliability and data integrity. Table 10 lists the reliability specifications.

Table 10   Reliability Specifications

Specification	Description
Cartridge load/eject	100,000 cartridge load/eject cycles (no thread)
Error recovery and control	• Error correction code techniques (C1 and C2 ECC) • Read-after-write (RAW) • Error monitoring and reporting (error log) • Retry on
Mean time between failures (MTBF)	250,000 hours MTBF at 100% duty cycle: power applied and tape moving continuously (tabletop drive; 50,000 hours at full load and 25°C)
Mean time to replace (MTTR)	Less than 30 minutes
Nonrecoverable error rate	Less than 1 in 10^{17} bits

Mean Time Between Failures

The mean time between failures (MTBF) for the internal drive is specified at 250,000 hours minimum. This specification includes all power-on and operational time but excludes maintenance periods. Operational time is assumed to be 100% of the power-on time. Operational time is the time the tape is loaded.

The MTBF for the tabletop drive power supply is 50,000 hours with the unit operated at full load and 25°C.

> **Note:** The MTBF rating does not represent any particular drive, but is derived from a large database of test samples. Actual rates may vary from unit to unit.

Mean Time to Replace

The mean time to replace (MTTR) is the average time required by a qualified service technician to diagnose a defective drive and to install a replacement drive. The MTTR for LTO products is less than 0.5 hour (30 minutes).

The Quantum LTO drives are field-replaceable units. If a problem occurs with a subassembly or component in the drive, you should replace the entire unit. Return the drive to the factory in its original packaging. Contact your distributor, dealer, your computer system company or your Quantum sales representative to arrange the return.

LTO Cartridge Specifications

Environmental Considerations

Table 11 lists the basic environmental tolerances for LTO Ultrium cartridges.

Table 11 Environmental
Tolerances

Specification	Value
Maximum localized temperature-permanent tape damage	Greater than 52°C
Operating temperature	10°C to 40°C
Relative humidity	10% to 80% storage, 20% to 80% operating
Wet bulb temperature	26° C max

If during storage and/or transportation a cartridge has been exposed to conditions outside the specified values, it must be conditioned before use in the operating environment. The conditioning shall be exposure to the operating environment for a time equal to, or greater than, the time away from the operating environment, up to a maximum of 24 hours. There shall be no deposit of moisture anywhere on or in the cartridge.

The stray magnetic field at any point on the tape shall not exceed 4000 A/m.

Cartridge Memory

Each Ultrium cartridge has 4 Kbytes of nonvolatile memory:

• 3 Kbytes are used to store tape-directory and hardware specific information.

• 1 Kbyte is available for application and OEM use.

The cartridge memory is powered, read, and written to via a radio-frequency link.

Cartridge Reliability

After 5,000 load/eject cycles, replace the cartridge to insure data integrity.
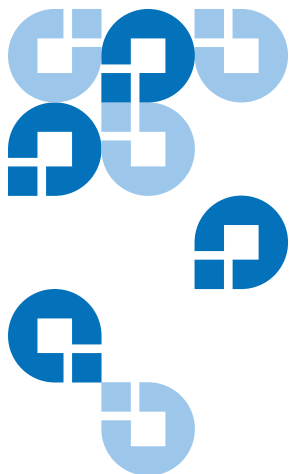
Troubleshooting Guide

This chapter provides best-practice installation guidelines for getting the most out of your LTO-3 Half-Height Tape Drive and troubleshooting information you can use to identify and resolve tape drive problems.

Topics covered in this chapter are:

- Installation Best Practices
- Troubleshooting Suggestions

Installation Best Practices

Following SCSI Best Practices

Always follow SCSI best practices when installing an LTO-3 Half-Height Tape Drive to ensure trouble-free installation and operation.

Using a Parallel SCSI Host Bus Adapter (HBA)

To achieve the very best performance from your parallel SCSI LTO-3 Half-Height Tape Drive and optimize your backup operations, always attach the dive to a SCSI controller that supports the SCSI Ultra 3 LVD interface with 160 MBytes per sec. transfer rate. Attaching the drive to a non-LVD controller, or attaching non-LVD devices to the same bus with

the LTO-3 Half-Height Tape drive would degrade the performance of the drive and your backup operations.

> **Caution:** Never connect the LTO-3 Half-Height Tape Drive to a disk RAID controller. This is not supported.

