

Ultrium Internal Tape Drive
Models T200 and T200F



Setup, Operator, and Service Guide

Ultrium Internal Tape Drive
Models T200 and T200F



Setup, Operator, and Service Guide

Note

Before using this information and the product it supports, read the information in "Safety and Environmental Notices" on page v and "Notices" on page 87.

Third Edition (September 2001)

This edition applies to the *IBM® Ultrium™ Internal Tape Drive Models T200 and T200F Setup, Operator, and Service Guide* and to all subsequent releases and modifications until otherwise indicated in new editions. This edition replaces GA32-0435-01.

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Safety and Environmental Notices

When using this product, observe the danger, caution, and attention notices that are contained in this guide. Symbols that represent the severity of the safety condition accompany the notices.

The sections that follow define each type of safety notice and give examples.

Danger Notice

A danger notice calls attention to a situation that is potentially lethal or extremely hazardous to people. A lightning bolt symbol always accompanies a danger notice to represent a dangerous electrical condition. A sample danger notice follows:



DANGER

An electrical outlet that is not correctly wired could place hazardous voltage on metal parts of the system or the products that attach to the system. It is the customer's responsibility to ensure that the outlet is correctly wired and grounded to prevent an electrical shock.

Caution Notice

A caution notice calls attention to a situation that is potentially hazardous to people because of some existing condition. One of several symbols can accompany a caution notice:

If the symbol is...	It means....
	A hazardous electrical condition with less severity than an electrical danger.
	A generally hazardous condition not represented by other safety symbols.
 Class I	A hazardous condition due to the use of a laser in the product. Laser symbols are always accompanied by the classification of the laser as defined by the U. S. Department of Health and Human Services (for example, Class I, Class II, and so forth).

Sample caution notices follow:



CAUTION:

The controller card contains a lithium battery. To avoid possible explosion, do not burn, exchange, or charge the battery. Discard the controller card as instructed by local regulations for lithium batteries.



CAUTION:

Do not attempt to use the handle on the module to lift the entire device (module and enclosure) as a unit. First remove the module; then, use two hands to lift the enclosure.

Attention Notice

An attention notice indicates the possibility of damage to a program, device, or system (server), or to data. An exclamation point symbol may accompany an attention notice, but is not required. Sample attention notices follow:



Attention: If you use a power screwdriver to perform this procedure it could destroy the tape.

Attention: Do not operate the Ultrium Tape Drive in a poor air quality environment.

Laser Safety and Compliance

These products contain components that comply with performance standards that are set by the U.S. Food and Drug Administration (Part 21CFR, 1040.10/11). This means that these products belong to a class of laser products that do not emit hazardous laser radiation. This classification was accomplished by providing the necessary protective housing and scanning safeguards to ensure that laser radiation is inaccessible during operation or is within Class I limits. External safety agencies have reviewed these products and have obtained approvals to the latest standards as they apply to this product type.

Summary of Changes

This section summarizes the changes that are contained in each edition of this book.

Second Edition

This edition includes information about attaching the Ultrium Tape Drive Model T200F, which features a Fibre Channel interface. Fibre Channel technology increases the maximum server-to-tape-drive distance by using fiber optic cables. In addition, Storage Area Network (SAN) components greatly extend the maximum distance and the Fibre Channel topologies.

Third Edition

This edition removes references to the StorageSmart™ by IBM brand and adds clarifications to sections of text.

Chapter 1. Introduction

The IBM Ultrium Internal Tape Drive Models T200 and T200F are high-performance, high-capacity data-storage devices that can be integrated into an enclosure, such as a desktop unit, tape cartridge autoloader, or tape library. The tape drives are designed to perform unattended backups, as well as retrieve and archive files. Table 1 outlines the features of the Models T200 and T200F. Figure 1 is a front view of the drive with and without a bezel.

Table 1. Features of the IBM Ultrium Internal Tape Drive

Model T200 - SCSI Drive	Model T200F - Fibre Channel Drive
Native storage capacity of up to 100 GB per cartridge ¹ (200 GB assuming 2:1 data compression)	
Native sustained data transfer rate of 15 MB per second ² (30 MB assuming 2:1 data compression)	
RS-422 interface for enhanced performance in automated tape libraries	
Burst data transfer rate of 80 MB per second	Burst data transfer rate of 100 MB per second
Ultra2 SCSI Low Voltage Differential/Single Ended (LVD/SE)	SC-Duplex, multimode optical connector with the use of SCSI protocol
J1 connector (for SCSI signals, SCSI ID selection, and power connection)	Attachment to Storage Area Network (SAN) components

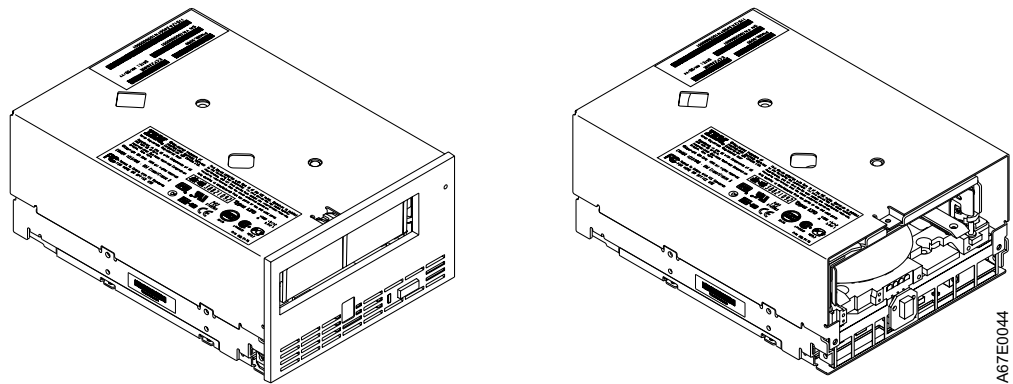


Figure 1. View of Drive With and Without Bezel

The Ultrium Internal Tape Drive uses a data compression algorithm known as LTO-DC (LTO Data Compression). A key difference between LTO-DC and previous compression algorithms is that record boundaries and file marks are encoded as control symbols in LTO-DC. LTO-DC detects them, but it will not recompress and test them. Another difference is that LTO-DC allows switching between compression and no compression within the data stream. This feature prevents the data from expanding when the drive compresses random or encrypted data.

IBM offers device drivers for the Ultrium Tape Drive. Device drivers enable the drive to interact with a variety of servers. To properly install an IBM device driver (if

1. 1 GB = one gigabyte or 1 000 000 000 bytes

2. 1 MB = one megabyte or 1 000 000 bytes

required), refer to the *IBM Ultrium Device Drivers Installation and User's Guide*. For applications that use other device drivers, see the application's documentation to determine which drivers to use.

In addition to using IBM tape cartridges with up to 100 GB capacity, the Ultrium Tape Drive also offers read/write capability for certified LTO Ultrium tape cartridges that have capacities of 50 GB, 30 GB, and 10 GB.

The Ultrium Tape Drive records by using a linear, serpentine recording method on 1/2-inch, magnetic tape.

SCSI Attachment

The Ultrium Internal Tape Drive Model T200 uses a SCSI interface and attaches to the following servers. For specific instructions about attachment, see the *IBM Ultrium Device Drivers Installation and User's Guide*.

Supported Servers	Supported Operating Systems
IBM AS/400® or IBM @server iSeries™	OS/400® Level V4R4 or later
IBM RS/6000®, IBM RS/6000 SP™, or IBM @server pSeries™	AIX® 4.3.3 or 5.1
Hewlett-Packard	HP-UX 11.0 PCI 64-bit or HP-UX 11i
SUN®	Solaris Version 2.6, 7, or 8
Intel®-compatible servers	Microsoft® Windows 2000® Level 2195 or later, or Windows NT® Server Version 4 with Service Pack 6 or later
	Red Hat® Linux® 7.1 kernel 2.4.2-2

Physical Characteristics of the SCSI Interface

The Ultrium Tape Drive Model T200 contains one SCSI port for attachment to the server. The SCSI connections and terminations are contained in the single J1 connector. The J1 connector contains the connections for the SCSI signals and grounds, the setting of the SCSI ID, the setting of the SCSI bus termination control, and the connection for the drive power and ground.

The Ultrium Tape Drive Model T200 supports differential SCSI cables with high-density, 68-pin connectors. All cables are for field or plant installation, and are available in the following lengths:

- 0.5 m (1.6 ft)
- 5.0 m (16 ft)
- 10 m (32 ft)
- 25 m (82 ft)

To order a cable, see “Appendix A. Tools and Supplies” on page 81.

Address Assignments

For enhanced functions in automated library systems, the SCSI drive contains an RS-422 interface. If the drive is connected to a library, its SCSI address can be set through the RS-422 interface.

Another option to setting the SCSI address is by attaching jumpers to the SCSI ID connector (see “Step 4. Set the SCSI ID (SCSI Drive Only)” on page 14).

Installing, Removing, or Resetting a Drive on an Active SCSI Bus

Attaching a drive to an active SCSI bus is supported. However, the preferred and safest method of adding, removing, or resetting a drive is to power-off the system.

When adding, removing, or resetting a drive on an active SCSI bus, perform the following steps:

1. Quiesce the drive. The drive to be added, removed, or reset must not be involved in any bus activity.
2. Disconnect power to the drive.
3. Connect or disconnect the SCSI bus cables to or from the drive's SCSI connector. Ensure that the SCSI bus remains intact from the server (initiator) to the terminator throughout the connection or disconnection process.

Note: Changing or moving the terminator disrupts the continuity of the SCSI bus and interrupts any process on the bus.

Fibre Channel Attachment



Attention: A Class I laser assembly, in the optical transceiver, is mounted on the Ultrium Fibre Channel electronics card. This laser assembly is registered with the Department of Health and Human Services and is in compliance with IEC825.

The Ultrium Tape Drive Model T200F has one Fibre Channel interface (also called a *port*). In accordance with the standards of the American National Standards Institute (ANSI), the port runs Fibre Channel Protocol (which includes SCSI commands on the Fibre Channel) with ANSI-defined Fibre Channel Tape Support. You can attach the Fibre Channel port to the following servers and SAN components. For additional information about the Fibre Channel connectivity, visit the web at <http://www.ibm.com/storage/storagesmart/1to>. To obtain information about adapters and operating systems, visit the web at <http://www.storage.ibm.com/1to>.

Supported Servers	Supported Operating Systems
IBM AS/400 or IBM @server iSeries	OS/400 Level V5R1 or later
IBM RS/6000, IBM RS/6000 SP, or IBM @server pSeries	AIX 4.3.3 with APARs IY10452 and IY15766, or AIX 5.1
Hewlett-Packard	HP-UX 11.0
SUN	Solaris Version 2.6, 7, or 8
Intel-compatible servers	Microsoft Windows 2000 Level 2195 or later, or Windows NT Server Version 4 with Service Pack 6a or later
Supported SAN Components	
IBM 2103 Fibre Channel hub (distance solution, only one target per hub)	
IBM 2109 Fibre Channel switches	

Physical Characteristics of the Fibre Channel Interface

The Ultrium Tape Drive Model T200F attaches to Open Systems servers by using short-wave, multimode fiber optic cables. All cables feature SC-duplex connectors and are designated as 50/125 (50 refers to the diameter of the optical fiber and 125 refers to the diameter of the cable; both are measured in micrometers). All cables are for field or plant installation, and are available in the following lengths:

- 0.5 m (1.6 ft)
- 13 m (43 ft)
- 25 m (82 ft)
- 61 m (200 ft)
- Custom-length fiber cable

You can order fiber cables for specific lengths (other than lengths with feature codes) by using part number 54G3391. The maximum length is 500 m (1640 ft). Cable length is measured from the drive's Fibre Channel port. To order a cable, see "Appendix A. Tools and Supplies" on page 81.

Supported Topologies

The drive supports Two-node Arbitrated Loop and Two-node Switched Fabric Loop topologies.

Two-node Arbitrated Loop

The drive supports the arbitrated loop topology, but only two nodes are supported on a loop.

Two-node Switched Fabric Loop

Two or more Fibre Channel end points interconnect through a switch. These switches must have loop-attachment capability. Two nodes are supported on each fabric loop.

Address Assignments

Each device on a Fibre Channel loop must have a Loop Identifier (LID) and a corresponding Arbitrated Loop Physical Address (AL_PA) to communicate with other devices in the topology. The AL_PA identifies the device on the loop. (LIDs and their corresponding AL_PAs are listed in Table 3 on page 17 and Table 4 on page 18.) You can set an AL_PA by using one of two methods known as *soft addressing* or *hard addressing*.

Soft addressing allows the drive to dynamically arbitrate the AL_PA with other Fibre Channel devices on the loop. Hard addressing allows you to choose the LID, which determines the corresponding AL_PA. The higher the AL_PA, the lower the priority of the device.

Generally, servers (initiators) require that devices use hard addressing; they do not support soft addressing. When setting addresses, assign the lowest AL_PA (and thus the highest priority) to the server; assign the highest AL_PA (and thus the lowest priority) to the drive.

To set soft or hard addressing, you must place jumpers on designated pins in the drive's LID/status connector (see (**2** in Figure 3 on page 11). The pin configuration for soft and hard addressing is defined in "Step 6. Set the Arbitrated Loop Physical Address (Fibre Channel Drive Only)" on page 15.

World Wide Names

Each Ultrium Tape Drive has an 8-byte World Wide Name that is assigned by IBM Manufacturing. The World Wide Name identifies physical drive ports. An enclosure queries the World Wide Name through the RS-422 interface; a server queries the Name through the Fibre Channel interface. The Ultrium Tape Drive reports the World Wide Name to switches. You can use the World Wide Name to uniquely identify the drive on a SAN.

Installing, Removing, or Resetting a Drive on an Active Fibre Channel

A Fibre Channel network supports dynamic drive attachment. When adding, removing, or resetting a drive on an active server or SAN, perform the following steps:

1. Quiesce the drive. The drive to be added, removed, or reset must not be involved in activity.
2. Connect or disconnect the Fibre Channel cables to or from the drive.

Chapter 2. Specifications

Table 2 gives the physical, power, and environmental specifications for the Ultrium Internal Tape Drive.

Table 2. Specifications for the Ultrium Internal Tape Drive

Specification	Model T200 with SCSI Interface	Model T200F with Fibre Channel Interface	
Width	146 mm (5.75 in.) without bezel 148 mm (5.83 in.) with bezel	146 mm (5.75 in.) without bezel 148 mm (5.83 in.) with bezel	
Length	206.5 mm (8.13 in.) without bezel 212.5 mm (8.37 in.) with bezel	206.5 mm (8.13 in.) without bezel 212.5 mm (8.37 in.) with bezel	
Height	82.5 mm (3.25 in.) without bezel 84.5 mm (3.33 in.) with bezel	82.5 mm (3.25 in.) without bezel 84.5 mm (3.33 in.) with bezel	
Weight	3 kg (6 lb 10 oz)	3 kg (6 lb 10 oz)	
Voltage (see Note 1)	+ 5 Vdc and + 12 Vdc ($\pm 10\%$)	+ 5 Vdc and + 12 Vdc ($\pm 10\%$)	
Current for 5 Vdc	4.7 A (typical) 5.0 A (maximum at steady state)	5.0 A (typical) 5.4 A (maximum for 4 ms)	
Current for 12 Vdc	1.4 A (typical) 2.3 A (maximum for 300 ms)	1.1 A (typical) 2.3 A (maximum for 300 ms)	
Power	41 W (typical) 47 W (maximum for 300 ms)	38 W (typical) 47 W (maximum for 300 ms)	
Maximum altitude	3048 m (10,000 ft)	3048 m (10,000 ft)	
Environmental Specifications			
Environmental Factor	Operating	Storage	Shipping
Drive temperature	10 to 40°C (50 to 104°F)	-40 to 60°C (-40 to 140°F)	-40 to 60°C (-40 to 140°F)
Recommended enclosure temperature (see Note 2)	10 to 42°C (50 to 108°F)	Not applicable	Not applicable
Relative humidity	20 to 80%	10 to 90%	10 to 90%
Wet bulb temperature	26°C (79°F)	26°C (79°F)	26°C (79°F)
Notes:			
1. The + 5 Vdc and + 12 Vdc maximum currents do not occur simultaneously. The Ultrium Tape Drive monitors voltage and reports problems to the server.			
2. The Ultrium Tape Drive features a temperature sensor indicator that acts as an alert when the drive exceeds the recommended temperature. The set point of the temperature indicator is between 45 and 48°C. To clear the indicator, lower the environmental temperature or clear the air passages of the drive, then reset the drive.			

Chapter 3. Installing the Tape Drive

Attention:

To avoid static electricity damage when you handle the Ultrium Internal Tape Drive, use the following precautions:

- Limit your movement. Movement can cause static electricity to build around you.
- Always handle the Ultrium Tape Drive carefully. Handle adapters by the edges. Never touch exposed circuitry.
- Prevent others from touching the Ultrium Tape Drive.
- Before you unpack and install the Ultrium Tape Drive into an enclosure, touch its static-protective packaging to an unpainted metal surface on the enclosure for at least 2 seconds. This reduces static electricity in the packaging and your body.
- When possible, remove the Ultrium Tape Drive from its static-protective packaging and install it directly into an enclosure without setting it down. When this is not possible, place the tape drive's packaging on a smooth, level surface and place the tape drive on the packaging.
- Do not place the Ultrium Tape Drive on the cover of the enclosure or on any other metal surface.

The steps that follow describe how to install the Ultrium Tape Drive.

Note: Depending on the type of enclosure, installation procedures may vary. Before starting this installation, read these instructions and compare them to the drive installation instructions for your enclosure.

When installing the Ultrium Tape Drive into an enclosure, refer to "Rear View of the SCSI Drive" on page 10 or "Rear View of the Fibre Channel Drive" on page 11.

Rear View of the SCSI Drive

Note: J1 (the SCSI power connector) contains the SCSI connector, SCSI ID connector, and the power connector.

- 1** SCSI connector (J1)
- 2** SCSI ID connector (J1)
- 3** Power connector (J1)
- 4** RS-422 connector (J2)

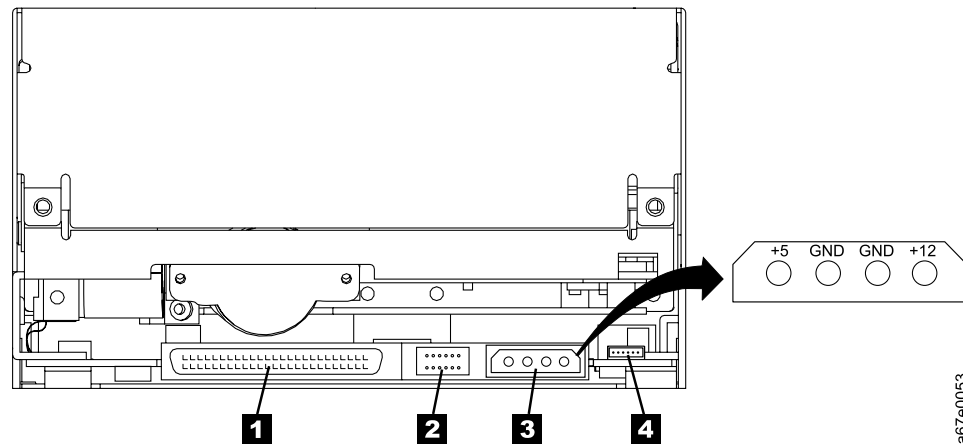


Figure 2. Rear View of the Ultrium Internal Tape Drive - SCSI Drive

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Rear View of the Fibre Channel Drive

- 1** Power connector
- 2** Loop identifier (LID)/status connector
- 3** Fibre Channel connector
- 4** RS-422 connector (J2)

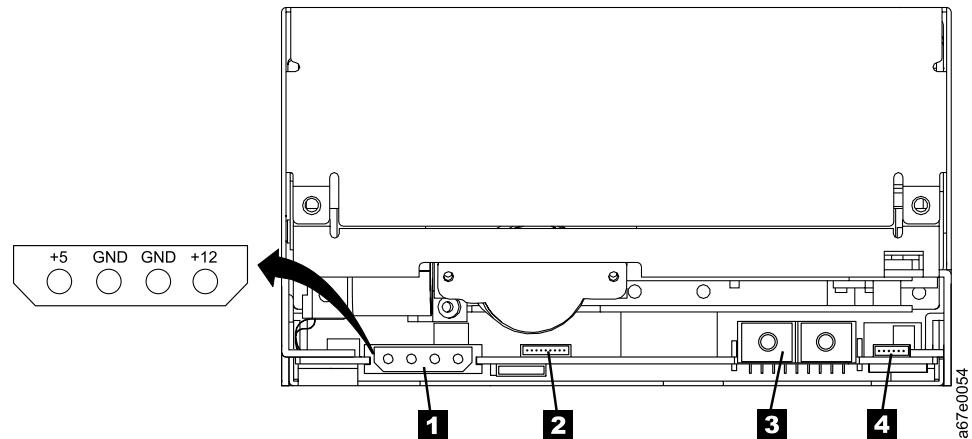


Figure 3. Rear View of the Ultrium Internal Tape Drive - Fibre Channel Drive

Step 1. Unpack the Drive

Unpack the Ultrium Tape Drive and store the packaging. You may need the packaging if you return the unit for service.

Step 2. Power-off the Enclosure (Optional)

It is recommended (but not required) that you power-off the enclosure when you install or remove the tape drive.

Step 3. Install the Cooling Fan Assembly (Optional)

The Ultrium Tape Drive's circuits require cooling. The drive is designed to move air across the circuits, with air entry at the lower front of the drive (the tape path and drive head are protected from airflow and associated debris).

If the cooling fan is not attached and the temperature inside your enclosure does not meet requirements, install the IBM cooling fan assembly (see the temperature requirements in Table 2 on page 7). The procedure for installing the fan varies, depending on whether your drive uses a SCSI or Fibre Channel interface. The sections that follow describe each procedure.

Installing the Cooling Fan onto a SCSI Drive

To install the optional cooling fan assembly onto an Ultrium Tape Drive that uses a SCSI interface:

1. Remove and discard the two cover screws from the rear of the Ultrium Tape Drive (see **1** in Figure 4). Use a Phillips screwdriver to remove the screws.
2. Position the fan shroud **2** at the rear of the drive and align its top with the top of the drive.
3. Attach the fan shroud to the rear of the drive by securing the two captured screws **3** with a Phillips screwdriver.
4. Connect the SCSI bus cable **4** to the connector at the rear of the SCSI drive.
5. Attach one end of the Y-cable **5** to the drive's power connector.
6. Attach the fan cover assembly **6** to the fan shroud **2** by securing four screws **7** with a Phillips screwdriver.
7. Connect the other end of the Y-cable **8** to the fan assembly's power connector **9**.
8. Connect the Y-cable **10** to the power supply in the enclosure.

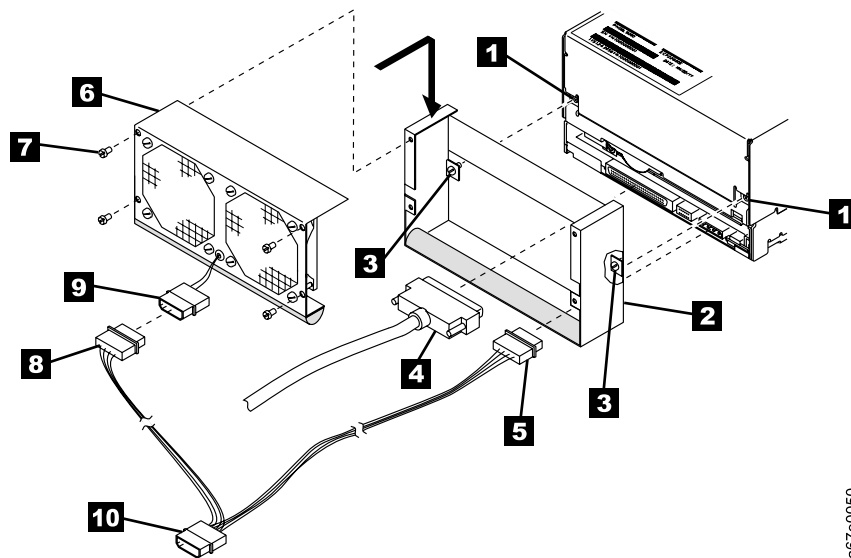


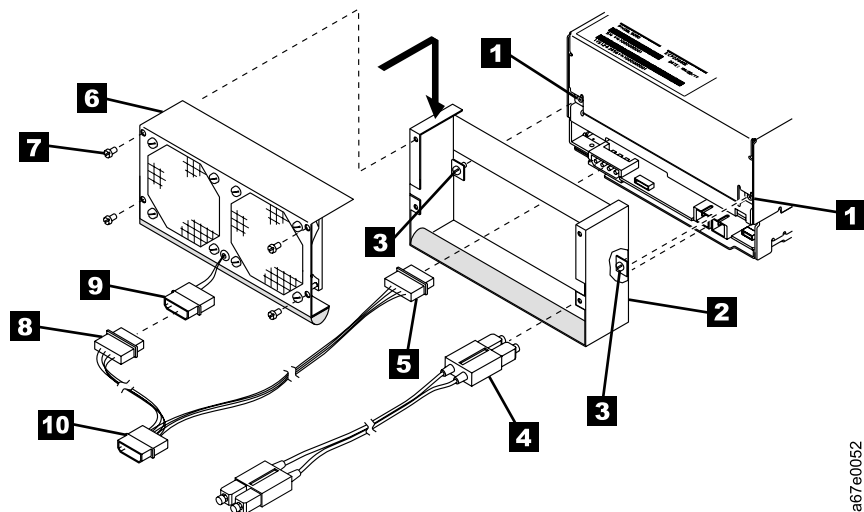
Figure 4. Installing the Cooling Fan Assembly onto a SCSI Drive

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Installing the Cooling Fan onto a Fibre Channel Drive

To install the optional cooling fan assembly onto an Ultrium Tape Drive that uses a Fibre Channel interface:

1. Remove and discard the two cover screws from the rear of the Ultrium Tape Drive (see **1** in Figure 5). Use a Phillips screwdriver to remove the screws.
2. Position the fan shroud **2** at the rear of the drive and align its top with the top of the drive.
3. Attach the fan shroud to the rear of the drive by securing the two captured screws **3** with a Phillips screwdriver.
4. Connect the fiber optic cable **4** to the connector at the rear of the Fibre Channel drive.
5. Attach one end of the Y-cable **5** to the drive's power connector.
6. Attach the fan cover assembly **6** to the fan shroud **2** by securing four screws **7** with a Phillips screwdriver.
7. Connect the other end of the Y-cable **8** to the fan assembly's power connector **9**.
8. Connect the Y-cable **10** to the power supply in the enclosure.



