

# HP StorageWorks Ultrium SCSI Tape Drives User Guide

Installation, Operating and Troubleshooting  
information for Ultrium half-height SCSI tape drives

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HP StorageWorks Ultrium SCSI Tape Drives User Guide

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## About this guide

This guide provides information about:

- Installing the HP StorageWorks Ultrium SCSI half-height tape drive
- Using the HP StorageWorks Ultrium SCSI half-height tape drive
- Troubleshooting the HP StorageWorks Ultrium SCSI half-height tape drive

## Related documentation

In addition to this guide, please refer to other documents for this product:

- 'Start here' poster for an overview of the installation information in this guide (available in English, French, German and Japanese)
- Regulatory booklet
- Safety booklet

These and other HP documents can be found on the HP web site: <http://www.docs.hp.com>.

## Registering your tape drive

Once you have installed and tested your HP StorageWorks Ultrium tape drive, please take a few minutes to register your product. You can register via the web ([www.register.hp.com](http://www.register.hp.com)).

To ensure your registration is complete, there are a number of questions on the electronic form that are mandatory. Other questions are optional. However, the more you feel able to complete, the better HP can meet your needs.

## HP technical support

Telephone numbers for worldwide technical support are listed on the HP support web site: <http://www.hp.com/support/>.

Collect the following information before calling:

- Technical support registration number (if applicable)
- Product serial numbers
- Product model names and numbers
- Applicable error messages
- Operating system type and revision level
- Detailed, specific questions

For continuous quality improvement, calls may be recorded or monitored.

HP strongly recommends that customers sign up online using the Subscriber's choice web site at <http://www.hp.com/go/e-updates>.

- Subscribing to this service provides you with e-mail updates on the latest product enhancements, newest versions of drivers, and firmware documentation updates as well as instant access to numerous other product resources.
- After signing up, you can quickly locate your products by selecting **Business support** and then **Storage** under Product Category.

## HP-authorized reseller

For the name of your nearest HP-authorized reseller:

- In the United States, call 1-800-345-1518.
- Elsewhere, visit the HP web site: <http://www.hp.com>. Then click **Contact HP** to find locations and telephone numbers.

## Helpful web sites

For third-party product information, see the following HP web sites:

- <http://www.hp.com>
- <http://www.hp.com/go/connect/>
- <http://www.hp.com/go/storage/>
- <http://www.hp.com/support/>
- <http://www.docs.hp.com>



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# 1 Before you start

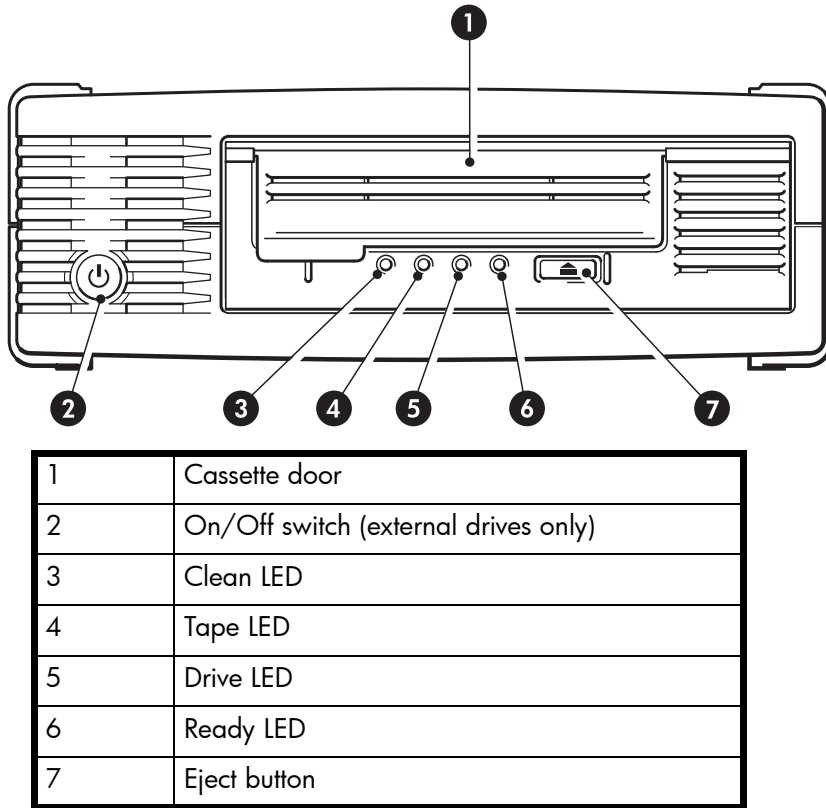
## HP StorageWorks Ultrium models

This guide describes how to install and operate the following HP StorageWorks Ultrium tape drive models:

- **HP StorageWorks Ultrium 920 internal, external and removable tape drives.** These are Ultra 320 SCSI devices with a maximum burst transfer speed of 320 MB/second. They can write uncompressed data at up to 60 MB/s (216 GB/hour) or compressed data at up to 120 MB/s (432 GB/hour), assuming 2:1 compression.
- **HP StorageWorks Ultrium 448 internal, external and removable tape drives.** These are Ultra 160 SCSI devices with a maximum burst transfer speed of 160 MB/second. They can write uncompressed data at up to 24 MB/s (86 GB/hour) or compressed data at up to 48 MB/s (172 GB/hour), assuming 2:1 compression.
- **HP StorageWorks Ultrium 232 internal and external tape drives.** These are Ultra 160 SCSI devices with a maximum burst transfer speed of 160 MB/second. They can write uncompressed data at up to 16 MB/s (59.6 GB/hour) or compressed data at up to 32 MB/s (119.2 GB/hour), assuming 2:1 compression.

For a detailed product specification, please refer to our World Wide Web site ([www.hp.com](http://www.hp.com)).

**Figure 1** Front view of half-height Ultrium tape drive



## Which operating systems are supported?

HP StorageWorks Ultrium drives can be connected to servers running under Windows®, NetWare, HP-UX, UNIX, Tru64, Linux and other major operating systems. Refer to the “HP StorageWorks Tape Software Compatibility” topic on our World Wide Web site ([www.hp.com/go/connect](http://www.hp.com/go/connect)) for the most recent information about the operating system versions that are supported.


## How do I connect the drive to my server?

The following guidelines apply:

- You will need a properly installed and configured SCSI host bus adapter (HBA) or a built-in SCSI controller on your server and a suitably-rated SCSI cable. This should be an Ultra320 or Ultra160 SCSI HBA. See also “[Why is the SCSI bus type important?](#)” on page 11.
- For optimum performance the drive should be the only device on the SCSI bus.
- Always terminate the SCSI bus. Ultrium internal and removable tape drives require terminators; external tape drives are auto terminating, as long as they are on a dedicated SCSI bus or the last device on a chain.

- Do not attach the drive to the same SCSI bus as your disk drive or to a RAID controller (unless you are connecting to a ProLiant server with a Smart Array 6i RAID controller).

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 **NOTE:** Always refer to [www.hp.com/go/connect](http://www.hp.com/go/connect) to ensure that you are connecting to a supported HBA running the recommended firmware version.

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## Internal drives

The tape drive is installed into a spare, industry-standard, 5¼-inch, half-height drive bay in your server (or HP Rack-Mount Option Kit) and is attached to the SCSI bus of the host server. Use an LVDS-compatible ribbon cable to connect the tape drive to a spare 68-pin, high density (HD), wide SCSI connector on the host server. For most servers we recommend that you use the terminated SCSI ribbon cable supplied with the drive.

See also “[Installing an internal Ultrium tape drive](#)” on page 17.

## External drives

Your tape drive is supplied with a 68-pin, wide, VHD-to-HD SCSI cable to attach to the host server. See also “[Installing an external Ultrium tape drive](#)” on page 27.

Check the usage models on “[Usage models](#)” on page 13. This shows how the HP StorageWorks Ultrium tape drive can be used in different system architectures.

## Removable drives

The individual tape drives are connected to their host server via the high-density LVD/SE SCSI connectors on the back of the tape array. They do not require any SCSI cables to plug into the tape array. However, cabling and terminators are required to connect the tape array with the SCSI host. See also “[Installing a removable Ultrium tape drive](#)” on page 31.

## Why is the SCSI bus type important?

The SCSI bus type determines the speed at which data can be transferred between devices on the bus and the maximum length of cable that can be used. HP Ultrium 920 drives support a burst transfer rate of 320 MB/sec. HP Ultrium 448 and 232 drives support a burst transfer rate of 160 MB/sec. To benefit from this level of performance, it is important to ensure that the drives are connected to a SCSI bus of a similar or higher specification. This means that you need:

- **An Ultra320 bus for HP Ultrium 920 drives**  
**An Ultra160 or Ultra320 SCSI bus for HP Ultrium 448 and 232 drives**  
If you attach the drive to a lower specification SCSI bus, it will still work but data may not be transferred as quickly.
- **LVD-rated SCSI cabling and terminators.** The LVD interface enables the data to be transferred at the drive's maximum rate.

**Table 1** Supported SCSI bus types

Ultra320 LVD	<b>Yes.</b> This is a <b>recommended</b> configuration for Ultrium 920, Ultrium 448 and Ultrium 232 tape drives.  Do not daisy chain Ultrium 920 tape drives and do not daisy chain Ultrium 448 and Ultrium 232 tape drives with Ultra320 devices.
Ultra160 LVD	<b>Yes.</b> This is a <b>recommended</b> configuration for Ultrium 448 and 232 tape drives. It is an acceptable configuration for Ultrium 920 tape drives.  Up to two Ultrium 448 and 232 tape drives may be daisy chained. Do not daisy chain Ultrium 920 tape drives.
Ultra2 LVD	Yes. This is acceptable for one Ultrium 448 drive per bus or two Ultrium 232 drives per bus.
Ultra wide LVD and single-ended	These are <b>not</b> recommended configurations as they will restrict performance.
Ultra narrow, single-ended	No. This will severely restrict performance and you will need a suitable cable or adapter.
High Voltage Differential	<b>No.</b> The drive will not work and you may damage the drive or controller

## How can I check the SCSI bus type and SCSI ID?

For many operating systems, you can install and run HP Library & Tape Tools from either the HP StorageWorks Tape CD-ROM or [www.hp.com/support/tapetools](http://www.hp.com/support/tapetools) to check your server's current SCSI configuration (see also "Diagnostic tools" on page 53). This will provide information about the SCSI bus and the SCSI IDs in use.

## Using the HP StorageWorks Tape CD-ROM

The HP StorageWorks Tape CD-ROM is a central source of information about your tape drive with utilities for getting the best performance from your tape drive.

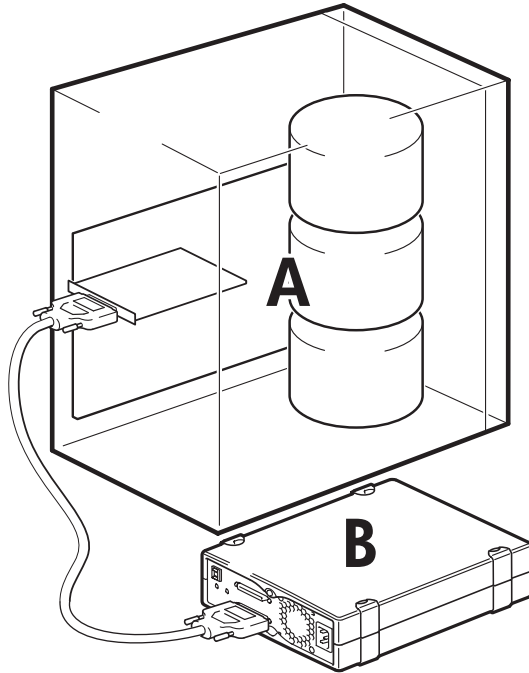
Use the HP StorageWorks Tape CD-ROM to check installation, as described in this guide, and to verify and troubleshoot performance after installation. It helps you to:

- Install your product, which includes access to drivers, an installation check, and performance information and tools
- Learn about your product
- Register your product
- Buy media online
- Troubleshoot with HP Library & Tape Tools.

## Usage models

HP StorageWorks Ultrium tape drives can be used in a stand-alone or network environment. However, they should always be directly attached to suitably-rated SCSI connector on the storage server.

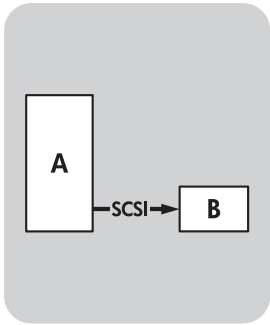
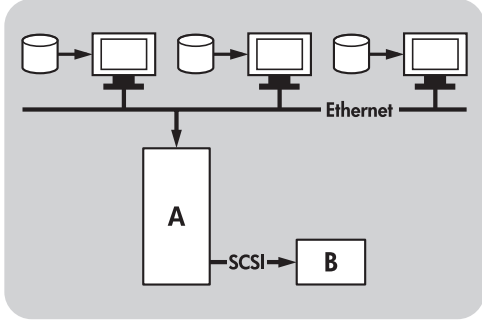
**Figure 2** usage model



A	Server
B	Tape drive

The following table shows the recommended usage models and “[Optimizing performance](#)” on page 54 provides further information about factors that can affect performance.

**Table 2** Recommended usage models

	<b>Direct Attach, single storage server</b>	<b>Across the Network, single storage server, multiple clients</b>
		
Ultrium 920	Recommended	Not recommended
Ultrium 448	Recommended	Recommended, anything less than Gigabit Ethernet may limit performance
Ultrium 232	Recommended	Recommended, anything less than 100 Base-T Ethernet may limit performance

A RAID disk subsystem is recommended for all usage models.

A single spindle disk will not be able to deliver good data throughput for an Ultrium 920 at any compression ratio. To maximize the capability of your Ultrium 920 drive, utilize aggregated disk sources (RAID) with multiple disk spindles.

A single disk, particularly a fast disk such as a 15K RPM drive, will be sufficient for Ultrium 448 and Ultrium 232 tape drives, but be aware of other factors that can affect performance—such as, compressibility of data, disk fragmentation and the number of files. See also “[Optimizing performance](#)” on page 54.

Use our free performance assessment tools, which are available stand-alone or integrated into HP Library & Tape Tools, to check tape performance and test whether your disk subsystem can supply data at the optimum transfer rate. You can also use these tools to calibrate your restore performance and maximal tape performance with more compressible data.

## Other usage models

The tape drive may work with other usage models, such as network attach storage (NAS) and storage area networks (SAN), but HP does not currently provide technical support for installing and using stand-alone Ultrium tape drives with these architectures. Similarly, connection to fibre channel may be possible, if you purchase and install a fibre channel/SCSI bridge, but it is not currently a supported option. Please check [www.hp.com/go/connect](http://www.hp.com/go/connect) for the latest supported configurations.

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## 2 Drivers and backup software

### Install drivers

#### Installing on Windows

The driver available from Microsoft update is acceptable, but the HP driver provides better support for all the features of your new tape drive. It is regularly updated and is available on the HP StorageWorks CD-ROM or on the HP Support web site at [www.hp.com/support](http://www.hp.com/support).

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 **NOTE:** The HP driver is suitable for use in most applications, but refer also to the documentation of your software application to ensure you are using the recommended driver.

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#### Installing on UNIX

The recommended backup applications use the operating system's standard, built-in device drivers. To upgrade drivers we recommend that you patch to the latest version of the operating system or configure device files, as described in the *UNIX Configuration Guide* on the CD-ROM.

#### Installing on IA64

If you are installing on an IA64 system, such as an HP Integrity server, check [www.hp.com/go/connect](http://www.hp.com/go/connect) for the latest information on the availability of backup application upgrades and drivers.