If you must use a SCSI host bus adapter (HBA), always:

- Use a dedicated SCSI HBA to enable the best performance and reduce the chance of installation difficulties that might be caused by duplicate SCSI IDs on the same bus channel.

- Use a SCSI LVD controller kit that includes a high-quality SCSI cable and terminator that conforms to Ultra 2 SCSI specifications. A low-quality cable, or a cable that does not conform to the Ultra 2 SCSI specifications can cause intermittent write/read errors, SCSI timeouts, and corrupted data.

- Make sure that:

    - Your operating system supports both the adapter and your backup software application.

    - You have the proper drivers for the HBA, if any are necessary.

Using a Serial-attached SCSI Host Bus Adapter

To achieve the very best performance from your serial-attached SCSI (SAS) LTO-3 Half-Height Tape Drive and optimize your backup operations, always attach the drive to a serial-attached SCSI controller that supports 3 GBytes per sec. per port transfer rate.

HBA Preinstallation Checks

Before installing the HBA, check and record your current system configuration. For example:

In the . . . operating system,	You can find information on any currently installed SCSI HBA by . . .
Windows 2000	**1** Double-clicking **Administrative Tools** in the Control Panel **2** Clicking **Computer Management** > **Device Manager** **3** Clicking the SCSI host adapters listed **4** Clicking **Properties** to view the **Resources** tab
UNIX/Linux	Viewing the boot log text file.

Refer to your operating system documentation for specific information on reviewing your system configuration.

After installing the SCSI HBA, restart the system. Then, ensure that the operating system recognizes the HBA and that there are no conflicts with other adapters.

Troubleshooting Suggestions

Computer Does Not Start

If the computer started and operated properly before installing a SCSI HBA and the LTO-3 Half-Height Tape Drive, but does not start now:

1 Remove the SCSI HBA.

2 Restart the system.

IF the system . . .	THEN . . .
starts normally,	there is a problem with the SCSI HBA. **1** Make sure that the SCSI HBA: • Is compatible with system • Does not have burnt components Reinstall the SCSI HBA in a different PCI slot and restart the computer.
still does not start,	contact Technical Support.

Computer Hardware Does Not Recognize the Tape Drive

If the computer starts normally but does not recognize the tape drive:

1 Restart the system and check whether the SCSI controller is recognized at system startup. You should see messages similar to:

SCSI Adapter Manufacturer SCSI BOIS xxxxxxx
CHA: SCSI ID #,   SCSI Device Name
SCSI ID #,   SCSI Device Name"

IF the SCSI controller is . . . during system startup,	THEN . . .
recognized	proceed to step 2 to determine whether the tape drive is recognized when the SCSI controller scans for devices.
not recognized	contact Technical Support.

2 If the SCSI controller is recognized during system startup, restart the system to determine whether the tape drive is recognized when the SCSI controller scans for devices. You should see messages similar to:

Bus Target   Lun Device
0   0   0   Quantum ULTRIUM 3

IF the tape drive is . . . during system startup,	THEN . . .
recognized	the problem has been resolved.
not recognized	proceed to step 3 to determine whether the tape drive is receiving power.

3 If the tape drive is not recognized when the SCSI controller scans for devices, check the **Power** LED on the LTO-3 Half-Height Tape Drive front panel to make sure the drive is receiving power.

IF the Power LED is . . .	THEN . . .
off,	proceed to step 4 to check the power connections to the tape drive.
on,	proceed to step 5 to determine whether the drive passed the Power On Self Test functions.

4 If the **Power** LED is off, check the power connections to the tape drive.

For the internal tape drive:

   a Shut down the system, remove the cover, and re-seat the DC power cable connector on tape drive.

   b Restart the system and check the **Power** LED.

.

IF the Power LED is . . .	THEN . . .
off,	shut down the system, replace the power connector attached to the tape drive with one from a known working device such as a CD-ROM, and restart the system. If the Power LED: • Comes on, then resolve the problem with the DC power cable/connector. • Remains off, then contact Technical Support to resolve the possible problem with the tape drive.
on,	repeat step 2 of this procedure to confirm that re-seating the DC power cable to the tape drive solved the problem and the tape drive is recognized during system startup. If the tape drive is: • Recognized during the SCSI controller scan, then the problem is resolved. Reinstall the computer cover. • Still not recognized, then proceed to step 5 to determine whether the drive passed the Power On Self Test functions.