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Figure 5. Installing the Cooling Fan Assembly onto a Fibre Channel Drive

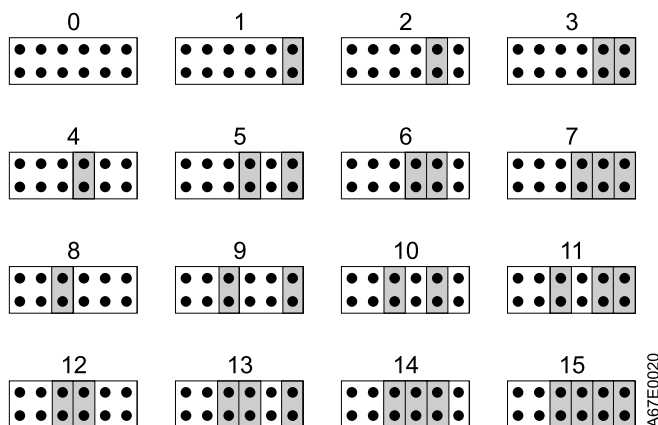
Step 4. Set the SCSI ID (SCSI Drive Only)

Notes:

1. When setting the SCSI ID, use the 2-mm jumpers that come attached to the Ultrium Tape Drive's SCSI ID connector (four jumpers are shipped on the connector; an additional jumper is unattached, but included in the ship group). To order additional jumpers, contact your IBM marketing representative.
2. If your enclosure uses a SCSI ID switch (rather than jumpers), do not perform the following procedure. Instead, remove the jumpers from the Ultrium Tape Drive and connect the switch (for instructions, refer to your enclosure's documentation).
3. If you are installing the Ultrium Tape Drive into a tape library, make sure that the drive's SCSI ID is set at 15 (see settings below). The library may issue a command to the tape drive to set the SCSI ID via the RS-422 interface.

To set the SCSI ID:

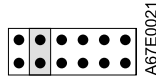
1. Locate the SCSI ID connector (see **2** in Figure 2 on page 10).
2. Before attaching the SCSI bus cable to the server, decide the number of the SCSI ID that you want. Make sure that the ID is not being used by another device.
3. Referring to the following figure, find the ID number that you chose, then place jumpers on the connector pins as shown (use a pair of needle-nose pliers to connect the jumpers to the pins that are shaded).



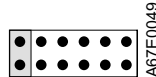
Step 5. Terminate the Drive and Supply TERMPower (SCSI Drive Only)

If the tape drive is the last device on the SCSI bus, you must terminate the bus outside the enclosure or internally at the SCSI ID connector (see **2** in Figure 2 on page 10).

To terminate the bus internally, locate one of the five jumpers shipped with the Ultrium Tape Drive and place it on the SCSI ID connector as shown in the following figure. Place the jumper on the pins that are shaded.



To supply TERMPower to the bus, locate one of the five jumpers shipped with the Ultrium Tape Drive and place it on the SCSI ID connector as shown in the following figure. Place the jumper on the pins that are shaded.



Step 6. Set the Arbitrated Loop Physical Address (Fibre Channel Drive Only)

Each device on a Fibre Channel loop must have an Arbitrated Loop Physical Address (AL_PA) to communicate. The AL_PA identifies the device on the loop. To set the Ultrium Tape Drive's AL_PA, you must place jumpers on specific pins in the drive's loop identifier (LID)/status connector. The placement of the jumpers indicates whether you want to choose the LID yourself (each LID corresponds to a specific AL_PA) or whether you want the drive to choose the AL_PA by arbitrating it with other devices on the loop. Valid LIDs and their corresponding AL_PAs are provided in this section.

Note: A Loop ID is part of a contiguous range of values; valid AL_PA values are not in a contiguous range.

In addition to establishing the AL_PA, by moving Feature Switch 3 on the drive to ON or off, you can set the drive so that it provides one of the following functions:

- Status about the Fibre Channel loop (through the use of external indicators in an enclosure)
- Additional LIDs

The sections that follow describe how to select the AL_PA. They also describe how to set Feature Switch 3 so that the drive gives status about the loop or provides additional LIDs.

Setting the Loop ID to Provide Status About the Loop

If Feature Switch 3 on the Ultrium Tape Drive is set to off (see **1** in Figure 6), the LID/status connector **2** has the following definition:

- Pins 1, 2, 3, 4, 7, and 8 are inputs and are used to set the LID.
- Pins 5 and 6 are used as outputs:
 - Pin 5 has three states: *off* (ground), *on* (3.3 V), and *alternating* (between off and on). If the drive does not detect light on the Fibre Channel connector or has not completed the Loop Initialization Protocol (LIP), pin 5 will be off. If the drive detects light and successfully completes the LIP process, the pin will be on. After the drive has completed the LIP process, the pin will be alternating when the drive is receiving SCSI commands, and the pin will be on when the drive is not receiving SCSI commands.
 - Pin 6 indicates that the drive detects light. If pin 6 is on but pin 5 is off, this could indicate communication problems across the fiber cable.
 - If the drive is installed in an enclosure, pins 5 and 6 may be used to support external indicators, such as light-emitting diodes (LEDs), on the enclosure.

Note: If indicators are used on an enclosure, the drive does not report error codes 8 and F (Fibre Channel problems) to the single-character display. Instead, pins 5 and 6 signal to the indicators that there is a problem.

- Pin 9 is ground.

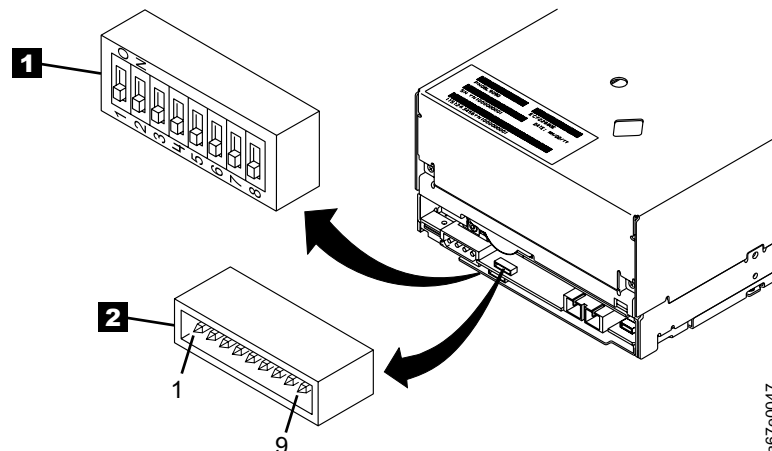


Figure 6. Setting the Loop ID and the AL_PA. The feature switches are located on the bottom of the drive.

To set the AL_PA:

1. Determine an unused AL_PA for the drive and refer to Table 3 on page 17 for its corresponding LID.
2. Locate the LID/status connector on the drive (see **2** in Figure 6).
3. Jumper pins 1, 2, 3, 4, 7, and 8 as shown in Table 3 on page 17.

By using hard addressing, you can specify one of 62 valid AL_PAs for the drive. If you jumper all of the pins, the drive gets the AL_PA from a field in its vital product data (VPD). (An enclosure can set the AL_PA in the VPD through the RS-422 interface.) If you do not jumper any pins, the drive uses soft addressing to determine the AL_PA.

Table 3. ID Settings that Provide Status About the Loop. The table lists the LIDs, corresponding AL_PAs, and definitions of the jumpers on the connector pins. Feature Switch 3 must be set to off.

LID	AL_PA	PIN					
		1	2	3	4	7	8
0	use soft addressing	-	-	-	-	-	-
1	E8	-	-	-	-	-	G
2	E4	-	-	-	-	G	-
3	E2	-	-	-	-	G	G
4	E1	-	-	-	G	-	-
5	E0	-	-	-	G	-	G
6	DC	-	-	-	G	G	-
7	DA	-	-	-	G	G	G
8	D9	-	-	G	-	-	-
9	D6	-	-	G	-	-	G
A	D5	-	-	G	-	G	-
B	D4	-	-	G	-	G	G
C	D3	-	-	G	G	-	-
D	D2	-	-	G	G	-	G
E	D1	-	-	G	G	G	-
F	CE	-	-	G	G	G	G
10	CD	-	G	-	-	-	-
11	CC	-	G	-	-	-	G
12	CB	-	G	-	-	G	-
13	CA	-	G	-	-	G	G
14	C9	-	G	-	G	-	-
15	C7	-	G	-	G	-	G
16	C6	-	G	-	G	G	-
17	C5	-	G	-	G	G	G
18	C3	-	G	G	-	-	-
19	BC	-	G	G	-	-	G
1A	BA	-	G	G	-	G	-
1B	B9	-	G	G	-	G	G
1C	B6	-	G	G	G	-	-
1D	B5	-	G	G	G	-	G
1E	B4	-	G	G	G	G	-
1F	B3	-	G	G	G	G	G

LID	AL_PA	PIN					
		1	2	3	4	7	8
20	B2	G	-	-	-	-	-
21	B1	G	-	-	-	-	G
22	AE	G	-	-	-	G	-
23	AD	G	-	-	-	G	G
24	AC	G	-	-	G	-	-
25	AB	G	-	-	G	-	G
26	AA	G	-	-	G	G	-
27	A9	G	-	-	G	G	G
28	A7	G	-	G	-	-	-
29	A6	G	-	G	-	-	G
2A	A5	G	-	G	-	G	-
2B	A3	G	-	G	-	G	G
2C	9F	G	-	G	G	-	-
2D	9E	G	-	G	G	-	G
2E	9D	G	-	G	G	G	-
2F	9B	G	-	G	G	G	G
30	98	G	G	-	-	-	-
31	97	G	G	-	-	-	G
32	90	G	G	-	-	G	-
33	8F	G	G	-	-	G	G
34	88	G	G	-	G	-	-
35	84	G	G	-	G	-	G
36	82	G	G	-	G	G	-
37	81	G	G	-	G	G	G
38	80	G	G	G	-	-	-
39	7C	G	G	G	-	-	G
3A	7A	G	G	G	-	G	-
3B	79	G	G	G	-	G	G
3C	76	G	G	G	G	-	-
3D	75	G	G	G	G	-	G
3E	74	G	G	G	G	G	-
3F	use AL_PA from VPD	G	G	G	G	G	G

Notes:

1. G means that the pin is jumpered to ground.
2. - means that the pin is not jumpered.

Setting the Loop ID to Provide Additional Loop IDs

If Feature Switch 3 on the Ultrium Tape Drive is set to 0N (see **1** in Figure 6 on page 16), the LID/status connector **2** has the following definition:

- Pins 1 through 7 are used to set the LID.
- Pin 8 overrides pins 1 through 7. If pin 8 is jumpered, the drive will use its vital product data (VPD) to set the AL_PA. The enclosure can set the AL_PA in VPD through the RS-422 interface.
- Pin 9 is ground.

Note: Feature Switch 3 does not support LEDs on an enclosure. Therefore, when Feature Switch 3 is set to 0N, the drive can report Fibre Channel problems (error codes 8 and F) on the single-character display, but not by using the enclosure's external indicators.

To set the AL_PA:

1. Determine an unused AL_PA address for the drive and refer to Table 4 for its corresponding LID.
2. Locate the LID/status connector on the drive (see **2** in Figure 6 on page 16).
3. Jumper pins 1 through 8 as shown in Table 4.

Table 4. ID Settings that Provide Additional Loop IDs. The table lists the LIDs, corresponding AL_PAs, and definitions of the jumpers on the connector pins. Feature Switch 3 must be set to 0N.

LID	AL_PA	PIN						
		1	2	3	4	5	6	7
0	EF	-	-	-	-	-	-	-
1	E8	-	-	-	-	-	-	G
2	E4	-	-	-	-	-	G	-
3	E2	-	-	-	-	-	G	G
4	E1	-	-	-	-	G	-	-
5	E0	-	-	-	-	G	-	G
6	DC	-	-	-	-	G	G	-
7	DA	-	-	-	-	G	G	G
8	D9	-	-	-	G	-	-	-
9	D6	-	-	-	G	-	-	G
A	D5	-	-	-	G	-	G	-
B	D4	-	-	-	G	-	G	G
C	D3	-	-	-	G	G	-	-
D	D2	-	-	-	G	G	-	G
E	D1	-	-	-	G	G	G	-
F	CE	-	-	-	G	G	G	G
10	CD	-	-	G	-	-	-	-
11	CC	-	-	G	-	-	-	G
12	CB	-	-	G	-	-	G	-
13	CA	-	-	G	-	-	G	G
14	C9	-	-	G	-	G	-	-
15	C7	-	-	G	-	G	-	G
16	C6	-	-	G	-	G	G	-
21	B1	-	G	-	-	-	-	G
22	AE	-	G	-	-	-	G	-
23	AD	-	G	-	-	-	G	G
24	AC	-	G	-	-	G	-	-
25	AB	-	G	-	-	G	-	G
26	AA	-	G	-	-	G	G	-
27	A9	-	G	-	-	G	G	G
28	A7	-	G	-	G	-	-	-
29	A6	-	G	-	G	-	-	G
2A	A5	-	G	-	G	-	G	-
2B	A3	-	G	-	G	-	G	G
2C	9F	-	G	-	G	G	-	-
2D	9E	-	G	-	G	G	-	G
2E	9D	-	G	-	G	G	G	-
2F	9B	-	G	-	G	G	G	G
30	98	-	G	G	-	-	-	-
31	97	-	G	G	-	-	-	G
32	90	-	G	G	-	-	G	-
33	8F	-	G	G	-	-	G	G
34	88	-	G	G	-	G	-	-
35	84	-	G	G	-	G	-	G
36	82	-	G	G	-	G	G	-
37	81	-	G	G	-	G	G	G

Table 4. ID Settings that Provide Additional Loop IDs (continued). The table lists the LIDs, corresponding AL_PAs, and definitions of the jumpers on the connector pins. Feature Switch 3 must be set to 0N.

LID	AL_PA	PIN						
		1	2	3	4	5	6	7
17	C5	-	-	G	-	G	G	G
18	C3	-	-	G	G	-	-	-
19	BC	-	-	G	G	-	-	G
1A	BA	-	-	G	G	-	G	-
1B	B9	-	-	G	G	-	G	G
1C	B6	-	-	G	G	G	-	-
1D	B5	-	-	G	G	G	-	G
1E	B4	-	-	G	G	G	G	-
1F	B3	-	-	G	G	G	G	G
20	B2	-	G	-	-	-	-	-
42	6E	G	-	-	-	-	G	-
43	6D	G	-	-	-	-	G	G
44	6C	G	-	-	-	-	G	-
45	6B	G	-	-	-	G	-	G
46	6A	G	-	-	-	G	G	-
47	69	G	-	-	-	G	G	G
48	67	G	-	-	G	-	-	-
49	66	G	-	-	G	-	-	G
4A	65	G	-	-	G	-	G	-
4B	63	G	-	-	G	-	G	G
4C	5C	G	-	-	G	G	-	-
4D	5A	G	-	-	G	G	-	G
4E	59	G	-	-	G	G	G	-
4F	56	G	-	-	G	G	G	G
50	55	G	-	G	-	-	-	-
51	54	G	-	G	-	-	-	G
52	53	G	-	G	-	-	G	-
53	52	G	-	G	-	-	G	G
54	51	G	-	G	-	G	-	-
55	4E	G	-	G	-	G	-	G
56	4D	G	-	G	-	G	G	-
57	4C	G	-	G	-	G	G	G
58	4B	G	-	G	G	-	-	-
59	4A	G	-	G	G	-	-	G
5A	49	G	-	G	G	-	G	-
5B	47	G	-	G	G	-	G	G
5C	46	G	-	G	G	G	-	-
5D	45	G	-	G	G	G	-	G
5E	43	G	-	G	G	G	G	-
LID	AL_PA	PIN						
		1	2	3	4	5	6	7
38	80	-	G	G	G	-	-	-
39	7C	-	G	G	G	-	-	G
3A	7A	-	G	G	G	-	G	-
3B	79	-	G	G	G	-	G	G
3C	76	-	G	G	G	G	-	-
3D	75	-	G	G	G	G	-	G
3E	74	-	G	G	G	G	G	-
3F	73	-	G	G	G	G	G	G
40	72	G	-	-	-	-	-	-
41	71	G	-	-	-	-	-	G
61	39	G	G	-	-	-	-	G
62	36	G	G	-	-	-	G	-
63	35	G	G	-	-	-	G	G
64	34	G	G	-	-	G	-	-
65	33	G	G	-	-	G	-	G
66	32	G	G	-	-	G	G	-
67	31	G	G	-	-	G	G	G
68	2E	G	G	-	G	-	-	-
69	2D	G	G	-	G	-	-	G
6A	2C	G	G	-	G	-	G	-
6B	2B	G	G	-	G	-	G	G
6C	2A	G	G	-	G	G	-	-
6D	29	G	G	-	G	G	-	G
6E	27	G	G	-	G	G	G	-
6F	26	G	G	-	G	G	G	G
70	25	G	G	G	-	-	-	-
71	23	G	G	G	-	-	-	G
72	1F	G	G	G	-	-	G	-
73	1E	G	G	G	-	-	G	G
74	1D	G	G	G	-	G	-	-
75	1B	G	G	G	-	G	-	G
76	18	G	G	G	-	G	G	-
77	17	G	G	G	-	G	G	G
78	10	G	G	G	G	-	-	-
79	0F	G	G	G	G	-	-	G
7A	08	G	G	G	G	-	G	-
7B	04	G	G	G	G	-	G	G
7C	02	G	G	G	G	G	-	-
7D	01	G	G	G	G	G	-	G

Table 4. ID Settings that Provide Additional Loop IDs (continued). The table lists the LIDs, corresponding AL_PAs, and definitions of the jumpers on the connector pins. Feature Switch 3 must be set to ON.

LID	AL_PA	PIN							LID	AL_PA	PIN						
		1	2	3	4	5	6	7			1	2	3	4	5	6	7
5F	3C	G	-	G	G	G	G	G	7E	SA	G	G	G	G	G	G	-
60	3A	G	G	-	-	-	-	-	7F	SA	G	G	G	G	G	G	G

Notes:

1. G means that the pin is jumpered to ground.
2. - means that the pin is not jumpered.
3. SA means soft addressing.

Step 7. Mount the Tape Drive into an Enclosure

Notes:

1. In the following procedure, you may find it easier to connect the cables to the back of the tape drive (as described on pages 21 through 22) before you secure it to the enclosure.
2. The Ultrium Tape Drive may be shipped with or without a front bezel (see Figure 1 on page 1).

To mount the Ultrium Tape Drive into an enclosure:

1. Place the drive into the enclosure so that its tape load compartment faces the tape load compartment of the enclosure.
2. Insert two 6-32 screws into the mounting holes on the side brackets of the chassis (see **2** in Figure 7).

Attention: When inserted into the Ultrium Tape Drive, the length of the mounting screws must not exceed 2.0 mm (0.08 in.) from the outside of the chassis. If the length exceeds this measurement, the tape drive may become damaged.

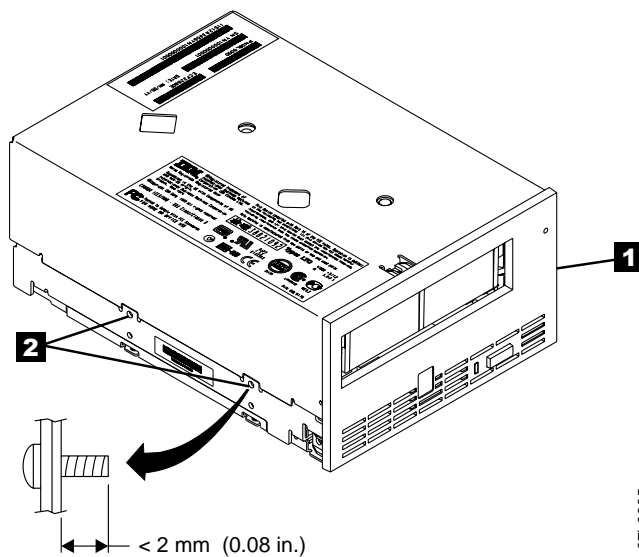


Figure 7. Mounting Holes on Ultrium Tape Drive. The holes are located on both sides of the drive. The tape drive is shown with a front bezel.

Step 8. Connect Power to the Tape Drive

The Ultrium Tape Drive is designed to be hot-pluggable (that is, you can physically install the drive into an enclosure without powering the enclosure off). If you install the drive in a hot-pluggable environment, watch for the indicators to behave as described in step 2.

To connect power to the Ultrium Tape Drive:

1. Connect the enclosure's internal power cable to the power connector on the drive (if you are using a SCSI drive, see **3** in Figure 2 on page 10; if you are using Fibre Channel drive, see **1** in Figure 3 on page 11). Ensure that the connector is properly keyed.
2. Review the location of the single-character display and the status light on page 23 (if your drive does not have a bezel, note that the bulb of the status light is recessed and the light is not visible until lit). Watch for the following while turning on the power to the enclosure:

Attention: If the single-character display does not come on, the drive may not be getting power.

- The single-character display increments, then becomes blank (not lit).
- The status light briefly becomes solid amber, then becomes solid green.

After the single-character display becomes blank, the tape drive is ready for the checkout procedure in the next step.

Step 9. Perform a Checkout of the Tape Drive

To perform a checkout of the Ultrium Tape Drive:

1. Place the drive in maintenance mode (see "Placing the Drive in Maintenance Mode" on page 27).
2. Run the tape drive diagnostics (Function Code 1 in Table 7 on page 29). If an error code appears on the single-character display, go to Table 12 on page 53.
3. Run the SCSI or Fibre Channel wrap test to ensure that the interface is functional (see Function Code 6 in Table 7 on page 29).
4. Attach an RS-422 wrap plug and run the RS-422 wrap test to ensure that the serial interface is functional (locate Function Code 7 in Table 7 on page 29).

Step 10. Connect the RS-422 Interface

Note: Use this step only if you are installing the Ultrium Tape Drive into an enclosure.

The Ultrium Tape Drive contains an RS-422 interface by which it can communicate with an enclosure.

To connect the RS-422 interface, connect the RS-422 cable to the J2 connector on the drive (see **4** in Figure 2 on page 10 and Figure 3 on page 11). Connect the other end of the cable to the enclosure.

Step 11. Connect the Tape Drive to the SCSI or Fibre Channel Interface

To connect the Ultrium Tape Drive to a SCSI or Fibre Channel interface, choose one of the following procedures.

Connecting the Drive to a SCSI Interface

To connect the Ultrium Tape Drive Model T200 to the SCSI bus:

1. Connect the enclosure's internal SCSI bus cable to the SCSI connector on the tape drive (see **1** in Figure 2 on page 10).
2. Run the appropriate SCSI attachment verification procedure on your server (for instructions, refer to the *IBM Ultrium Device Drivers Installation and User's Guide*). If a SCSI error occurs, refer to "Using Sense Data" on page 59.

If you want to power a device on or off while it is connected to the same SCSI bus as an Ultrium Tape Drive, you can do so if, during the power-on cycle, you quiesce all devices (including the Ultrium Tape Drive) on the bus.

Connecting the Drive to a Fibre Channel Interface

To connect the Ultrium Tape Drive Model T200F to the Fibre Channel interface:

1. Connect the enclosure's internal fiber cable to the Fibre Channel connector on the tape drive (see **3** in Figure 3 on page 11).

Note: Model T200F can be ordered with several lengths of fiber cabling, up to 61 m (200 ft). For ordering information, see Table 13 on page 81.

2. Run the Fibre Channel wrap test at the end of a cable that does not exceed 250 m (820 ft) (see Function Code 6 in Table 7 on page 29). Do not bend the cable more than a radius of 50.8 mm (2 in.) or the optical fiber may break.
3. Connect the fiber cable to an appropriate attachment (server, switch, or hub). For information about attaching the fiber cable, refer to the documentation for your server, switch, or hub.

Step 13. Configure the Tape Drive to the Server, Switch, or Hub

To configure the tape drive to the server, or to configure the Model T200F Fibre Channel drive to a switch or hub, refer to the server's documentation.

Chapter 4. Operating the Tape Drive

Attention: Before operating the Ultrium Internal Tape Drive, let the drive (and any tape cartridges to be inserted) acclimate to the operating environment for 24 hours or the time necessary to prevent condensation in the drive (the time will vary, depending on the environmental extremes to which the drive was exposed).

When operating the Ultrium Tape Drive, refer to Figure 8 which shows the front of the unit.