### Upgrade backup software

It is important to check [www.hp.com/go/connect](http://www.hp.com/go/connect) for software compatibility and install any recommended upgrades.

For optimum performance it is important to use a backup application that is appropriate for your system's configuration. In a direct attach configuration, where the tape drive is attached to a standalone server, you can use backup software that is designed for a single server environment. In network configurations you will need backup software that supports enterprise environments. HP, Symantec, Legato, Yosemite and Computer Associates all provide suitable products. Further details about these and other products that may be appropriate can be found on our connectivity web site.

1. Go to our connectivity web site: [www.hp.com/go/connect](http://www.hp.com/go/connect) and select **tape backup**.
2. Select **software compatibility**.
3. Select your combination of operating system and tape drive model in the table. A list of supported backup applications is displayed. This will also tell you whether your configuration is compatible with HP One-Button Disaster Recovery, HP OBDR. (All HP StorageWorks Ultrium tape drives support HP OBDR. However, you can only use this feature if your system configuration and backup application also support it. See "[Compatibility](#)" on page 49.)
4. Make sure you have a backup application that supports HP StorageWorks Ultrium tape drives and download any upgrades or patches, if required.





### 3 Installing an internal Ultrium tape drive

If you are installing an external Ultrium tape drive, please refer to [Chapter 4](#).

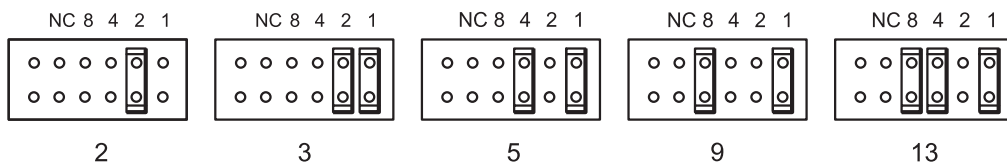
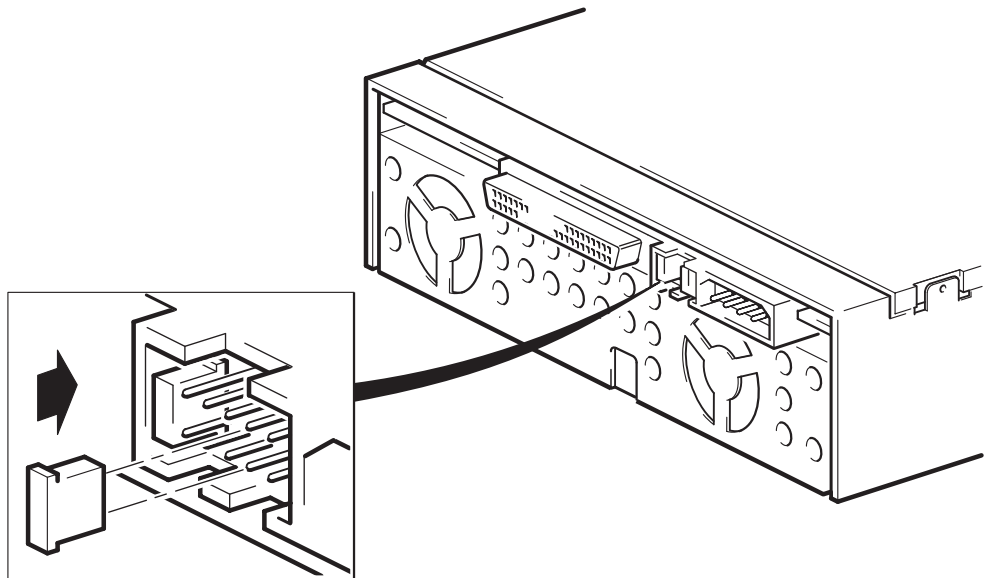
If you are installing a removable Ultrium tape drive, please refer to [Chapter 5](#).

#### Check the drive's SCSI ID

Your HP StorageWorks Ultrium drive is shipped with a default SCSI ID of 3. Each device on the SCSI bus must have a unique SCSI ID number. The drive can be assigned any *unused* ID between 0 and 15. Do not use SCSI ID 7, which is reserved for the SCSI controller. SCSI ID 0 is typically assigned to the boot disk and should also not be used unless the tape drive is on a dedicated SCSI bus.

△ **CAUTION:** Static electricity can damage electronic components. Always wear an antistatic wriststrap if possible. If not, to equalize the electromagnetic charges, touch a bare metal part of the server (such as the back plate) before you remove the tape drive from its bag.

**Figure 3** Checking the SCSI ID



1. Determine whether you need to change the SCSI ID from the default of 3.

For most operating systems you can run HP Library & Tape Tools from the HP StorageWorks Tape CD-ROM to check your server's current SCSI configuration (see page 53). This will provide information about the SCSI bus and the SCSI IDs in use. To do this, select the 'troubleshoot with L&TT' option from the CD-ROM menu. (See also "[Troubleshooting with Library & Tape Tools](#)" on page 53.)

The *UNIX Configuration Guide* on the HP StorageWorks Tape CD-ROM also contains instructions on how to determine the SCSI IDs of existing devices on UNIX servers.

2. Change the tape drive's SCSI ID, if necessary.

The SCSI ID is set using jumpers on a set of pins at the rear of the drive, as shown in figure 3. Use tweezers or small pliers to move the jumpers to the pattern corresponding to the ID you want. Spare jumpers are provided with the drive.

## Prepare mounting bay

For many servers, no mounting tray or rails are required. Devices simply slide into the server's chassis and are fixed with screws. Other servers have built-in trays or rails.

Rail kits for a number of industry-standard servers may be available. For more details refer to: [www.hp.com/go/connect](http://www.hp.com/go/connect).

Some servers use non-standard mounting rails and do not include spares. If this is the case with your system, you will have to order these accessories from the server manufacturer before you can install the tape drive.

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⚠ **WARNING!** To avoid personal injury or damage to the server or tape drive, ensure that the server is disconnected from the mains power supply while you install the drive.

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⚠ **CAUTION:** Static electricity can damage electronic components. Always wear an antistatic wriststrap if one is available. If not, after you have disconnected power from the server and removed the cover, touch a bare metal part of the chassis. Similarly, touch a bare metal part of the drive before installing it.

---

1. Assemble the necessary tools and materials:

- Phillips screwdriver
- Flat-bladed screwdriver (if your server uses slotted screws)
- Torx screwdriver (if your server uses torx screws)
- Your server manuals (for reference during installation)

2. Perform a normal system shutdown and turn off the server and any connected peripherals.

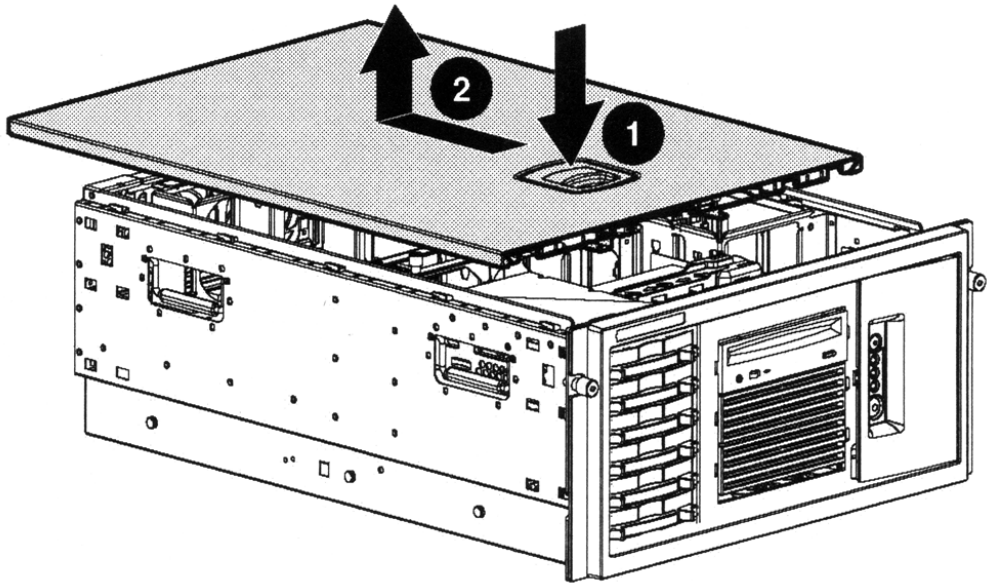
3. Remove the cover and front panel from the server, as detailed in your server's documentation.

As you work inside the server, you may have to disconnect other signal cables or power cables from other devices to maneuver the new drive into place. If you have to do this, make a note of their position and connections so you can put them back correctly later.



**NOTE:** The server must provide forced cooling and be capable of drawing 6 cfm (0.17 m<sup>3</sup>/minute or 10.08 m<sup>3</sup>/hour) of air through the tape drive at 40° C ambient operation. This reduces to 4 cfm at 35° C ambient operation. Ensure that empty bays have the appropriate blanking plates installed so that airflow is maintained.

**Figure 4** Removing cover from ProLiant ML370 server



1	Release catch
2	Push cover back and lift off

4. Remove the filler panel from a spare 5¼-inch bay of your server, as described in your server's documentation. With some servers, such as the HP AlphaServer ES40, you must also remove the half-height device divider.
5. You are now ready to install your tape drive.

## Attach mounting hardware

If your server requires special rails or other hardware to install the tape drive, mount them on the tape drive now.

*If your server does not require special mounting hardware, proceed to "Install drive" on page 22 now.*

---

△ **CAUTION:** The Ultrium half-height drive only allows 3 mm of the engagement of the screw into the drive. If you remove an existing drive, do not assume the screws that you remove are the correct length for your new Ultrium drive. Always use the screws supplied with your Ultrium drive.

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## HP ProLiant servers

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📄 **NOTE:** If mounting hardware is supplied with your tape drive, it may not be exactly the same as shown in the illustrations.

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Different models of server require different mounting methods. The server may also incorporate a locking mechanism to hold the tape drive in place. See “[Secure the drive](#)” on page 25.

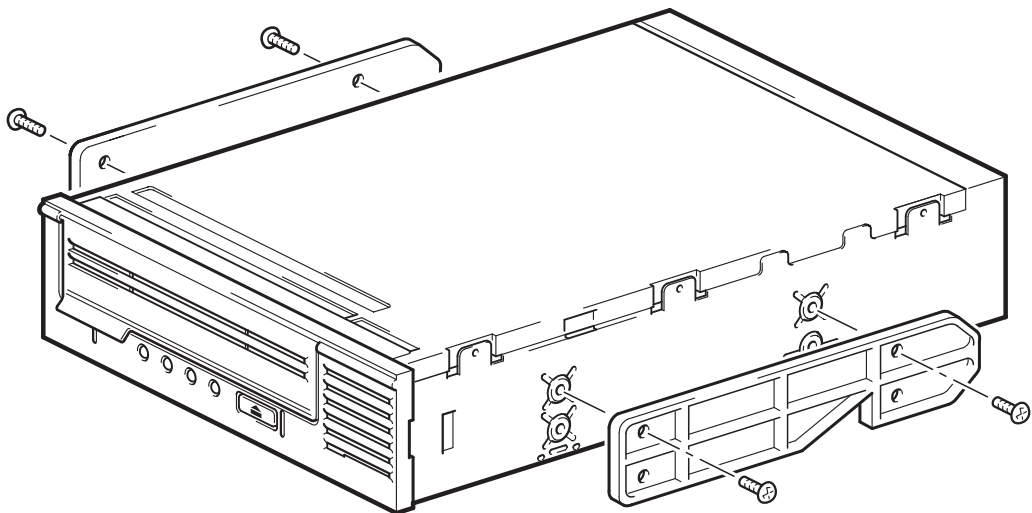
Please check your HP ProLiant server documentation to ascertain the correct method of mounting, and to check whether mounting hardware is provided with the server.

### Mounting rails

Some HP ProLiant servers, such as ML570, require mounting rails. These may be metal or plastic rails attached to the server's drive bay filler panel.

Use a regular Phillips screwdriver to attach the appropriate rails. Use the M3 screws provided with the tape drive, in the screw pack labeled ‘General Mounting Screws’, as shown in Figure 5a.

**Figure 5** Attaching mounting rails in a typical HP ProLiant ML570



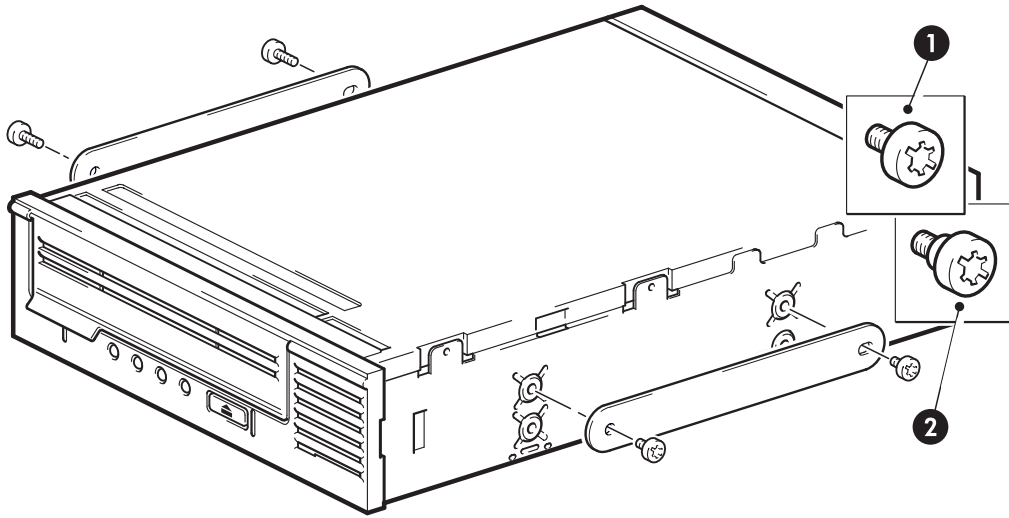
Ensure you do use the M3 screws provided. The rails may be attached to the filler panel by screws of a different thread/size type and these should not be used. If in doubt, refer to your HP ProLiant server documentation.

## Mounting screws

Other HP ProLiant server models, such as ML350 and ML370, only require the use of special locating screws with no mounting rail.

Use a T8 Torx screwdriver to attach the appropriate screws. You may need to purchase the M3 screws separately. Position the screws, as shown in [Figure 6](#).

**Figure 6** Attaching locating screws in a typical HP ProLiant 350 or 370



1	M3 mounting screws
2	M3 offset mounting screws

- HP ProLiant ML350: Use the metal shims and screw pack labeled 'ProLiant 350'. These have a thicker head than the general mounting screws.
- HP ProLiant ML370: Use the metal shims and screw pack labeled 'ProLiant 370'. These have a thick offset piece and a thicker head than the general mounting screws.