For the tabletop tape drive:

a Set the drive AC power switch to the off position and re-seat the AC power cord connector.

b Set the drive AC power switch to the on position and check the **Power** LED.

IF the Power LED is . . .	THEN . . .
off,	set the drive AC power switch to the off position, replace the AC power cable with one from a known working device, and reset the AC power switch to the on position.
	If the Power LED:
	• Comes on, then resolve the problem with the AC power cable/connector.
	• Remains off, then contact Technical Support to resolve the possible problem with the tape drive.
on,	repeat step 2 of this procedure to confirm that re-seating or replacing the AC power cable solved the problem and the tape drive is recognized during system startup.
	If the tape drive is:
	• Recognized during the SCSI controller scan, then the problem is resolved.
	• Still not recognized, then proceed to step 5 to determine whether the drive passed the Power On Self Test functions.

5 If the **Power** LED is on, but the tape drive is not recognized during the SCSI controller scan, use the front panel LEDs to determine whether the drive passes the Power on Self Test (POST) functions. (See table 4 on page 37.)

IF the LEDs show that the tape drive . . . the POST functions,	THEN . . .
fails	contact Technical Support to resolve the possible problem with the tape drive.
passes	proceed to step 6 to check for possible SCSI problems.

6 If the tape drive LEDs indicate that the drive has passed the POST functions, check the SCSI bus connections.

For the internal tape drive:

a Shut down the system.

b Verify that there are no SCSI ID conflicts between the tape drive and other SCSI devices.

c Make sure you are using a proper SCSI cable and proper bus termination.

d Check the SCSI cable for bent pins.

e If possible, replace the SCSI cable with one from another SCSI controller bus chain.

f If checks a through e do not reveal a problem, contact Technical Support to resolve the possible problem with the tape drive.

For the tabletop tape drive:

a Shut down the system and cycle the tape drive AC power switch through its Off/On positions.

b Verify that there are no SCSI ID conflict between the tape drive and other SCSI devices.

c Make sure you are using a proper SCSI cable and proper bus termination.

d Check the SCSI cable for bent pins.

    e If possible, replace the SCSI cable with one from another SCSI controller bus chain.

    f If checks <u>a</u> through <u>e</u> do not reveal a problem, contact Technical Support to resolve the possible problem with the tape drive.

Computer Software Does Not Recognized the Tape Drive

Depending on your operating system environment, refer to the following subsections for troubleshooting guidelines if the LTO-Half-Height Tape drive is recognized by the system hardware at startup, but not by the operating system or applications.

Windows Operating System Environments

When a tape drive is installed in a Windows operating system environment, Windows displays a message on the screen if it does not have a driver in place for the tape drive.

IF the tape drive is for use in . . .	THEN you . . .
an ISV application,	can click the **Cancel** button to clear the message.
	When the ISV backup software application is running, the application invokes its own drivers to run the tape drive.
a native Windows operating system backup utility,	must install the proper driver for the tape drive.

Red Hat Linux Operating System Environments

The tape driver for Red Hat Linux, called **st**, is included as part of the Red Hat Linux operating system.

When Red Hat Linux starts, the operating system recognizes the tape drive and automatically configures it as a device in the **/dev** directory. If it is the first tape device in the **/dev** directory, the tape drive is known as:

/dev/st0 or /dev/nst0.

There are various ways to view the log files to see whether Linux recognizes the tape drive:

- One method is to open a terminal window and issue the following command from the root directory:

  dmesg | grep SCSI

  This command produces an output similar to:

  (scsi0)<Adaptec AHA-294XX Ultra2 SCSI host adapter> found at PCI 0/16/0

- Another method might be to use the command:

  cat /proc/scsi/scsi

  This command produces an output similar to:

  Host: scsi0 Channel: 0 Id:6 Lun:00
  Vendor: Quantum Model: ULTRIUM 3 Rev: 1897
  Type: Sequential-Access ANSI SCSI revision 04

- You can also use a text editor to view the messages in the file **/var/log/** and look for tape drive entries.

- Sometimes a system can have multiple tape device names in the **/dev** directory and will not know which **st** number to use. To view the **st** device number for your attached tape drive, use the command:

  dmesg | grep tape

  This command produces an output similar to:

  Detected SCSI tape st0 and scsi0 . . .