- 1** Status light
- 2** Unload button
- 3** Single-character display

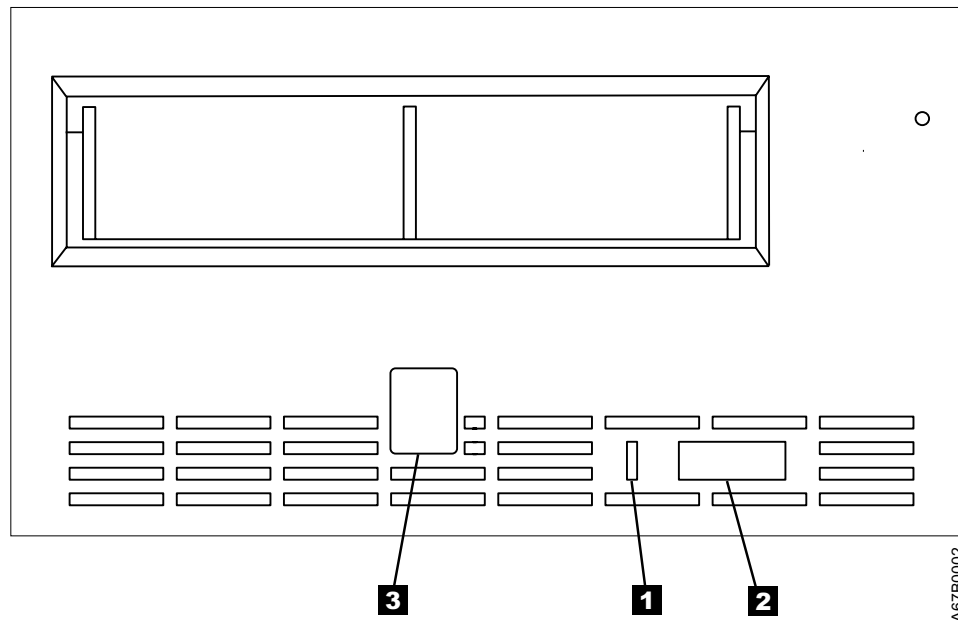


Figure 8. Front View of the Ultrium Internal Tape Drive

Status Light

The status light (**1** in Figure 8 on page 23) is a light-emitting diode (LED) that provides information about the state of the Ultrium Tape Drive. The light can be green or amber, and (when lit) solid or flashing. Table 5 lists the conditions of the status light and provides an explanation of what each condition means.

Table 5. Meaning of Status Light Activity

Color and Condition of Status Light	Meaning
Off	The tape drive has no power or is powered off.
Green/Solid	The tape drive is powered on or (if a solid C displays in the single-character display) needs cleaning.
Green/Flashing	<p>The tape drive is reading from the tape, writing to the tape, rewinding the tape, locating data on the tape, loading the tape, or unloading the tape.</p> <p>The status light also flashes green if the tape drive contains a cartridge during the power-on cycle. In this case, the drive completes POST and slowly rewinds the tape (the process may take approximately 13 minutes). The light stops blinking when the drive completes the recovery and is ready for a read or write operation. To eject the cartridge, press the unload button.</p>
Amber/Solid	The tape drive is powering on or is in maintenance mode.
Amber/Flashing	<p>One of the following applies:</p> <ul style="list-style-type: none">• If the light flashes once per second, an error occurred and the tape drive or media may require service. Note the code on the single-character display, then go to Table 12 on page 53 to determine the action that is required.• If the light flashes twice per second, the tape drive is updating firmware through the field microcode replacement (FMR) tape, or the SCSI, Fibre Channel, or RS-422 interface (see "Updating the Firmware" on page 38).• If the light flashes four times per second, the tape drive detected an error and is performing a firmware recovery. It resets automatically.

Unload Button

The unload button (**2** in Figure 8 on page 23) enables you to perform several functions. Table 6 lists the functions and explains how to initiate them.

Notes:

1. If a function is supported, you may also initiate it through the SCSI, Fibre Channel, or RS-422 interface. To determine if a function is supported, refer to the *IBM Ultrium Internal Tape Drive Models T200 and T200F and IBM 3580 Ultrium Tape Drive SCSI Reference* or refer to the documentation for your enclosure.
2. When you select a function, the condition of the status light changes to acknowledge the request.

Table 6. Functions that the Unload Button Performs

Function Performed by Unload Button	How to Initiate the Function
Rewind the tape into the cartridge and eject the cartridge from the tape drive	Press the unload button once. The status light flashes green while the tape drive is rewinding and unloading. Note: During a rewind and eject operation, the tape drive does not accept SCSI or Fibre Channel commands from the server.
Place the tape drive in maintenance mode	Ensure that the tape drive is unloaded. Then, within a 1-second interval, push the unload button three times. You are in maintenance mode when the status light becomes solid amber and 0 appears in the single-character display. Note: While in maintenance mode, the tape drive does not accept SCSI or Fibre Channel commands from the server. The tape drive does accept RS-422 interface commands.
Scroll through the maintenance functions	While in maintenance mode, push the unload button once per second to increment the display characters by one. When you reach the character of the diagnostic or maintenance function that you want (see Table 7 on page 29), press and hold the unload button for 3 seconds.
Exit maintenance mode	Press the unload button once per second until 0 displays. Then press and hold the unload button for 3 seconds. Maintenance mode is exited when the status light becomes solid green and the single-character display becomes blank.
Force a drive dump	Attention: If the tape drive detects a permanent error and displays an error code, it automatically forces a drive dump (also known as a save of the firmware trace). If you force a drive dump, the existing dump will be overwritten and data will be lost. After you force a drive dump, do not turn off the power to the tape drive or you may lose the dump data. Choose one of the following procedures: <ul style="list-style-type: none"> • If the tape drive is in maintenance mode (status light is solid amber), go to Table 7 on page 29 and select Function Code 4. • If the tape drive is in operating mode (status light is solid or flashing green), press and hold the unload button for 10 seconds. If captured dump data exists, the tape drive places it into a dump area (for information about retrieving the data, see "Obtaining a Drive Dump" on page 63).
Reset the drive	Press and hold the unload button on the drive for 10 seconds. The drive saves the dump, then reboots to allow communication. Do not cycle the power (turn it off, then on), as this will erase the dump's contents.

Single-character Display

The Ultrium Tape Drive features an LED (**3** in Figure 8 on page 23) that presents a single-character code for:

- Diagnostic or maintenance functions
- Error conditions and informational messages

Table 7 on page 29 lists each single-character code that is used for diagnostic or maintenance functions. Table 12 on page 53 lists the codes for error conditions and informational messages. If multiple errors occur, the code with the highest priority (represented by the lowest number) displays first. When the error is corrected, the code with the next highest priority displays, and so on until no errors remain.

The single-character display is blank during normal operation of the tape drive.

Inserting a Tape Cartridge

To insert a tape cartridge:

1. Ensure that the Ultrium Tape Drive is powered-on.
2. Ensure that the write-protect switch is properly set (see “Setting the Write-Protect Switch” on page 43).
3. Grasp the cartridge so that the write-protect switch faces you (see **1** in Figure 9).
4. Slide the cartridge into the tape load compartment.

Notes:

- a. If the cartridge is already in an ejected position and you want to reinsert it, remove the cartridge then insert it again.
- b. If the cartridge is already loaded and you cycle the power (turn it off, then on), the tape will reload.

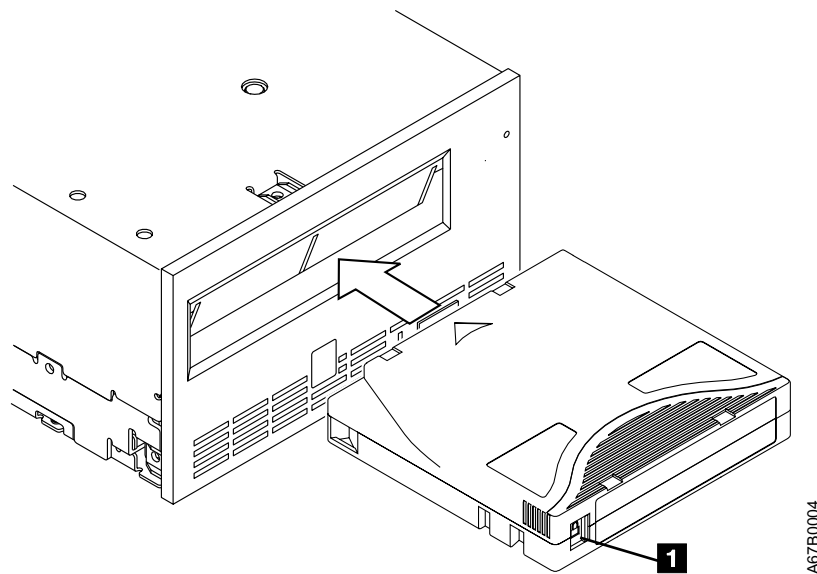


Figure 9. Inserting a Cartridge into the Ultrium Tape Drive

A67B0004

Removing a Tape Cartridge

To remove a tape cartridge:

1. Ensure that the Ultrium Tape Drive is powered-on.
2. Press the unload button. The drive rewinds the tape and partially ejects the cartridge. The status light flashes green while the tape rewinds, then goes out before the cartridge partially ejects.
3. After the cartridge partially ejects, grasp the cartridge and remove it.

If you are unable to remove the cartridge, see “Manually Removing a Tape Cartridge” on page 73. Whenever you unload a tape cartridge, the tape drive writes any pertinent information to the cartridge memory.

Cleaning the Drive Head

Attention: To clean the drive head, use the IBM LTO Ultrium Cleaning Cartridge or an IBM-approved cleaning cartridge.

Clean the drive head whenever **C** displays on the single-character display and the status light is solid green. To clean the head, insert the cleaning cartridge into the tape load compartment (see Figure 9 on page 26). The drive performs the cleaning automatically. When the cleaning is finished, the drive ejects the cartridge. The IBM LTO Ultrium Cleaning Cartridge is valid for 50 uses.

Placing the Drive in Maintenance Mode

The Ultrium Tape Drive can run diagnostics, verify write and read operations, verify a suspect tape cartridge, update its own firmware, and perform other diagnostic and maintenance functions listed in Table 7 on page 29. The drive must be in maintenance mode to perform these functions.

Attention: Maintenance functions cannot be performed concurrently with read or write operations. While in maintenance mode, the tape drive does not accept SCSI or Fibre Channel commands from the server. The tape drive does accept RS-422 interface commands.

To place the drive in maintenance mode:

1. Make sure that no cartridge is in the drive.
2. Within a 1-second interval, press the unload button three times. The status light becomes solid amber, which means that the drive is in maintenance mode.

Note: If a cartridge is in the drive, it will eject the first time that you press the unload button and the drive will not be placed in maintenance mode. To continue placing the drive in maintenance mode, remove the cartridge and repeat this step.

Selecting a Diagnostic or Maintenance Function

To select a diagnostic or maintenance function:

1. Make sure that no cartridge is in the drive.
2. Within a 1-second interval, press the unload button three times. The status light becomes solid amber, which means that the drive is in maintenance mode.

Note: If a cartridge is in the drive, it will eject the first time that you press the unload button and the drive will not be placed in maintenance mode. To continue placing the drive in maintenance mode, remove the cartridge and repeat this step.

3. In Table 7 on page 29, locate the function that you want and its code.
4. Press the unload button once per second until the code that you want appears in the single-character display.

Note: If you cycle past the desired code, press the unload button once per second until the code redisplay.

5. Press and hold the unload button for 3 seconds. The drive performs the function that you selected.
 - If the diagnostic or function requires you to insert a tape cartridge, **C** displays. Within 60 seconds, insert a cartridge or the tape drive exits maintenance mode.
 - If an invalid or write-protected tape cartridge is inserted, **7** displays. The tape drive unloads the cartridge and exits maintenance mode.
 - If the function completes successfully, **0** temporarily displays, and the drive exits maintenance mode.

Note: Certain diagnostics loop and may need to be ended. To end a looping diagnostic, press the unload button. The drive acknowledges the request by slowing the length of time that the currently displayed character flashes on the single-character display (from twice per second to once per second). When the loop ends, **0** temporarily displays and the drive exits maintenance mode.

- If the function fails, the status light flashes amber, an error code displays, and the drive exits maintenance mode. To resolve the error, refer to Table 12 on page 53.
- To reset an error, cycle (remove, then reapply) power to the tape drive.

Table 7. Diagnostic and Maintenance Functions

Function Code 1 - Run Tape Drive Diagnostics
<p>Causes the tape drive to run the following self tests:</p> <ul style="list-style-type: none">• Electrical• Motors• Write data flow• Loop write-to-read• Sensors <p>Attention: Insert only a scratch data cartridge for this test. Data on the cartridge will be overwritten.</p> <ol style="list-style-type: none">1. Make sure that no cartridge is in the drive.2. Within a 1-second interval, press the unload button three times. The status light becomes solid amber, which means that the drive is in maintenance mode. Note: If a cartridge is in the drive, it will eject the first time that you press the unload button. The drive will not be placed in maintenance mode. To continue placing the drive in maintenance mode, remove the cartridge and repeat this step.3. Press the unload button once per second until 1 appears in the single-character display. Note: If you cycle past 1, press the unload button once per second until it redisplay.4. To select the function, press and hold the unload button for 3 seconds. After you select the function, the drive runs diagnostics for approximately 90 seconds, then C flashes. When C flashes, the drive is waiting for a cartridge.5. Within 60 seconds, insert a scratch data cartridge (or the tape drive exits maintenance mode). After you insert the cartridge, 1 flashes:<ul style="list-style-type: none">• If the diagnostic completes successfully, it begins again and runs for a maximum of 10 times. Each loop takes approximately 20 minutes to run. After the tenth loop, the diagnostic stops and automatically exits maintenance mode. To halt the diagnostic, press the unload button within the first 20 minutes of the test (or the diagnostic will run another 20 minutes). The drive acknowledges the request by slowing the length of time that the currently displayed character flashes on the single-character display (from twice per second to once per second). The diagnostic continues to the end of its loop and then stops. The tape drive then displays 0, rewinds and unloads the cartridge, and exits maintenance mode.• If the diagnostics fail, the status light flashes amber and an error code displays. The tape drive unloads the tape cartridge and exits maintenance mode. To resolve the error, locate the code in Table 12 on page 53.

Table 7. Diagnostic and Maintenance Functions (continued)

<p>Function Code 2 - Update Tape Drive Firmware from FMR Tape</p> <p>Causes the tape drive to load updated firmware from a field microcode replacement (FMR) tape.</p> <p>Attention: Do not power-off the tape drive while loading code.</p> <ol style="list-style-type: none"> 1. Make sure that no cartridge is in the drive. 2. Within a 1-second interval, press the unload button three times. The status light becomes solid amber, which means that the drive is in maintenance mode. <ul style="list-style-type: none"> Note: If a cartridge is in the drive, it will eject the first time that you press the unload button and the drive will not be placed in maintenance mode. To continue placing the drive in maintenance mode, remove the cartridge and repeat this step. 3. Press the unload button once per second until 2 appears in the single-character display. <ul style="list-style-type: none"> Note: If you cycle past 2, press the unload button once per second until it redisplay. 4. To select the function, press and hold the unload button for 3 seconds. After you select the function, C flashes. When C flashes, the drive is waiting for a cartridge. Within 60 seconds, insert the FMR tape cartridge (or the tape drive exits maintenance mode). After you insert the cartridge, 2 flashes, the status light flashes amber twice per second, and the tape drive loads the updated firmware from the FMR tape cartridge into its erasable programmable read-only memory (EPROM) area: <ul style="list-style-type: none"> • If the update completes successfully, the tape drive rewinds and unloads the FMR tape, resets itself, and is ready to use the new firmware. • If the update fails, the tape drive posts an error code to the single-character display (to resolve the error, see Table 12 on page 53). The drive then unloads the FMR tape and exits maintenance mode.
<p>Function Code 3 - Create FMR Tape</p> <p>Causes the tape drive to copy its field microcode replacement (FMR) data to a scratch data cartridge.</p> <p>Attention: If you select this function, the tape drive will overwrite existing data on the scratch data cartridge.</p> <ol style="list-style-type: none"> 1. Make sure that no cartridge is in the drive. 2. Within a 1-second interval, press the unload button three times. The status light becomes solid amber, which means that the drive is in maintenance mode. <ul style="list-style-type: none"> Note: If a cartridge is in the drive, it will eject the first time that you press the unload button and the drive will not be placed in maintenance mode. To continue placing the drive in maintenance mode, remove the cartridge and repeat this step. 3. Press the unload button once per second until 3 appears in the single-character display. <ul style="list-style-type: none"> Note: If you cycle past 3, press the unload button once per second until it redisplay. 4. To select the function, press and hold the unload button for 3 seconds. After you select the function, C flashes. When C flashes, the drive is waiting for a cartridge. Within 60 seconds, insert a scratch data cartridge that is not write protected (or the tape drive exits maintenance mode). After you insert the cartridge, 3 flashes and the tape drive copies the FMR data to the scratch data cartridge: <ul style="list-style-type: none"> • If the tape drive creates the FMR tape successfully, it displays 0, rewinds and unloads the new FMR tape, and exits maintenance mode. • If the tape drive fails to create the FMR tape, it displays 7, unloads the FMR tape, and exits maintenance mode.

Table 7. Diagnostic and Maintenance Functions (continued)

<p>Function Code 4 - Force a Drive Dump</p> <p>Causes the tape drive to perform a collection (or <i>dump</i>) of data. (A drive dump is also known as a save of the firmware trace.) The dump (firmware trace) can only be analyzed by IBM.</p> <p>Note: When an error code is displayed, a dump already exists. Function Code 4 will overwrite this dump and cause the error information to be lost.</p> <ol style="list-style-type: none"> 1. Make sure that no cartridge is in the drive. 2. Within a 1-second interval, press the unload button three times. The status light becomes solid amber, which means that the drive is in maintenance mode. Note: If a cartridge is in the drive, it will eject the first time that you press the unload button and the drive will not be placed in maintenance mode. To continue placing the drive in maintenance mode, remove the cartridge and repeat this step. 3. Press the unload button once per second until 4 appears in the single-character display. Note: If you cycle past 4, press the unload button once per second until it redisplay. 4. To select the function, press and hold the unload button for 3 seconds. After you select the function, 4 displays, followed by 0. The single-character display then goes blank, and the tape drive exits maintenance mode. <p>To retrieve the dump from the drive, see Function Code 5 on page 31.</p> <p>You can also perform this operation when the tape drive is in normal operating mode. Simply press and hold the unload button for 10 seconds.</p>
<p>Function Code 5 - Copy the Drive Dump to Tape (at Beginning of Tape)</p> <p>Causes the tape drive to copy data from a drive dump (captured with Function Code 4) to the beginning of a scratch data cartridge.</p> <ol style="list-style-type: none"> 1. Make sure that no cartridge is in the drive. 2. Within a 1-second interval, press the unload button three times. The status light becomes solid amber, which means that the drive is in maintenance mode. Note: If a cartridge is in the drive, it will eject the first time that you press the unload button and the drive will not be placed in maintenance mode. To continue placing the drive in maintenance mode, remove the cartridge and repeat this step. 3. Press the unload button once per second until 5 appears in the single-character display. Note: If you cycle past 5, press the unload button once per second until it redisplay. 4. To select the function, press and hold the unload button for 3 seconds. After you select the function, C flashes. When C flashes, the drive is waiting for a cartridge. Within 60 seconds, insert a scratch data cartridge that is not write-protected (or the tape drive exits maintenance mode). After you insert the cartridge, 5 flashes and the tape drive writes the dump data to the tape (at the beginning of the tape). When the function is complete, the drive rewinds and unloads the tape, and exits maintenance mode. <p>From the server, issue the SCSI READ command to read the dump from the tape to a file or electronic image. For information about where to send the electronic image, contact your nearest Customer Assistance Center (see "Getting Help" on page 90).</p>

Table 7. Diagnostic and Maintenance Functions (continued)

Function Code 6 - Run Wrap Test

Causes the drive to perform one of the following:

- A check of the SCSI circuitry from and to the SCSI connector
- A check of the Fibre Channel circuitry from and to the Fibre Channel connector or fiber cable

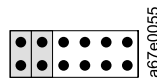
To run the test, determine whether your drive uses a SCSI or Fibre Channel interface, then choose one of the following procedures.

Running a SCSI Wrap Test

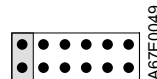
This test evaluates the SCSI circuitry. A SCSI LVD wrap plug (part number 19P0481) is required for this procedure. To order the wrap plug, see "Appendix A. Tools and Supplies" on page 81.

Before you select this function, terminate the SCSI bus and attach a SCSI wrap plug by doing one of the following:

- Place a jumper on pins 5 and 6 of the drive's SCSI ID connector (as shown by the shaded area in the figure below), then attach the SCSI wrap plug to the connector (in place of the SCSI cable).



- Place a jumper on pin 6 of the drive's SCSI ID connector (as shown by the shaded area in the figure below), then connect a Y-cable to the SCSI connector. Connect a terminator to one end of the Y-cable and connect the SCSI wrap plug to the other end of the cable.



1. Ensure that the drive does not contain a cartridge.
2. Within a 1-second interval, press the unload button three times. The status light becomes solid amber, which means that the drive is in maintenance mode.
Note: If a cartridge is in the drive, it will eject the first time that you press the unload button and the drive will not be placed in maintenance mode. To continue placing the drive in maintenance mode, remove the cartridge and repeat this step.
3. Press the unload button once per second until **6** appears in the single-character display.
Note: If you cycle past **6**, press the unload button once per second until it redisplay.
4. To select the function, press and hold the unload button for 3 seconds. After you select the function, the tape drive automatically starts the test:
 - If the test is successful, it loops and begins again. Press the unload button. The test stops, **0** displays, and the tape drive exits maintenance mode. To continue to isolate the problem, go to "Fixing SCSI Bus Errors" on page 65 and locate the steps to take after you run the SCSI wrap test.
 - If the test fails, **8** displays, the test stops, and the tape drive exits maintenance mode. To resolve the error, replace the tape drive (see "Removing the SCSI Tape Drive" on page 71).

Table 7. Diagnostic and Maintenance Functions (continued)

Running a Fibre Channel Wrap Test

This test evaluates the Fibre Channel circuitry at the drive's Fibre Channel connector, then at the fiber cable. A Fibre Channel wrap plug (part number 08L9459, formerly 34L2629) is required for this procedure. To run the wrap test through the fiber cable, a duplex adapter is required (part number 19P0242). To order the wrap plug and adapter, see "Appendix A. Tools and Supplies" on page 81. All cables and wrap plugs are hot-pluggable (that is, they can be removed from or added to the drive while the drive or its enclosure is powered-on).

1. Take all devices on the Fibre Channel offline (for instructions, refer to your server's documentation).
2. Make sure that no cartridge is in the drive.
3. Disconnect the fibre cable from the drive and replace it with the Fibre Channel wrap plug. (When you disconnect the cable, the connection to the Fibre Channel loop may break, but will be restored at the end of the procedure when you reconnect the cable. For other devices on the loop, operations may temporarily be disrupted.)

Attention: Do not run the wrap test while the drive is connected to a Fibre Channel loop. This could disturb the Fibre Channel loop and cause performance or I/O problems.

4. Within a 1-second interval, press the unload button three times. The status light becomes solid amber, which means that the drive is in maintenance mode.

Note: If a cartridge is in the drive, it will eject the first time that you press the unload button and the drive will not be placed in maintenance mode. To continue placing the drive in maintenance mode, remove the cartridge and repeat this step.

5. Press the unload button once per second until **6** appears in the single-character display.

Note: If you cycle past **6**, press the unload button once per second until it redisplay.

Testing the Circuitry at the Drive's Fibre Channel Connector

6. To select the function, press and hold the unload button for 3 seconds. After you select the function, the tape drive automatically starts the test:
 - If the test is successful, the circuitry at the drive's Fibre Channel connector is working properly. The test loops and begins again. Press the unload button. **0** displays and the tape drive exits maintenance mode. Continue to step 7 to test the fiber cable.
 - If the test fails, an error code displays and the status light flashes amber. The test stops and the drive exits maintenance mode. To resolve the error, locate the code in Table 12 on page 53.
7. Disconnect the Fibre Channel wrap plug from the drive.

Testing the Circuitry at the Fiber Cable

8. Connect the duplex adapter, then the Fibre Channel wrap plug to the end of the fiber cable.

Note: The Fibre Channel wrap test can only be run on cable lengths up to 250 meters (820 ft).
9. Within a 1-second interval, press the unload button three times. The status light becomes solid amber, which means that the drive is in maintenance mode.

Note: If a cartridge is in the drive, it will eject the first time that you press the unload button and the drive will not be placed in maintenance mode. To continue placing the drive in maintenance mode, remove the cartridge and repeat this step.
10. Press the unload button once per second until **6** appears in the single-character display.

Note: If you cycle past **6**, press the unload button once per second until it redisplay.
11. To select the function, press and hold the unload button for 3 seconds. After you select the function, the tape drive automatically starts the test:
 - If the test is successful, the drive and the cable are working properly. The problem is at the server. To resolve the error, refer to the service guide for the server.
 - If the test fails, replace the fiber cable.
12. Remove the Fibre Channel wrap plug and the duplex adapter, and reconnect the fiber cable.

Table 7. Diagnostic and Maintenance Functions (continued)

<p>Function Code 7 - Run RS-422 Wrap Test</p> <p>Causes the tape drive to perform a check of the circuitry from and to the RS-422 connector.</p> <p>Before you select this function, attach an RS-422 wrap plug to the tape drive's RS-422 connector (in place of the RS-422 cable). To order the wrap plug (part number 19P0519), see "Appendix A. Tools and Supplies" on page 81.</p> <ol style="list-style-type: none">1. Make sure that no cartridge is in the drive.2. Within a 1-second interval, press the unload button three times. The status light becomes solid amber, which means that the drive is in maintenance mode. Note: If a cartridge is in the drive, it will eject the first time that you press the unload button and the drive will not be placed in maintenance mode. To continue placing the drive in maintenance mode, remove the cartridge and repeat this step.3. Press the unload button once per second until 7 appears in the single-character display. Note: If you cycle past 7, press the unload button once per second until it redisplay.4. To select the function, press and hold the unload button for 3 seconds. After you select the function, the tape drive automatically starts the test:<ul style="list-style-type: none">• If the test is successful, it loops and begins again. To halt the test, press the unload button. The test continues to the end of its loop and then stops. The tape drive then displays 0, rewinds and unloads the cartridge, and exits maintenance mode.• If the test fails, 9 displays, the test stops, and the tape drive exits maintenance mode. To resolve the error, locate 9 in Table 12 on page 53.
<p>Function Code 8 - Convert FMR Tape to Scratch Tape</p> <p>Causes the tape drive to erase the field microcode replacement (FMR) data on a scratch data cartridge and rewrite the cartridge memory on the tape. This turns the cartridge into a valid scratch data cartridge.</p> <ol style="list-style-type: none">1. Make sure that no cartridge is in the drive.2. Within a 1-second interval, press the unload button three times. The status light becomes solid amber, which means that the drive is in maintenance mode. Note: If a cartridge is in the drive, it will eject the first time that you press the unload button and the drive will not be placed in maintenance mode. To continue placing the drive in maintenance mode, remove the cartridge and repeat this step.3. Press the unload button once per second until 8 appears in the single-character display. Note: If you cycle past 8, press the unload button once per second until it redisplay.4. To select the function, press and hold the unload button for 3 seconds. After you select the function, C flashes. When C flashes, the drive is waiting for a cartridge. Within 60 seconds, insert the FMR cartridge (or the tape drive exits maintenance mode). After you insert the cartridge, 8 flashes, the tape drive erases the firmware on the tape, then rewrites the header in the cartridge memory to change the cartridge to a valid scratch data cartridge:<ul style="list-style-type: none">• If the operation is successful, the tape drive displays 0, rewinds and ejects the newly converted scratch data cartridge, and exits maintenance mode.• If the operation is not successful, an error code displays. To resolve the error, locate the code in Table 12 on page 53.