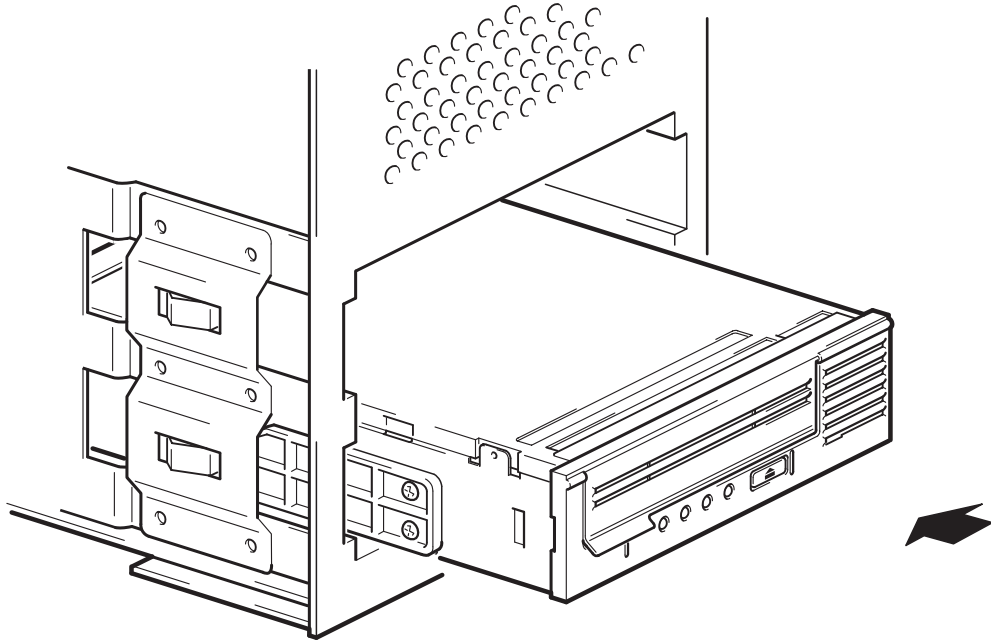
## Other servers

1. Attach the appropriate mounting hardware. Refer to the manufacturer's documentation for instructions.
- If you are installing on a server that requires a tray, place the tape drive in the tray.
- Some servers have snap-on mounting rails attached to the filler panel. These can be removed and attached to the tape drive with screws.

## Install drive

1. Slide the tape drive into the open bay, aligning the tray or rails with the slots in the bay, as shown in [Figure 7](#).

**Figure 7** Installing tape drive



If your server does not use mounting hardware, check that the holes in the chassis are aligned with the holes in the side of the tape drive.

Do not secure the drive at this point because you may have to move the drive to get the cables into place.

## Attach power and SCSI cables

To support the high performance of the tape drive it is important that you connect to a recommended SCSI bus and use a suitably-rated SCSI cable, see “[Why is the SCSI bus type important?](#)” on page 11. We recommend that you attach the SCSI ribbon cable supplied with the tape drive to the SCSI host bus adapter.

Electrical specifications are as follows.

	Ultrium 920	Ultrium 448 and 232
Power consumption	13 Watts idle, 26 Watts typical, 40 Watts maximum	13 Watts idle, 20 Watts typical, 33 Watts maximum
Power requirements	+5V @ 1.9A typical +5V @ 3.9A maximum +12V @ 0.7A typical +12V @ 2.5A maximum	+5V @ 2.5A typical +5V @ 2.5A maximum +12V @ 0.7A typical +12V @ 2.1A maximum

1. Check your server or HBA documentation to ensure that the SCSI bus and cabling supports the tape drive’s bus speeds; Ultra320 for Ultrium 920 tape drives, Ultra160 or Ultra320 for Ultrium 448 and Ultrium 232 tape drives.
2. Attach the SCSI ribbon cable supplied with the tape drive to the SCSI host bus adapter and connect it to the SCSI connector of the drive, as shown in [Figure 8](#).
3. Attach a spare power cable from the server's internal power supply to the power connector, as shown in [Figure 8](#).
4. If the drive is the last device on the SCSI chain, make sure that the SCSI cable is terminated correctly.

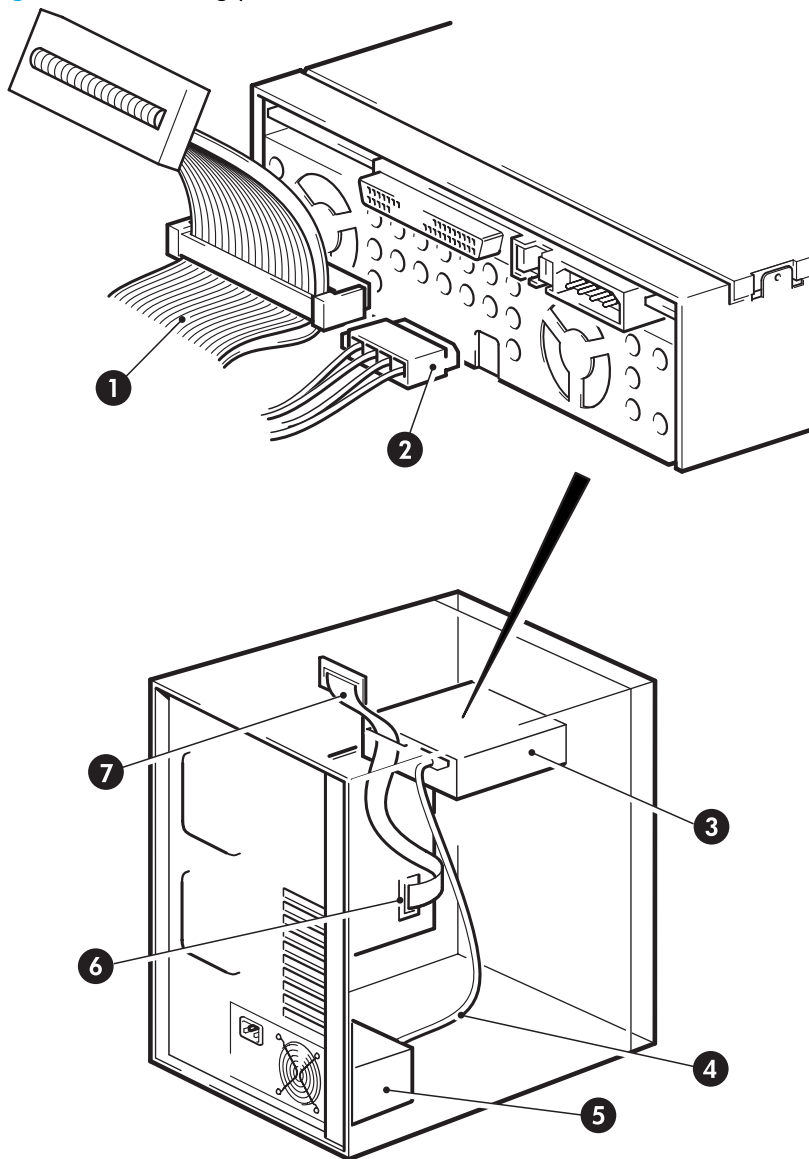
Daisy-chaining two devices is not recommended. If you do so, do not mix drive families (only daisy-chain with other Ultrium tape drives) and do not daisy chain Ultra 320 devices. See also Table 1, “Supported SCSI bus types,” on page 12.

## Where should the SCSI terminator be?

Termination must be present at two and ONLY two positions on the SCSI bus—at the beginning of the SCSI bus and at the end of the SCSI bus. Termination is normally enabled by default on the HBA and most internal SCSI cables have a terminator attached. This will usually be a small, rectangular block of plastic attached to the cable end and marked ‘SCSI Terminator’.

Therefore, assuming the HBA is the first device on the bus, you should check that the second terminator is placed after the last device, as shown in [Figure 8](#), item 1.


**Figure 8** Connecting power and SCSI cables



1 and 7	terminated SCSI cable
2 and 4	power cable
3	tape drive
5	server's power supply
6	SCSI controller



# Secure the drive

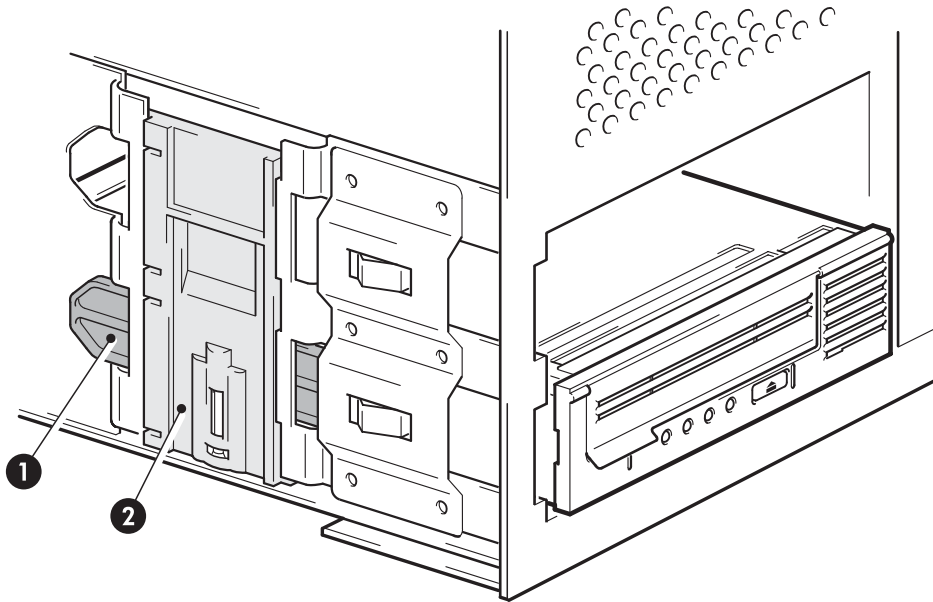
 **NOTE:** The server latches and side views of your server model may not be exactly the same as shown in the illustrations. Please refer also to your server documentation.

## Mounting hardware used (HP ProLiant)

Ensure that you use the correct mounting rails or locating screws, as described in “[Attach mounting hardware](#)” on page 19. The server also incorporates a locking mechanism to hold the tape drive in place.

1. Push the server latch down to lock the tape drive into position, as shown in [Figure 9](#).

**Figure 9** Securing drive, mounting hardware used



1	Plastic rail
2	Server latch

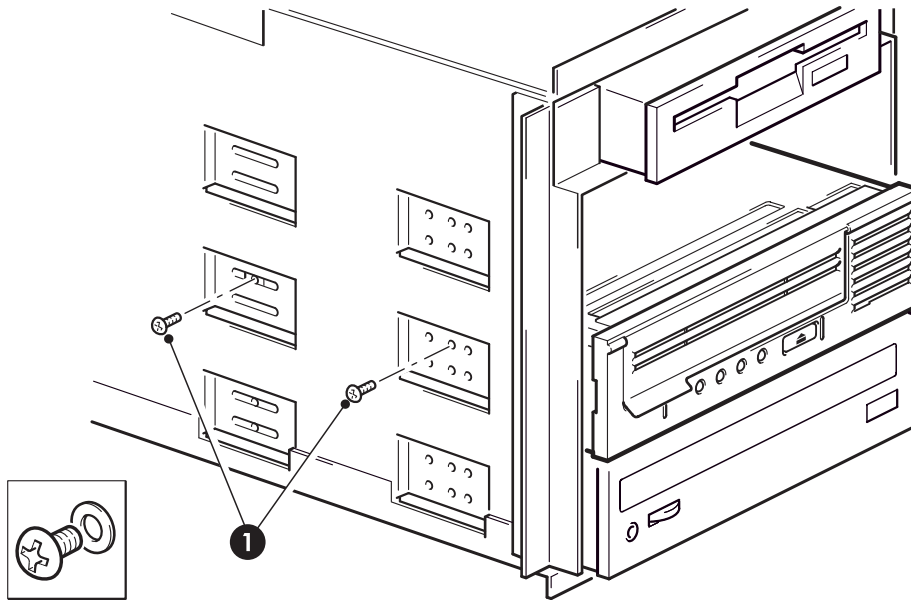
2. Ensure blanking plates are in place over empty bays and replace the cover on the server.

## No mounting hardware used

1. Use the M3 screws provided with the tape drive in the screw pack labeled ‘General Mounting Screws’. Check that the holes in the chassis are aligned with the holes in the sides of the drive and use a regular Phillips screwdriver to secure the M3 screws, as shown in [Figure 10](#).

If you cannot tighten the screws, use the washers provided in the pack.

**Figure 10** Securing drive, no mounting hardware used



1	M3 screws, supplied with tape drive
---	-------------------------------------

2. Ensure blanking plates are in place over empty bays and replace the cover on the server.

## 4 Installing an external Ultrium tape drive

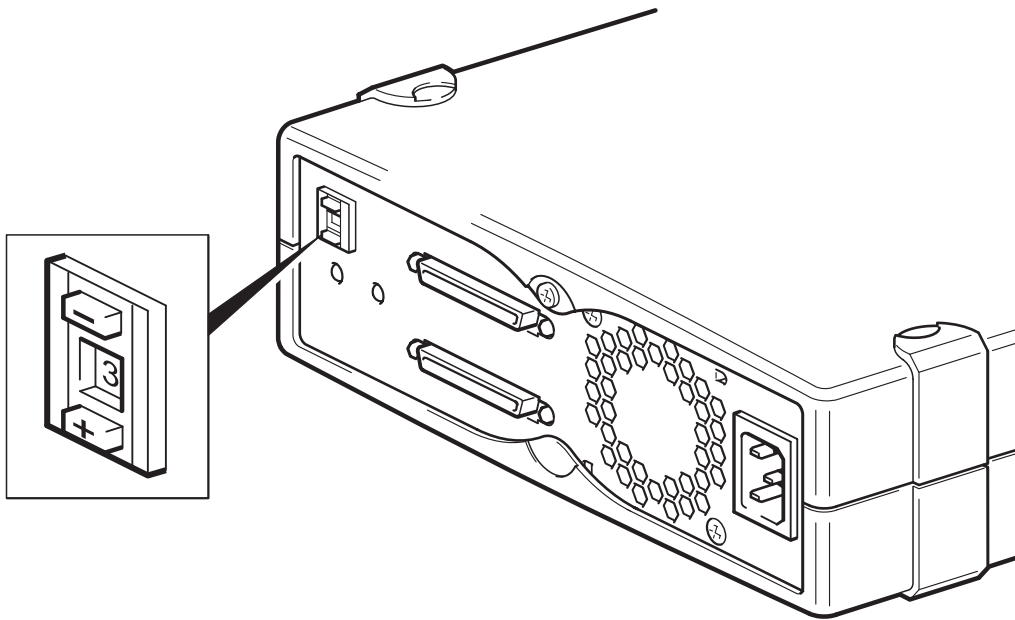
If you are installing an internal Ultrium tape drive, please refer to [Chapter 3](#).

If you are installing a removable Ultrium tape drive, please refer to [Chapter 5](#).

### Check the drive's SCSI ID

Your HP StorageWorks Ultrium drive is shipped with a default SCSI ID of 3. Each device on the SCSI bus must have a unique SCSI ID number. The drive can be assigned any *unused* ID between 0 and 15. Do not use SCSI ID 7, which is reserved for the SCSI controller. SCSI ID 0 is typically assigned to the boot disk and should also not be used unless the tape drive is on a dedicated SCSI bus.

**Figure 11** Setting the SCSI ID



1. Determine whether you need to change the SCSI ID from the default of 3.


For many operating systems you can install and run HP Library & Tape Tools from the HP StorageWorks Tape CD-ROM to check your server's current SCSI configuration. This will provide information about the SCSI bus and the SCSI IDs in use. To do this, select the 'troubleshoot with L&TT' option from the CD-ROM menu. (See also "[Troubleshooting with Library & Tape Tools](#)" on page 53.)

The UNIX Configuration Guide on the HP StorageWorks Tape CD-ROM also contains instructions on how to determine the SCSI IDs of existing devices on UNIX servers.

2. Change the tape drive's SCSI ID, if necessary.

Use a small screwdriver or a ball-point pen to press the indented SCSI ID selector buttons on the rear panel (see [Figure 12](#)) until the required value is displayed. Do not use a pencil because small bits of graphite could contaminate the drive.

---


 **NOTE:** The server and the tape drive SCSI IDs are only checked at power-on. To change the SCSI ID after installation, power down both the server and the tape drive, change the drive's SCSI ID, power up the tape drive, and then power up the server.