Drive Does Not Load the Tape Cartridge

If you cannot load a tape cartridge into the LTO-3 Half-Height Tape Drive:

1 Verify that the tape drive Power LED is on and that all other LEDs are off.

IF the Power LED is . . .	AND other LEDs are . . .	THEN . . .
off,	off,	refer to the procedures for troubleshooting power problems under Computer Hardware Does Not Recognize the Tape Drive on page 65 to determine why the Power LED is not on.
on,	on or flashing,	see table 4 on page 37 to determine whether the other LED activity is normal or abnormal. Then proceed to step 2 of this procedure. If the amber **Status** LED is on and the orange **Error** LED is flashing fast to indicate a Power On Self Test error, contact Technical Support to resolve the possible problem with the tape drive.
on,	off,	skip to step 3 of this procedure.

2   If other LEDs are on, reset the tape drive by either:

- Pressing and holding the Eject button on the front panel for more than 5 seconds and releasing it (both internal and tabletop drives),

- Or by cycling the drive AC power switch off and on (tabletop tape drive only).

3   Verify that the tape drive passes the Power On Self Test by viewing LED activity. All LEDs should be off for approximately 20 to 30 seconds after the tape drive resets.

If the amber **Status** LED is on and the orange **Error** LED is flashing fast to indicate a Power On Self Test error, contact Technical Support to resolve the possible problem with the tape drive.

4   If the **Power** LED is on, all the other LEDs are off, and you still cannot load a tape cartridge into the tape drive, examine the tape and the inside of the tape drive.

- Verify that:

    - There are no tape labels interfering with tape insertion.

    - Tape labels are only on proper tape surfaces, and that labels are flat and not curled.

    - The tape drive opening is free of debris and tape labels.

    - The tape pin and tape are fully within the cartridge.

- If you are inserting a cleaning cartridge, verify that the cleaning tape:

    - Is valid. The tape drive ejects unsupported cleaning tapes.

    - Has not expired. See table 4 on page 37 for Cleaning Cartridge at EOT.

5   Attempt to insert a different tape cartridge.

6   If a tape still cannot be inserted into the tape drive, contact Technical Support to resolve the possible problem with the tape drive.

Drive Does Not Eject the Tape Cartridge

If you cannot eject a tape cartridge from the LTO-3 Half-Height Tape Drive:

1 Verify that the tape drive **Power** LED is on and that all other LEDs are off.

IF the Power LED is . . .	AND other LEDs are . . .	THEN . . .
off,	off,	refer to the procedures for troubleshooting power problems under <u>Computer Hardware Does Not Recognize the Tape Drive</u> on page 65 to determine why the Power LED is not on.
on,	on or flashing,	see <u>table 4</u> on page 37 to determine whether the other LED activity is normal or abnormal. Then proceed to step 2 of this procedure.
		If the amber **Status** LED is on and the orange **Error** LED is flashing fast to indicate a Power On Self Test error, contact Technical Support to resolve the possible problem with the tape drive.
on,	off,	skip to step 3 of this procedure.

2 If other LEDs are on, reset the tape drive by either:

- Pressing and holding the Eject button on the front panel for more than 5 seconds and releasing it (both internal and tabletop drives)

- Cycling the drive AC power switch off and on (tabletop tape drive only)

3 With the **Power** LED on and all other LEDs off, press the Eject button on the front panel.

IF . . .	THEN . . .
the **Drive** LED flashes, with no other LED indicators on,	wait for the tape to eject (normally takes from 2 to 3 minutes). • If the tape ejects, and the **Drive** LED stops flashing, the problem has been resolved. • If the tape does not eject, and there are no other LED indications, contact Technical Support to resolve the possible problem with the tape drive.
you see a message similar to: You cannot eject the cartridge because the tape drive is in use. Wait until the operation is complete before ejecting the cartridge. The backup software may still have the tape drive in prevent mode so that the cartridge cannot be ejected. Use the backup software commands to eject the tape.	use the **mt offline** command to eject the tape. **Note:** In UNIX/Linux environments, the message may not appear, even though the operating system prevents the drive from ejecting the tape. Use the **mt offline** command anyway.
the orange **Error** LED fast flashed to indicate a hardware error,	the cartridge might be physically jammed inside the drive. Contact Technical Support to resolve the possible problem with the tape drive.