Table 7. Diagnostic and Maintenance Functions (continued)

<p>Function Code 9 - Display Error Code Log</p> <p>Causes the tape drive to display the last 10 error codes, one at a time (the codes are ordered; the most recent is presented first and the oldest (tenth) is presented last).</p> <ol style="list-style-type: none"> 1. Make sure that no cartridge is in the drive. 2. Within a 1-second interval, press the unload button three times. The status light becomes solid amber, which means that the drive is in maintenance mode. Note: If a cartridge is in the drive, it will eject the first time that you press the unload button and the drive will not be placed in maintenance mode. To continue placing the drive in maintenance mode, remove the cartridge and repeat this step. 3. Press the unload button once per second until 9 appears in the single-character display. Note: If you cycle past 9, press the unload button once per second until it redisplay. 4. To select the function, press and hold the unload button for 3 seconds. After you select the function, press the unload button to view the most recent error code. Press the unload button again to view successive error codes. If you press the unload button for 3 seconds after the tenth error code displays, 0 displays (if there are no errors in the log) and the drive exits maintenance mode.
<p>Function Code A - Clear Error Code Log</p> <p>Causes the tape drive to erase the contents of the error code log.</p> <ol style="list-style-type: none"> 1. Make sure that no cartridge is in the drive. 2. Within a 1-second interval, press the unload button three times. The status light becomes solid amber, which means that the drive is in maintenance mode. Note: If a cartridge is in the drive, it will eject the first time that you press the unload button and the drive will not be placed in maintenance mode. To continue placing the drive in maintenance mode, remove the cartridge and repeat this step. 3. Press the unload button once per second until A appears in the single-character display. Note: If you cycle past A, press the unload button once per second until it redisplay. 4. To select the function, press and hold the unload button for 3 seconds. After you select the function, the tape drive erases all errors from the error code log, displays 0, then exits maintenance mode.
<p>Function Code C - Insert Cartridge into Tape Drive</p> <p>This function cannot be selected by itself. It relates to other maintenance functions (such as Run Tape Drive Diagnostics or Create FMR Tape) that require an FMR tape cartridge or scratch tape cartridge that is not write protected.</p>

Table 7. Diagnostic and Maintenance Functions (continued)

Function Code E - Test Cartridge & Media
<p>Causes the tape drive to perform a Write/Read test (on the edge bands) to ensure that a suspect cartridge and its magnetic tape are acceptable. The tape drive takes approximately 10 minutes to run the test.</p> <p>Attention: Data on the suspect tape will be overwritten.</p> <ol style="list-style-type: none"> 1. Make sure that no cartridge is in the drive. 2. Within a 1-second interval, press the unload button three times. The status light becomes solid amber, which means that the drive is in maintenance mode. <p>Note: If a cartridge is in the drive, it will eject the first time that you press the unload button and the drive will not be placed in maintenance mode. To continue placing the drive in maintenance mode, remove the cartridge and repeat this step.</p> 3. Press the unload button once per second until E appears in the single-character display. <p>Note: If you cycle past E, press the unload button once per second until it redisplay.</p> 4. To select the function, press and hold the unload button for 3 seconds. After you select the function, C flashes. When C flashes, the drive is waiting for a cartridge. Within 60 seconds, insert the suspect data cartridge (or the tape drive exits maintenance mode). After you insert the cartridge, E flashes: <ul style="list-style-type: none"> • If no error is detected, the test begins again and runs for a maximum of 10 times. After the tenth loop, the test stops and the drive automatically exits maintenance mode. To halt the test, press the unload button. The drive acknowledges the request by slowing the length of time that the currently displayed character flashes on the single-character display (from twice per second to once per second). The test continues to the end of its loop and then stops. The tape drive then displays 0, rewinds and unloads the cartridge, and exits maintenance mode. • If an error is detected, the tape drive displays 7, unloads the tape cartridge, and exits maintenance mode. To resolve the error, locate 7 in Table 12 on page 53.
Function Code F - Fast Read/Write Test
<p>Causes the tape drive to perform tests to ensure that the drive can read from and write to tape. This diagnostic performs fewer tests than the Run Tape Drive Diagnostics test (Function Code 1). The tape drive takes approximately three minutes to run the test. The Fast Read/Write Test is not as comprehensive a test and is not recommended for isolating errors between the drive and the media.</p> <p>Attention: Data on the suspect tape will be overwritten.</p> <ol style="list-style-type: none"> 1. Make sure that no cartridge is in the drive. 2. Within a 1-second interval, press the unload button three times. The status light becomes solid amber, which means that the drive is in maintenance mode. <p>Note: If a cartridge is in the drive, it will eject the first time that you press the unload button and the drive will not be placed in maintenance mode. To continue placing the drive in maintenance mode, remove the cartridge and repeat this step.</p> 3. Press the unload button once per second until F appears in the single-character display. <p>Note: If you cycle past F, press the unload button once per second until it redisplay.</p> 4. To select the function, press and hold the unload button for 3 seconds. After you select the function, C flashes. When C flashes, the drive is waiting for a cartridge. Within 60 seconds, insert the suspect data cartridge (or the tape drive exits maintenance mode). After you insert the cartridge, F flashes. <ul style="list-style-type: none"> • If no error is detected, the test begins again and runs for a maximum of 10 times. Each loop takes approximately 3 minutes to run. After the tenth loop, the test stops and the drive automatically exits maintenance mode. To halt the test, press the unload button. The drive acknowledges the request by slowing the length of time that the currently displayed character flashes on the single-character display (from twice per second to once per second). The test continues to the end of its loop and then stops. The tape drive then displays 0, rewinds and unloads the cartridge, and exits maintenance mode. • If an error is detected, the tape drive displays an error code, unloads the tape cartridge, and exits maintenance mode. To resolve the error, locate the code in Table 12 on page 53.

Table 7. Diagnostic and Maintenance Functions (continued)

Function Code H - Test Head
<p>Causes the tape drive to perform the Head Resistance Measurements test and a Write/Read test (on the center of the tape). The drive runs these tests to ensure that the tape drive's head and tape-carriage mechanics are working correctly. The tape drive takes approximately 10 minutes to run the test.</p> <ol style="list-style-type: none">1. Make sure that no cartridge is in the drive.2. Within a 1-second interval, press the unload button three times. The status light becomes solid amber, which means that the drive is in maintenance mode. Note: If a cartridge is in the drive, it will eject the first time that you press the unload button and the drive will not be placed in maintenance mode. To continue placing the drive in maintenance mode, remove the cartridge and repeat this step.3. Press the unload button once per second until H appears in the single-character display. Note: If you cycle past H, press the unload button once per second until it redisplay.4. To select the function, press and hold the unload button for 3 seconds. After you select the function, C flashes. When C flashes, the drive is waiting for a cartridge. Within 60 seconds, insert a scratch data cartridge (or the tape drive exits maintenance mode). After you insert the cartridge, H flashes.<ul style="list-style-type: none">• If no error is detected, the test begins again and runs for a maximum of 10 times. Each loop takes approximately 10 minutes to run. After the tenth loop, the test stops and the drive automatically exits maintenance mode. To halt the test, press the unload button. The drive acknowledges the request by slowing the length of time that the currently displayed character flashes on the single-character display (from twice per second to once per second). The test continues to the end of its loop and then stops. The tape drive then displays 0, rewinds and unloads the cartridge, and exits maintenance mode.• If an error is detected, the tape drive displays 5, unloads the tape cartridge, and exits maintenance mode. To resolve the error, locate 5 in Table 12 on page 53.

Exiting Maintenance Mode

To manually exit maintenance mode, press the unload button once per second until **0** appears on the single-character display. Press and hold the unload button for 3 seconds. The drive exits maintenance mode (the solid amber status light becomes solid green, then turns off).

Updating the Firmware

Attention: When updating firmware, do not power-off the tape drive until the update is complete, or the firmware may be lost.

Periodically check for updated levels of drive firmware by visiting the web at <http://www.ibm.com/storage/storagesmart/1to>. You can update your drive's firmware by:

- Obtaining the new firmware image and downloading it to the drive through the SCSI, Fibre Channel, or RS-422 interface
- Loading the firmware from a field microcode replacement (FMR) tape cartridge

For instructions about how to obtain a new firmware image or FMR tape, visit the preceding web site. To update the firmware, refer to the following sections.

Updating Firmware through the SCSI, Fibre Channel, or RS-422 Interface

Attention: SCSI drives and Fibre Channel drives require different firmware images.

When you update the tape drive's firmware by using the SCSI or Fibre Channel interface, the procedure varies, depending on whether your server uses an IBM tape device driver or a non-IBM tape device driver (such as a driver from Sun, Hewlett-Packard, or Microsoft).

For instructions about updating code from a server that uses an IBM tape device driver, refer to the *IBM Ultrium Device Drivers Installation and User's Guide*.

To update code from a server that uses a non-IBM tape device driver, refer to the documentation for that device driver.

To update code from the RS-422 interface, see your library's documentation.

Updating the Firmware with an FMR Tape Cartridge

Attention: SCSI drives and Fibre Channel drives require different firmware images.

To update the Ultrium Tape Drive's firmware from an FMR tape cartridge:

1. Ensure that the tape drive is unloaded.
2. Place the drive in maintenance mode by pressing the unload button three times within a 1-second interval. The status light becomes solid amber, which means that the drive is in maintenance mode.
3. Press the unload button once per second until **2** displays, then press and hold the button for 3 seconds. When **C** flashes, the drive is waiting for a cartridge.
4. Insert the FMR tape cartridge. **2** flashes, the drive loads the updated firmware from the cartridge, and the status light flashes amber. When the update completes successfully, **0** displays and the cartridge automatically ejects.

The drive resets itself and automatically activates the new firmware.

If the update fails, an error code displays. To resolve the error, locate the code in Table 12 on page 53.

Chapter 5. Using the Media

The IBM Ultrium Internal Tape Drive Models T200 and T200F use the following cartridge types:

- IBM LTO Ultrium Data Cartridge
- IBM LTO Ultrium Cleaning Cartridge

To ensure that your tape drive conforms to IBM's specifications for reliability, use only the preceding cartridges. You may use other LTO-certified data cartridges, but they may not meet the standards of reliability that is established by IBM. The IBM LTO Ultrium Data Cartridge cannot be interchanged with the media used in other IBM non-LTO Ultrium tape products.

In addition to using LTO Ultrium Tape Cartridges with up to 100 GB capacity, the tape drive reads and writes to certified LTO Ultrium Tape Cartridges that have capacities of 50 GB, 30 GB, and 10 GB.

Figure 10 shows the IBM LTO Ultrium Data Cartridge and its components.

- | | | | |
|----------|----------------------|----------|-----------------|
| 1 | Cartridge door | 4 | Label area |
| 2 | Leader pin | 5 | Insertion guide |
| 3 | Write-protect switch | | |

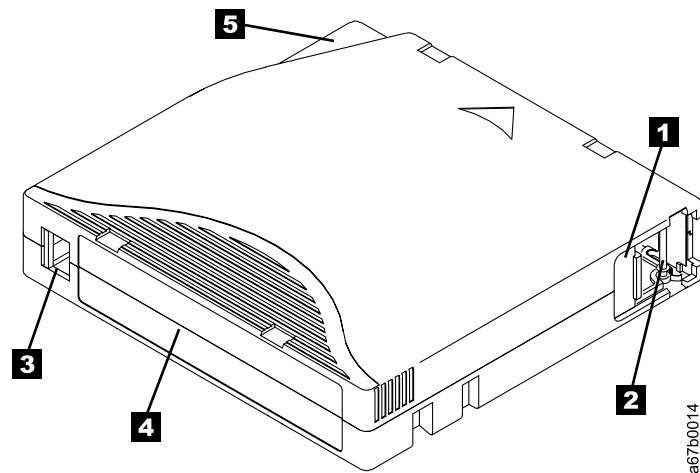


Figure 10. The IBM LTO Ultrium Data Cartridge

Data Cartridge

The IBM LTO Ultrium Data Cartridge contains 1/2-inch, metal-particle tape that has a native data capacity of 100 GB. When processing the tape, the Ultrium Internal Tape Drive uses a linear, serpentine recording format, and reads and writes data on 384 tracks, eight tracks at a time. The first set of eight tracks is written from near the beginning of the tape to near the end of the tape. The head then repositions to the next set of eight tracks for the return pass. This process continues until all tracks are written and the tape is full, or until all data is written.

The IBM LTO Ultrium Data Cartridge includes a Linear Tape-Open Cartridge Memory (LTO-CM) chip, which contains information about the cartridge and the tape (such as the name of the manufacturer that created the tape), as well as statistical information about the cartridge's use. Whenever you unload a tape cartridge, the tape drive writes any pertinent information to the cartridge memory.

The cartridge door (**1** in Figure 10 on page 41) protects the tape from contamination when the cartridge is out of the drive. Behind the door, the tape is attached to a leader pin **2**. When you insert the cartridge into the drive, a threading mechanism pulls the pin (and tape) out of the cartridge, across the drive head, and onto a non-removable takeup reel. The head can then read or write data from or to the tape.

The write-protect switch **3** prevents data from being written to the tape cartridge. The label area **4** provides a location for you to place a label. When affixing a label, place it only in the recessed label area. A label that extends outside of the recessed area can cause loading problems in the drive. The insertion guide **5** is a large, notched area that prevents you from inserting the cartridge incorrectly.

The IBM LTO Ultrium Data Cartridge has a nominal cartridge life of 5000 load and unload cycles.


Cleaning Cartridge

The drive itself determines when a head needs to be cleaned. It alerts you by displaying **C** on the single-character display. To clean the head, insert the IBM LTO Ultrium Cleaning Cartridge into the tape load compartment (see Figure 9 on page 26). The tape drive performs the cleaning automatically. When the cleaning is finished, the drive ejects the cartridge.

To remove a cleaning cartridge, see "Unload Button" on page 25. The IBM LTO Ultrium Cleaning Cartridge is valid for 50 uses. The cartridge's LTO-CM chip tracks the number of times that the cartridge is used.

Setting the Write-Protect Switch

The position of the write-protect switch on the tape cartridge (see **1** in Figure 11) determines whether you can write to the tape:

- If the switch is set to  (solid red), data cannot be written to the tape.
- If the switch is set to unlocked (black void), data can be written to the tape.

To set the switch, slide it left or right to the desired position.

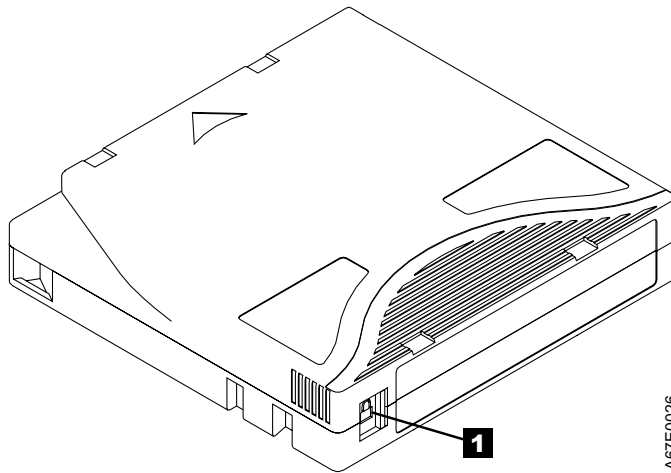


Figure 11. Setting the Write-Protect Switch

Reattaching a Leader Pin

If the leader pin detaches from the tape in your cartridge, you must use the IBM Leader Pin Reattachment Kit (part number 08L9129) to reattach it. (Do not reattach the pin if you must remove more than 7 meters (23 feet) of leader tape.)

The first meter of tape is leader tape. Once the leader tape has been removed there is a possibility of tape breakage. After reattaching the leader pin, transfer data from the defective tape cartridge. **Do not reuse the defective tape cartridge.**

The Leader Pin Reattachment Kit contains three parts:

- **Leader pin attach tool** (see **1** in Figure 12). A plastic brace that holds the cartridge door open.
- **Cartridge manual rewind tool** (see **2** in Figure 12). A device that fits into the cartridge's hub and lets you wind the tape into and out of the cartridge.
- **Pin supplies** (see **3** in Figure 12). Leader pins and C-clips.

Attention:

- Use only the IBM Leader Pin Reattachment Kit to reattach the leader pin to the tape. Other methods of reattaching the pin will damage the tape, the drive, or both.
- Use this procedure on your tape cartridge only when the leader pin detaches from the magnetic tape and you must copy the cartridge's data onto another cartridge. Destroy the damaged cartridge after you copy the data. This procedure may affect the performance of the leader pin during threading and unloading operations.
- Touch only the end of the tape. Touching the tape in an area other than the end can damage the tape's surface or edges, which may interfere with read or write reliability.

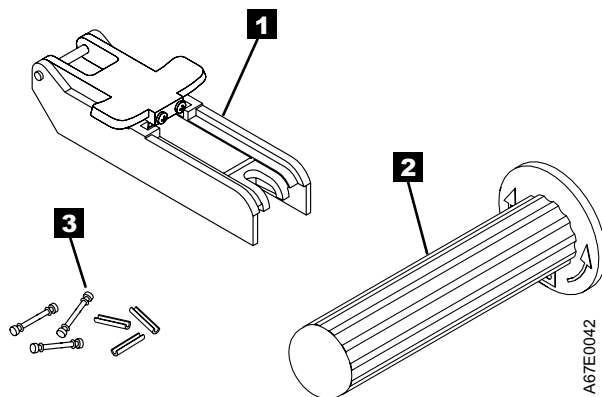
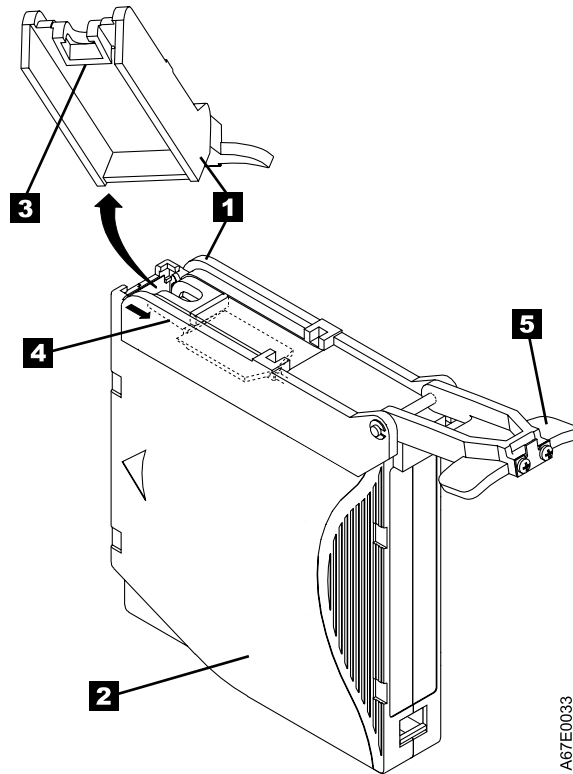


Figure 12. Leader Pin Reattachment Kit

The following procedure describes how to reattach a leader pin.

To reattach a leader pin by using the IBM Leader Pin Reattachment Kit:

1. Attach the leader pin attach tool (**1** in Figure 13) to the cartridge (**2**) so that the tool's hook (**3**) latches into the cartridge's door (**4**). Pull the tool back to hold the door open, then slide the tool onto the cartridge. Open the tool's pivot arm (**5**).



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Figure 13. Attaching the Leader Pin Attach Tool to the Cartridge. To hold the cartridge door open, hook the tool into the door and pull the tool back.

2. To find the end of the tape inside the cartridge, attach the cartridge manual rewind tool (**1** in Figure 14) to the cartridge's hub (**2**) by fitting the tool's teeth between the teeth of the hub. Turn the tool clockwise until you see the end of the tape inside the cartridge. Then, slowly turn the rewind tool counterclockwise to bring the tape edge toward the cartridge door (**3**).
3. Continue to turn the rewind tool counterclockwise until approximately 12.7 cm (5 in.) of tape hangs from the cartridge door. If necessary, grasp the tape and pull gently to unwind it from the cartridge.
4. Remove the rewind tool by pulling it away from the cartridge. Set the tool and the cartridge aside.

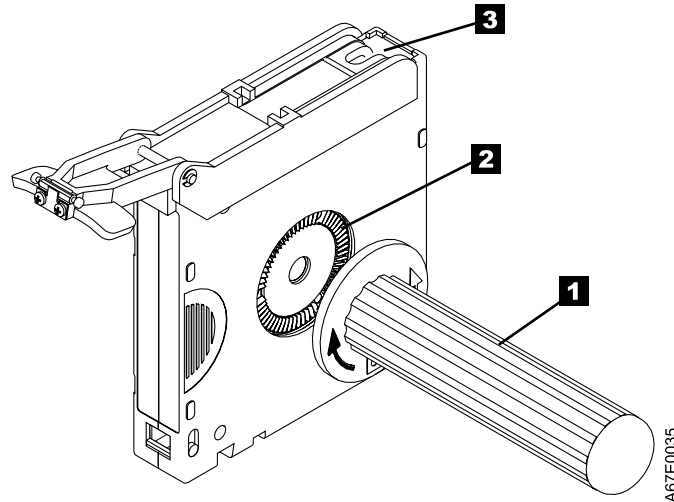


Figure 14. Winding the Tape Out of the Cartridge. Turn the cartridge manual rewind tool clockwise to see the end of the tape, then turn it counterclockwise to bring the tape to the cartridge door.

5. On the leader pin (**1** in Figure 15), locate the open side of the C-clip (**2**). The C-clip is a small black part that secures the tape (**3**) to the pin.
6. Remove the C-clip from the leader pin by using your fingers to push the clip away from the pin. Set the pin aside and discard the clip.

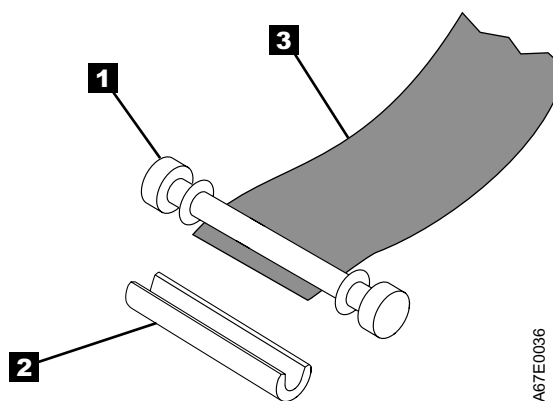


Figure 15. Removing the C-Clip from the Leader Pin. Use your fingers to push the C-clip from the leader pin.

7. Position the tape in the alignment groove of the leader pin attach tool (see **1** in Figure 16).
8. Place a new C-clip into the retention groove **2** (Figure 16) on the leader pin attachment tool and make sure that the clip's open side faces up.
9. Place the leader pin (from step 6 on page 46) into the cavity **3** (Figure 16) of the leader pin attach tool.

Attention: To prevent the leader pin from rolling into the cartridge, in the following step use care when folding the tape over the pin.

10. Fold the tape over the leader pin and hold it with your fingers (see Figure 16).

Note: Use care to ensure that the tape is centered over the leader pin. Failure to properly center the tape on the pin will cause the repaired cartridge to fail. When the tape is properly centered, a 0.25-mm (0.01-in.) gap exists on both sides of the pin.

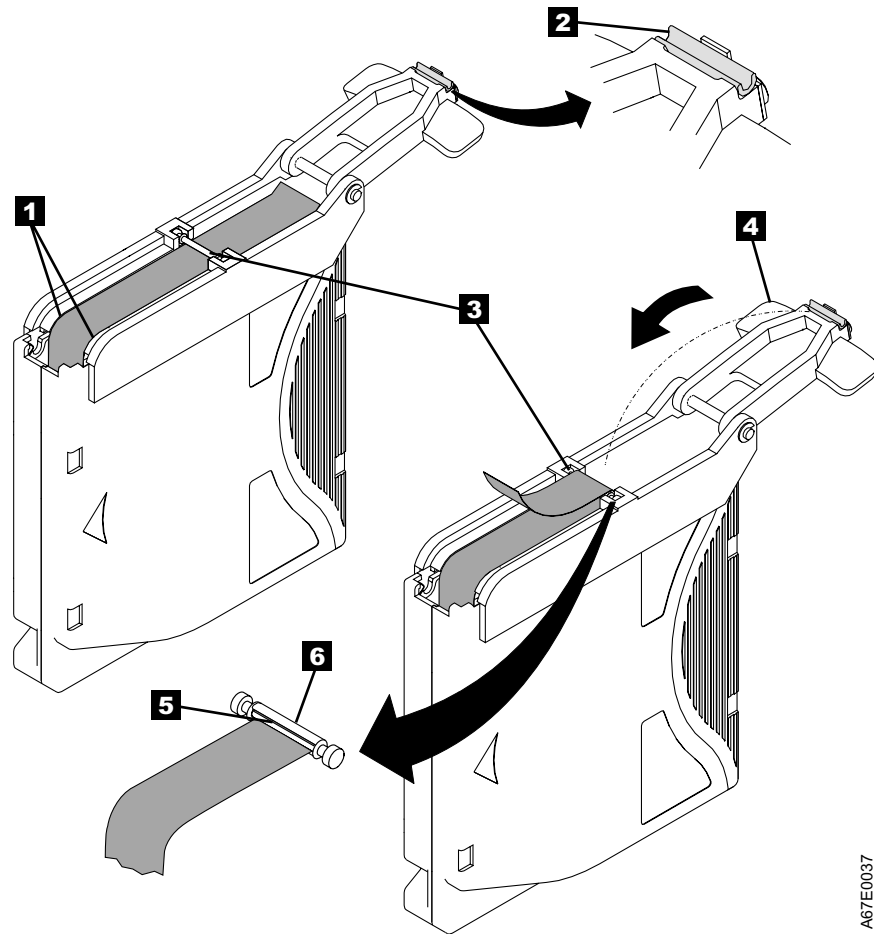


Figure 16. Attaching the Leader Pin to the Tape

11. Close the pivot arm **4** of the leader pin attach tool by swinging it over the leader pin so that the C-clip snaps onto the pin and the tape.
12. Swing the pivot arm open and trim the excess tape **5** so that it is flush with the reattached leader pin **6**.
13. Use your fingers to remove the leader pin from the cavity **3** in the leader pin attach tool.