---

## Connect the SCSI cable

A 68-pin, wide VHD-to-HD SCSI cable is provided to connect your HP StorageWorks Ultrium tape drive to a VHD SCSI port on an LVD SCSI bus. If your server has an HD SCSI port, you must either purchase and install a VHD-to-HD adapter or use an HD-to-HD cable instead of the supplied cable. Refer to our web site for recommended products: [www.hp.com/go/connect](http://www.hp.com/go/connect).

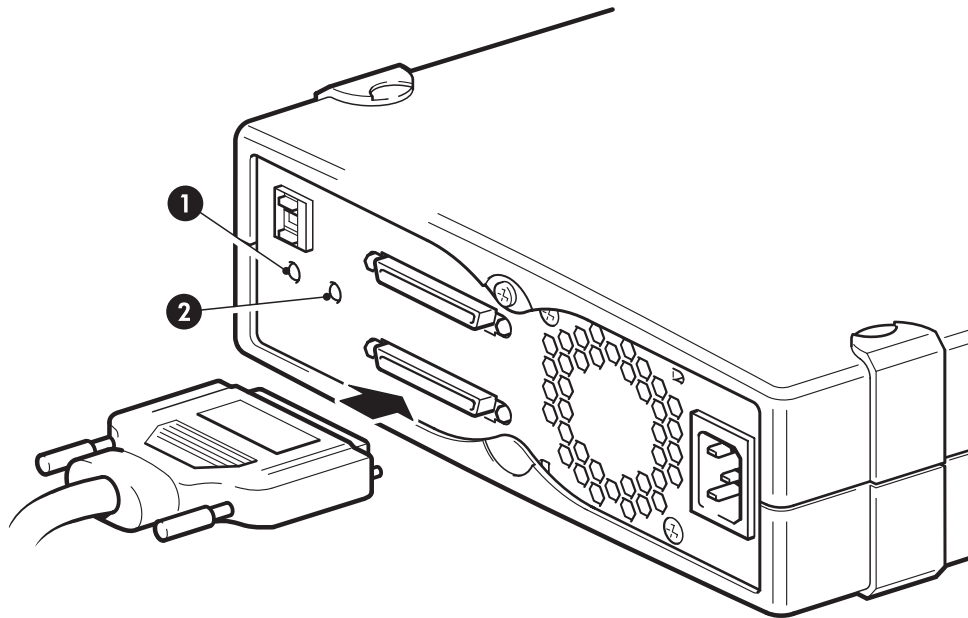
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 **CAUTION:** To avoid damaging the computer or tape drive, ensure that both are powered off while you attach the SCSI cable.

---

1. Make sure you are connecting to a recommended SCSI bus type. For optimum performance your tape drive should be connected to an Ultra320 or Ultra160 SCSI bus. See "[Why is the SCSI bus type important?](#)" on page 11. Do **not** connect the tape drive to a single-ended SCSI bus or to RAID controller. For optimum performance, we recommend that your HP StorageWorks Ultrium drive is installed on a dedicated SCSI bus. If it is not, do not connect it to the same bus as your disk drive.
2. Perform a normal system shutdown and turn off the server and any connected peripherals.
3. Attach the VHD connection on the SCSI cable to the server's external SCSI connector and secure it by tightening the screws.

**Figure 12** Connecting the SCSI cable



1	Act TERM LED
2	Fan/Power LED

4. Attach the VHD connection on the SCSI cable to the server's external SCSI connector and secure it by tightening the screws.
5. Attach the HD connection on the SCSI cable to the SCSI-IN connector on the rear panel of the tape drive and secure it by tightening the screws. (See [Figure 12](#).) Do **not** connect the cable to the SCSI-OUT connector.
6. The SCSI-OUT connector is only used when daisy-chaining two devices. This is not recommended. If you do so, do not mix drive families (only daisy-chain with other Ultrium tape drives). See also [Table 1](#) on page 12.

## Does the tape drive need a terminator?

If the tape drive is on a dedicated SCSI bus, it does not require a terminator. When the cable is connected to the SCSI-IN connector, the enclosure provides active termination.

If it is not the only device on the SCSI bus, you must make sure that the SCSI bus is terminated. You can do this in two ways:

- Place the tape drive at the end of the chain and attach the HD connection on the SCSI cable to the SCSI-IN connector; the enclosure provides active termination.
- Attach the HD connection on the SCSI cable to the SCSI-IN connector and use the SCSI-OUT connector on the tape drive to connect to the next device in the chain. Make sure that the last device in the chain is terminated with an LVD multimode terminator

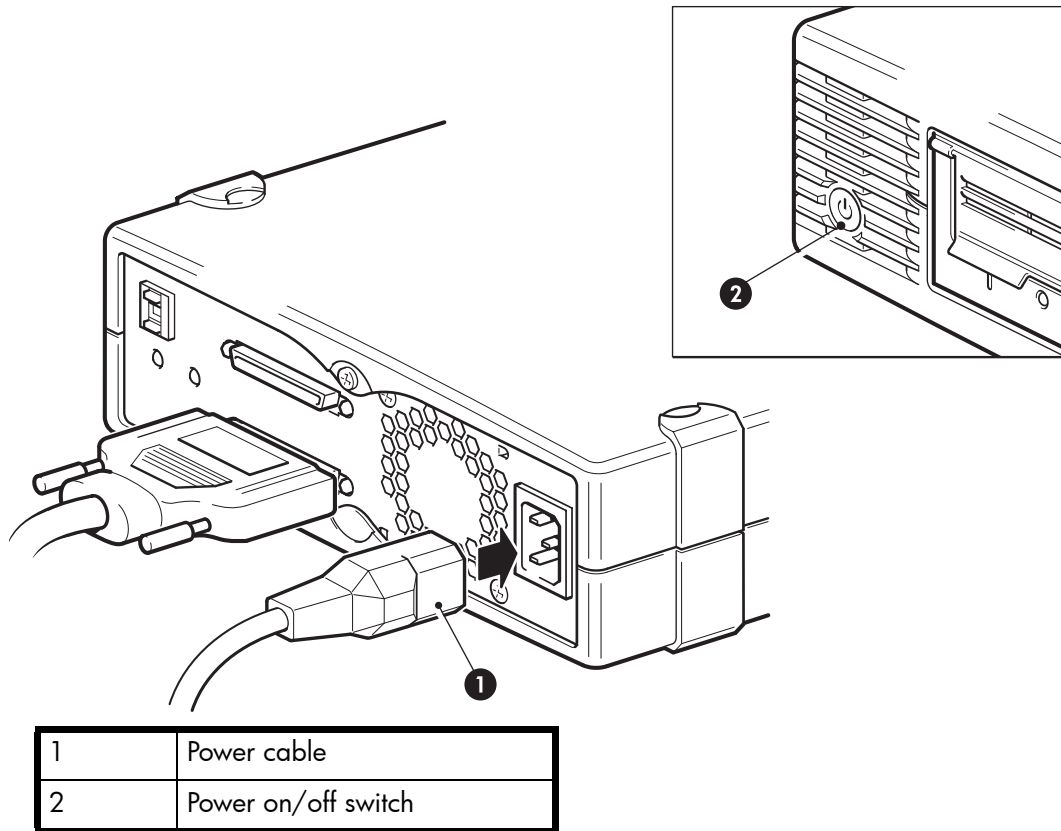
## Connect the power cable

No adjustment is needed. Electrical specifications are as follows.

	Ultrium 920	Ultrium 448 and 232
Power consumption	13 Watts idle, 26 Watts typical, 40 Watts maximum	13 Watts idle, 20 Watts typical, 33 Watts maximum
Power requirements	100–240 VAC 50-60 Hz, auto-ranging 0.7A maximum	100–240 VAC 50-60 Hz, auto-ranging 0.7A maximum

1. Plug the power cable securely into the socket on the rear panel of the drive.
2. Plug the other end of the power cable into the power outlet. The power on/off switch is on the front panel, see [Figure 13](#).

**Figure 13** Connecting the power cable



## 5 Installing a removable Ultrium tape drive

If you are installing an internal Ultrium tape drive, please refer to [Chapter 3](#).

If you are installing an external Ultrium tape drive, please refer to [Chapter 4](#).

### Which rackmount systems can I use?

HP StorageWorks Ultrium removable tape drives are used in conjunction with the HP Tape Array 5300 system, which can be used with both full-height and half-height tape drives. It will hold up to two full-height and up to four half-height HP StorageWorks Ultrium tape drives. The tape array is designed to be installed into HP, IBM and other compatible 19" rackmount systems. It must be properly installed and configured. Refer to your tape array documentation for further details.

### Electrical specification

Electrical specifications are as follows.

	<b>Ultrium 920</b>	<b>Ultrium 448 and 232</b>
Power consumption	13 Watts idle, 26 Watts typical, 40 Watts maximum	13 Watts idle, 20 Watts typical, 33 Watts maximum
Power requirements	+5V @ 1.9A typical +5V @ 3.9A maximum +12V @ 0.7A typical +12V @ 2.5A maximum	+5V @ 2.5A typical +5V @ 2.5A maximum +12V @ 0.7A typical +12V @ 2.1A maximum

### Airflow requirements

The HP Tape Array 5300 is designed to provide adequate airflow for up to four half-height or up to two full-height tape drives. As long as the tape array is fully populated, it will provide adequate airflow for your HP StorageWorks Ultrium tape drives. If you have unused bays in the tape array, you must install the blanking plates provided with the tape array. This ensures that there is adequate airflow to the drives. See the documentation with the tape array for details on installing blanking plates.

You should ensure that ventilation is adequate at the front and rear of the tape array.

### How do I connect the drive to my server?

The following guidelines apply:

- For optimum performance the drive should be the only device on the SCSI bus.
- If you daisy-chain devices, make sure that devices are of the same SCSI type and that each device on the same SCSI bus has a unique SCSI ID and is terminated appropriately. Do not daisy-chain more than two devices on the same SCSI bus.

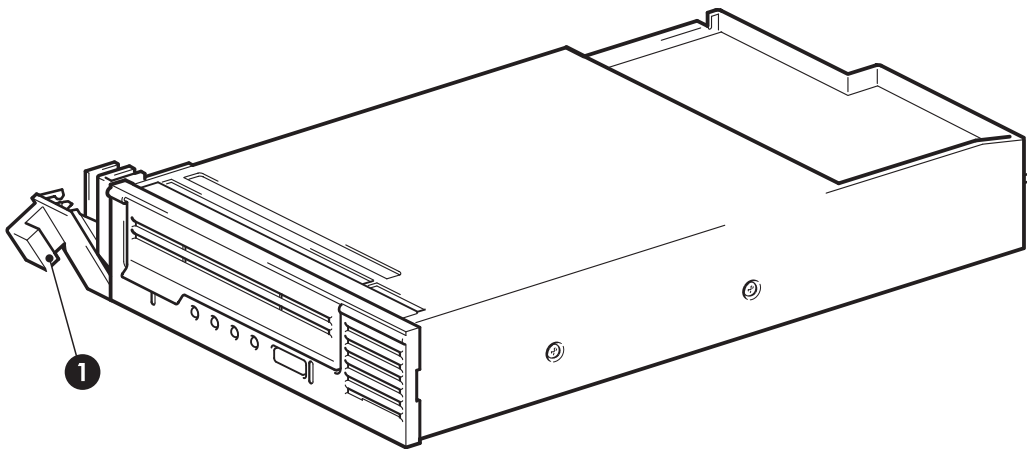
- Always terminate the SCSI bus.
- Do not attach the drive to the same SCSI bus as a your disk drive or to a RAID controller unless you are connecting to a ProLiant server with a Smart Array 6i RAID controller.

The individual tape drives are connected to their host server via the high density LVD/SE SCSI connectors on the back of the tape array. They do not require any SCSI cables to plug into the tape array. However, suitably-rated cabling and terminators are required to connect the tape array with the SCSI host.

## Install the drive

1. Before installing a tape drive, make sure that the extractor lever is in the fully open position (pulled out).

**Figure 14** Extractor lever on tape drive fully open



1	Extractor lever, open
---	-----------------------



**CAUTION:** When handling a tape drive, hold the drive by the side carrier framework. To avoid possible damage, do not hold the body of the drive and do not push or pull on the tape drive's front panel.

2. Slide the tape drive into one of the open bays, ensuring that the guide rails on both sides of the drive locate into the slots on the partition wall. Carefully but firmly ensure the tape drive is pushed fully in so that the rear connectors are securely seated. The extractor level will close slightly.

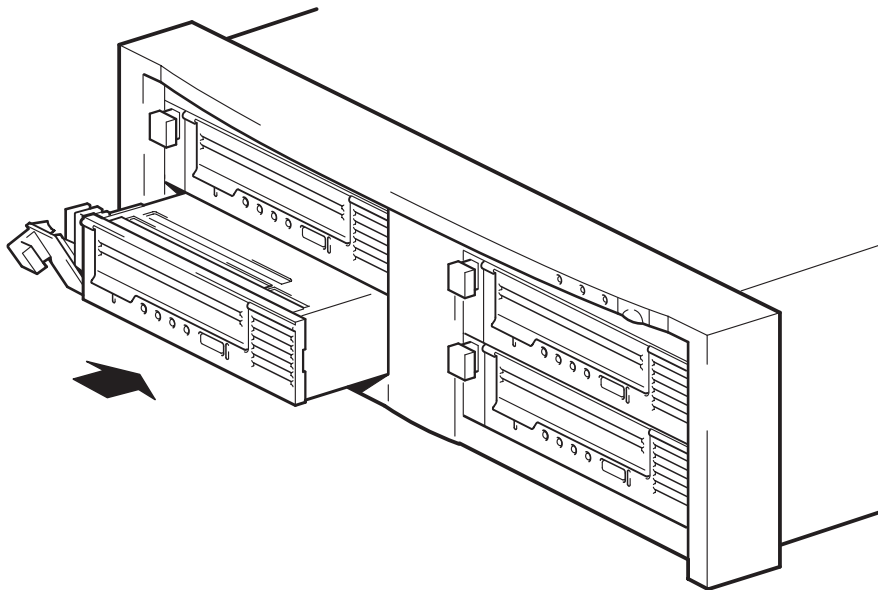


**NOTE:** Correct alignment of SCSI tape drives in the tape array is essential to ensure a secured connection is made between the interface of the drive and the interface of the array.



3. Push on the extractor lever to complete the insertion and to lock the tape drive in place.

**Figure 15** Inserting the tape drive



4. If there are empty bays, insert a blanking plate. This is essential to ensure adequate airflow is maintained. Failure to do so may affect tape drive performance.

See the documentation with the tape array for details on installing blanking plates.

## Set the drive's SCSI ID

To set the tape drive's SCSI ID you need to set the appropriate switch on the rear of the tape array. The number of address switches corresponds to the number of tape drives that can be inserted into the tape array.

Each device on the SCSI bus must have a unique SCSI ID.

- For HP ProLiant servers where the tape drive is connected to the built-in SCSI bus, we recommend that the tape drive is assigned a SCSI ID between 1 and 6.
- For all other servers and when used with separate HBAs, it can be assigned any *unused* ID between 0 and 15. Do not use SCSI ID 7, which is reserved for the SCSI controller. SCSI ID 0 is typically assigned to the boot disk and should also not be used unless the tape drive is on a dedicated SCSI bus.

Typically, the HP Tape Array may hold up to four tape drives where each drive is attached to a separate server. Under this configuration, the SCSI IDs of each tape drive will not conflict with each other as they are each installed onto a separate SCSI bus.