Slow Backup Operations

Many factors can make backups appear to be slow. To achieve the highest possible transfer rate, the LTO-3 Half-Height Tape Drive:

• MUST be attached to a Low Voltage Differential (LVD) SCSI controller capable of a minimum of 80 Mbytes per sec., and

• MUST NOT share the same SCSI bus as another active SCSI device such as hard drives.

1 Verify that the tape drive is attached to an LVD SCSI controller. You can do this by:

• Watching the system the startup process

• Examining the system startup log files

IF the tape drive is . . . to an LVD SCSI controller,	THEN . . .
attached	proceed to step 2 of this procedure to determine whether the tape drive shares the SCSI bus with another active SCSI device.
not attached	attach the tape drive to an LVD SCSI controller to achieve the best possible hardware performance for the best possible transfer rate.

2 If the tape drive is attached to an LVD SCSI controller, verify that it does not share the SCSI bus with another active SCSI device by:

- Checking:
  - Windows Device Manager
  - Unix/Linux logs

- Monitoring the SCSI controller activity during system startup.

IF the tape drive . . .	THEN . . .
shares the SCSI bus with other SCSI devices that are active when tape backups are performed,	reconfigure the SCSI setup to make the tape drive the only active device on the SCSI bus.
is the only active device on the SCSI bus	proceed to step 3 of this procedure to determine whether the method of performing tape backups is a factor.

3 The method of performing tape backups can be a factor in slow backup operations. Data sent to the tape drive over a network connection and delays in data transfer over a network connection can cause backups to slow down.

To determine whether the method of performing tape backups is a factor:

a Use the tape diagnostic software to perform a write/read test.

> **Caution:** The read/write test will overwrite any data on the tape. Always use a new/blank or "scratch" cartridge for diagnostic read/write tests.

The diagnostic write/read test evaluates the connection between the tape drive and the SCSI controller and removes the network data transfer and the backup software from the performance evaluation.

b When the test finishes, determine the megabytes per second data transfer rate to verify that the tape drive is performing at an acceptable rate.

IF you believe that the read/write transfer rate is . . .	THEN . . .
too slow,	use the tape diagnostic software to perform a trace buffer retrieval.
	Send the diagnostic output file to Technical Support for evaluation of the SCSI bus condition.
acceptable, but backups still seem to be slow,	it might be attributed to the number of files and the average size of the backup files.
	These factors can have a significant effect on the backup performance.
	Backups where the average file size is less than 200 Kbytes, for example, are slower than backups where the average file size is greater than 200 Kbytes.
	Obtain backup log files to determine number of files and average file size.

**Failed Operations
TapeAlert Messages**

The LTO-3 Half-Height Tape Drive supports the TapeAlert standard, and issues the appropriate alert messages in response to operational error conditions. You can view TapeAlert messages either directly, on the system screen, or in the log file of your backup application. Note, however, that some operational error conditions can cause more than one TapeAlert message.

The following subsections provide troubleshooting guidelines for dealing with the most common TapeAlert error conditions.

Backup Failure TapeAlert Messages

A number of problems can cause a backup operation to fail.

This TapeAlert message . . .	Signifies . . .
The operation has stopped because an error has occurred while reading or writing data which the drive cannot correct.	that a media error occurred during a read or write operation. Proceed to step 1 of the following procedure.
The tape is from a faulty batch or the tape drive is faulty. or: The tape is damaged or the drive is faulty. Call the tape drive supplier helpline.	that a media error occurred during a read or write operation. These messages frequently appear in addition to the "The operation has stopped because..." message. In this case, proceed to step 1 of the following procedure. Otherwise, repeat the backup operation with a known good tape and proceed to step 1 of the following procedure if the problem persists.

1 Review the configuration subsections in chapter 2, Installation Procedures, on page 5 and verify that the SCSI bus is properly configured and terminated.

2 Retry the backup operation if you make any changes are made to the SCSI cabling or termination, or if you unplug and reconnect any SCSI cables.

3 If the problem persists, remove the data tape, insert a cleaning cartridge to clean the tape drive (see Cleaning the Tape Drive on page 41).

4 After the tape drive ejects the cleaning cartridge, reload the data tape and retry the backup operation.

5 If the problem persists, use the tape diagnostic software to perform a write/read test with 4 Gbytes of data.

Caution:	The write/read test will overwrite any data on the tape. Always use a new/blank or "scratch" cartridge for diagnostic write/read tests.