14. Use the cartridge manual rewind tool to wind the tape back into the cartridge (wind the tape clockwise). Ensure that the leader pin is latched by the pin-retaining spring clips on each end of the leader pin.
15. Remove the rewind tool.
16. Remove the leader pin attach tool by lifting its end up and away from the cartridge.

Use a repaired tape cartridge only to recover data and move it to another cartridge. Continued use of a repaired cartridge may void the warranties of the drive and the cartridge.

Handling the Cartridges

Incorrect handling or an incorrect environment can damage the LTO Ultrium Tape Cartridge or its magnetic tape. To avoid damage to your tape cartridges and to ensure the continued high reliability of your Ultrium Internal Tape Drive, use the following guidelines:

- Before you use a cartridge, let it acclimate for at least 24 hours to the normal operating environment.
- Ensure that all surfaces of a cartridge are dry before inserting it.
- Do not insert a damaged tape cartridge into your Ultrium Tape Drive. A damaged cartridge can interfere with the reliability of the drive. Before inserting a tape cartridge, inspect the cartridge case, cartridge door, and write-protect switch for cracks or breaks. If you need to recover data from a damaged cartridge, contact your nearest Customer Assistance Center (see “Getting Help” on page 90).
- Do not open the cartridge case at any time. The upper and lower parts of the case are welded; separating them destroys the usefulness of the cartridge.
- Do not handle tape that is outside the cartridge. Handling the tape can damage the tape’s surface or edges, which may interfere with read or write reliability. Pulling on tape that is outside the cartridge can damage the tape and the brake mechanism in the cartridge.
- Do not stack more than six cartridges. Although cartridges are shipped and should be stored with the reel in the vertical position, you can temporarily lay the cartridges flat when moving them.
- Do not expose the tape cartridge to moisture or direct sunlight.
- Do not degauss a tape cartridge that you intend to reuse. Degaussing makes the tape unusable.
- **Do not perform bulk erasure of the tape.** Bulk erasure makes the cartridge unusable.
- Do not expose recorded or blank tape cartridges to stray magnetic fields of greater than 100 oersteds (for example, terminals, motors, video equipment, X-ray equipment, or fields that exist near high-current cables or power supplies). Such exposure can cause the loss of recorded data or make the blank cartridge unusable.
- Maintain the conditions that are described in “Environmental and Shipping Specifications for Tape Cartridges” on page 49.

Environmental and Shipping Specifications for Tape Cartridges

Before you use a tape cartridge, acclimate it to the operating environment for 24 hours or the time necessary to prevent condensation in the drive (the time will vary, depending on the environmental extremes to which the drive was exposed).

The best storage container for the cartridges (until they are opened) is the original shipping container. The plastic wrapping prevents dirt from accumulating on the cartridges and partially protects them from humidity changes.

When you ship a cartridge, place it in a sealed, moisture-proof bag to protect it from moisture, contaminants, and physical damage. Ship the cartridge in a shipping container that has enough packing material to cushion the cartridge and prevent it from moving within the container.

Table 8 gives the environment for operating, storing, and shipping LTO Ultrium Tape Cartridges.

Table 8. Environment for Operating, Storing, and Shipping the LTO Ultrium Tape Cartridge

Environmental Specifications				
Environmental Factor	Operating	Operational Storage ¹	Archival Storage ²	Shipping
Temperature	10 to 45°C (50 to 113°F)	16 to 32°C (61 to 90°F)	16 to 25°C (61 to 77°F)	-23 to 49°C (-9 to 120°F)
Relative humidity (noncondensing)	10 to 80%	20 to 80%	20 to 50%	5 to 80%
Wet bulb temperature	26°C (79°F)	26°C (79°F)	26°C (79°F)	26°C (79°F)
Notes: 1. Operational storage equals less than 1 year. 2. Archival storage equals 1 to 10 years.				

Disposing of Tape Cartridges

Under the current rules of the U.S. Environmental Protection Agency (EPA), regulation 40CFR261, the LTO Ultrium Tape Cartridge is classified as non-hazardous waste. As such, it may be disposed of in the same way as normal office trash. These regulations are amended from time to time, and you should review them at the time of disposal.

If your local, state, country (non-U.S.A.), or regional regulations are more restrictive than EPA 40CFR261, you must review them before you dispose of a cartridge. Contact your account representative for information about the materials that are in the cartridge.

If a tape cartridge must be disposed of in a secure manner, you can erase the data on the cartridge by using a high-energy AC degausser (use a minimum of 1200 oersted peak field over the entire space that the cartridge occupies). Degaussing makes the cartridge unusable.

If you burn the cartridge and tape, ensure that the incineration complies with all applicable regulations.

Ordering Media Supplies

Table 9 lists the cartridges and media supplies that you can order for the IBM Ultrium Internal Tape Drive Models T200 and T200F. To order media supplies, visit the web at <http://www.ibm.com/storage/storagesmart/lto>.

Table 9. Media Supplies for the IBM Ultrium Internal Tape Drive Models T200 and T200F

IBM Part Number	Product Description
08L9120	IBM LTO Ultrium Data Cartridge (100 GB) (includes only human-writable labels)
19P1053	LTO Ultrium Data Cartridge Bar Code Labels, sheet of 20, black and white
08L9124	IBM LTO Ultrium Cleaning Cartridge (includes only human-writable labels)
08L9267	LTO Ultrium Cleaning Cartridge Bar Code Labels, sheet of 20, black and white

Ordering Custom Bar Code Labels

If custom bar code labels are required for your IBM LTO Ultrium Data or Cleaning Cartridges, order them directly from the following authorized label supplier or visit the web at <http://www.colorflex.com/tri-optic>.

In America and Asia

Colorflex™
697 South Pierce Street
Louisville, CO 80027
U. S. A.
Telephone: 1-888-438-8362
Fax: 303-266-2166

In Europe

EDP Europe, Ltd.
43 Redhills Road
South Woodham Ferrers
Chelmsford, Essex CM3 5UL
U. K.
Telephone: +44-1245-322380
Fax: +44-1245-323484

Chapter 6. Resolving Problems

If you encounter problems when running the Ultrium Internal Tape Drive, refer to Table 10. If the problem is not identified in Table 10, refer to “Methods of Receiving Errors and Messages” on page 53. The color and condition of the status light may also indicate a problem. For more information, see “Status Light” on page 24.

Table 10. Troubleshooting Tips for the Ultrium Internal Tape Drive

If the problem is this....	Do this....
A code displays on the single-character display and the status light flashes amber.	The tape drive detected an error or is directing you to an informational message. See Table 12 on page 53.
The status light or single-character display never turns on.	The tape drive has no power. Check the power at the power source. Connect power to the tape drive (see “Step 8. Connect Power to the Tape Drive” on page 21). If the problem persists, replace the tape drive.
The tape drive will not load a tape cartridge.	One of the following has occurred: <ul style="list-style-type: none"> • A tape cartridge is already inserted. To remove the cartridge, press the unload button. If the cartridge does not eject, turn off the power to the tape drive, then turn it back on and press the unload button. • The tape cartridge was inserted incorrectly. To properly insert a cartridge, see “Inserting a Tape Cartridge” on page 26. • The tape cartridge was defective. Insert another tape cartridge. If the problem persists, replace the tape drive (see “Removing the SCSI Tape Drive” on page 71 or “Removing the Fibre Channel Tape Drive” on page 72). • The tape drive has no power. Connect power to the tape drive (see “Step 8. Connect Power to the Tape Drive” on page 21). • If the problem exists for multiple cartridges, the tape drive is defective. Replace the tape drive (see “Removing the SCSI Tape Drive” on page 71 or “Removing the Fibre Channel Tape Drive” on page 72).
The tape drive will not unload the tape cartridge.	The tape cartridge is stuck or is broken. Press the unload button. If the cartridge does not eject, turn off the power to the tape drive, then turn it back on. If the cartridge still does not eject, manually remove it (see “Manually Removing a Tape Cartridge” on page 73).
The server received TapeAlert flags.	See “Appendix B. TapeAlert Flags” on page 83.
The server reported SCSI problems (such as selection or command time-outs, or parity errors).	See “Resolving Problems Reported by the Server” on page 65.
The server reported Fibre Channel problems.	See “Fixing Fibre Channel Errors” on page 67.
The Fibre Channel drive indicates no Fibre Channel light, or has light but cannot communicate.	See “Fixing Fibre Channel Errors” on page 67.
A library reported an interface problem.	The RS-422 circuitry may be defective. Run the RS-422 wrap test (Function Code 7 in Table 7 on page 29). If the test runs successfully but the problem persists, refer to your library’s service documentation.
Codes display on the single-character display, but the status light does not turn on.	The tape drive is defective. Replace the tape drive (see “Removing the SCSI Tape Drive” on page 71 or “Removing the Fibre Channel Tape Drive” on page 72).

Table 10. Troubleshooting Tips for the Ultrium Internal Tape Drive (continued)

If the problem is this....	Do this....
The tape drive does not respond to server commands.	Press and hold the unload button on the drive for 10 seconds to force a drive dump. The drive will save the dump and then reboot to allow communication to the drive to occur. Do not cycle power, as this will erase the contents of the dump.
The status light flashes green.	Typically, no action is required because a flashing green LED means normal operation. However, the tape drive may have contained a cartridge when it was powered-on. If so, the drive completes POST and slowly rewinds the tape (the process may take approximately 13 minutes). The light stops blinking when the drive completes the recovery and is ready for a read or write operation. To eject the cartridge, press the unload button.

Methods of Receiving Errors and Messages

Use Table 11 as a guide for identifying error codes and message codes reported by the Ultrium Tape Drive, its enclosure (if applicable), or the server.

Note: The codes on the single-character display have different meanings, depending on whether they display during normal operations or while the drive is in maintenance mode. Codes that occur during normal operations are defined in Table 12. Codes that occur while in maintenance mode are defined in Table 7 on page 29.

Table 11. Methods of Receiving Errors and Messages for the Ultrium Internal Tape Drive

If the error or message was presented by....	Do this....
The enclosure's display (if the tape drive is enclosed in a library or autoloader)	Refer to the documentation for the enclosure.
The tape drive's single-character display and the status light flashes yellow	See Table 12. To determine the meaning of status light activity, see "Status Light" on page 24.
The tape drive's single-character display and the status light is solid yellow	See Table 7 on page 29. To determine the meaning of status light activity, see "Status Light" on page 24.
SCSI log sense data (such as TapeAlert flags), SCSI drive sense data, or Fibre Channel autosense data at the server console	See "Appendix B. TapeAlert Flags" on page 83, Table 12, or "Using Sense Data" on page 59.
Drive sense data sent to a library (if the tape drive is enclosed in a library)	Refer to your library's documentation, then see Table 12.
The tape drive's error log	See Table 12 and "Viewing the Drive Error Log" on page 64.

Descriptions and Corrective Actions for Errors and Messages

Table 12 gives descriptions of the errors and messages that pertain to the Ultrium Tape Drive, and tells what to do when you receive them.

Attention: If the tape drive detects a permanent error and displays an error code other than 0, it automatically performs a drive dump. If you force a drive dump, the existing dump will be overwritten and data will be lost. After you force a drive dump, do not turn off the power to the tape drive or you may lose the dump data.

Table 12. Codes for Error Conditions and Informational Messages for the Ultrium Internal Tape Drive. The single-character display clears if you power-off the drive.

Code	Cause and Action
0	<p>No error occurred and no action is required. This code displays:</p> <ul style="list-style-type: none"> • When power is cycled (turned off, then on) to the tape drive. • When diagnostics have finished running and no error occurred. <p>Note: The single-character display is blank during normal operation of the tape drive.</p>

Table 12. Codes for Error Conditions and Informational Messages for the Ultrium Internal Tape Drive (continued). The single-character display clears if you power-off the drive.

Code	Cause and Action
1	<p>Cooling problem. The tape drive detected that the recommended operating temperature was exceeded. Perform the following action:</p> <ol style="list-style-type: none"> 1. If a fan is present in the enclosure, ensure that it is rotating and is quiet. If not, replace the fan (for instructions about replacing the fan, see your enclosure's documentation or reverse the steps in "Step 3. Install the Cooling Fan Assembly (Optional)" on page 11). 2. Remove any blockage that prevents air from flowing freely through the tape drive. 3. Ensure that the operating temperature and airflow is within the specified range (see "Chapter 2. Specifications" on page 7). 4. If the operating temperature is within the specified range and the problem persists, replace the tape drive. <p>The error code clears when you power-off the tape drive or place it in maintenance mode.</p>
2	<p>Power problem. The tape drive detected that the externally supplied power is either approaching the specified voltage limits (the drive is still operating) or is outside the specified voltage limits (the drive is not operating). Perform the following action:</p> <ol style="list-style-type: none"> 1. Ensure that the power connector is properly seated. 2. Ensure that the proper dc voltages are being applied within the tolerances allowed (see "Chapter 2. Specifications" on page 7). 3. If the proper voltages are being applied but the problem persists, replace the tape drive. <p>The error code clears when you power-off the tape drive or place it in maintenance mode.</p>
3	<p>Firmware problem. The tape drive determined that a firmware error occurred. Perform the following action:</p> <ol style="list-style-type: none"> 1. Collect a drive dump from one of the following: <ul style="list-style-type: none"> • Note: Do not force a new dump; the tape drive has already created one. • Server's SCSI or Fibre Channel interface by using a device driver utility or system tool (for instructions about reading a drive dump from tape, visit the Web at http://www.ibm.com/storage/storagesmart/1to) • Enclosure (refer to the procedures for reading a drive dump in your enclosure's documentation) • Ultrium Tape Drive (to read a drive dump, use Function Code 5 in Table 7 on page 29) 2. Power the tape drive off and on, then retry the operation that produced the error. 3. If the problem persists, download new firmware and retry the operation. 4. If the problem persists, send the drive dump that you collected in step 1 to your nearest Customer Assistance Center (see "Getting Help" on page 90). <p>The error code clears when you power-off the tape drive or place it in maintenance mode.</p>

Table 12. Codes for Error Conditions and Informational Messages for the Ultrium Internal Tape Drive (continued). The single-character display clears if you power-off the drive.

Code	Cause and Action
4	<p>Firmware or tape drive problem. The tape drive determined that a firmware or tape drive hardware failure occurred. Perform the following action:</p> <ol style="list-style-type: none"> 1. Collect a drive dump from one of the following: <ul style="list-style-type: none"> Note: Do not force a new dump; one already exists. • Server's SCSI or Fibre Channel interface by using a device driver utility or system tool (for instructions about reading a drive dump from tape, visit the Web at http://www.ibm.com/storage/storagesmart/1to) • Enclosure (refer to the procedures for reading a drive dump in your enclosure's documentation) • Ultrium Tape Drive (to read a drive dump, use Function Code 5 in Table 7 on page 29) 2. Power the tape drive off and on, then retry the operation that produced the error. The error code clears when you power-off the tape drive or place it in maintenance mode. 3. If the problem persists, download new firmware and retry the operation; if new firmware is not available, replace the tape drive.
5	<p>Tape drive hardware problem. The drive determined that a tape path or read/write error occurred. To prevent damage to the drive or tape, the drive will not allow you to insert a cartridge if the current cartridge was successfully ejected. If the problem persists, replace the tape drive. The error code may clear when you cycle power to the tape drive or place it in maintenance mode.</p>

Table 12. Codes for Error Conditions and Informational Messages for the Ultrium Internal Tape Drive (continued). The single-character display clears if you power-off the drive.

Code	Cause and Action
6	<p>Tape drive or media error. The drive determined that an error occurred, but it cannot isolate the error to faulty hardware or to the tape cartridge. Perform the following action:</p> <p>For Problems with Writing Data:</p> <p>If the problem occurred while the drive was writing data to the tape, and if you know the volume serial number (located on the cartridge label) of the tape cartridge loaded in the drive when the problem occurred, retry the operation with a different cartridge:</p> <ul style="list-style-type: none"> • If the operation succeeds, the original cartridge was defective. Copy data from the defective cartridge and discard it. • If the operation fails and another drive is available, insert the cartridge into the other drive and retry the operation. <ul style="list-style-type: none"> – If the operation fails, discard the defective cartridge. – If the operation succeeds, insert a scratch cartridge into the first drive and run the tape drive diagnostics (see Function Code 1 in Table 7 on page 29). <ul style="list-style-type: none"> - If the diagnostics fail, replace the drive. - If the diagnostics succeed, the error was temporary. • If the operation fails and another drive is not available, insert a scratch cartridge into the drive and run the tape drive diagnostics (see Function Code 1 in Table 7 on page 29). <ul style="list-style-type: none"> – If the diagnostics fail, replace the drive. – If the diagnostics succeed, discard the cartridge. <p>If the problem occurs with multiple tape cartridges or if you do not know the tape cartridge's volume serial number, run the tape drive diagnostics (see Function Code 1 in Table 7 on page 29):</p> <ul style="list-style-type: none"> • If the diagnostics fail, replace the tape drive. • If the diagnostics succeed, run the Test Head diagnostic (see Function Code H in Table 7 on page 29). <ul style="list-style-type: none"> – If the Test Head diagnostic fails, replace the tape drive. – If the Test Head diagnostic succeeds, replace the cartridges that caused the problem. <p>The error code clears when you remove the tape cartridge or place the drive in maintenance mode.</p> <p>For Problems with Reading Data:</p> <p>If the problem occurred while the drive was reading data from the tape, and if you know the volume serial number of the tape cartridge, perform one of the following procedures:</p> <ul style="list-style-type: none"> • If another drive is available, insert the cartridge into the other drive and retry the operation: <ul style="list-style-type: none"> – If the operation fails, discard the defective cartridge. – If the operation succeeds, insert a scratch cartridge into the first drive and run the tape drive diagnostics (see Function Code 1 in Table 7 on page 29): <ul style="list-style-type: none"> - If the diagnostics fail, replace the drive. - If the diagnostics succeed, the error was temporary. • If another drive is not available, insert a scratch cartridge into the drive and run the tape drive diagnostics (see Function Code 1 in Table 7 on page 29): <ul style="list-style-type: none"> – If the diagnostics fail, replace the drive. – If the diagnostics succeed, discard the cartridge. <p>If the problem occurs with multiple tape cartridges or if you do not know the tape cartridge's volume serial number, run the tape drive diagnostics (see Function Code 1 in Table 7 on page 29):</p> <ul style="list-style-type: none"> • If the diagnostics fail, replace the tape drive. • If the diagnostics succeed, run the Test Head diagnostic (see Function Code H in Table 7 on page 29). <ul style="list-style-type: none"> – If the Test Head diagnostic fails, replace the tape drive. – If the Test Head diagnostic succeeds, replace the cartridges that caused the problem. <p>The error code clears when you remove the tape cartridge or place the drive in maintenance mode.</p>

Table 12. Codes for Error Conditions and Informational Messages for the Ultrium Internal Tape Drive (continued). The single-character display clears if you power-off the drive.

Code	Cause and Action
7	<p>A high probability of media error. The tape drive determined that an error occurred because of a faulty tape cartridge. Try another tape cartridge. If the problem occurs with multiple tape cartridges, see “Resolving Media-Related Problems” on page 69.</p> <p>The error code clears when you remove the tape cartridge or place the drive in maintenance mode.</p>
8	<p>For SCSI drive:</p> <p>Tape drive or SCSI bus failure. The tape drive determined that a failure occurred in the tape drive’s hardware or in the SCSI bus. See “Fixing SCSI Bus Errors” on page 65. The error code clears 10 seconds after the drive detected the error or when you place the drive in maintenance mode.</p> <p>For Fibre Channel drive:</p> <p>Tape drive or Fibre Channel failure. The tape drive determined that a failure occurred in the tape drive’s hardware or in the Fibre Channel. It detects light through the fiber cable but cannot perform data communication properly. The length of the cable between the devices may exceed 500 m (1640 ft). See “Fixing Fibre Channel Errors” on page 67. The error code clears when the drive detects light and can communicate, or when you place the drive in maintenance mode.</p>
9	<p>Tape drive or RS-422 error. The tape drive determined that a failure occurred in the tape drive hardware or in the RS-422 connection. Run the RS-422 wrap test (see Function Code 7 in Table 7 on page 29):</p> <ul style="list-style-type: none"> • If the diagnostic fails, replace the tape drive. • If the diagnostic runs successfully, the problem is with the enclosure or the cable to the enclosure. Refer to your enclosure’s documentation. <p>The error code clears 10 seconds after the drive detected the error or when you place the drive in maintenance mode.</p>
o, c, b, or h	<p>No error or message assigned. There may be a problem with the single-character display. Turn the power off, then on and determine whether all segments on the single-character display are lit. If so, you may have a down-level version of both your enclosure’s firmware and documentation (the documentation may not describe all of the available error codes). Refer to the latest version of the firmware or documentation.</p>
A	<p>Tape drive hardware problem. The tape drive determined that a problem occurred which degraded the operation of the tape drive, but it did not restrict continued use. If the problem persists, replace the tape drive. The drive is usable, though the single-character display continues to indicate an error and the status light flashes amber.</p> <p>The error code may clear when you cycle power to the tape drive or place it in maintenance mode.</p>
B	<p>No error or message is assigned. See error code 8 in this table.</p>
C	<p>The tape drive needs to be cleaned. Clean the tape drive. See “Cleaning the Drive Head” on page 27.</p> <p>The error code clears when you clean the tape drive or place it in maintenance mode.</p>
d	<p>Fibre Channel AL_PA conflict. More than one device has the same address. Each device must have its own unique AL_PA address. See “Step 6. Set the Arbitrated Loop Physical Address (Fibre Channel Drive Only)” on page 15.</p>
D	<p>No error or message assigned. See error code 0 in this table.</p>

Table 12. Codes for Error Conditions and Informational Messages for the Ultrium Internal Tape Drive (continued). The single-character display clears if you power-off the drive.

Code	Cause and Action
E	<p>Informational message. The tape drive's Fibre Channel port has been placed offline by another device or by an operator. This code is set when the Offline command is received from another device on the Fibre Channel interface. Determine why the device at the other end of the Fibre Channel (the server, switch, or other device) placed the drive offline.</p> <p>The drive is placed online when it receives the Online command from the Fibre Channel interface.</p> <p>After a reset, the drive comes online.</p>
F	<p>The tape drive determined that no light is being received over the Fibre Channel. See "Fixing Fibre Channel Errors" on page 67.</p> <p>The error code clears when the drive detects light or when you place the drive in maintenance mode.</p>

Using Sense Data

When a tape drive encounters an error, it makes sense data available. You can use IBM device drivers to examine the sense data and determine errors. Instructions for downloading, installing, and properly configuring the IBM device drivers are available in the *IBM Ultrium Device Drivers Installation and User's Guide*. The IBM device drivers may conflict with some commercial software applications unless properly configured. To avoid conflicts on Windows® operating systems, refer to your device driver's procedures for setting the driver to manual startup mode. For applications that use Open Systems device drivers that are provided by IBM (for example, AIX, Linux, Sun Solaris, HP-UX, Windows/NT, and Windows 2000), the *IBM Ultrium Device Drivers Installation and User's Guide* contains information about how to obtain sense data after an error has occurred.

If your application uses other device drivers, see the appropriate documentation for those drivers to obtain the sense data.

Raw sense data (as returned from the Ultrium Tape Drive) is documented in the *IBM Ultrium Internal Tape Drive Models T200 and T200F and IBM 3580 Ultrium Tape Drive SCSI Reference*.

In addition to device drivers, other methods exist for obtaining sense data and error information. The sections that follow describe alternative ways for gathering such information from the IBM AS/400, @server iSeries, RS/6000, and @server pSeries servers.