However, if you daisy-chain devices make sure that the devices are of the same SCSI type and that each device on the same SCSI bus has a unique SCSI ID. Do not daisy-chain more than two devices on the same SCSI bus and make sure that the end device is terminated. Do not mix drive families

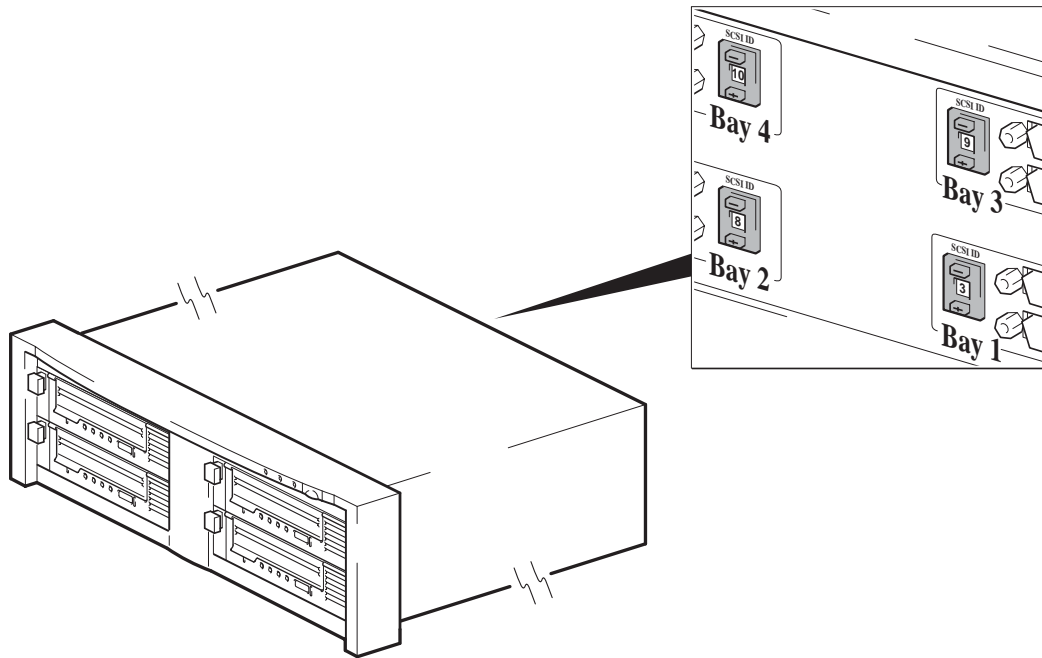
(only daisy-chain with other Ultrium tape drives) and do not put Ultra160 drives on the same bus as any Ultra320 device.

1. Decide which SCSI ID to use.

For many operating systems you can run HP Library & Tape Tools to check your computer's current SCSI configuration (see "Diagnostic tools" on page 53). This will provide information about the SCSI bus and the SCSI IDs in use. The *UNIX Configuration Guide* on the HP StorageWorks Tape CD-ROM, also provides instructions on how to determine the SCSI IDs of existing devices.

2. Set the appropriate switch. Figure 16 shows the address switch on the back panel of the HP Tape Array 5300.

Figure 16 SCSI address switch on tape array



The HP Tape Array 5300 has four SCSI ID switches to enable the installation of up to four half-height drives.

3. Make sure that a SCSI terminator is attached to the appropriate SCSI-OUT connector on the back of the tape array.
4. Determine whether you need to change the SCSI ID from the default of 3.

## Why does the tape drive need a terminator?

Terminators are essential, as they provide the correct voltages on the SCSI bus and prevent unwanted signal reflections from interfering with data transfers. The rule is:

**There must be termination at both physical ends of the bus and only at the ends.**

Normally the HBA forms one end of the SCSI bus and provides termination. You, therefore, need to ensure that the other end of the bus is terminated. Attach the terminator to the appropriate SCSI-OUT connector on the tape array.

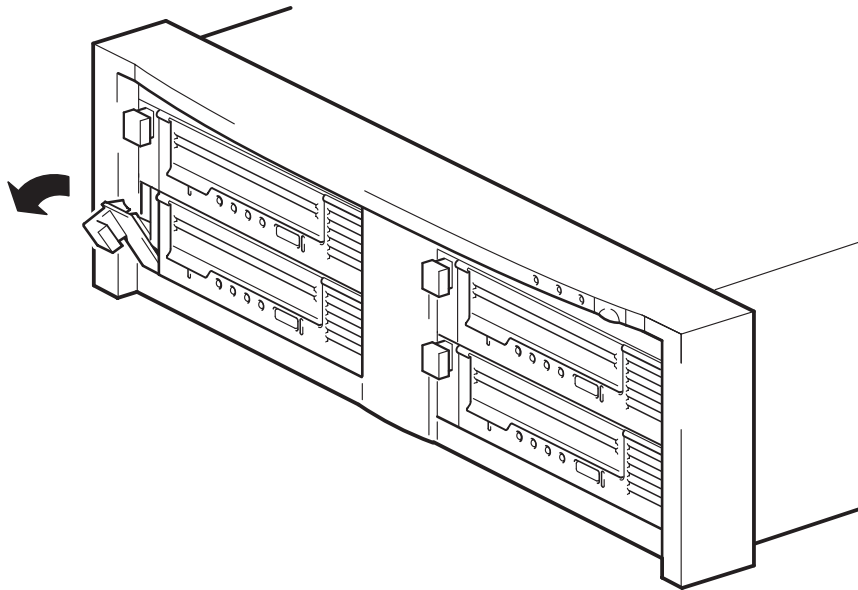
## Replacing the drive

HP StorageWorks Ultrium removable drives can be removed and replaced without powering down the tape array. However you should be aware of the following:

- If all drives in the tape array are powered up when the system is turned on, the host will be aware of those drives. You can remove any of those drives and replace it with another drive as long as there is no activity on the bus.
- Do not remove or add drives to a bus that already has drives connected and running, for example backing up or restoring data. Wait until there is no activity on the bus before removing or adding drives.
- If a drive is not powered up or you place a drive in an empty slot *after* the system has been powered up, the system will have to be reset before the host will recognize the drive.
- The SCSI IDs are controlled by the tape array, not by the drives themselves, so if you remove a drive and replace it with another the ID will not change.

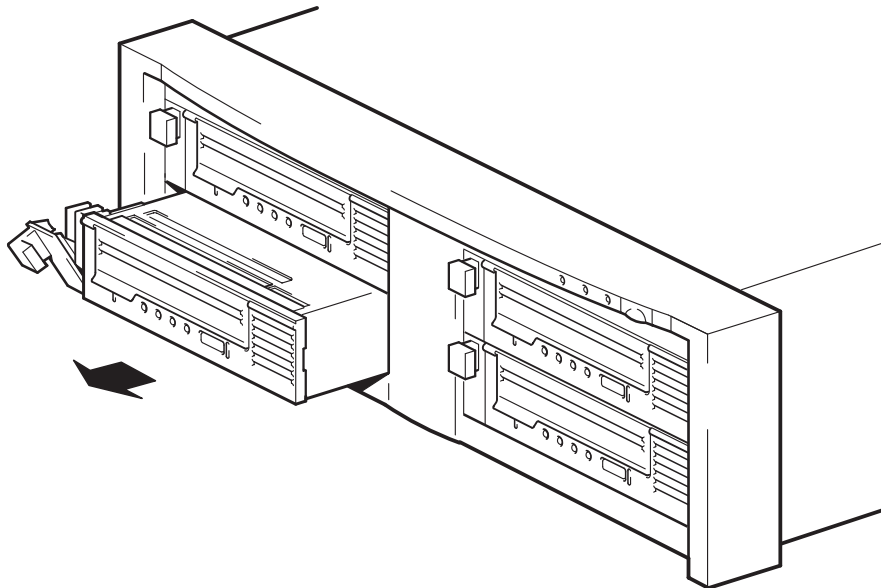
1. Pull the extraction lever of the drive that you want to replace so that it is in the out position.

**Figure 17** Extractor lever in out position



2. Using the extraction lever, pull the drive gently and firmly out of the tape array.

**Figure 18** Removing the tape drive



3. To insert another drive, follow the instructions in "[Install the drive](#)" on page 32.

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## 6 Verify installation

Once you have installed the drive hardware, check that drivers have been installed correctly and you have the correct version of backup software, and verify that the tape drive is functioning properly before you store your valuable data.

1. Switch on the drive and the server.
2. The tape drive will run its hardware self-test, which takes about 5 seconds. If self-test passes, the green Ready LED flashes and then shows steady green. If the test fails, the Drive Error and Tape Error LEDs flash, while the Ready and Clean LEDs are off. This continues until the drive is reset. See "[Front panel](#)" on page 39 for more information about front panel lights.

3. Install drivers.

On Windows systems, the Windows Hardware Installation wizard is displayed automatically. We recommend that you close the wizard and install the drivers from the link on the HP StorageWorks Tape CD-ROM.

- Insert the CD-ROM, select **drivers**.

On UNIX systems, we recommend that you patch to the latest version of the operating system or configure device files, as described in the *UNIX Configuration Guide* on the CD-ROM.


4. Verify that the tape drive installation was successful.

See "[Troubleshooting with Library & Tape Tools](#)" on page 53 for more information.

5. For all operating systems ensure that you have downloaded any upgrades necessary for your backup application. Check [www.hp.com/go/connect](http://www.hp.com/go/connect) for software compatibility and install any recommended upgrades.
6. Carry out a backup and restore test to check that the drive can write data to tape. Use a blank cartridge.

Windows Backup or Unix native backup applications can be used to check basic tape drive operation, but they will not support all the advanced features of your tape drive. We recommend that you upgrade your software application before running this test, see step 4.

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 **NOTE:** If you encounter a problem during this verification procedure, turn to "[Troubleshooting](#)" on page 57 for help in diagnosing and fixing the problem.

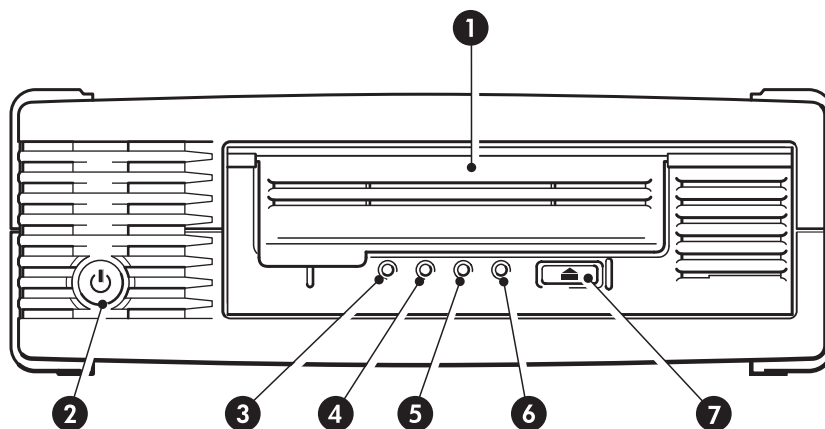
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## 7 Operating your tape drive

### Front panel

Figure 19 Front panel



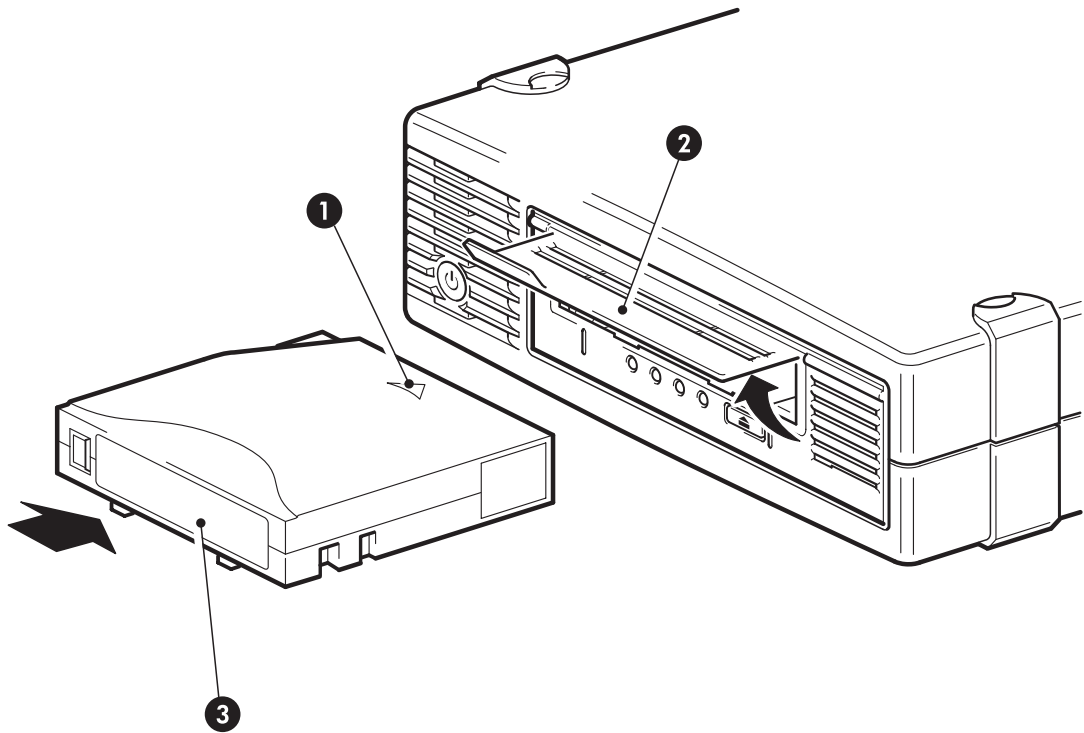
1	Cartridge door
2	Power on/off button (external drives only)
3	Clean LED
4	Tape LED
5	Drive LED
6	Ready LED
7	Eject button

See also "[Understanding LED sequences](#)" on page 58.

# Loading and unloading

## Inserting cartridges

**Figure 20** Inserting a cartridge



1	Arrow indicates leading direction
2	Cartridge door
3	Label area

1. Lift the cartridge door and insert the cartridge into the slot in the front of the drive with the white arrow uppermost and facing the drive door.
2. Apply gentle pressure until the drive takes the cartridge and loads it. (See [Figure 20](#).)
3. The Ready light flashes green while the drive performs its load sequence. When the cartridge is loaded, the Ready light shows steady green.

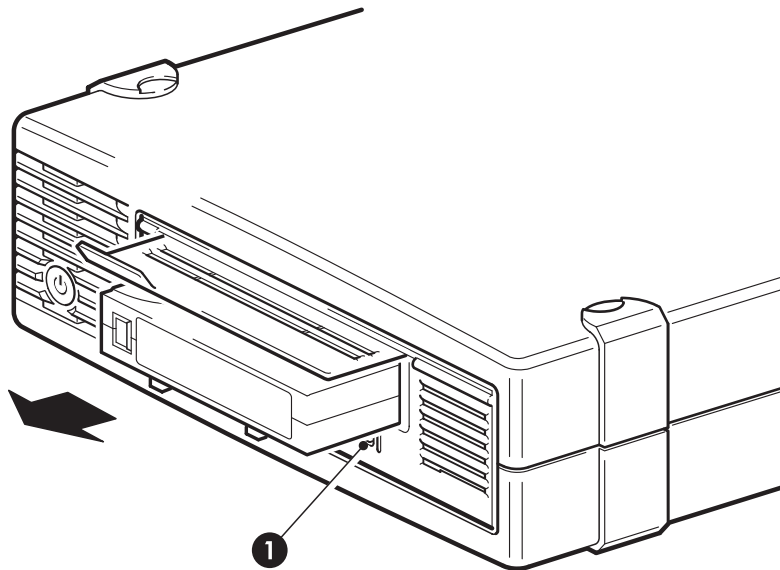


## Removing cartridges

△ **CAUTION:** Never try to remove a cartridge before it is fully ejected.

1. Press the Eject button on the front panel.

**Figure 21** Ejecting a cartridge



1	Eject button
---	--------------

2. The drive will complete its current task, rewind the tape to the beginning, and eject the cartridge. The rewind process may take up to 10 minutes. The Ready light will flash to indicate that the unload is still in progress.