IF the diagnostic test . . .	THEN . . .
completes normally,	retry the backup operation using the same new/blank or "scratch" tape that you used for the diagnostic write/read test. If the backup retry: • Succeeds, discard the original data tape. The problem is resolved. • Fails, repeat steps 3 and 4 of this procedure to clean the tape drive a second time and proceed to step 6.
fails,	repeat steps 3 and 4 of this procedure to clean the tape drive a second time and proceed to step 6.

6 Retry the backup operation. If the backup retry:

- Succeeds, the problem is resolved.

- Fails, contact Technical Support to resolve the possible problem with the tape drive.

Write-Protected TapeAlert Messages

Write-protected TapeAlert messages can appear in response to:

• Actual write-protected tape cartridges

• Defective tape cartridges

• Cartridges of a type that appear to be write protected

This TapeAlert message . . .	Signifies . . .
You are trying to write to a write-protected cartridge. Remove the write-protection or use another tape.	that you are trying to write to a tape cartridge that is actually write protected. 1 Eject the tape cartridge from the drive. 2 Set the cartridge write-protect switch to the unlocked (read-enabled) position (see figure 13 on page 39). 3 Retry the backup operation.
The memory in the tape cartridge has failed, which reduces performance. Do not use the cartridge for further backup operations. and/or: You have loaded a cartridge of a type that is read-only in this drive. The cartridge will appear as write-protected.	you are trying to write to a tape cartridge that is either defective (failed Cartridge Memory chip), or the wrong type. Retry the backup operation using a known good cartridge of the proper type. If the problem persists, contact Technical Support to resolve the possible problem with the tape drive.
Overwrite protection is set to <*setting*>. Click OK to overwrite the media or insert new media that can be overwritten.	a software-related problem. Refer to the documentation for your backup software for information on the overwrite and append settings.

Hardware Failure TapeAlert Messages

Hardware failure TapeAlert messages are descriptive and straightforward.

This TapeAlert message . . .	Signifies . . .
The tape drive has a hardware fault: 1. Eject the tape or magazine. 2. Reset the drive. 3. Restart the operation. Or: The tape drive has a hardware fault: 1. Turn the tape drive off and then on again. 2. Restart the operation. 3. If the problem persists, call the tape drive supplier helpline.	a tape drive hardware failure.

1 Press the Eject button on the front panel to eject the tape cartridge.

2 Cycle the tape drive power to the off then on position:

For the internal LTO-3 Half-Height Tape Drive:

  a Terminate all running applications.

  b Shut down the workstation or server system.

  c Restart the system.

For the tabletop LTO-3 Half-Height Tape Drive, use the AC power on/off switch on the back panel to cycle the drive power to the off then on positions.

3 Check the tape drive front panel LED indicators to determine the operational condition of the drive (see).

This LED indication . . .	Signifies . . .
• Amber **Power** LED on steady and: • All others off	the normal operational configuration. The problem is resolved.

This LED indication . . .	Signifies . . .
• Orange **Error** LED fast flashing	a hardware failure condition. Contact Technical Support to resolve the possible problem with the tape drive.
• Orange **Error** LED fast flashing and: • Amber **Status** LED on steady	a failed Power On Self Test function. Contact Technical Support to resolve the possible problem with the tape drive.

Tape Cleaning TapeAlert Messages

Tape cleaning TapeAlert messages indicate problems when you insert a cleaning cartridge into the LTO-3 Half-Height Tape Drive. Like hardware failure TapeAlert messages, tape cleaning TapeAlert messages are descriptive and straightforward.

This TapeAlert message . . .	Signifies . . .
The last cleaning cartridge used in the tape drive has worn out: 1. Discard the worn out cleaning cartridge. 2. Wait for the current operation to finish. 3. Then use a new cleaning cartridge.	that the cleaning cartridge is used up. Discard it. See Cleaning the Tape Drive on page 41 and use a new or still functional LTO cleaning cartridge to clean the tape drive.
The last cleaning cartridge used in the tape drive was an invalid type: 1. Do not use this cleaning cartridge in this drive. 2. Wait for the current operation to finish. 3. Then use a valid cleaning cartridge.	the tape drive does not recognize the cleaning tape as being of a valid type. See Cleaning the Tape Drive on page 41 and use a valid LTO-type cleaning cartridge to clean the tape drive.