Obtaining Error Information from the AS/400 or @server iSeries with RISC Processor

For OS/400, sense data is provided by the System Service Tools application. To obtain error information from the AS/400 or @server iSeries by using the tool:

1. On the command entry line of the AS/400 Main Menu, type **STRSST** (Start System Service Tools) and press Enter.
2. Select Start a service tool.
3. Select Product activity log.
4. Select Analyze log.
5. Specify the time period for searching the error log, then select the Magnetic media option.
6. On the Select Analysis Report Options menu, specify a device type of 3580 and press Enter. Leave all other options at their default values.
7. Use the Display Report option to display the desired error log entry. Figure 17 on page 60 shows a sample error log for the Ultrium Tape Drive.

```

                                Display Detail Report for Resource

Name          Type      Model      Serial      Resource
TAP07         3580     001       00-00000   TAP07

Log ID . . . . . : 00452B54   Sequence . . . . . : 4732468
Date . . . . . : 02/14/01   Time . . . . . : 09:50:21
Reference code . . . . . : 9210   Secondary code . . . . . : 00000000
Table ID . . . . . : 63A00001   IPL source/state . . . . . : B/3

Class . . . . . : Permanent
System Ref Code . . . . . : 63A09210
Illegal or unsupported tape unit response

Press Enter to continue.

F3=Exit          F4=Additional Information   F6=Hexadecimal report
F9=Address Information  F10=Previous detail report  F12=Cancel

```

Figure 17. Example of an Error Log from the AS/400 or IBM @server iSeries

8. Press F4 to view the sense data (see the example in Figure 18).

```

                                Display Additional Information for Resource

Name          Type      Model      Serial      Resource
TAP07         3580     001       00-00000   TAP07

SENSE DATA FOLLOWS. . . . . :
DATA OFFSET          0 1 2 3      4 5 6 7      8 9 A B      C D E F
00000000             70000500    0000001C    00000000    240000C0
00000010             00020000    00000000    00000000    00000000
00000020             058B0000

```

Figure 18. Example of Sense Data from the AS/400 or IBM @server iSeries

Obtaining Error Information from the RS/6000 or @server pSeries

The AIX[®] Tape and Media Changer Device Driver for the IBM RS/6000 or IBM @server pSeries provides logging to the system error log for a variety of errors. You can view the error log by issuing the AIX **errpt** command. Figure 19 on page 61 displays a sample drive error log; Figure 20 on page 62 displays a sample SCSI bus error log.

To view the error log:

1. At the AIX command line, type **errpt -a |pg** to display a detailed report.
2. Press Enter to scroll through the error log.
3. Type **q** to quit the error log at any time.

Example of a Drive Error Log:

In the SENSE DATA area of Figure 19, entries in bold are defined as follows:

Hexadecimal Code	Description
01	SCSI Command
0000, 0200, 0000	Command parameters
70	Byte 0 of SCSI sense data
03	Sense key
5200	ASC/ASCQ (Additional Sense Code/Additional Sense Code Qualifier)
20B0	FSC (Fault Symptom Code)
058A	Relative LPOS
02	SCSI ID

```

LABEL:          TAPE_ERR1
IDENTIFIER:     4865FA9B

Date/Time:     Wed Oct 11 11:39:43
Sequence Number: 25264
Machine ID:    000D090D4C00
Node ID:      tsm
Class:        H
Type:         PERM
Resource Name: rmt2
Resource Class: tape
Resource Type: LTO
Location:     40-60-00-2,0
VPD:
  Manufacturer.....IBM
  Machine Type and Model.....ULT3580-TD1
  Serial Number.....1300015078
  Device Specific.(FW).....0B70 (Firmware Level)
Description
TAPE OPERATION ERROR

Probable Causes
TAPE

User Causes
MEDIA DEFECTIVE
DIRTY READ/WRITE HEAD

Recommended Actions
FOR REMOVABLE MEDIA, CHANGE MEDIA AND RETRY
PERFORM PROBLEM DETERMINATION PROCEDURES

Detail Data
SENSE DATA
0602 0000 0100 0000 0200 0000 0000 0000 0000 0000 7000 0300 0000 001C 0000 0000
5200 0700 20B0 0000 0000 0000 0000 0000 0000 0000 058A 0200 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
  
```

Figure 19. Example of an AIX ERRPT Drive Error Log

Example of a SCSI Bus Error:

```
LABEL:          SCSI_ERR10
IDENTIFIER:     0BA49C99

Date/Time:      Wed Oct 18 09:55:32
Sequence Number: 16140
Machine Id:     00003ABF4C00
Node Id:        ofgtsm
Class:          H
Type:           TEMP
Resource Name:  scsi3
Resource Class: adapter
Resource Type:  sym896
Location:       40-59
VPD:
    Product Specific.( ).....DUAL CHANNEL PCI TO ULTRA2 SCSI
                          ADAPTER
    Part Number.....03N3606
    EC Level.....F71335
    Manufacture ID.....A16592
    Serial Number.....0749

Description
SCSI BUS ERROR

Probable Causes
CABLE
CABLE TERMINATOR
DEVICE
ADAPTER

Failure Causes
CABLE LOOSE OR DEFECTIVE
DEVICE
ADAPTER

Recommended Actions
PERFORM PROBLEM DETERMINATION PROCEDURES
CHECK CABLE AND ITS CONNECTIONS

Detail Data
SENSE DATA
0001 0017 0000 0000 0000 0091 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 4304 0000 0000 0000 0000 2000 0003 0203 6760 9808 0000 F7FB E1B8
0000 0015 000B 0210 0678 C800 0000 8200 8277 1B20 00A2 ED00 0000 0002 FFFF FFFF
00FF 0000 111F F000 F3DF F110
```

Figure 20. Example of an Error that Suggests a SCSI Bus Problem

Obtaining a Drive Dump

You can obtain a drive dump by selecting a function code on the Ultrium Internal Tape Drive or by using a device driver utility (or a system tool) on the server. The sections that follow describe each method.

Using the Drive to Obtain a Dump

To obtain a drive dump directly from the Ultrium Internal Tape Drive:

1. Make sure that no cartridge is in the drive.
2. Within a 1-second interval, press the unload button three times. The status light becomes solid amber, which means that the drive is in maintenance mode.
3. Press the unload button once per second until 5 appears in the single-character display.
4. To select the function, press and hold the unload button for 3 seconds. After you release the button, C flashes. Within 60 seconds, insert a scratch data cartridge that is not write-protected. After you insert the cartridge, 5 flashes and the drive writes the dump data to the scratch tape. When the function is complete, the drive rewinds and unloads the tape.
5. Insert the tape into a drive.
6. From the server, issue the SCSI READ command to read the dump from the tape to a file or electronic image (you may need to issue the command several times to read the complete dump).
7. To determine where to send the file for analysis, contact your nearest Customer Assistance Center (see “Getting Help” on page 90).

Using a Device Driver Utility to Obtain a Dump

To obtain a drive dump by using a device driver utility, determine whether your server is installed with a utility that can read files from the server’s memory. Open the tool and select the options to force the dump, read it, and write it to a file for analysis.

There are many device driver utilities and system tools that read data from a tape cartridge. For AIX-attached drives, the `dd` command or *tapeutil* (the IBM device driver utility) can be used. For Windows NT and Windows 2000, *ntutil* (another IBM device driver) can be used, but NT Backup cannot be used.

Note: After starting *ntutil* and opening the tape drive, select option 47: restore data.

For more information about capturing and reading drive dumps, visit the web at <http://www.storage.ibm.com/techsup/tapetech/tapedumps.htm>.

For information about using IBM and non-IBM device driver utilities with Windows NT, Windows 2000, AIX, Sun Solaris, and HP-UX, see the *IBM Ultrium Device Drivers Installation and User’s Guide*. To learn about other facilities that read data from a tape, refer to your operating system’s documentation.

To determine where to send a file that contains a drive dump to be analyzed, contact your nearest Customer Assistance Center (see “Getting Help” on page 90).

Viewing the Drive Error Log

The Ultrium Tape Drive keeps an error log that you can use to identify and correct errors. The log contains the 10 most recent error codes, which appear (one at a time) on the single-character display.

To view the drive error log:

1. Make sure that no cartridge is in the drive.
2. Within a 1-second interval press the unload button three times. The status light becomes solid amber, which means that the drive is in maintenance mode.
3. Press the unload button once per second until **9** appears in the single-character display.
4. Press and hold the unload button for 3 seconds to view the most recent error code.
5. Refer to Table 12 on page 53 to determine the meaning of the code and the action to take.
6. Press the unload button to view the next error code. (The codes are ordered; the most recent is presented first and the oldest (tenth) is presented last.)
7. Continue to press the unload button until the 10 error codes have been displayed. After you display the tenth error code, the drive automatically exits maintenance mode.

To redisplay the error codes, repeat steps 1 through 7.

Resolving Problems Reported by the Server

The procedure for fixing SCSI bus or Fibre Channel errors varies, depending on whether the error is consistent or intermittent, and whether your configuration contains single or multiple Ultrium Tape Drives. The sections that follow describe how to fix each type of error.

Fixing SCSI Bus Errors

Note: If you are using a Storage Area Network (SAN) Data Gateway to convert a drive with a SCSI interface to a Fibre Channel interface, ensure that the problem is occurring between the SAN Data Gateway and the drive by running the SCSI wrap test on the drive and running the SCSI loopback test on the SAN Data Gateway. (To run the SCSI wrap test, see Function Code 6 in Table 7 on page 29; to run the SCSI loopback test, refer to the section about that test in the *IBM Storage Area Network Gateway Module Setup, Operator, and Service Guide*.)

Fixing a Consistent Error with a Single Drive on a SCSI Bus

1. Ensure that the power is on to the Ultrium Tape Drive.
2. Ensure that the tape drive's SCSI address is the same as the SCSI address assigned by the server.
3. Run the SCSI wrap test (see Function Code 6 in Table 7 on page 29).
 - If the test runs successfully, replace the SCSI terminator first, then the SCSI cable and the interposer (if installed). Repeat the operation that caused the error. If you replaced the SCSI terminator or SCSI cable and the problem persists, the fault is with the server's hardware or software. To isolate the cause of the failure, refer to the server's service documentation.
 - If the test fails, replace the tape drive (see "Removing the SCSI Tape Drive" on page 71).

Fixing a Consistent Error with Multiple Drives on a SCSI Bus

When a consistent error occurs in a configuration that has multiple tape drives on the SCSI bus, you must determine if the problem exists with more than one tape drive. If the problem is with all of the devices on the SCSI bus, the bus is stuck in a SCSI phase and cannot change to another phase or the SCSI cable from the server to the first device is defective.

1. Ensure that the SCSI cable from the server to the first device is connected.
2. Disconnect all but the first tape drive on the SCSI bus. Move the terminator to the first SCSI device.
3. Run a device driver utility (such as IBM's *ntutil* or *tapeutil*) to determine whether the error will occur.
 - If the error occurs, run the SCSI wrap test on the first tape drive (see Function Code 6 in Table 7 on page 29).
 - If the test runs successfully, replace the SCSI terminator first, then the SCSI cable and the interposer (if installed) to the first tape drive. Repeat the operation that caused the error. If you replaced the SCSI terminator or SCSI cable and the problem persists, the fault is with the server's hardware or software. To isolate the cause of the failure, refer to the server's service documentation.
 - If the test fails, replace the tape drive (see "Removing the SCSI Tape Drive" on page 71).

- If the error does not occur, connect one tape drive at a time back to the bus and repeat step 3 for each tape drive until you can identify which drive is defective.

Note: Ensure that the SCSI terminator is always on the last tape drive on the SCSI bus.

4. Determine if the problem is with only one tape drive or with two or more tape drives.
 - If the problem is with only one tape drive, run the SCSI wrap test on that tape drive (see Function Code 6 in Table 7 on page 29).
 - If the test runs successfully, replace the SCSI terminator first, then the SCSI cable to that tape drive and interposer (if installed).
 - If the test fails, replace the tape drive (see “Removing the SCSI Tape Drive” on page 71).
 - If the problem is with two or more tape drives, locate the first tape drive that has the error and replace the SCSI cable that connects the tape drive and the interposer (if installed).

Fixing an Intermittent Error with a Single Drive on a SCSI Bus

1. Replace the SCSI terminator on the tape drive.
2. Run the operation that caused the error. If the problem persists, the problem may be with the cable.
3. Isolate which cable is causing the problem by replacing one cable at a time and running the operation that caused the error after each replacement. If the problem persists after all cables have been replaced, the problem may be with the Ultrium Tape Drive.
4. Replace the tape drive (see “Removing the SCSI Tape Drive” on page 71). If the problem persists, the problem is with your server. Consult your server’s documentation.

Fixing an Intermittent Error with Multiples Drives on a SCSI Bus

Refer to the server’s error logs to determine which tape drive is the source of the problem:

- If only one tape drive is reporting a SCSI failure, replace that tape drive (see “Removing the SCSI Tape Drive” on page 71).
- If multiple tape drives are reporting SCSI failures, the problem may be with the terminator or the SCSI cables:
 - Replace the terminator and run the operation that caused the error. If the problem persists, the problem may be with the cables.
 - Isolate which cable is causing the problem by replacing one cable at a time and run the operation that caused the error after each replacement.

Fixing Fibre Channel Errors

Starting Problem Determination

Before starting the problem determination, perform the following steps:

1. Determine the type of Fibre Channel topology that you are using (see “Supported Topologies” on page 4).
2. Using this guide or the service guides of associated switch, hub, or fiber products, try to determine where the problem exists (whether in the drive, cable, or the device to which the drive and cable attach).
3. Ensure that the configuration and software levels are supported (see “Fibre Channel Attachment” on page 3).
4. If you are connected to a Fibre Channel Storage Area Network (SAN) by using a SAN Data Gateway, use the *IBM Storage Area Network Gateway Module Setup, Operator, and Service Guide* to determine whether the problem is occurring between the drive and the SAN Data Gateway. If you are using a SCSI drive and are having SCSI problems, see “Fixing SCSI Bus Errors” on page 65.
5. Ensure that the Fibre Channel cables are installed correctly. Refer to the appropriate steps in “Chapter 3. Installing the Tape Drive” on page 9.
6. Go to one of the following procedures:
 - “Fixing a Consistent Error with a Single Drive on a Fibre Channel Loop”
 - “Fixing a Consistent Error with Multiple Drives on a Fibre Channel Loop” on page 68
 - “Fixing Intermittent Fibre Channel Errors” on page 68

Fixing a Consistent Error with a Single Drive on a Fibre Channel Loop

1. Ensure that the tape drive is powered on.
2. Verify that the tape drive’s serial number is the same as the drive serial number that the server program is using.
3. Ensure that the drive’s Fibre Channel AL_PA is set correctly, that it is on the loop, and that it is not being used by another device (see “Step 6. Set the Arbitrated Loop Physical Address (Fibre Channel Drive Only)” on page 15). The tape drive must be able to detect light and communicate with the server.
4. Run the Fibre Channel wrap test at the drive’s Fibre Channel connector (see Function Code 6 in Table 7 on page 29).
 - If the test fails, replace the tape drive.
 - If the test is successful, go to step 5.
5. Run the Fibre Channel wrap test at the end of the fiber cable (see Function Code 6 in Table 7 on page 29).
 - If the test fails, replace the fiber cable.
 - If the test is successful, go to step 6.
6. Check the Fibre Channel cable connection at the server.
7. Using a device driver utility such as *ntutil* or *tapeutil*, verify that the drive is properly configured and available at the server.
8. If the problem persists, the fault may be with the server’s hardware or software. Refer to your server’s service manual.
9. When the problem is corrected (or determined to be a server problem), restore all of the fiber cables to their correct position.

Fixing a Consistent Error with Multiple Drives on a Fibre Channel Loop

Use the following procedure to determine if all of the drives on the Fibre Channel have the problem:

1. Use a device driver utility (such as *ntutil* or *tapeutil*) to verify that the drive is available and properly configured at the server.
2. Determine the type of Fibre Channel topology that you are using (see “Supported Topologies” on page 4).
3. Using this guide or the service guides of associated switch, hub, or fiber products, try to isolate which part of the Fibre Channel Storage Area Network (SAN) is experiencing problems.
4. Perform one of the following:
 - If the problem exists on a small number of drives, go to “Fixing a Consistent Error with a Single Drive on a Fibre Channel Loop” on page 67.
 - If the problem exists with a large number of drives, perform the following steps:
 - a. Disconnect all except one failing drive on the Fibre Channel.
 - b. Run the Fibre Channel wrap test to determine if a failure occurs on that drive (see Function Code 6 in Table 7 on page 29). If it does, perform the procedure in “Fixing a Consistent Error with a Single Drive on a Fibre Channel Loop” on page 67.
 - c. Continue to connect one drive at a time to the Fibre Channel loop.
5. When the problem is corrected, restore all of the Fibre Channel cables to their correct position.

Fixing Intermittent Fibre Channel Errors

1. Determine the type of Fibre Channel topology that you are using (see “Supported Topologies” on page 4).
2. Ensure that the configuration and software levels are supported (see “Fibre Channel Attachment” on page 3).
3. Check that each Fibre Channel cable does not exceed 500 m (1640 ft).
4. Ensure that all Fibre Channel cables are installed correctly. Refer to the appropriate steps in “Chapter 3. Installing the Tape Drive” on page 9.
5. Using this guide or the service guides of associated switch, hub, or fiber products, determine that a problem exists between the drive, drive cable, and the device to which they attach. Try to isolate which part of the Storage Area Network (SAN) is experiencing problems.
6. Using this guide or the service guides of associated switch, hub, or fiber products, verify that the SAN configurations are correct (such as switch zoning for drive sharing).
7. Obtain all errors reported by the drive to the server (see “Using Sense Data” on page 59), then contact your nearest Customer Assistance Center for error analysis (see “Getting Help” on page 90).

Resolving Media-Related Problems

To resolve problems that are related to media, the Ultrium Tape Drive's firmware includes:

- Test Cartridge & Media diagnostic that verifies whether a suspect cartridge and its magnetic tape are acceptable for use.
- Statistical Analysis and Reporting System (SARS) to assist in isolating failures between media and hardware. To determine the cause of failure, SARS uses the cartridge performance history that is saved in the cartridge memory (CM) and the drive performance history that is kept in the drive's flash erasable programmable read-only memory (EPROM). Any failures that SARS detects are reported as TapeAlert flags on the server (see "Appendix B. TapeAlert Flags" on page 83).

Attention: If you insert the IBM LTO Ultrium Data Cartridge into another manufacturer's tape drive, the SARS data in the cartridge memory may become lost or invalid.

If you encounter a media-related problem, use the following procedure:

Attention: When you run the Test Cartridge & Media diagnostic, data on the suspect tape is overwritten. Use only a scratch data cartridge to run the test.

1. If possible, run the tape cartridge in a different tape drive. If the operation in the other tape drive fails and 6 or 7 displays, replace the media. If the operation succeeds, run the Test Cartridge & Media diagnostic (see Function Code E in Table 7 on page 29).
2. If the Test Cartridge & Media diagnostic fails, replace the media. If it runs successfully, clean the tape drive and run the tape drive diagnostics (see "Cleaning the Drive Head" on page 27 and Function Code 1 in Table 7 on page 29).
3. If the tape drive diagnostics fail, replace the tape drive. If the tape drive diagnostics run successfully, perform the operation that produced the initial media error.

Chapter 7. Servicing the Ultrium Internal Tape Drive

If problem-determination procedures identify the Ultrium Internal Tape Drive as the source of a problem, replace the entire unit. Do not attempt to open the drive for repairs. Opening the drive and attempting a repair other than manually removing a tape cartridge will void your warranty.

After you take the tape drive offline by using the server's software, you may remove power. You are not required to turn off the enclosure's power before you remove the power connection to the drive.

Removing the SCSI Tape Drive

To remove the Ultrium Internal Tape Drive Model T200 from an enclosure, perform the following steps:

1. Ensure that the tape drive does not contain a tape cartridge.
2. Deconfigure the drive from the server (for instructions, see your server's documentation).
3. Turn off the power to the enclosure.
4. Disconnect the internal power cable from the power connector (see **3** in Figure 21).
5. Disconnect the internal RS-422 cable from the J2 connector **4**.
6. Disconnect the internal SCSI bus cable from the SCSI connector **1**.
7. Disconnect the SCSI address cable from the SCSI ID connector **2**.
8. Remove the mounting screws from the side brackets of the chassis (see **2** in Figure 7 on page 20).
9. Remove the tape drive from the enclosure.

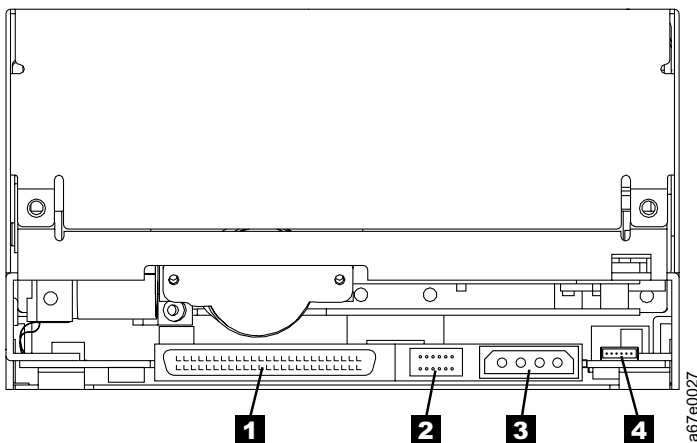


Figure 21. Rear View of the Ultrium Internal Tape Drive Model T200 (SCSI Drive)

Removing the Fibre Channel Tape Drive

To remove the Ultrium Internal Tape Drive Model T200F from an enclosure, perform the following steps:

1. Ensure that the tape drive does not contain a tape cartridge.
2. Deconfigure the drive from the server (for instructions, see your server's documentation).
3. Turn off the power to the enclosure.
4. Disconnect the internal power cable from the power connector (see **1** in Figure 22).
5. Disconnect the internal RS-422 cable from the J2 connector **4**.
6. Disconnect the internal fiber cable from the Fibre Channel connector **3**.
7. Disconnect the fiber address cable from the LID/status connector **2**.
8. Remove the mounting screws from the side brackets of the chassis (see **2** in Figure 7 on page 20).
9. Remove the tape drive from the enclosure.

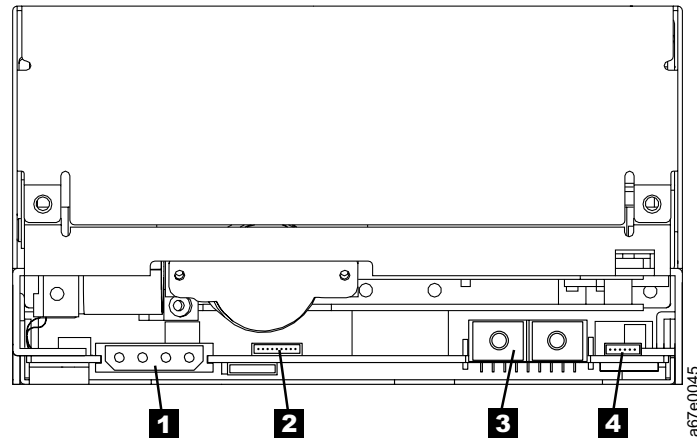


Figure 22. Rear View of the Ultrium Internal Tape Drive Model T200F (Fibre Channel Drive)

Manually Removing a Tape Cartridge

If a tape cartridge fails to eject from the Ultrium Internal Tape Drive, you can manually remove the cartridge. The following tools are required for the procedure:

- 2.5-mm allen wrench
- #3 Phillips screwdriver
- Small-blade screwdriver or potentiometer-setting tool
- Flashlight (optional)



Attention: Before performing this procedure, note the following:

- This procedure may damage the tape cartridge. If you use this procedure, you must replace the stuck tape cartridge after removing it and copying its data to another cartridge. If you choose to return the drive and the stuck tape cartridge to your reseller for maintenance, the tape cartridge will be scrapped.
- The use of a power screwdriver to perform this procedure can destroy the tape.
- Never touch the head or electronic components within the drive. Touching may cause contamination or damage by electrostatic discharge.

To manually remove a tape cartridge, perform the following steps:

1. Place the drive so that the front faces you, then tilt it on its left side (see Figure 23).
2. Locate the access hole at the bottom of the unit (see **1** in Figure 23).
3. Insert a 2.5-mm allen wrench into the access hole and position the wrench so that it is seated in the screw of the supply reel motor (the screw is not visible).
4. Push open the door of the tape load compartment and locate the flag **2** on the cartridge's takeup reel.

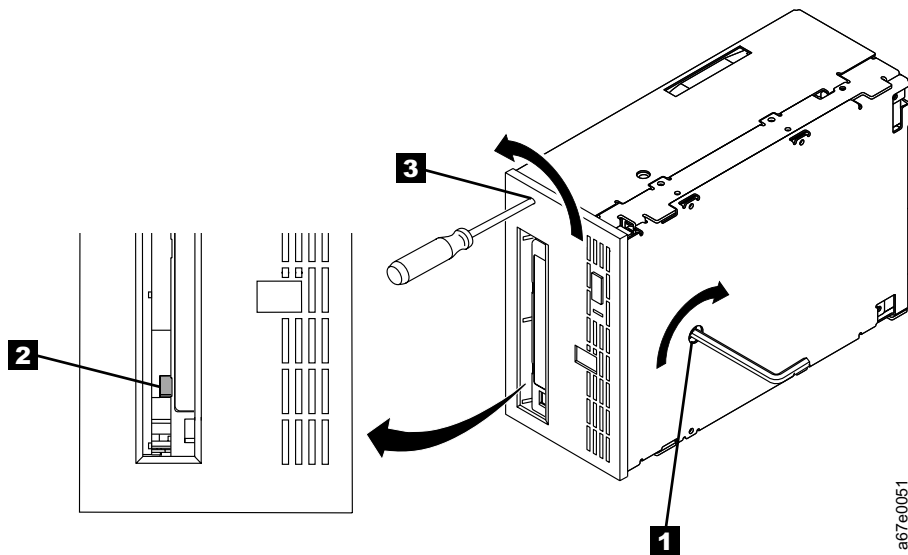


Figure 23. Determining Whether the Tape is Broken

Attention: In the following step, rotate the allen wrench clockwise, not counterclockwise. A counterclockwise motion may damage the tape.

5. To determine whether the tape is broken, watch the flag **2** on the cartridge's takeup reel while you rotate the allen wrench **1** clockwise (do not let the wrench move counterclockwise):
 - If the takeup reel turns when you rotate the supply reel motor screw clockwise with the allen wrench, the tape is not broken. Go to step 6 on page 75.
 - If the takeup reel does not turn when you rotate the supply reel motor screw clockwise with the allen wrench and if supply reel motor screw rotates freely, the tape is broken. Insert a small-blade screwdriver or potentiometer-setting tool into the access hole for the loader motor gear **3**. Rotate the screwdriver counterclockwise. You may have to rotate for a lengthy period:
 - If the cartridge moves up, the tape is completely in the cartridge. Continue rotating the screwdriver until the cartridge ejects. Remove the cartridge.
 - If you feel resistance and the cartridge does not move up, the tape is broken or the leader block is not in the home position. Go to “Fixing an Internal Jam” on page 76.