## Removing power from the drive

To ensure reliable operation, do not remove power from the drive during read, write, fast-search, load and unload activities.



## 8 Use the correct media

For best performance we recommend HP branded media. Order online at: [www.hp.com/go/storagemedia](http://www.hp.com/go/storagemedia).

### Data cartridges

HP StorageWorks Ultrium tape drives use Ultrium tape cartridges. These are single-reel cartridges that match your drive's format and are optimized for high capacity, throughput and reliability. Compatible media can be recognized by the Ultrium logo, which is the same as the logo on the front of your drive. Do not use other format cartridges in your tape drive and do not use Ultrium cartridges in other format tape drives.

For optimum performance always use a data cartridge that matches the specification of your tape drive, (see [Table 3](#)). A lower specification will have a lower transfer speed and may not support write activities; a higher specification will not support read or write. We recommend:

- Ultrium 800 GB RW\* and Ultrium 800 GB\* WORM tape cartridges for use with Ultrium 920 tape drives.
- Ultrium 400 GB\* tape cartridges for use with Ultrium 448 tape drives.
- Ultrium 200 GB\* tape cartridges for use with Ultrium 232 tape drives.

**Table 3** Data cartridge compatibility

	<b>Ultrium 200 GB* data cartridge</b>	<b>Ultrium 400 GB* data cartridge</b>	<b>Ultrium 800 GB* data cartridge</b>	<b>Ultrium 800 GB* WORM cartridge</b>
HP StorageWorks Ultrium 920	read only	read/write	<b>read/write (C7973A)</b>	<b>read many/ write once</b>
HP StorageWorks Ultrium 448	read/write	<b>read/write (C7972A)</b>	no	no
HP StorageWorks Ultrium 232	<b>read/write (C7971A)</b>	no	no	no

\* Capacity assumes 2:1 compression.

### HP Ultrium WORM data cartridges

The HP StorageWorks Ultrium 920 tape drive includes support for both re-writable and Write-Once, Read-Many, WORM, data cartridges. WORM cartridges provide for an enhanced level of data security against accidental or malicious alteration of data on the tape cartridge. The WORM data cartridge can be appended to maximize the full capacity of the tape cartridge, but the user will be unable to erase or overwrite data on the cartridge. Any attempt to modify a WORM cartridge to enable writing over existing data will result in the media becoming permanently write protected. It should still be readable in a WORM drive, depending upon the severity of the tampering, but no further appended backups will be possible.

WORM data cartridges are clearly identified by their distinctive, two-tone cartridge color. They do not have a write-protect slider and can only be used with Ultrium tape drives that support the WORM feature.

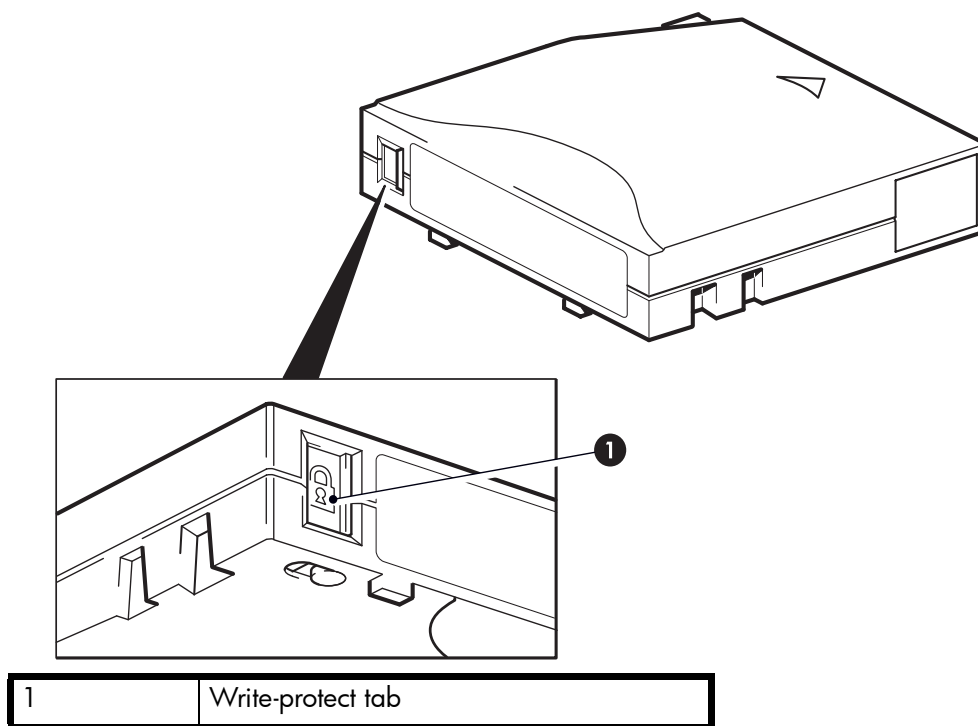
To check whether your backup or archive software application supports WORM cartridges, refer to the following web site: [www.hp.com/go/connect](http://www.hp.com/go/connect).

For information on how your HP Ultrium StorageWorks 920 tape drive and WORM cartridge can help your business meet Information Lifecycle Management and regulatory compliance requirements, please refer to the HP Business Support Center at: [www.hp.com](http://www.hp.com).

## Write protecting cartridges

If you want to protect the data on a cartridge from being altered or overwritten, you can write protect the cartridge.

**Figure 22** Write protecting a cartridge



Always remove the cartridge from the tape drive before you change the write protection.

- To write protect a cartridge, push the switch to the right to prevent any data recording on the cartridge. Note the padlock on the tab that indicates that the cartridge is protected.
- To write enable a cartridge, push the switch to the left to allow data recording on the cartridge. [Figure 22](#) illustrates the location of the write-protect tab

Write-protection will not protect your cartridges against magnets. Write-protection will not prevent a cartridge being erased by bulk-erasure or degaussing. Do **not** bulk erase Ultrium format cartridges. This will destroy pre-recorded servo information and make the cartridge unusable.

## Cleaning cartridges

You must use Ultrium cleaning cartridges with HP StorageWorks Ultrium tape drives, as other cleaning cartridges will not load and run. We recommend the HP Ultrium universal cleaning cartridge (see [Table 4](#)). Unlike some earlier Ultrium cleaning cartridges, the orange-colored HP Ultrium universal cleaning cartridge is designed to work with any Ultrium drive.

**Table 4** cleaning cartridge compatibility

Type of cartridge	Recommended cartridge	Other options
Cleaning	<b>HP Ultrium universal cleaning cartridge C7978A (Orange)</b>	HP Ultrium cleaning cartridge C7979A (Blue). Do not use early, non-universal Ultrium cleaning cartridges from other manufacturers.

## To clean the tape drive

HP StorageWorks Ultrium tape drives do not require regular cleaning. An Ultrium universal cleaning cartridge should only be used when the orange Clean LED is flashing.

1. Insert the Ultrium universal cleaning cartridge.
2. The drive will carry out its cleaning cycle and eject the cartridge on completion (which can take up to 5 minutes). During the cleaning cycle the orange Clean LED will be on solidly and the green Ready LED will flash.

Each HP Ultrium universal cleaning cartridge (C7978A) can be used up to 50 times with Ultrium tape drives. (The blue HP Ultrium cleaning cartridges, C7979A, can only be used up to 15 times with any tape drive.) If the cleaning cartridge is ejected immediately with the Tape LED on, it has expired.

## Handling cartridges

- Do not touch the tape media.
- Do not attempt to clean the tape path or tape guides inside the cartridge.
- Do not leave cartridges in the drive. The tape loses tension in the power-off state, which can lead to problems, particularly if the drive has been moved.
- Do not leave cartridges in excessively dry or humid conditions.
- Do not leave cartridges in direct sunlight or in places where magnetic fields are present (for example, under telephones, next to monitors or near transformers).
- Do not drop cartridges or handle them roughly.
- Stick labels onto the label area only.
- Do not bulk erase (degauss) Ultrium format cartridges because this will render them unusable.

## Operating and storage environment

To prevent condensation and for long life, the cartridge should only be operated or stored as follows:

- Operation: 10° C to 45° C (50° F to 113° F)
- Day-to-day storage (in plastic container): 16° C to 32° C (60° F to 90° F)
- Non-condensing relative humidity: 10% to 80% (operating), 20% to 60% (non-operating)
- Wet bulb temperature should not exceed 26°C (79°F).

Tapes intended for archiving data should be stored in the plastic containers, at temperatures between 5°C and 23°C (41°F and 73°F) and 10% to 50% relative humidity.

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## 9 Using HP OBDR

### Compatibility

HP One-Button Disaster Recovery is a standard feature on all HP StorageWorks Ultrium tape drives. However, it can only be used with specific configurations and will recover only the server to which the tape drive is directly connected.

To check whether your system (hardware, operating system and backup software) is OBDR-compatible, please refer to our World Wide Web site [www.hp.com/go/connect](http://www.hp.com/go/connect).

For more specific information concerning the benefits of OBDR and the latest new features please refer to our World Wide Web site [www.hp.com/go/obdr](http://www.hp.com/go/obdr).

If your system does not support HP One-Button Disaster Recovery, you can still use your tape drive normally to back up and restore data. However, you must remember to create a separate set of emergency recovery disks for your operating system whenever you change your system configuration.

### What does HP OBDR do?

Using just the tape drive and the most recent backup cartridge HP OBDR allows you to recover from the following types of system disaster:

- Hard disk failures, as long as the replacement hard disk is the same size or larger than the original and uses the same interface (for example, replace a SCSI hard disk with another SCSI disk)
- Hardware failures where the server is replaced by an **identical** component
- File corruption because of an operating system error
- File corruption because of an application software error
- Viruses that prevent you from booting your system correctly
- User errors that stop you from booting your system correctly

When you run HP One-Button Disaster Recovery, your tape drive goes through the following sequence:

1. It goes into a special disaster recovery mode that enables it to restore your operating system and reboot. It acts like a bootable CD-ROM. (Your system's ability to boot from CD-ROM is normally enabled by default. If you have changed this setting, you will need to enable it again. Refer to your system BIOS manual for further details.)
2. It returns to normal tape drive mode and restores the data.

### Remote disaster recovery (ProLiant servers only)

The HP Remote Insight Lights-Out Edition (RILOE) on ProLiant servers gives the IT Administrator the ability to completely recover a failed server at a remote location without physically traveling to where the server resides. The on-site non-technical person need only insert the bootable cartridge into the tape drive when asked to do so by the administrator.

Refer to the HP OBDR web site at [www.hp.com/go/obdr](http://www.hp.com/go/obdr) for more information about using this feature and compatibility.

## Testing for compatibility

We recommend that you perform a full disaster recovery immediately after installation—if possible, onto a blank hard disk. If you do not have a blank hard disk and do not want to overwrite your system, you can safely cancel the disaster recovery process at step 3 in the following procedure.

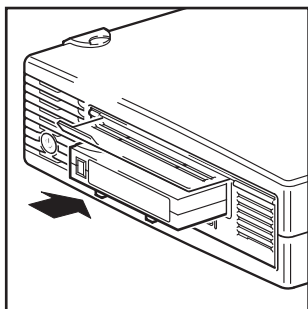
Refer to our connectivity web site ([www.hp.com/go/connect](http://www.hp.com/go/connect)) for more information about suitable backup applications.

## Running HP OBDR

HP OBDR can only be used with backup applications that support one-button disaster recovery and methods of operating OBDR will vary between different software companies. Check our World Wide Web site ([www.hp.com/go/obdr](http://www.hp.com/go/obdr)) for the latest information about software compatibility, firmware upgrades and troubleshooting before you use HP OBDR.

1. Insert the latest bootable cartridge in the tape drive. The cartridge must be written by a backup application that writes data to tape in CD-ROM format.

**Figure 23** Inserting cartridge for OBDR



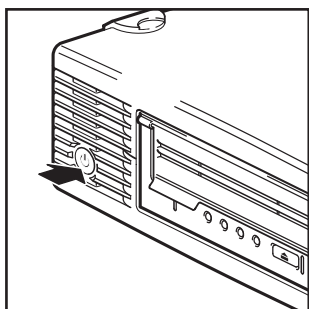
2. Hold down the eject button on the tape drive. Keeping the eject button pressed down, power on your tape drive (external drives only) and server. This activates the HP One-Button Disaster Recovery process. Release the button as soon as the Ready LED on the front panel flashes in the OBDR sequence. This is a repeated pattern of: flashing-steady on-flashing.

### Keyboard shortcut for HP ProLiant servers

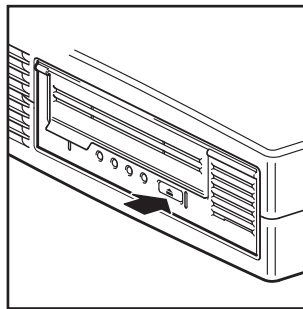
There is no need to press the Eject button. Just power on your server and press the [F8] function key during the Power On Self Test (POST). This invokes OBDR to restore your system. For more information and specific instructions please refer to our World Wide Web site at [www.hp.com/go/obdr](http://www.hp.com/go/obdr).



**Figure 24** Keeping eject button pressed down, power on in OBDR mode



**external drives only:** switch on tape drive before server



**all drives:** hold down eject button on tape drive and power on server

3. Follow the on-screen instructions to set up the operating system. Normally, you can accept the default response to all the prompts, for example just press <Enter>.
4. The LEDs will flash in OBDR mode (as described in step 2) while the tape drive restores your operating system to a state where it can run a normal data restore.
5. Once the operating system has been set up and rebooted, the Ready LED display on the tape drive changes to constant green and you can remove the backup cartridge, if you wish. You are now ready to run a normal data restore. Follow the normal process for your restore application.

## If restore fails

If the restore fails for any reason, refer to our World Wide Web site ([www.hp.com/go/obdr](http://www.hp.com/go/obdr)) and do a search on "OBDR" for detailed troubleshooting information.



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# 10 Diagnostic Tools and Performance

## Diagnostic tools

### HP Library & Tape Tools

HP StorageWorks Library & Tape Tools is the recommended diagnostic and support tool for your HP tape storage product. It is available on the CD shipped with your product or as a free download from the HP web site. It is supported on nearly all major operating systems.

See [www.hp.com/support/tapetools](http://www.hp.com/support/tapetools) for compatibility information, updates and the latest version of the tool.

### Troubleshooting with Library & Tape Tools


1. From the HP StorageWorks CD, select **troubleshoot**.

This will allow you to run Library & Tape Tools in standard mode, either directly from the CD (no installation on the server) or as an installation on your server. HP recommends installation of Library & Tape Tools, so that it can be quickly accessed at any time. HP Support will also request that you use Library & Tape Tools should you need to contact them in the future, so it is a good idea to have it installed.

2. When Library & Tape Tools is first run, it will scan for HP tape drives and libraries on your system and ask you to select the one to work with. At this time you can see the HBA configuration of your server, how your devices are connected and the SCSI IDs of those devices.
3. Once you have selected your device you have a number of choices for troubleshooting.
  - Device identification: shows part number, serial number and information about any cartridge loaded
  - Firmware upgrade: allows you to locate and upgrade to the latest firmware. You will need to be connected to the internet for this.
  - Run tests: allows you to run proactive tests on your drive, such as the drive assessment test, which will verify the functionality of your drive in around 20 minutes. HP recommends running this test before calling HP Support. You will need to provide a 'trusted' cartridge that can be written to during this test.
  - Generate a support ticket: this is a full dump of the drive logs along with interpretation and is used by HP Support to learn about the condition of your drive. Most useful is the device analysis section which is the output from approximately 20 rules forming a comprehensive analysis of the health of your drive. These rules may give advice such as cleaning the head or trying a different tape if issues are found. The support ticket can be sent to HP Support for further analysis.
  - Run the performance tests: the tests to measure the write/read performance of your tape drive and the data generation rates of your disk subsystem are also integrated into Library & Tape Tools. Use these tests to find the performance bottleneck in your system.

