Half High LTO Generation 3 SAS Tape Drive

User's Guide

Important:
Review the maintenance information in "Cleaning the drive head" on page 19 and the Warranty document that comes with the tape drive, because periodic maintenance is not covered by the IBM warranty. Repairs or exchanges that result from improper maintenance might result in billable service charges.

Half High LTO Generation 3 SAS Tape Drive

User's Guide

Note: Before using this information and the product it supports, read the general information in Appendix D, “Notices,” on page 39, the *Safety Information* and *Environmental Notices and User Guide* documents on the IBM *Documentation* CD, and the *Important Notices* and *Warranty information* documents that come with the product.

Second Edition (May 2011)

Safety

Before installing this product, read the Safety Information.

قبل تركيب هذا المنتج، يجب قراءة الملاحظات الآمنية

Antes de instalar este produto, leia as Informações de Segurança.

在安装本产品之前，请仔细阅读 Safety Information (安全信息)。

安裝本產品之前，請先閱讀「安全資訊」。

Prije instalacije ovog produkta obavezno pročitajte Sigurnosne Upute.

Před instalací tohoto produktu si přečtěte příručku bezpečnostních instrukcí.

Læs sikkerhedsforskrifterne, før du installerer dette produkt.

Lees voordat u dit product installeert eerst de veiligheidsvoorschriften.

Ennen kuin asennat tämän tuotteen, lue turvaohjeet kohdasta Safety Information.

Avant d'installer ce produit, lisez les consignes de sécurité.

Vor der Installation dieses Produkts die Sicherheitshinweise lesen.

Πριν εγκαταστήσετε το προϊόν αυτό, διαβάστε τις πληροφορίες ασφάλειας (safety information).

לפני שתתקינו מוצר זה, קראו את הוראות הבטיחות.

A termék telepítése előtt olvassa el a Biztonsági előírásokat!

Prima di installare questo prodotto, leggere le Informazioni sulla Sicurezza.

製品の設置の前に、安全情報をお読みください。

본 제품을 설치하기 전에 안전 정보를 읽으십시오.

Пред да се инсталира овој продукт, прочитајте информацијата за безбедност.

Les sikkerhetsinformasjonen (Safety Information) før du installerer dette produktet.

Przed zainstalowaniem tego produktu, należy zapoznać się z książką "Informacje dotyczące bezpieczeństwa" (Safety Information).

Antes de instalar este produto, leia as Informações sobre Segurança.

Перед установкой продукта прочтите инструкции по технике безопасности.

Pred inštaláciou tohto zariadenia si pečítaje Bezpečnostné predpisy.

Pred namestitvijo tega proizvoda preberite Varnostne informacije.

Antes de instalar este producto, lea la información de seguridad.

Läs säkerhetsinformationen innan du installerar den här produkten.

Statement 1:

DANGER

Electrical current from power, telephone, and communication cables is hazardous.

To avoid a shock hazard:

- **Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.**
- **Connect all power cords to a properly wired and grounded electrical outlet.**
- **Connect to properly wired outlets any equipment that will be attached to this product.**
- **When possible, use one hand only to connect or disconnect signal cables.**
- **Never turn on any equipment when there is evidence of fire, water, or structural damage.**
- **Disconnect the attached power cords, telecommunications systems, networks, and modems before you open the device covers, unless instructed otherwise in the installation and configuration procedures.**
- **Connect and disconnect cables as described in the following table when installing, moving, or opening covers on this product or attached devices.**

To Connect:	**To Disconnect:**
1. Turn everything Off.	1. Turn everything Off.
2. First, attach all cables to devices.	2. First, remove power cords from outlet.
3. Attach signal cables to connectors.	3. Remove signal cables from connectors.
4. Attach power cords to outlet.	4. Remove all cables from devices.
5. Turn device ON.	

Contents

Chapter 1. Introduction

The IBM® Half High LTO Generation 3 SAS Tape Drive is a versatile backup and restore device for xSeries® and System x® servers. The tape drive is available as an internal or external device.

The drive can be installed in many IBM xSeries and System x servers. See http://www.ibm.com/servers/eserver/serverproven/compat/us/xseries/storage/matrix.html for a list of servers that support the drive.