6. Continue to rotate the allen wrench until you feel resistance. The tape has been rewound as far as it can go without unthreading.

Note: The number of required rotations depends on where the beginning of the tape is on the cartridge's takeup reel. You may have to rotate the allen wrench for a lengthy period.

7. With the allen wrench still inserted into the bottom access hole, insert a small-blade screwdriver or potentiometer-setting tool into the access hole for the loader motor gear **3**.
8. While keeping torque on the supply reel motor screw and rotating the allen wrench **1** clockwise, rotate the loader motor gear with the small-blade screwdriver **3** counterclockwise (see arrow). As you rotate the screwdriver, the allen wrench moves slightly.
9. With the small-blade screwdriver, continue to rotate the loader motor gear in the unload direction (counterclockwise):
 - If you feel no resistance to the allen wrench and the cartridge slowly moves up and out of the tape load compartment, the procedure was successful. Go to step 10.
 - If you feel resistance to the allen wrench and the cartridge does not move, the loader mechanism is jammed. Go to "Fixing an Internal Jam" on page 76.
10. Remove the tape cartridge.

After you remove the stuck tape cartridge, copy the data on the tape to another tape. Then, if appropriate, return the stuck tape cartridge in its original packaging or in the packaging from its replacement to your reseller. If the leader pin detached from the tape in the cartridge, go to "Reattaching a Leader Pin" on page 44.

Fixing an Internal Jam

To fix a jammed loader mechanism and rewind the tape in a tape cartridge, perform the following procedure.



Attention: If you use a power screwdriver to perform this procedure it could destroy the tape.

1. If the drive is mounted in an enclosure, perform the procedure to remove it (see “Removing the SCSI Tape Drive” on page 71 or “Removing the Fibre Channel Tape Drive” on page 72).
2. Place the drive on a nonslip surface.
3. Remove the cover of the drive by performing the following steps:
 - a. Remove the three screws and washers (see **1** in Figure 24) that secure the bezel **2**. Remove the bezel.
 - b. Remove the four cover-mounting screws and washers **3**.
 - c. Remove the cover by lifting it up. Set the cover aside.



Attention: Never touch the head or electronic components within the tape drive. Touching may cause contamination or damage by electrostatic discharge.

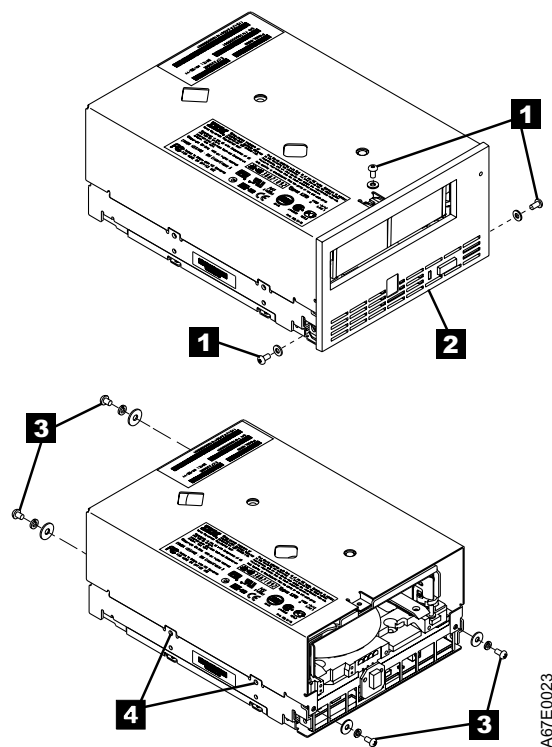


Figure 24. Removing the Top Cover of the Drive

4. Place the tape drive so that the front faces you, then tilt it on its left side (see Figure 25).
5. At the bottom of the drive, locate the access hole (**1** in Figure 25).

Attention: In the next step, do not let the leader-pin block touch the head. Damage may result to the head.

6. Insert a 2.5-mm allen wrench into the access hole and position the wrench so that it is seated in the screw of the supply reel motor (the screw is not visible).
7. With clean needle-nose pliers, grasp the end of the leader pin and pull it out of the cartridge so that you can grip it with your fingers (see **2** in Figure 25).
8. While keeping the tape taut with your fingers, rotate the allen wrench clockwise **1** to wind the excess tape into the cartridge. Guide the leader pin toward the cartridge and drop it inside the cartridge door. Ensure that no tape is left outside of the cartridge. Remove the allen wrench.

Note: Do not attempt to seat the leader pin into the cartridge's clips; this will interfere with the motion of the leader-pin block.

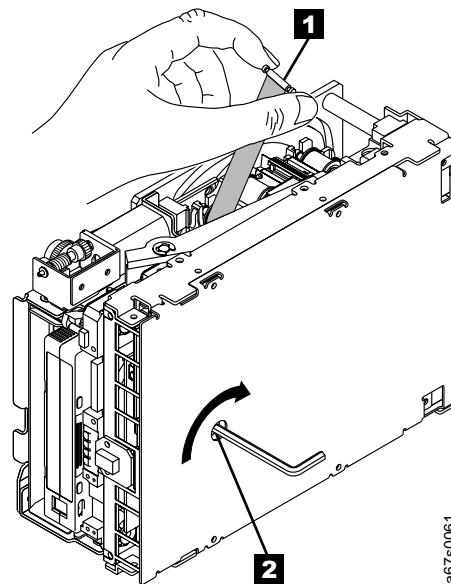


Figure 25. Rewinding the Leader Pin into the Tape Cartridge

9. Manually rotate the loader motor gear (see **1** in Figure 26) in the unload direction (counterclockwise) until the leader-pin block **2** reaches the last roller **3**.

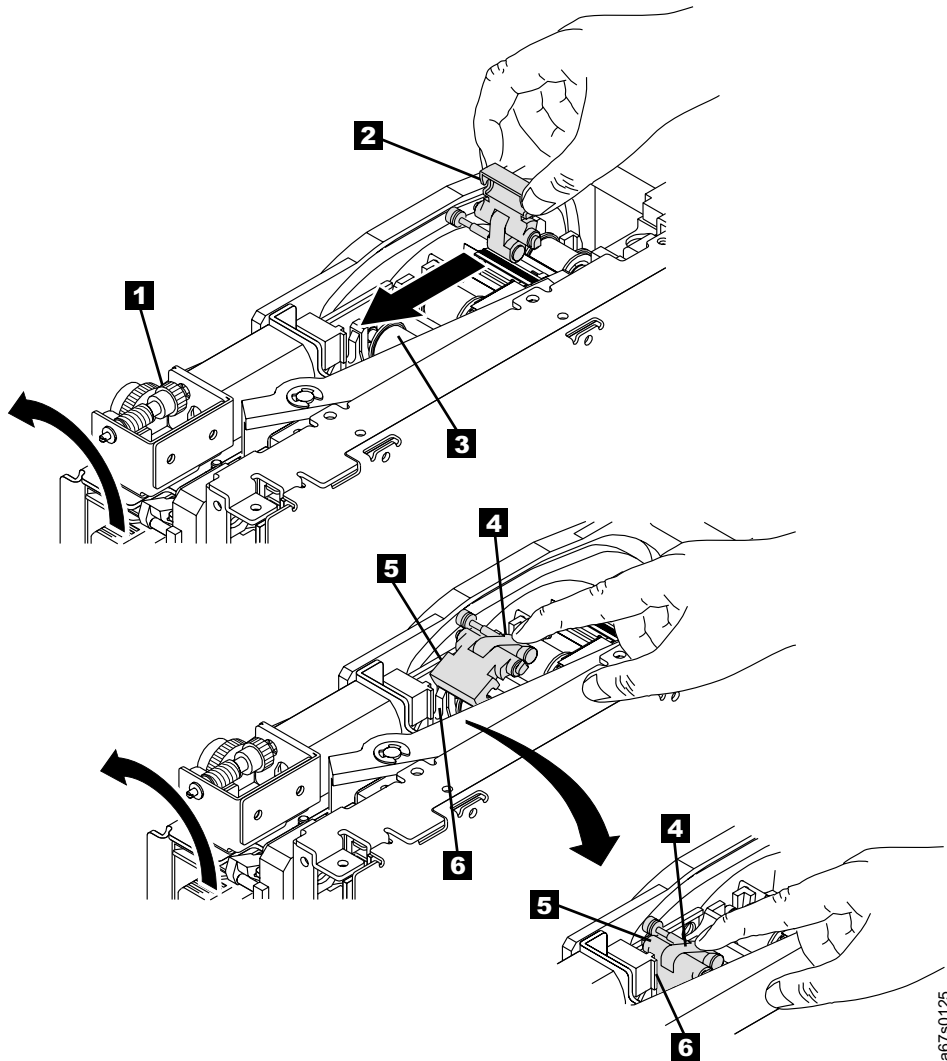


Figure 26. Guiding the Leader Pin into the Tape Cartridge

10. To prevent the leader-pin block from jamming, press down on the linkage of the leader-pin block **4** to force the hinged section of the block upward.
11. While manually rotating the loader motor gear in the unload direction, guide the end of the leader-pin block **5** into the white block guide (home position) **6**. The leader-pin block will pivot so that it clears the cartridge shell.
12. Continue to rotate the loader motor gear counterclockwise until you feel resistance and the cartridge rises and ejects. The leader-pin block must be in home position **6** to allow the cartridge to rise and eject.

- 13. Remove the tape cartridge. If the leader pin is not seated correctly in the cartridge, see “Reattaching a Leader Pin” on page 44.
- 14. Copy the data on the stuck tape cartridge to another cartridge. If appropriate, return the stuck tape cartridge for analysis in its original packaging or in the packaging from its replacement.

If you need help with this procedure, contact your nearest Customer Assistance Center (see “Getting Help” on page 90).

To reassemble the tape drive, reverse the preceding steps.

Appendix A. Tools and Supplies

Table 13 lists the tools and supplies that you can use with the Ultrium Internal Tape Drive. To order tools and supplies, visit the web at <http://www.ibm.com/storage/storagesmart/lto>, or contact your preferred reseller or distributor.

Note: The SCSI, Fibre Channel, and RS-422 wrap plugs are not provided with the tape drive.

Table 13. Tools and Supplies for the Ultrium Internal Tape Drive

IBM Part Number	Product Description
08L9129	Leader pin reattachment kit
--	2.5-mm allen wrench (procure locally)
08L9120	IBM LTO Ultrium Data Cartridge
08L9124	IBM LTO Ultrium Cleaning Cartridge
19P0481	Single port LVD wrap plug
08L9459	Single port Fibre Channel wrap plug (formerly part number 34L2629)
19P0519	RS-422 wrap plug
19P0242	Fibre Channel duplex adapter
35L1782	SCSI Y-cable
19P0051	0.5-m (1.6-ft) SCSI cable
19P0052	5.0-m (16-ft) SCSI cable
19P0053	10-m (32-ft) SCSI cable
05H4651	25-m (82-ft) SCSI cable
19P0855	Power Y-cable
03K9201	5-m (16-ft) fiber cable
54G3386	13-m (43-ft) fiber cable
03K9203	25-m (82-ft) fiber cable
54G3390	61-m (200-ft) fiber cable
54G3391	Custom-length fiber cable

Appendix B. TapeAlert Flags

TapeAlert is a patented technology and standard of the American National Standards Institute (ANSI) that defines conditions and problems that are experienced by tape drives. The technology enables a server to read TapeAlert flags from a tape drive through the SCSI, Fibre Channel, or RS-422 interface. The server reads the flags from Log Sense Page 0x2E. This appendix lists the TapeAlert flags that are supported by the Ultrium Internal Tape Drive.

TapeAlert Flags Supported by the Drive

TapeAlert Flags Supported by the Ultrium Internal Tape Drive			
Flag Number	Flag	Description	Action Required
3	Hard error	Set for any unrecoverable read, write, or positioning error. (This flag is set in conjunction with flags 4, 5, or 6.)	See the Action Required column for Flag 4, 5, or 6 in this table.
4	Media	Set for any unrecoverable read, write, or positioning error that is due to a faulty tape cartridge.	Replace the tape cartridge.
5	Read failure	Set for any unrecoverable read error where isolation is uncertain and failure could be due to a faulty tape cartridge or to faulty drive hardware.	If Flag 4 is also set, the cartridge is defective. Replace the tape cartridge. If Flag 4 is not set, see error code 6 in Table 12 on page 53.
6	Write failure	Set for any unrecoverable write or positioning error where isolation is uncertain and failure could be due to a faulty tape cartridge or to faulty drive hardware.	If Flag 9 is also set, make sure that the write-protect switch is set so that data can be written to the tape (see "Setting the Write-Protect Switch" on page 43). If Flag 4 is also set, the cartridge is defective. Replace the tape cartridge. If Flag 4 is not set, see error code 6 in Table 12 on page 53.
8	Not data grade	Set when severe servo errors occur while loading a tape cartridge.	Replace the tape cartridge. If this error occurs with multiple tapes, see error code 6 in Table 12 on page 53.
9	Write protect	Set when the tape drive detects that the tape cartridge is write-protected.	Make sure that the cartridge's write-protect switch is set so that the tape drive can write data to the tape (see "Setting the Write-Protect Switch" on page 43).
10	No removal	Set when the tape drive receives an UNLOAD command after the server prevented the tape cartridge from being removed.	Refer to the documentation for your server's operating system.
11	Cleaning media	Set when you load a cleaning cartridge into the drive.	No action required.
12	Unsupported format	Set when you load an unsupported cartridge type into the drive or when the cartridge format has been corrupted.	Use a supported tape cartridge.

TapeAlert Flags Supported by the Ultrium Internal Tape Drive

Flag Number	Flag	Description	Action Required
15	Cartridge memory chip failure	Set when a cartridge memory (CM) failure is detected on the loaded tape cartridge.	Replace the cartridge. If this error occurs on multiple tapes, see error code 6 in Table 12 on page 53.
16	Forced eject	Set when you manually unload the tape cartridge while the drive was reading or writing.	No action required.
18	Tape directory corrupted in the cartridge memory	Set when the drive detects that the tape directory in the cartridge memory has been corrupted.	Re-read all data from the tape to rebuild the tape directory.
20	Clean now	Set when the tape drive detects that it needs cleaning.	Clean the tape drive. See "Cleaning the Drive Head" on page 27.
21	Clean periodic	Set when the drive detects that it needs routine cleaning.	Clean the tape drive as soon as possible. The drive can continue to operate, but you should clean the drive soon. See "Cleaning the Drive Head" on page 27.
22	Expired clean	Set when the tape drive detects a cleaning cartridge that has expired.	Replace the cleaning cartridge.
23	Invalid cleaning tape	Set when the drive expects a cleaning cartridge and the loaded cartridge is not a cleaning cartridge.	Use a valid cleaning cartridge.
30	Hardware A	Set when a hardware failure occurs which requires that you reset the tape drive to recover.	If resetting the drive does not recover the error, use the error code from the single-character display, library user interface, or SCSI drive sense data. See Table 12 on page 53.
31	Hardware B	Set when the tape drive fails its internal self tests.	Use the error code on the single-character display, library user interface, or SCSI drive sense data. See Table 12 on page 53.
32	Interface	Set when the tape drive detects a problem with the SCSI, Fibre Channel, or RS-422 interface.	Locate error code 8 or 9 in Table 12 on page 53.
33	Eject media	Set when a failure occurs that requires you to unload the cartridge from the drive.	Unload and reload the tape cartridge.
34	Download fail	Set when an FMR image is unsuccessfully downloaded to the tape drive via the SCSI or Fibre Channel interface.	Ensure that it is the correct image. Download the FMR image again.
36	Drive temperature	Set when the drive's temperature sensor indicates that the drive's temperature is exceeding the recommended temperature of the enclosure (see Table 2 on page 7).	See error code 1 in Table 12 on page 53.

TapeAlert Flags Supported by the Ultrium Internal Tape Drive			
Flag Number	Flag	Description	Action Required
37	Drive voltage	Set when the drive detects that the externally supplied voltages are either approaching the specified voltage limits or are outside the voltage limits (see Table 2 on page 7).	See error code 2 in Table 12 on page 53.
39	Diagnostics required	Set when the drive detects a failure that requires diagnostics to isolate the problem.	See error code 6 in Table 12 on page 53.

Notices

Trademarks

The following are trademarks of International Business Machines Corporation in the United States, or other countries, or both.

AIX	iSeries	SP
AS/400	OS/400	StorageSmart
@server	pSeries	Ultrium
IBM	RS/6000	

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Linear Tape-Open
LTO
Ultrium

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Solaris and Sun are registered trademarks of Sun Microsystems Incorporated in the United States, or other countries, or both.

Other company, product, or service names may be the trademarks or service marks of others.

Electronic Emission Notices

Special Considerations for Electromagnetic Compatibility

Models T200 and T200F of the IBM Ultrium Internal Tape Drive have been found to satisfy electromagnetic compatibility (EMC) requirements when they are installed in a suitably designed enclosure. Due to the high-performance and high-frequency operation of these drives, your enclosure must have sufficient EMC shielding and filtering for the intended product class (A or B). It is the manufacturer's responsibility to ensure compliance to the required EMC standards by using appropriate testing and certification.

IBM Ultrium Internal Tape Drive Models T200 and T200F

The following statement applies to this product. The statement for other products that are intended for use with this product will appear in their accompanying manuals.

Federal Communications Commission (FCC) Class B Statement

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult an IBM authorized dealer or service representative for help.

IBM is not responsible for any radio or television interference caused by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Industry Canada Class B Emission Compliance Statement

This Class B digital apparatus complies with Canadian ICES-003.

Avis de conformité à la réglementation d'Industrie Canada

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

European Union (EU) Electromagnetic Compatibility Directive

This product has been tested and found to comply with the limits for Class B Information Technology Equipment according to European Standard EN 55022. The limits for Class B equipment were derived for typical residential environments to provide reasonable protection against interference with licensed communication devices.

Germany Electromagnetic Compatibility Directive

Zulassungsbescheinigung laut dem Deutschen Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG) vom 30. August 1995 (bzw. der EMC EG Richtlinie 89/336).

Dieses Gerät ist berechtigt, in Übereinstimmung mit dem Deutschen EMVG das EG-Konformitätszeichen - CE - zu führen.

Verantwortlich für die Konformitätserklärung nach Paragraph 5 des EMVG ist die IBM Deutschland Informationssysteme GmbH, 70548 Stuttgart.

Informationen in Hinsicht EMVG Paragraph 3 Abs. (2) 2: Das Gerät erfüllt die Schutzanforderungen nach EN 50082-1 und EN 55022 Klasse B.

EN 50082-1 Hinweis: "Wird dieses Gerät in einer industriellen Umgebung betrieben (wie in EN 50082-2 festgelegt), dann kann es dabei eventuell gestört werden. In solch einem Fall ist der Abstand bzw. die Abschirmung zu der industriellen Störquelle zu vergrößern."

Anmerkung: Um die Einhaltung des EMVG sicherzustellen, sind die Geräte wie in den IBM Handbüchern angegeben zu installieren und zu betreiben.

Japan VCCI Class B ITE Electronic Emission Statement

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取扱説明書に従って正しい取り扱いをして下さい。

vcci-b

Getting Help

If you need assistance while installing or operating your Ultrium Internal Tape Drive, refer to Table 14 and contact your nearest Customer Assistance Center. (Table to be filled in by the OEM.)

Table 14. Telephone Numbers and e-mail Addresses for Customer Assistance Centers

World Wide Web Site: http://www.		
Geographic Location	Customer Assistance Center	
	Telephone	e-mail
Americas		
North America		
South America		
Hawaii		
Guam		
Europe, Middle East, Africa		
United Kingdom		
Austria		
Belgium		
France		
Italy		
Republic of Ireland		
Netherlands		
Germany		
Sweden		
Norway		
Denmark		
Finland		
Asia Pacific		
Japan		
Australia		
New Zealand		
Other Asia Pacific locations		

Warranty

The warranty for this product is negotiated on a per-customer basis.

Related Publications

Refer to the following publications for additional information about the Ultrium Tape Drive. To ensure that you have the latest publications, visit the web at <http://www.ibm.com/storage/storagesmart/1to>.

IBM Ultrium Publications

- *IBM Ultrium Internal Tape Drive Models T200 and T200F and IBM 3580 Ultrium Tape Drive SCSI Reference*, WB1109, provides the supported SCSI commands and protocol that govern the behavior of the SCSI interface for the Ultrium Internal Tape Drive Models T200 and T200F, and for the 3580 Ultrium Tape Drive.
- *IBM Ultrium Device Drivers Installation and User's Guide*, GA32-0430, provides instructions for attaching IBM-supported hardware to Open Systems operating systems. It indicates what devices and levels of operating systems are supported, gives the requirements for adapter cards, and tells how to configure servers to use the device driver with the Ultrium family of devices.
- *IBM Ultrium Device Drivers Programming Reference*, WB1304, supplies information to application owners who want to integrate their Open Systems applications with IBM-supported Ultrium hardware. The reference contains information about the application programming interfaces (APIs) for each of the various supported operating-system environments.

IBM Fibre Channel Publications

- *Fibre Channel Storage Hub IBM 2103 Model H07 Installation, Service, and User's Guide*, SC26-7288
- *IBM SAN Fibre Channel Switch 2109 Model S08 User's Guide*, SC26-7349
- *IBM SAN Fibre Channel Switch 2109 Model S08 Installation and Service Guide*, SC26-7350
- *IBM SAN Fibre Channel Switch 2109 Model S16 User's Guide*, SC26-7351
- *IBM SAN Fibre Channel Switch 2109 Model S16 Installation and Service Guide*, SC26-7352

Other Publications

- *IBM Storage Area Network Gateway Module Setup, Operator, and Service Guide*, GA32-0436, describes the interface between devices and a storage area network or Fibre Channel server. The guide gives instructions for installation and operation of the unit, as well maintenance analysis procedures and a SCSI command reference.

Web Sites

IBM Storage Media support:

- http://www.storage.ibm.com/media/how_buy.html
Provides access to current regional and country-specific IBM telephone numbers.

IBM Storage Products:

- <http://www.storage.ibm.com/hardsoft/menu.htm>
Furnishes documentation for IBM hardware products in a PDF format for viewing and printing.

Device Driver support:

- <ftp://ftp.software.ibm.com/storage/devdrv/>
Provides device driver software that you can download.

Glossary

This glossary defines the special terms, abbreviations, and acronyms that are used in this publication.

Numbers

2:1 compression. The relationship between the quantity of data that can be stored with compression as compared to the quantity of data that can be stored without compression. In 2:1 compression, twice as much data can be stored with compression as can be stored without compression.

A

A. See *ampere*.

active. The condition that the SCSI bus is in when a server is trying to use one or more devices on the bus.

adapter. See *adapter card*.

adapter card. A circuit board that adds function to a computer.

AL_PA. See *Arbitrated Loop Physical Address*.

amp. See *ampere*.

ampere (A, amp). A unit of measure for electric current that is equivalent to a flow of one coulomb per second, or equivalent to the current produced by one volt applied across a resistance of one ohm.

Arbitrated Loop Physical Address (AL_PA). An 8-bit value that identifies a device in an arbitrated loop. All Fibre Channel ports communicate by using AL_PAs.

autosense data. Sent by the drive to the server, sense data that automatically accompanies a Check Condition in response to an error. The server does not need to send a REQUEST SENSE command to get the sense data. Autosense data is available only in the Fibre Channel version of the Ultrium Tape Drive (Model T200F).

B

backups. The short-term retention of records used for restoring essential business and server files when vital data has been lost because of program or server errors or malfunctions.

backreflection. Pertaining to instances where light is launched into an optical fiber in a forward direction, the light that is returned to the launch point in the reverse direction.

bar code. A code that represents characters by sets of parallel bars of varying thickness and separation. The bars are read optically by transverse scanning.

bar code label. A slip of paper bearing a bar code and having an adhesive backing. The bar code label must be affixed to a tape cartridge to enable the library to identify the cartridge and its volume serial number.

bezel. The removable frame that fits over the front of the Ultrium Tape Drive.

burst data transfer rate. The maximum speed at which data is transferred.

bus. See *SCSI bus*.

byte. A string that consists of a certain number of bits (usually 8) which are treated as a unit and represent a character. A byte is a fundamental unit of data.

C

C. See *Celsius*.

capacity. The amount of data that can be contained on storage media and expressed in bytes.

cartridge. See *tape cartridge*.

cartridge door. On a tape cartridge, the hinged barrier that can be opened to access, or closed to protect, the magnetic tape within the cartridge.

cartridge manual rewind tool. A device that can be fitted into the reel of a cartridge and used to rewind tape into or out of the cartridge.

cartridge memory. See *LTO cartridge memory*.

Celsius. Having a thermometric scale on which the interval between the freezing point and the boiling point of water is divided into 100 degrees, with 0° representing the freezing point and 100° representing the boiling point.

circuit board. A thin sheet on which chips and other electronic components are placed. Computers consist of one or more boards, often called cards or adapters.

cleaning cartridge. A tape cartridge that is used to clean the heads of a tape drive. Contrast with *data cartridge*.

clockwise. In the direction that the hands of a clock rotate, as viewed from the front.

command time-out. Following the issuance of a command, a period of time during which it is determined that there is a bad connection between the server and the drive.

compression. The process of eliminating gaps, empty fields, redundancies, and unnecessary data to shorten the length of records or blocks.

configure. To describe to a server the devices, optional features, and programs installed on the system.

contiguous. Touching along a boundary or at a point.

core. The light-conducting central portion of an optical fiber. The core is composed of material that has a higher index of refraction than the cladding (the material that surrounds the core).

counterclockwise. In a direction opposite to that in which the hands of a clock rotate, as viewed from the front.

current. The quantity of charge per unit of time. Current is measured in amperes.

cycle power. To apply and remove electrical power to a device within a short time span.