# Performance Assessment Tools

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 **NOTE:** We strongly recommend that you check the information on our web site at [www.hp.com/support/pat](http://www.hp.com/support/pat). This contains detailed support information that will enable you to identify bottlenecks and take full advantage of the performance capabilities of the Ultrium family of tape drives.

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You can use our free, standalone performance assessment tools to check tape performance and test whether your disk subsystem can supply data at the maximum transfer rate.

The tools are located online at [www.hp.com/support/pat](http://www.hp.com/support/pat). They are also integrated into HP Library & Tape Tools, which is available both online ([www.hp.com/support/tapetools](http://www.hp.com/support/tapetools)) and on the CD-ROM supplied with your tape drive.

## Optimizing performance

Various factors can affect tape drive performance, particularly in a network environment or if the drive is not on a dedicated bus. In nearly all cases when performance is not as expected, it is the data rates of the disk subsystem that cause the bottleneck.

If your tape drive is not performing as well as expected—for example, if backup windows are longer than expected—please try the tools and consider the following points before contacting HP Support at [www.hp.com/support](http://www.hp.com/support).

### Is the tape drive on a dedicated SCSI bus?

We recommend that the tape drive is the only device on the SCSI bus. If it is not, ensure other devices are LVD-compliant. If they are single-ended, the bus will switch to single-ended mode with a lower transfer speed. There will also be restrictions on cable length.

With external drives auto termination powers down when the tape drive powers down. This can cause a problem, if there are other devices on the SCSI bus.

### Can your system deliver the required performance?

- The Ultrium 920 tape drive can write uncompressed data at up to 60 MB/s (216 GB/hour) or compressed data at up to 120 MB/s (432 GB/hour), assuming 2:1 compression.
- The Ultrium 448 tape drive can write uncompressed data at up to 24 MB/s (86 GB/hour) or compressed data at up to 48 MB/s (172 GB/hour), assuming 2:1 compression.
- The Ultrium 232 tape drive can write uncompressed data at up to 16 MB/s (59.6 GB/hour) or compressed data at up to 32 MB/s (119.2 GB/hour), assuming 2:1 compression.

To get this performance it is essential that your whole system can deliver this performance. In most cases, the backup application will provide details of the average time taken at the end of the backup.

Typical areas where bottlenecks can occur are:

- **Disk subsystem**

A single spindle disk will not be able to deliver good data throughput for an Ultrium 920 at any compression ratio. To maximize the capability of your Ultrium 920 drive, utilize aggregated disk sources (RAID) with multiple disk spindles.

A single spindle disk may be sufficient for an Ultrium 448 or 232 depending on your data's compressibility. Best practice to ensure good throughput is to utilize multiple disk spindles or data sources.

- **System architecture**

Be aware of the architecture of your data protection environment; multiple clients backed up over a network may mean you are unable to take advantage of the Ultrium 920 because the Ethernet infrastructure connecting such systems may limit performance.

For Ultrium 448 and 232 drives, the aggregation of multiple client sources over a network remains a good way of delivering good performance, but anything less than Gigabit Ethernet may limit performance for Ultrium 448 tape drives.

Some enterprise class backup applications can be made to interleave data from multiple sources, such as clients or disks, to keep the tape drive working at optimum performance.

- **Tape media type**

The data cartridge should match the specification of the tape drive. A lower specification will have a lower transfer speed (see "Data cartridges" on page 43).

Use Ultrium 800 GB or Ultrium WORM 800 GB cartridges with Ultrium 920 tape drives, Ultrium 400 GB cartridges with Ultrium 448 tape drives and Ultrium 200 GB cartridges with Ultrium 232 tape drives.

- **Data and file types**

The type of data being backed up or restored can affect performance. Typically, small files incur greater overhead in processing and access than large files. Equally, data that is not compressible will always limit the speed at which the drive can write/read data. You will achieve no more than native rates with uncompressible data.

Examples of files that compress well are plain text files, spreadsheets; those that compress poorly are those that are either compressed as part of their format (such as, JPEG photographic files) or stored as compressed (such as, .ZIP files or .gz/.Z files on Unix platforms).



# 11 Troubleshooting

Many users can use HP Library & Tape Tools to help them diagnose problems, see “[Diagnostic tools](#)” on page 53. We also recommend the detailed troubleshooting guide at [www.hp.com/go/support](http://www.hp.com/go/support) for comprehensive troubleshooting information.

## General Procedure

If a problem occurs, the first step is to try to establish whether the problem lies with the cartridge, the drive, the host computer and connections, or the way the system is being operated.

- ❑ Has the system just been installed?  
There could be an installation problem:
  1. Check through the information in the relevant installation chapter of this guide.
  2. Check the power connectors and SCSI cabling.
  3. Is the SCSI ID correctly set? Is there a SCSI system conflict? Has the SCSI bus been correctly terminated? See also “[SCSI configuration guide](#)” on page 67.
  4. Are appropriate drivers and application software installed on the host?
  5. Check the environmental conditions against the specified limits.

**Table 5** Environmental specifications for half-height Ultrium tape drives

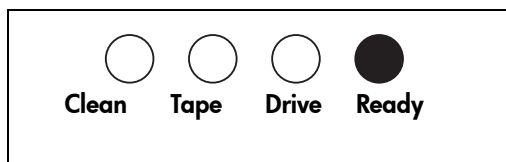
	Temperature range	Non-condensing humidity range
Operating	50 to 95 degrees F (10 to 35 degrees C) at a minimum of 6 CFM airflow	20 to 80% RH (non-condensing)
Storage	-40 to 151 degrees F (-40 to 66 degrees C)	10 to 95% RH (non-condensing)

- ❑ Are you using new cartridges or a different brand of cartridge? Have you been using the particular cartridge for a very long time?  
The problem could lie with the cartridge:
  1. Check through the media chapter on page 43.
  2. Check that you are using an Ultrium cartridge. Compatible media can be recognized by the Ultrium logo, which is the same as the logo on the front of your drive.
  3. Use the correct media type, for example:
    - Ultrium 800 GB RW\* (C7973A) and Ultrium 800 GB\* WORM tape cartridges for use with Ultrium 920 tape drives.
    - Ultrium 400 GB\* tape cartridges (C7972A) for use with Ultrium 448 tape drives.
    - Ultrium 200 GB\* tape cartridges (C7971A) for use with Ultrium 232 tape drives.

4. Has the cartridge been write-protected, see “[Write protecting cartridges](#)” on page 44?
  5. Clean the tape heads with the cleaning cartridge, see “[Cleaning cartridges](#)” on page 46.
  6. Try the operation again.
  7. If the problem still occurs, try using a different cartridge.
  8. If the problem is still there, the problem probably lies with the drive or the host computer.
- Has the drive been moved recently? Have any cables been disconnected and reconnected? Has the environment changed—unusually hot, cold, damp or dry? Has there been dust or dirt near the drive. Have reasonable precautions against static been taken?
- The problem could lie with the drive:
1. Check the cables and connectors.
  2. Clean the tape heads with the cleaning cartridge.
  3. If the problem persists, check the environmental conditions against the specified limits, see table above or refer to [www.hp.com](http://www.hp.com). Perhaps move the drive to a more suitable site.
- Has a new operating system been installed in the host computer? Has new backup software been installed?
- The problem could lie with the host or the software. Consult the computer’s operating manuals, the software manual, or seek help from a service engineer.

## Understanding LED sequences

**Figure 25** Ultrium LEDs



Your Ultrium tape drive has four LEDs (light emitting diodes) on the front panel, which indicate drive status. These LEDs provide useful troubleshooting information.





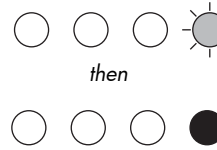
The tape drive performs a power on self-test whenever power is applied or the drive is reset. The test takes about 5 seconds.

- The green Ready light flashes several times and then remains on if self-test passes. All other LEDs remain off.
- If the self-test fails, the Drive and Tape LEDs flash, while the Ready and Clean LEDs are off. This continues until the drive is reset.





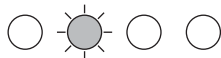


Use the following table to interpret the front panel LED sequences and the appropriate action to take, if any. If you cannot resolve a problem, contact customer service at [www.hp.com/support](http://www.hp.com/support).

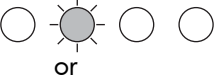

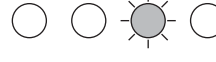
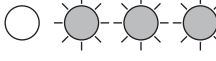


**Table 6** LED sequences

LED Sequence	Cause	Action required
 <i>All LEDs OFF.</i>	Drive may not have power, may be faulty or may have been power cycled or reset during a firmware upgrade.	Make sure the drive is switched on. The power on/off switch on an external drive incorporates a green LED.  Check the power cable connection and replace the cable if necessary. You can use the power cable from your monitor or another device to check that the connection is working.  If the power supply is present and all LEDs remain off, power cycle or reset the drive (see page 62). If it still fails, call for service.
 <i>Ready and Clean OFF. Drive and Tape FLASH.</i>	The drive has failed to execute power-on self test (POST).	Power cycle or reset the drive (see page 62).  If the error condition reappears, call for service.
 <i>Ready is ON.</i>	The drive is ready for operation.	None. This is normal.
 <i>Ready FLASHES.</i>	The drive is carrying out a normal activity (read, write).	None.  If the drive is upgrading firmware, do not reset or power cycle it.
 <i>Ready FLASHES- steady ON- FLASHES.</i>	The drive is in OBDR mode.	See "Running HP OBDR" on page 50 for further details.

**Table 6** LED sequences

LED Sequence	Cause	Action required
 <i>Ready FLASHES fast.</i>	The drive is downloading firmware.	None. Do not reset or power cycle the drive.
 <i>Ready is OFF, others are ON.</i>	Firmware is being reprogrammed.	None. Do not reset or power cycle the drive.
 <i>Clean FLASHES.</i>	The drive requires cleaning.	Load the Ultrium cleaning cartridge. See page 46 for supported cartridges and instructions.  If the Clean LED is still flashing when you load a new or known good data cartridge after cleaning, call for service.
 <i>Ready FLASHES and Clean is ON.</i>	Cleaning is in progress.	None. The cleaning cartridge will eject on completion.  The cleaning cycle can take up to 5 minutes to complete.
 <i>Tape FLASHES.</i>	The drive believes the current tape or the tape just ejected is faulty.	Unload the tape cartridge. Make sure that you are using the correct format cartridge; an Ultrium data cartridge or Ultrium universal cleaning cartridge. (See page 43.)  Reload the cartridge. If the Tape LED still flashes or starts flashing during the next backup, load a new or known good cartridge.  If the Tape LED is now off, discard the 'suspect' tape cartridge. If it is still on, call for service.

**Table 6** LED sequences

LED Sequence	Cause	Action required
 <p>or</p>  <p>The tape is ejected immediately and Tape FLASHES, or Drive FLASHES on unloading tape.</p>	The tape cartridge memory (CM) may be faulty.	Write-protect the cartridge by sliding the switch on the tape cartridge, see page 44. The tape can be loaded and the data read. Once the data is recovered, the cartridge must be discarded.
 <p>Drive FLASHES.</p>	The drive mechanism has detected an error.	Load a new cartridge. If the error persists, power cycle or reset the drive.  If the Drive LED remains on, call for service.
 <p>Drive, Tape and Ready FLASH.</p>	There is a firmware download problem.	Insert a cartridge to clear the LED sequence. If the condition persists, call for service.
 <p>then</p>  <p>Drive and Ready ON with Tape and Clean OFF. Alternates repeatedly.</p>	The drive has a firmware error.	Power cycle or reset the drive.  Upgrade the firmware. If the condition persists, call for service.

## Problems with cartridges

If you experience any problems using HP branded cartridges, check:

- The cartridge case is intact and that it contains no splits, cracks or damage.
- The cartridge has been stored at the correct temperature and humidity. This prevents condensation. See the insert included with the tape cartridge for storage conditions.
- The write-protect switch is fully operational. It should move from side to side with a positive click.
- The World Wide Web site for more detailed troubleshooting information: [www.hp.com/support](http://www.hp.com/support).

## The cartridge is jammed

If the cartridge is jammed or the backup application is unable to eject it, you can force eject the cartridge. Once the cartridge is successfully ejected, it is good practice to run Library & Tape Tools to diagnose the problem and to upgrade the firmware. If the failure occurs regularly, contact customer service at [www.hp.com/support](http://www.hp.com/support).

1. Either press and hold the Eject button on the front of the tape drive for at least 10 seconds.
2. Wait for the cartridge to be ejected. This process may take up to 10 minutes (the maximum rewind time). It is important that you allow sufficient time for the drive to complete this process. If you interrupt it, you may damage the media or the tape drive. The drive is then reset as though you had turned the power off and then on again.

You may lose data if you force eject a cartridge. The tape may also become unreadable because an EOD (End of Data) mark may not be properly written.

3. If the cartridge is still jammed, the tape drive has failed. Contact customer service at [www.hp.com/support](http://www.hp.com/support).

## Emergency reset

As a last resort, if the drive has disappeared off the SCSI bus and appears to have failed, it can be reset by holding the eject button down for 20 seconds. This will allow the drive to reset its internal hardware, including the SCSI port, and potentially make it visible to a host again.

The reset process may take up to 10 minutes (the maximum rewind time) to complete.

---

**NOTE:** This form of reset will clear the internal buffers and, therefore, lose any data in them. If the drive was writing at the time, data may be lost and the cartridge will not have an EOD, which means that subsequent restores are likely to fail. Discard the cartridge.

---

If the cartridge is still jammed, the tape drive has failed. Contact customer service at [www.hp.com/support](http://www.hp.com/support).

## The drive will not accept the cartridge (or ejects it immediately)

The cartridge may have been damaged, for example dropped, or the drive may have a fault. If it is a cleaning cartridge, it has probably expired and should be discarded immediately. For data cartridges:

1. Check that the drive has power (the power cable is properly connected and the Ready LED is on).
2. Check that you are using the correct media. Only use Ultrium media, (see "Data cartridges" on page 43). We recommend:
  - The HP Ultrium 800 GB cartridge or 800 GB WORM cartridge for Ultrium 920 drives.
  - The HP Ultrium 400 GB cartridge for Ultrium 448 drives.
  - The HP Ultrium 200 GB cartridge for Ultrium 232 drives.
3. Make sure that you have loaded the cartridge with the correct orientation (see "Loading and unloading" on page 40).

4. Check for damage to your media and discard it if it is damaged.
5. Use a new or known, good piece of media and see if it loads. If it does, the original cartridge is faulty and should be discarded.
6. Check if another Ultrium drive of the same model will accept the cartridge. If it does, the original drive may be faulty. Before calling customer service, please check that the tape drive is responding. See "[Troubleshooting with Library & Tape Tools](#)" on page 53.



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## 12 Replacing an internal tape drive

If your tape drive proves to be faulty and cannot be repaired and it is still covered by the original warranty, it will be replaced. HP will provide a replacement tape drive free of charge. Based on availability and where geography permits, the replacement tape drive will be shipped for next business day delivery. Same day or four-hour delivery may be offered at an additional charge where geography permits. If you request HP to install the replacement tape drive, you will be charged for the travel and labor costs of this service.