You can also install the drive in a tape-drive enclosure. For information about installing the drive in a tape-drive enclosure, see the documentation that comes with the enclosure.

The drive comes with a limited warranty. For more information, see the *Warranty information* document that came with the tape drive.

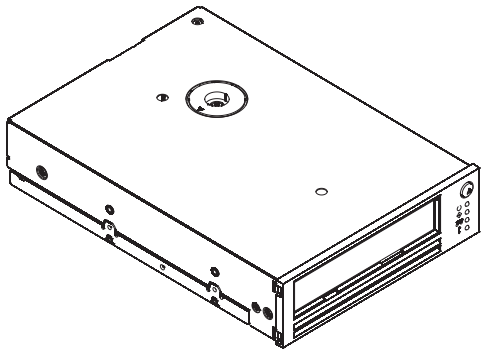
In addition to the IBM *Documentation* CD, the internal and external models of the tape drive contain the items in the following table:

Table 1. Internal and external tape drive package components

Internal drive	External drive
• IBM SAS Half High Generation 3 LTO drive • M3 x 3 mounting screws (4) • Cleaning cartridge • Internal SAS cable	• IBM SAS Half High Generation 3 LTO drive • Cleaning cartridge • External SAS Cable (3 m)

Contact your place of purchase if an item is missing or damaged. Be sure to retain your proof of purchase. It might be required for you to receive warranty service.

The drive uses IBM Ultrium LTO 3 data cartridges and LTO cleaning cartridges. See “Working with cartridges” on page 11 for more information.



The CRU and Option part numbers for the IBM Half High LTO Generation 3 SAS Tape Drive replaceable components are shown in the following table:

Table 2. CRU and Option part numbers

Description	CRU part number	Option part number
IBM Internal Half High LTO Gen 3 SAS Tape Drive	46X5663	43W8478
IBM External Half High LTO Gen 3 SAS Drive, with US line cord	95Y8021	3628L3X
IBM External Half High LTO Gen 3 SAS Drive, with no line cord	95Y8021	3628N3X
Mounting screw	42C3934	
SAS cable, internal	44E8878	
Mini-SAS cable, external, 3 m x 4 plug	39R6532	
US line cord, 3 ft, 10 A / 125 V	39M5081	

Drive features

The drive has the following features:

- SAS host interface.
- Half-height form factor.
- Native storage capacity of 400 GB per cartridge (800 GB at 2:1 compression).
- Maximum native data-transfer rate of up to 60 MB per second (120 MB per second with 2:1 compression).
- Burst data-transfer rate of 300 MB per second.
- Dual-stage 16-channel head actuator for precision head alignment to help support higher track density with improved data integrity and backward compatibility with previous LTO generations.
- Internal buffer size of 128 MB.
- Independent tape loader and threader motors to help with cartridge insertion in the drive.
- Cartridge auto-eject on over-temperature function to safely unload a cartridge when an over-temperature condition is detected in the drive. After cooling, the drive resumes normal operations.

Front view of the drive

Note: The illustrations in this document might differ slightly from your hardware.

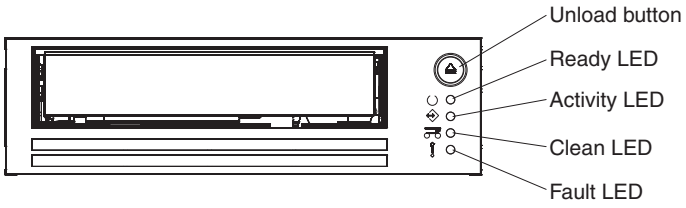


Figure 1. Front-panel components

Rear view of the drive

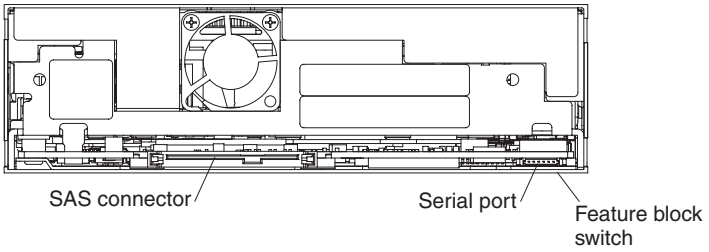


Figure 2. Rear-panel components

Host interface

The drive has a SAS (Serial Attached SCSI) host interface. A drive with a SAS interface can be linked directly to controllers. SAS is a performance improvement over traditional SCSI because SAS enables multiple devices (up to 128) of different sizes and types to be connected simultaneously with thinner and longer cables; SAS supports full-duplex signal transmission at 3.0 GB per second.