This TapeAlert message . . .	Signifies . . .
The tape drive needs cleaning: 1. If the operation has stopped, eject the tape and clean the drive. 2. If the operation has not stopped, wait for it to finish and then clean the drive. 3. Check the tape drive users manual for device specific cleaning instructions.	the tape drive has issued a message to the backup software to instruct you to clean the tape drive. See Cleaning the Tape Drive on page 41.
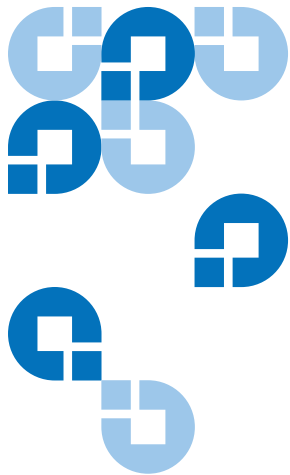
Installation Checklists

Use the following quick-start checklists to get your tape drive up and running as quickly as possible:

- Internal LTO-3 Half-Height Tape Drive Quick Start
- Tabletop LTO-3 Half-Height Tape Drive Quick Start

Internal LTO-3 Half-Height Tape Drive Quick Start

Use the following quick-start procedure to install the internal LTO-3 Half-Height Tape Drive. Print this page and check each step as you complete it. If you need more information about a step, see the sebsection referenced in the step.

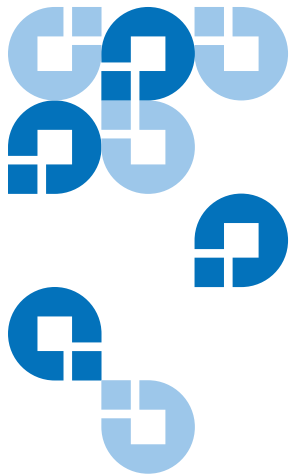| ❏	1	Unpack the contents of your drive package, and check for damaged items. See <u>Unpacking and Inspecting the Drive</u> on page 8.
❏	2	Review a parallel SCSI drive's default settings and change them if necessary: • SCSI ID: 6 • Terminator Power: Enabled See <u>Configuring the Internal Parallel SCSI Tape Drive</u> on page 10.
❏	3	Turn off your computer, remove its covers and power cable, and select a mounting bay for the drive. See <u>Mounting the Internal Tape Drive</u> on page 13.
❏	4	Connect a parallel SCSI or serial-attached SCSI (SAS) interface cable to the drive. See <u>Connecting the Internal Drive Interface and DC Power Cables</u> on page 15.
❏	5	Terminate the parallel SCSI bus if the internal tape drive is the last device on the SCSI bus. See <u>figure 3</u> on page 13.
❏	6	Connect a serial cable, if installing the tape drive in a tape library system. See <u>Connecting the Internal Drive Interface and DC Power Cables</u> on page 15.
❏	7	Connect a DC power cable to the drive. See <u>Connecting the Internal Drive Interface and DC Power Cables</u> on page 15.
❏	8	Replace the computer covers and AC power cable, turn on the computer, and verify that the internal tape drive is operating properly.
❏	9	Register your tape drive. See <u>Registering the LTO-3 Half-Height Tape Drive</u> on page 25.

Tabletop LTO-3 Half-Height Tape Drive Quick Start

Use the following quick-start procedure to install tabletop LTO-3 Half-Height Tape Drive. Print this page and check each step as you complete it. If you need more information about a step, see the subsection referenced in the step.

❑	1	Unpack the contents of your drive package, and check for damaged items.
		See <u>Unpacking and Inspecting the Drive</u> on page 8.
❑	2	Review the parallel SCSI drive's default settings and change them if necessary:
		• SCSI ID: 6
		• Terminator Power: Enabled
		See <u>Configuring the Tabletop Parallel SCSI Tape Drive</u> on page 19.
❑	3	Connect a parallel SCSI or serial-attached SCSI (SAS) interface cable to the drive.
		See <u>Connecting the Internal Drive Interface and DC Power Cables</u> on page 15.
❑	4	Check SCSI bus termination for a parallel SCSI drive.
		See <u>figure 8</u> on page 20.
❑	5	Connect a power cable to the drive.
		See <u>Connecting the Tabletop Drive Interface and AC Power Cables</u> on page 21.
❑	6	• Turn on the computer
		• Turn on the tabletop tape drive
		• Verify that the tabletop tape drive is operating properly.
❑	7	Register your tape drive.
		<u>Registering the LTO-3 Half-Height Tape Drive</u> on page 25.
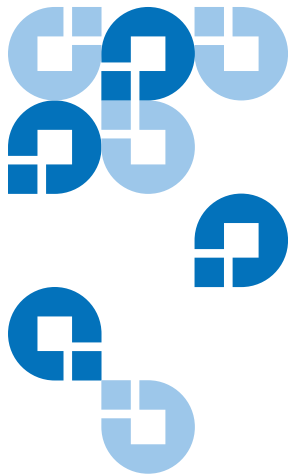
Disposal of Electrical & Electronic Equipment
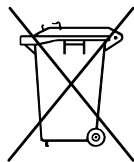
This symbol on the LTO-3 Half-Height Tape Drive or on its packaging indicates that the tape drive should not be disposed of with your other waste materials. Instead, it should be submitted to a designated collection point for the recycling of electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal helps conserve natural resources and ensures that the equipment is recycled in a manner that protects human health and the environment.