### To disconnect your drive

1. Unpack your replacement drive, and retain the packaging.
2. Power off the server and any other devices that are on the same SCSI bus and disconnect from the mains power supply.
3. Remove the cover from the server.
4. Observing normal anti-static precautions (see page 18) remove any screws that are holding the tape drive in place.
5. Disconnect the drive from the server's power and SCSI cables and slide it carefully out of the mounting bay.
6. Put the drive into the packaging that contained the replacement drive.
7. Return the faulty drive to your local HP Service Center. Instructions on where to return faulty drives will be shipped with the replacement drive. You must ship the defective drive back to HP within a defined period of time, normally five (5) business days. The defective part must be returned with the associated documentation in the provided shipping material. Failure to return the defective part may result in HP billing you for the replacement. HP will pay all shipping and part return costs and determine the courier/carrier to be used.



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**NOTE:** If you are not replacing the drive immediately, you should insert a blanking plate into the empty bay. Replace the cover on the server and secure with screws, as appropriate.

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### To reconnect your tape drive

Follow the step-by-step instructions in this User Guide.

See complete HP limited warranty statement at:

<http://h18006.www1.hp.com/products/storageworks/warranty.html>





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# A SCSI configuration guide

## SCSI in HP StorageWorks Ultrium devices

HP StorageWorks Ultrium 920 tape drives are Ultra320 SCSI-3 compatible devices. HP StorageWorks Ultrium 448 and 232 tape drives are Ultra160 SCSI-2 compatible devices. They are designed to operate on a low voltage differential (LVD) SCSI interface. They are not compatible with high voltage differential (HVD) SCSI devices.

Ultrium 920 drives support a burst transfer rate of 320 MB/sec, Ultrium 448 and 232 drives support a burst transfer rate of 160 MB/sec. To benefit from this level of performance, it is important to ensure that the drives are connected to a SCSI bus of a similar or higher specification. This means that you need:

- **An Ultra320 bus for HP Ultrium 920 drives**  
**An Ultra160 or Ultra320 SCSI bus for HP Ultrium 448 and 232 drives**  
If you attach the drive to a lower specification SCSI bus, it will still work but data may not be transferred as quickly. Ultra2 SCSI is also supported, but performance may be degraded if there are several devices on the SCSI bus.
- **LVD-rated SCSI cabling and terminators.** The LVD interface enables the data to be transferred at the drive's maximum rate and provides a maximum cable length of 12 meters.

We also recommend that the tape drive is connected to a dedicated host bus adapter. If you need to connect multiple devices to the bus, performance may be restricted if there are too many (3 or more) devices on the bus that are accessed simultaneously. Connecting devices of lower SCSI specification, such as Ultra2 or Ultra SCSI, may also restrict performance to your tape drive. Using Single Ended 8-Bit SCSI devices on the same bus is not recommended, as performance will be severely impacted and complicated bus configuration is required to overcome bus termination issues.

Make sure that the last device on the SCSI bus is terminated. We recommend that you do not attach the tape drive to the same SCSI bus as the disk drive. See "[SCSI termination](#)" on page 69 for more information about terminating HP StorageWorks DAT tape drives.

## SCSI terminology

SCSI is a bus interface: all the devices are connected to a single cable (some of this may be inside and some outside the host computer's case). The connection to the host itself is known as the Host Bus Adapter (HBA). You can have several HBAs in a single computer, each with its own SCSI bus: this is a common arrangement in high-performance servers. Some host bus adapters (such as the LSI Logic LSI22320-R) have more than one SCSI bus available on a single card.

Various terms are used when describing SCSI devices. These terms relate to the factors that affect performance and cable length:


- The speed of the data bus, which may be Fast, Ultra, Ultra2, Ultra3, Ultra160 or Ultra320.
- The width of the data bus, which may be Narrow or Wide (16-Bit or 8-Bit).

- The voltage level of the interface, which may be single-ended (SE) or low voltage differential (LVD).

## Setting up the SCSI bus

Each device on a SCSI bus, including the SCSI host bus adapter (HBA), must be configured with a unique ID (identifier). The SCSI bus must be terminated.

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 **NOTE:** HP recommends that a dedicated host bus adapter is used for the tape drive. A suitable adapter is available from HP as an accessory (see [www.hp.com/go/connect](http://www.hp.com/go/connect)).

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## SCSI ID numbers

For wide SCSI buses, the SCSI ID will be a number from 0 through 15, so a typical wide SCSI HBA can accommodate up to fifteen other devices. (On narrow SCSI buses, the SCSI Id is a number from 0 through 7.)

**Narrow:** 7 6 5 4 3 2 1 0  
          High ——— priority ——— Low  
**Wide:** 7 6 5 4 3 2 1 0 15 14 13 12 11 10 9 8

Each device must have a unique SCSI ID. The drive can be assigned any unused ID between 0 and 15. Do not use SCSI ID 7, which is reserved for the SCSI controller. SCSI ID 0 is typically assigned to the boot disk and should also not be used unless the tape drive is on a dedicated SCSI bus.

SCSI ID 7 is normally reserved for the HBA because it has the highest priority on the bus. On wide buses, the priority runs from 7 (highest) to 0, then 15 down to 8 (lowest).

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 **NOTE:** As a general rule, avoid putting tape devices on the same bus as any hard disks.

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## Identifying SCSI IDs

If your computer already has devices connected to the SCSI bus, you will need to know their IDs to avoid any conflict with the new tape drive. Here are some methods of finding out the information:

- The fastest and easiest way is to run HP Library & Tape Tools from this CD-ROM. HP Library & Tape Tools will check your SCSI configuration, including the SCSI controller itself and any devices currently attached to it.
- Most computers display a list of SCSI devices and IDs during the boot-up process. This usually scrolls past very fast. If you press the [Pause] key, you should be able to halt the scrolling and view the list.
- On Windows systems you can use Device Manager.
- If you have Novell NetWare installed, use its LIST DEVICES command.

If none of these is available to you, try the following sources of information:

- The details of all installed devices and settings may have been written down and stored with your computer's documentation (for new computers, this is often done by the supplier).
- Your HBA's documentation should tell you which settings it uses.
- Look at each device to find out its ID. This is usually easy with external devices. With internal devices, you will probably need the help of the device's documentation to identify the SCSI ID setting, which is usually set with jumpers.

## Setting the SCSI id on HP StorageWorks drives

For all cases, see the User Guide that came with your tape drive for more details. Note that host adapters check SCSI IDs only at power-on, so any changes will not take effect until the host system is power-cycled.

- On internal HP StorageWorks drives, set the SCSI ID by attaching or removing jumpers at the rear of the drive, see "[Check the drive's SCSI ID](#)" on page 17.
- On external HP StorageWorks drives, the ID is displayed on the rear panel and can be set by pressing the little buttons above and below the number (using a ball point pen), see "[Check the drive's SCSI ID](#)" on page 27.
- On removable HP StorageWorks drives, the ID is set on the back of the tape array, see "[Set the drive's SCSI ID](#)" on page 33.

## SCSI termination

Terminators are essential, as they provide the correct voltages on the SCSI bus and prevent unwanted signal reflections from interfering with data transfers. The rule is:

- There must be termination at both physical ends of the bus and only at the ends.

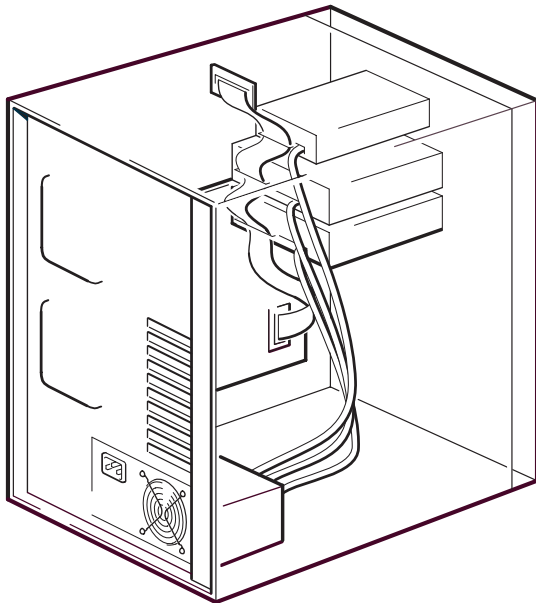
There are two main types of termination, active and passive. Active terminators reduce interference and allow faster data throughput. On devices with high transfer speeds, such as HP StorageWorks tape devices, active termination is required, using an LVD or multimode active terminator. (Multimode terminators allow both LVD and single-ended devices to be connected to the same bus. They detect the type of bus and automatically supply the correct termination.)

Normally the HBA forms one end of the SCSI bus and provides termination. You only need to ensure that the other end of the bus is terminated.

## Internal drives

HP StorageWorks Ultrium internal tape drives do not provide termination. A suitably terminated LVD internal ribbon cable is supplied with the tape drive. The terminator is usually a small, rectangular block of plastic attached to the cable end and marked 'SCSI Terminator'.

**Figure 26** SCSI termination in internal drives



As long as this terminator is attached, you do not need to take any further action. However, if you have other devices attached to the cable, make sure that they have termination removed or disabled.

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**NOTE:** If you have an internal and external device attached to the same SCSI bus, the HBA will be in the middle of the cable and thus its termination must be disabled. See the host bus adapter's documentation for details of how to do this.

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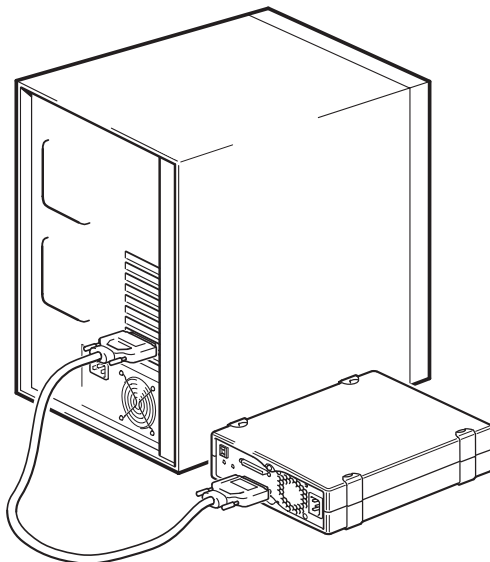
## External drives

For HP StorageWorks Ultrium external tape drives the enclosure provides active termination.

As long as the drive is the only device on the SCSI chain, no terminators are required. The green ACT Term LED on the rear of the drive indicates whether auto-termination is active (on) or not (off)

Make sure the terminator is firmly attached to the SCSI-OUT connector on the rear of the device when you install it. With the HP StorageWorks DAT 72 drive always use the supplied LVD terminator for proper operation.

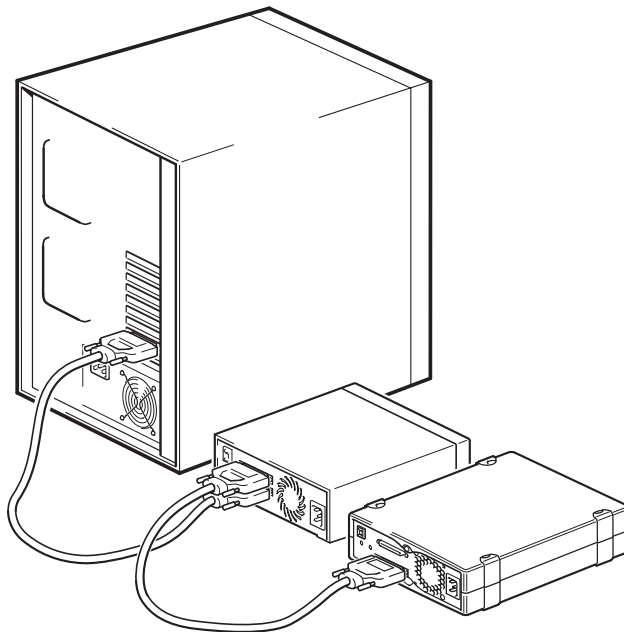
**Figure 27** SCSI termination in external drives



If you have more than one device on the SCSI bus, daisy-chain them by connecting an LVD-rated cable from the SCSI-OUT connector on the first device to the SCSI-IN connector on the second device. Assuming you have two Ultrium tape drives connected, the enclosure on the second drive provides termination. The green ACT Term LED on the rear of the first drive will be off while on the

rear of the second drive it will be on. If the second device is not an Ultrium external drive, make sure that it is terminated using an LVD-rated multimode terminator.

**Figure 28** SCSI termination in daisy-chained external drives



## Removable drives

For HP StorageWorks Ultrium removable tape drives, termination is provided by connecting a terminator to the spare SCSI connector on the rear of the tape array. There are two connectors for each bay in the tape array. It doesn't matter which is used for SCSI-IN and SCSI-OUT.

If you have each removable drive in the tape array attached to a separate bus, then, for each bay in use, you must attach a terminator to the spare connector for each device.

If you are using the removable drives to mirror backups, you can daisy-chain devices (but no more than two on each SCSI bus). Connect an LVD-rated cable from the spare SCSI connector for the first device to one of the SCSI connectors for the second device and attach the terminator to the spare SCSI connector for the second device.

Refer to your tape array documentation for detailed instructions.

## SCSI cables

Cables matter in SCSI systems. There are two factors to consider: cable length and cable quality.

### Cable length

- For single-ended SCSI with Fast devices there is a maximum permissible length of 6 meters for a single SCSI bus.

- For single-ended SCSI with Ultra devices the maximum permissible length is 3 meters for four or fewer devices, and 1.5 meters for more than four devices.
- For LVD SCSI the maximum length for a single device is 25 meters. For multiple devices, the maximum combined internal/external length is 12 meters.
- If you have a combination of LVD and SE devices on the bus, the maximum cable length reverts to the SE specification. See note on SE and LVD interfaces for more information.
- For best performance, keep lengths to a minimum, but avoid very short overall lengths (less than 0.5 meters).

## Cable quality

- It is important to use good quality cables. Generally speaking, cable quality affects performance and reliability. This is particularly true for external, shielded cables.
- Look after your SCSI cables. In particular, take care when connecting or disconnecting not to damage the high-density connectors. Avoid putting excessive twists in external shielded cables, as this can cause premature failure.

## With internal devices

For HP StorageWorks Ultrium internal devices, you need a SCSI ribbon cable with the correct termination. HP StorageWorks Ultrium drives have a 68-pin wide, high-density SCSI connector. A suitable SCSI ribbon cable is supplied with the tape drive.

If you are using an HP StorageWorks Ultrium drive on an internal bus with other peripherals that run at Ultra2 speeds, it is important that a 68-pin LVD-compatible ribbon cable is used. Do not connect your tape drive to lower-rated SCSI or to narrow SCSI.

## With external devices

The cable provided with all HP StorageWorks Ultrium external tape drives will attach to a computer with a wide, very high density (VHD), LVDS SCSI connector.

If your server or host bus adapter is equipped with a high density (HD) wide SCSI connector, you will need to order a 68-pin VHD-to-HD converter or 68-pin VHD-to-HD cable. See [www.hp.com/go/connect](http://www.hp.com/go/connect).

## With removable devices

For HP StorageWorks DAT removable tape drives, appropriate cables and terminators are provided with the tape array.

## Note on SE and LVD interfaces

SE and LVD define how the signals are transmitted along the cable.

- With single-ended (SE) SCSI, each signal travels over a single wire and each signal's value is determined by comparing the signal to a paired ground wire. Signal quality tends to decrease over longer cable lengths or at increased signal speed.
- With low voltage differential (LVD) signaling, signals travel along two wires and the difference in voltage between the wire pairs determines the signal value. This enables faster data rates and

longer cabling with less susceptibility to noise than SE signaling and reduced power consumption.

If you use LVD SCSI devices on the same bus as single-ended devices this will switch the LVD SCSI host adapter into single-ended mode and restrict cable length.

If you connect only LVD SCSI devices, the bus will operate in low voltage differential mode and Ultra160 and higher speeds will be enabled. You can use a combination of Ultra160 and Ultra2 devices. Each device will operate at its optimum speed.