D

data. Any representations such as characters or analog quantities to which meaning is, or might be, assigned.

data cartridge. A tape cartridge that is dedicated to storing data. Contrast with *cleaning cartridge*.

data compression. See *compression*.

data transfer rate. The average number of bits, characters, or blocks per unit of time that pass between corresponding equipment in a data transmission system. The rate is expressed in bits, characters, or blocks per second, minute, or hour.

dc. Direct current.

degauss. To make a magnetic tape nonmagnetic by exposing the tape to electrical coils which carry currents that neutralize the magnetism of the tape.

device. Any hardware component or peripheral, such as a tape drive or tape library, that can receive and send data.

device driver. A file that contains the firmware that is needed to use an attached device.

diagnostic. A software program that is designed to recognize, locate, and explain faults in equipment or errors in programs.

diagnostic cartridge. A tape cartridge that enables the detection and isolation of errors in programs and faults in equipment.

direct current (dc). An electric current flowing in one direction only and substantially constant in value.

drive. See *Ultrium Internal Tape Drive*.

drive dump. The recording, at a particular instant, of the contents of all or part of one storage device into another storage device, usually as a safeguard against faults or errors, or in connection with debugging.

drive head. The component that records an electrical signal onto magnetic tape, or reads a signal from tape into an electrical signal.

drive sense data. See *SCSI drive sense data*.

dump. See *drive dump*.

duplex. See *duplex transmission*.

duplex adapter. A mechanism that allows a device to send and receive communication at the same time.

duplex transmission. Transmission in both directions, either one direction at a time (half-duplex) or both directions simultaneously (full-duplex).

E

eject. To remove or force out from within.

electronic mail. Correspondence in the form of messages transmitted between user terminals over a computer network.

e-mail. See *electronic mail*.

enclosure. A device, such as a desktop unit, tape cartridge autoloader, or tape library, into which you can install the Ultrium Tape Drive.

error log. Maintained by the Ultrium Tape Drive, a list that contains the ten most recent error codes. The codes identify errors that pertain to the drive.

F

fan shroud. The wire mesh enclosure around the fan that holds it in place and prevents direct access. The shroud mounts the fan assembly to the Ultrium Tape Drive.

feature switch. Located under the Ultrium Tape Drive, a bank of eight micro switches that can be manually toggled on or off to activate or deactivate different characteristics of the drive.

fiber optic cable. The medium by which light is transmitted through fibers or thin rods of glass or some other transparent material of high refractive index.

fiber optics. A branch of optics dealing with the transmission of light through fibers or thin rods of glass or some other transparent material of high refractive index.

Fibre Channel. A 100-MB-per-second, full-duplex, serial communications technology that is capable of interconnecting Ultrium Tape Drives and servers which are separated by as much as 11 kilometers (7 miles). Fibre Channel technology combines features of the input/output (I/O) and networking interfaces.

Fibre Channel address. For a tape drive that uses a Fibre Channel interface, an identifier (such as an AL_PA or Loop ID) that enables other device ports to communicate with that drive. A Fibre Channel drive has a 3-byte address. The switch assigns the upper 2 bytes of the address. If no switch is attached, the 2 bytes equal 0. The lower byte assignment (which is the AL_PA) varies, depending on whether hard or soft addressing is used.

Fibre Channel cable. The cable that connects a Fibre Channel tape drive to another device. The conductive element within the cable is constructed of either copper wires or optical fibers. Generally, copper wires are used for short distances (up to 30 meters or 98 feet); optical fibers are used for longer distances. Fiber-optic cabling is referred to by mode or the frequencies of light waves that are carried by a particular cable type. Multimode fiber cables are generally used for distances up to 500 meters (1640 feet) and with short-wave (780 nanometer) laser light. Single-mode fiber cables are used for distances greater than 500 m (1640 feet) and with long-wave (1300 nanometer) laser light.

Fibre Channel wrap test. A diagnostic that causes the Ultrium Tape Drive to perform a check of the Fibre Channel circuitry from and to the drive's Fibre Channel connector or the fiber cable.

field microcode replacement tape. A tape cartridge that contains new or revised firmware (microcode) for the Ultrium Tape Drive.

file. A named set of records that are stored or processed as a unit.

filemark. Located on the magnetic tape within a tape cartridge, a recorded element that typically marks the organizational boundaries in a serial file structure (such as directory boundaries) and that is requested to be written or read by the server.

firmware. Proprietary code that is usually delivered as part of an operating system. Firmware is more efficient than software that is loaded from an alterable medium, and is more adaptable to change than pure hardware circuitry. An example of firmware is the Basic

Input/Output System (BIOS) in read-only memory (ROM) on a PC motherboard.

FMR tape. See *field microcode replacement tape*.

foot. A unit of length comprising 12 inches.

G

GB. See *gigabyte*.

gigabyte (GB). 1 000 000 000 bytes.

ground. An object that makes an electrical connection with the earth.

H

hard addressing. Pertaining to the Fibre Channel drive (Model T200F), a method that identifies the drive's LID and, consequently, its AL_PA (the AL_PA enables the drive to communicate with other devices).

hardware. The physical equipment or devices that form a computer.

head. See *drive head*.

Head Resistance Measurements test. Part of the Test Head diagnostic, a procedure that determines whether the tape drive's head works correctly. The test measures the head's ability to withstand cracks and other defects.

host. The controlling or highest-level system in a data communication configuration. Synonymous with *server*.

hot-pluggable. Pertaining to the Ultrium Tape Drive, the ability to remove the drive from an enclosure while the enclosure is powered-on.

hub. A communications device to which nodes on a multi-point bus or loop are physically connected. Hubs are commonly used in Fibre Channel networks to improve the manageability of physical cables. They maintain the logical loop topology of the network of which they are a part, while creating a "hub and spoke" physical star layout. Unlike switches, hubs do not aggregate bandwidth. They typically support the addition or removal of nodes from the bus while it is operating.

I

IBM Ultrium Internal Tape Drive. See *Ultrium Internal Tape Drive*.

ID. Identifier.

in. See *inch*.

inch. A unit of length equal to 1/36 yard or 25.4 mm.

initiator. In SCSI terms, a SCSI device that requests an I/O process to be performed by another SCSI device (a target). In many cases, an initiator can also be a target.

input/output (I/O). Data that is provided to a computer or data that results from computer processing.

insertion guide. On the surface of the IBM LTO Ultrium Tape Cartridge, a large, notched area that prevents you from inserting the cartridge incorrectly.

install. (1) To set up for use or service. (2) The act of adding a product, feature, or function to a server or device either by a singular change or by the addition of multiple components or devices.

Internet. The worldwide collection of interconnected networks that use the Internet suite of protocols and permit public access.

interposer. An adapter-like device that allows a connector of one size and style to connect to a mating connector of a different size and style. Data provided to the computer or data resulting from computer processing.

I/O. See *input/output*.

J

J1 connector. Located at the rear of the Ultrium Tape Drive, a single connector that contains the connections for the SCSI signals and grounds, SCSI ID, SCSI bus termination, and drive power.

J2 connector. Located at the rear of the Ultrium Tape Drive, the connector for the RS-422 interface.

jumper. (1) A tiny connector that fits over a pair of protruding pins in a connector. A jumper can be moved to change electrical connectors. When in place, the jumper connects the pins electrically. (2) To place a jumper on a connector pin.

L

label. A slip of paper with an adhesive backing that can be written on and affixed to a tape cartridge as a means of identification or description.

label area. On the LTO Ultrium Tape Cartridge, a recessed area next to the write-protect switch where a bar code label must be affixed.

LAN. See *local area network*.

leader-pin block. Located within the Ultrium Tape Drive, the part that engages the steel pin which is attached to the tape in an LTO Ultrium Tape Cartridge. Once engaged, the leader-pin block pulls the tape from the cartridge into the drive.

leader pin. On the LTO Ultrium Tape Cartridge, a small metal column that is attached to the end of the magnetic tape. During tape processing the leader pin is grasped by a threading mechanism, which pulls the pin and the tape out of the cartridge, across the drive head, and onto a takeup reel. The head can then read or write data from or to the tape.

LED. See *light-emitting diode*.

LID. See *loop identifier*.

LID/status connector. See *loop identifier (LID)/status connector*.

LIP. See *loop initialization protocol*.

light-emitting diode (LED). A semiconductor diode that emits light when subjected to an applied voltage and that is used in an electronic display.

Linear Tape-Open (LTO). A type of tape storage technology developed by the IBM Corporation, Hewlett-Packard, and Seagate. LTO technology is an "open format" technology, which means that its users have multiple sources of product and media. The "open" nature of LTO technology enables compatibility between different vendors' offerings by ensuring that vendors comply with verification standards.

load. Following the insertion of a tape cartridge into the tape load compartment, the act of positioning the tape (performed by the tape drive) for reading or writing by the drive's head.

load and unload cycle. The act of inserting a cartridge into a tape drive, loading the tape to load point, rewinding the tape into the cartridge, and ejecting the cartridge from the drive.

local area network (LAN). A computer network that is located on a user's premises within a limited geographical area. The network consists of a set of devices that are connected to one another for communication and that can be connected to a larger network. Communications are limited to a moderate-sized geographic area (1 to 10 km) such as a single office building, warehouse, or campus.

log sense data. See *SCSI log sense data*.

loop. (1) A series of instructions that is repeated until a terminating condition is reached. (2) To connect so as to complete a loop.

loop ID. See *loop identifier*.

loop identifier (LID). In a Fibre Channel topology, the identifier that a device assigns to an Ultrium Tape Drive. An operator uses the LID to set the AL_PA.

loop identifier (LID)/status connector. Located on the Model T200F, the connector that is used to set the Loop ID and provide status about the loop.

loop initialization protocol (LIP). A method by which a device in a Fibre Channel Arbitrated Loop acquires its AL_PA.

loss. In fiber optics technology, the amount of a signal's power (expressed in dB) that is lost in connectors, splices, or fiber defects.

Low Voltage Differential (LVD). A low-noise, low-power, and low-amplitude electrical signaling system that enables data communication between a supported server and the Ultrium Tape Drive. LVD signaling uses two wires to drive one signal over copper wire. The use of wire pairs reduces electrical noise and crosstalk.

LTO. See *Linear Tape-Open*.

LTO cartridge memory (LTO-CM). Within each LTO Ultrium Data Cartridge, an embedded electronics and interface module that can store and retrieve a cartridge's historical usage and other information.

LTO-CM. See *LTO cartridge memory*.

LVD. See *Low Voltage Differential*.

M

m. See *meter*.

magnetic tape. A tape with a magnetizable surface layer on which data can be stored by magnetic recording.

maintenance mode. The state of operation in which the Ultrium Tape Drive must be before it can run diagnostics, verify write and read operations, verify a suspect tape cartridge, update its own firmware, and perform other diagnostic and maintenance functions.

MB. See *megabyte*.

media. The plural of *medium*.

media capacity. See *capacity*.

medium. A physical material in or on which data may be represented, such as magnetic tape.

megabyte (MB). 1 000 000 bytes.

metal particle tape. In the LTO Ultrium Tape Cartridge, tape that uses very small, pure metal particles (rather than oxide coatings) in the magnetic layer.

meter. In the Metric System, the basic unit of length; equal to approximately 39.37 inches.

micrometer. One millionth of a meter (.000001 m). Synonymous with *micron*. Abbreviated as μm .

micron. One millionth of a meter (.000001 m). Synonymous with *micrometer*. Abbreviated as μm .

millimeter. One thousandth of a meter (.001 m).

mm. See *millimeter*.

Model T200. The version of the Ultrium Internal Tape Drive that uses the SCSI interface.

Model T200F. The version of the Ultrium Internal Tape Drive that uses the Fibre Channel interface.

multimode fiber. An optical fiber that has a core that is large enough to propagate more than one electromagnetic wave of light. The typical diameter is 62.5 micrometers.

N

N/A. Not applicable.

native storage capacity. The amount of data that can be stored without compression on a tape cartridge.

native sustained data transfer rate. See *data transfer rate*.

network. A configuration of data processing devices and software that is connected for information interchange.

network server. In a local area network, a personal computer that provides access to files for all of the workstations in the network.

node. In Fibre Channel technology, a communicating device.

ntutil. Created by IBM, a utility program for LTO devices that connect to Windows NT and Windows 2000. *ntutil* provides problem determination for hardware or connections, assists with device and medium changer recognition, forces dumps, loads new firmware, sends and receives SCSI commands to and from the hardware, and obtains SCSI sense data to use in resolving errors.

O

oersted. The unit of magnetic field strength in the unrationalized centimeter-gram-second (cgs) electromagnetic system. The oersted is the magnetic field strength in the interior of an elongated, uniformly wound solenoid that is excited with a linear current density in its winding of one abampere per 4π centimeters of axial length.

offline. The operating condition that the Ultrium Tape Drive is in when the server's applications cannot interact with it.

online. The operating condition that the Ultrium Tape Drive is in when the server's applications can interact with it.

Open Systems. Computer systems whose standards are not proprietary.

operating environment. The temperature, relative humidity rate, and wet bulb temperature of the room in which the Ultrium Tape Drive routinely conducts processing.

operating system. The master computer control program that translates the user's commands and allows software application programs to interact with the computer's hardware.

optical transceiver. A device that both transmits and receives analog or digital signals over a light source.

P

parity. The state of being even-numbered or odd-numbered. A parity bit is a binary number that is added to a group of binary numbers to make the sum of that group always odd (odd parity) or even (even parity).

parity error. A transmission error that occurs when the received data does not have the parity that is expected by the receiving system. This usually occurs when the sending and receiving systems have different parity settings.

port. (1) A system or network access point for data entry or exit. (2) A connector on a device to which cables for other devices such as display stations and printers are attached. (3) The representation of a physical connection to hardware. A port is sometimes referred to as an adapter; however, there can be more than one port on an adapter.

power connector. Located at the rear of the Ultrium Tape Drive, the connector to which the internal power cable of an enclosure connects.

power cord. A cable that connects a device to a source of electrical power.

power-off. To remove electrical power from a device.

power-on, powered-on. (1) To apply electrical power to a device. (2) The state of a device when power has been applied to it.

protocol. The meanings of, and the sequencing rules for, requests and responses that are used to manage a network, transfer data, and synchronize the states of network components.

Q

quiesce. To put a device into a temporarily inactive or inhibited state, but not remove it from the server.

R

read. To acquire or interpret data from a storage device, from a data medium, or from another source.

reboot. To reinitialize the execution of a program by repeating the initial program load (IPL) operation.

record. The smallest distinct set of data bytes that is supplied from a server for processing and recording by a tape drive, and the smallest distinct set of data to be read from tape, reprocessed, and made available to a server by a tape drive.

record boundaries. The fixed limits of a record.

relative humidity. The ratio of the amount of water vapor actually present in the air to the greatest amount possible at the same temperature.

repeater. A device that regenerates signals to extend the range of transmission between data stations or to interconnect two branches. A repeater is a node of a local area network.

reset. To return a device or circuit to a clear state.

RS-422 connector. Located at the rear of the Ultrium Tape Drive, the connector to which the internal RS-422 cable of an enclosure connects. The connection enables serial devices to communicate with the drive.

RS-422 interface. An electrical interface standard that is approved by the Electronic Industries Association (EIA) for connecting serial devices. The RS-422 standard, which supports higher data rates and greater immunity to electrical interference, is an alternative to the older RS-232 interface, and uses individual differential signal pairs for data transmission. Depending on data transmission rates, RS-422 can be used at distances up to 1,275 m (4,000 ft). The RS-422 interface also supports multi-point connections.

RS-422 wrap plug. A connector mechanism that connects to an RS-422 port for the purpose of testing the Ultrium Tape Drive's circuitry for the RS-422 interface.

RS-422 wrap test. A diagnostic that can be run on the Ultrium Tape Drive to determine whether the circuitry functions properly to and from the RS-422 connector.

S

SAN. See *Storage Area Network*.

SAN Data Gateway. A device that provides Fibre Channel attachment between Open Systems servers and SCSI disk and tape storage systems.

SC. See *subscription channel connector*.

scratch cartridge. A data cartridge that contains no useful data, but can be written to with new data.

SCSI. See *Small Computer Systems Interface*.

SCSI bus. (1) A collection of wires through which data is transmitted from one part of a computer to another. (2) A generic term that refers to the complete set of signals that define the activity of the Small Computer Systems Interface (SCSI).

SCSI connector. Located at the rear of the Ultrium Tape Drive, the connector that facilitates commands to and from the server, and to which the internal SCSI cable of an enclosure connects.

SCSI device. Anything that can connect into the SCSI bus and actively participate in bus activity.

SCSI drive sense data. In response to inquiry from the server about an error condition, a packet of SCSI sense bytes that contains information about the error and that is sent back to the server by the drive.

SCSI ID. The unique address (from 1 to 15) that you assign to an Ultrium Tape Drive that uses a SCSI interface (Model T200).

SCSI ID connector. Located at the rear of the Ultrium Tape Drive, the connector that enables the drive's SCSI address to be set. Addresses are determined by the placement of jumpers on the pins.

SCSI ID switch. Located on an enclosure that contains a Ultrium Tape Drive, a mechanism that connects to the drive and allows you to change the drive's SCSI ID without using jumpers.

SCSI log sense data. In response to inquiry from the server about the Ultrium Tape Drive's error logs and counters, a packet of SCSI sense bytes which contains that information and which is sent back to the server by the drive. Log sense data is used to diagnose problems, especially if the problems are intermittent.

SCSI wrap plug. A connector mechanism that connects to a SCSI port for the purpose of testing the Ultrium Tape Drive's circuitry for the SCSI interface.

SCSI wrap test. A diagnostic that can be run on the Ultrium Tape Drive to determine whether the circuitry functions properly to and from the SCSI connector.

selection time-out. Following the selection of an option (for example, a data transfer), the period of time during which it is determined that there is a bad connection between the server and the drive.

sense data. Data that describes an I/O error. Sense data is presented to a server in response to a Sense I/O command.

serial interface. An interface that sequentially or consecutively executes two or more operations in a single device, such as an arithmetic and logic operation.

server. A functional unit that provides services to one or more clients over a network. Examples include a file server, a print server, or a mail server. The IBM @server pSeries, IBM @server iSeries, HP, and Sun are servers. Synonymous with *host*.

ship group. The group of supplies, cords, or documentation that is shipped with the Ultrium Tape Drive.

shipping environment. The temperature, relative humidity rate, and wet bulb temperature of the environment to which the Ultrium Tape Drive is exposed when it is transferred from one location to another.

short-wave cable. In Fibre Channel technology, a laser cable that uses a wavelength of 780 nanometers and is only compatible with multimode fiber.

single-character display. Located at the front of the Ultrium Tape Drive, an LED that presents an alphabetical or numeric code which represents a diagnostic or maintenance function, error condition, or informational message.

Small Computer Systems Interface (SCSI). A standard used by computer manufacturers for attaching peripheral devices (such as tape drives, hard disks, CD-ROM players, printers, and scanners) to computers (servers). Pronounced "scuzzy." Variations of the SCSI interface provide for faster data transmission rates than standard serial and parallel ports (up to 160 megabytes per second). The variations include:

- Fast/Wide SCSI: Uses a 16-bit bus, and supports data rates of up to 20 MBps.
- SCSI-1: Uses an 8-bit bus, and supports data rates of 4 MBps.
- SCSI-2: Same as SCSI-1, but uses a 50-pin connector instead of a 25-pin connector, and supports multiple devices.
- Ultra SCSI: Uses an 8- or 16-bit bus, and supports data rates of 20 or 40 MBps.
- Ultra2 SCSI: Uses an 8- or 16-bit bus and supports data rates of 40 or 80 MBps.
- Ultra3 SCSI: Uses a 16-bit bus and supports data rates of 80 or 160 MBps.

soft addressing. Pertaining to the Fibre Channel drive (Model T200F), a method that enables the drive to dynamically arbitrate its AL_PA with other Fibre Channel devices on the loop. The AL_PA enables the drive to communicate with other devices.

software. Programs, procedures, rules, and any associated documentation pertaining to the operation of a computer system.

status light. Located at the front of the Ultrium Tape Drive, an LED that can be green or amber, and (when lit) solid or flashing. The condition of the light represents the state of the drive.

Storage Area Network (SAN). A high-speed subnetwork of shared storage devices. A SAN's architecture makes all storage devices available to all servers on a LAN or WAN. As more storage devices are added to a SAN, they too will be accessible from any server in the larger network. Because stored data does not reside directly on any of a network's servers, server power is used for business applications, and network capacity is released to the end user.

storage environment. The temperature, relative humidity rate, and wet bulb temperature of the environment in which the Ultrium Tape Drive is nonoperational and is being kept for future use.

subscription channel connector (SC). A push-pull type of optical connector that features high density, low loss, low backreflection, and low cost.

switch. A network infrastructure component to which multiple nodes attach. Unlike hubs, switches typically have the ability to switch node connections from one to another. A typical switch can facilitate several simultaneous bandwidth transmissions between different pairs of nodes.

T

TapeAlert. A patented technology and ANSI standard that defines conditions and problems that are experienced by tape drives.

TapeAlert flags. Status and error messages that are generated by the TapeAlert utility and display on the server's console.

tape cartridge. A removable storage case that houses belt-driven magnetic tape that is wound on a supply reel and a takeup reel.

tape drive. See *Ultrium Internal Tape Drive*.

tape path. Within a tape drive, the channel in which the media moves.

tapeutil. Created by IBM, a utility program for LTO devices that connect to all supported servers except Windows NT and Windows 2000. *tapeutil* provides service aids for tape subsystems, offers a menu-driven tool for exercising or testing IBM tape and medium changer devices, and includes a command-line interface that is convenient for use in shell scripts.

terminate. To prevent unwanted electrical signal reflections by applying a device (known as a terminator) that absorbs the energy from the transmission line.

terminator. (1) A part that is used to end a SCSI bus. (2) A single-port, 75- Ω device that is used to absorb energy from a transmission line. Terminators prevent energy from reflecting back into a cable plant by absorbing the radio frequency signals. A terminator is usually shielded, which prevents unwanted signals from entering or valid signals from leaving the cable system.

TERMPower. Electrical power that is provided by a device (such as the Ultrium Tape Drive) to a SCSI terminator so that the SCSI bus can function. To supply TERMPower, a jumper must be placed on pin 1 of the SCSI ID connector on the Ultrium Tape Drive.

Test Head diagnostic. A test that determines whether the heads of the Ultrium Tape Drive are operating properly and whether the drive can correctly read from and write to tape.

topology. In communications, the physical or logical arrangement of nodes in a network, especially the relationships among nodes and the links between them.

track. A linear or angled pattern of data that is written on a tape surface.

transfer rate. See *data transfer rate*.

two-node arbitrated loop. In Fibre Channel technology, the connection of two nodes that communicate directly (without the use of a switch) and use the same protocol.

two-node switched fabric loop. In Fibre Channel technology, the connection of two or more nodes that communicate by using a switch. The nodes may not use the same protocol.

U

Ultrium Tape Drive. See *Ultrium Internal Tape Drive*.

uniform resource locator (URL). The address of an item on the World Wide Web. It includes the protocol followed by the fully qualified domain name (sometimes called the host name) and the request. The web server typically maps the request portion of the URL to a path and file name. For example, if the URL is `http://www.networking.ibm.com/nsg/nsgmain.htm`, the protocol is `http`; the fully qualified domain name is `www.networking.ibm.com`; and the request is `/nsg/nsgmain.htm`.

unload. The act (performed by the drive) of unthreading tape from the drive's internal tape path and returning it (with the leader block) to the tape cartridge.

unload button. Located at the front of the Ultrium Tape Drive, a push button that, when depressed, rewinds the tape in a cartridge and ejects the cartridge from the drive. The unload button can also be used to place the tape drive in maintenance mode, scroll

through maintenance functions, exit maintenance mode, force a drive dump, and reset the drive.

Ultrium Internal Tape Drive. A data-storage device that controls the movement of the magnetic tape in an IBM LTO Ultrium Tape Cartridge. The drive houses the mechanism (drive head) that reads and writes data to the tape. The drive is the first of four drives planned for the Ultrium format. Its native data capacity is 100 GB per cartridge; with 2:1 compression, its capacity is up to 200 GB.

URL. See *uniform resource locator*.

utility. See *utility program*.

utility program. A computer program that supports computer processes. For example, a diagnostic program, a trace program, or a sort program.

V

Vdc. Volts dc (direct current).

vital product data (VPD). Information about a product. Among other details, the VPD may include a model number, serial number, part number, or level of firmware.

volt. The SI (international) unit of potential difference and electromotive force. Formally defined as the difference of electric potential between two points of a conductor that carries a constant current of one ampere when the power dissipated between these points is equal to one watt.

VPD. Vital product data.

W

W. Watts.

WAN. See *wide area network*.

watt. The metric unit of power that is required to do work at the rate of one joule per second.

web. See *World Wide Web*.

wet bulb temperature. The temperature at which pure water must be evaporated adiabatically at constant pressure into a given sample of air in order to saturate the air under steady-state conditions. Wet bulb temperature is read from a wet bulb thermometer.

wide area network (WAN). A data communications network that is designed to serve an area of hundreds or thousands of miles (for example, national telephone networks).

World Wide Name. A unique, 8-byte identifier that is assigned by IBM Manufacturing to each Ultrium Tape Drive and used to identify a drive.

World Wide Web. A network of servers that contain programs and files. Many of the files contain hypertext links to other documents that are available through the network.

write. To make a permanent or transient recording of data in a storage device or on a data medium.

write protected. Applicable to a tape cartridge, the condition that exists when some logical or physical mechanism prevents a device from writing on the tape in that cartridge.

write-protect switch. Located on the LTO Ultrium Tape Cartridge, a switch that prevents accidental erasure of data. Pictures of a locked and unlocked padlock appear on the switch. When you slide the switch to the locked padlock, data cannot be written to the tape. When you slide the switch to the unlocked padlock, data can be written to the tape.

Write/Read test. Part of the Test Head diagnostic, a procedure that determines whether the Ultrium Tape Drive can correctly read from and write to tape.

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Printed in the United States of America
on recycled paper containing 10%
recovered post-consumer fiber.

GA32-0435-02