 For more information about properly disposing of your waste equipment for recycling, please visit our website at qcare.quantum.com or contact your local government authority, your household waste disposal service, or the business from which you purchased the product.

Appendix C
Regulatory Compliances

This appendix identifies the he LTO-3 Half-Height Tape Drive regulatory compliances. The topics include:

- Safety Compliances
- Electromagnetic Compatibility (EMC) Compliances on page 91

Safety Compliances

The LTO-3 Half-Height Tape Drives are safety compliant with the following regulatory codes in the countries indicated:

Country	Regulatory Organization	Compliant to:
Canada	Canadian Standards Association (CSA)	UL/CSA 60950-1
EU member nations	Comité Europèen de Normalisation Electrotechnique – the European Committee for Electrotechnical Standardization (CENELEC)	EN 60950-1, 1st edition
IECEE member nations*	International Electrotechnical Commission on Electrical Equipment (IECEE) for Mutual Recognition of Test Certificates for Electrical Equipment "CB Scheme"	CB Scheme per IEC 60950-1 with details and exceptions for each member country
Israel	SII	CB Scheme
Taiwan	BSMI	BSMI certification, CNS 14336
United States	Underwriters Laboratories (UL)	UL/CSA 60950-1

* IECEE member nations include: Argentina, Austria, Australia, Belgium, Brazil, Canada, China (PR), Czech Republic, Denmark, Finland, France, Germany, Hungary, India, Ireland, Israel, Italy, Japan, (South) Korea, Montenegro, Netherlands, Norway, Poland, Russian Federation, Serbia, Singapore, Slovakia, Slovenia, South Africa, Spain, Switzerland, Turkey, United Kingdom, and USA.

Electromagnetic Compatibility (EMC) Compliances

The LTO-3 Half-Height Tape Drives are EMC compliant with the following regulatory organizations and codes in the countries indicated:

Country	Regulatory Organization	Compliant to:
Australia	Australian Communications and Media Authority (ACMA)	AS/NZS 3548 (same as CISPR 22)
Canada	Industry Canada Digital Apparatus - Interference-Causing Equipment Standard (ICES-003)	ICES-003 Digital Apparatus
EU member nations	CE	Emissions per CISPR 22, EN55022 and Immunity per CISPR 24, EN55024
Israel	SII	CISPR 22 and CISPR 24
Japan	Voluntary Control Council for Interface (VCCI)	VCCI
New Zealand	Australian Communications and Media Authority (ACMA)	AS/NZS 3548 (same as CISPR 22)
South Korea	MIC	CISPR 22 and CISPR 24
Taiwan	Bureau of Commodity Inspection and Quarantine (BSMI)	BSMI EMC certification, CNS 14338
United States	Federal Communications Commission (FCC)	Title 47: Code of Federal Regulations, Part 15, Subpart B (47CFR15B),

> **Note:** Use the LTO-3 Half-Height Tape Drive only in equipment where the combination has been determined to be suitable by an appropriate certification organization (for example, Underwriters Laboratories Inc. or the Canadian Standards Association in North America).

Also consider the following safety points:

- Install the drive in an enclosure that limits the user's access to live parts, gives adequate system stability and provides the necessary grounding for the drive.

- Provide the correct voltages (+5 VDC and +12 VDC) based on the regulation applied—Extra Low Voltage (SEC) for UL and CSA, and Safety Extra Low Voltage for BSI and VDE (if applicable).

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