Device drivers

See the `drivers` folder on the IBM *Documentation* CD for the supported device driver. IBM periodically releases new device drivers; to locate the latest device driver, complete the following steps.

Note: Changes are made periodically to the IBM website. The actual procedure might vary slightly from what is described in this document.

1. Go to http://www-947.ibm.com/support/entry/portal/.
2. In the **Search within all of support & downloads** text field at the bottom of the screen, type `tape files` and press Enter.
3. In the list of search results, click the link **Tape Files (index) - Software for tape drives and libraries**.

For information about installing device drivers, see the instructions that are provided in the `drivers` folder on the IBM *Documentation* CD.

Note: There are different drivers for Windows 2003 and Windows 2008. No drivers are required for Linux.

The IBM Documentation CD

The IBM *Documentation* CD contains documentation for the drive in Portable Document Format (PDF) and includes the IBM Documentation Browser to help you find information quickly.

Hardware and software requirements

The IBM *Documentation* CD requires the following minimum hardware and software:

- Microsoft Windows XP, Windows 2000, or Red Hat Linux
- 100 MHz microprocessor
- 32 MB of RAM

- Adobe Acrobat Reader 3.0 (or later) or xpdf, which comes with Linux operating systems

Using the Documentation Browser

Use the Documentation Browser to browse the contents of the CD, read brief descriptions of the documents, and view documents, using Adobe Acrobat Reader or xpdf. The Documentation Browser automatically detects the regional settings in your system and displays the documents in the language for that region (if available). If a document is not available in the language for that region, the English-language version is displayed.

Use one of the following procedures to start the Documentation Browser:

- If Autostart is enabled, insert the CD into the CD or DVD drive. The Documentation Browser starts automatically.
- If Autostart is disabled or is not enabled for all users, use one of the following procedures:
  - If you are using a Windows operating system, insert the CD into the CD or DVD drive and click **Start --> Run**. In the **Open** field, type

    ```
    e:\win32.bat
    ```

    where *e* is the drive letter of the CD or DVD drive, and click **OK**.
  - If you are using Red Hat Linux, insert the CD into the CD or DVD drive; then, run the following command from the `/mnt/cdrom` directory:

    ```
    sh runlinux.sh
    ```

Select the tape drive from the **Product** menu. The **Available Topics** list displays all the documents for your tape drive. Some documents might be in folders. A plus sign (+) indicates each folder or document that has additional documents under it. Click the plus sign to display the additional documents.

When you select a document, a description of the document is displayed under **Topic Description**. To select more than one document, press and hold the Ctrl key while you select the documents. Click **View Book** to view the selected document or documents in Acrobat Reader or xpdf. If you selected more than one document, all the selected documents are opened in Acrobat Reader or xpdf.

To search all the documents, type a word or word string in the **Search** field and click **Search**. The documents in which the word or word string appears are listed in order of the most occurrences. Click a document to view it, and press Crtl+F to use the Acrobat search function, or press Alt+F to use the xpdf search function within the document.

Click **Help** for detailed information about using the Documentation Browser.

Notices and statements in this document

The caution and danger statements in this document are also in the multilingual *Safety Information* document, which is on the IBM *Documentation* CD. Each statement is numbered for reference to the corresponding statement in your language in the *Safety Information* document.

The following notices and statements appear in this document:

- **Note:** These notices provide important tips, guidance, or advice.

- **Attention:** These notices indicate potential damage to programs, devices, or data. An attention notice is placed just before the instruction or situation in which damage might occur.
- **Danger:** These statements indicate a situation that can be potentially lethal or extremely hazardous to you. A danger statement is placed just before the description of a potentially lethal or extremely hazardous procedure step or situation.

Chapter 2. Installing the drive

Note: See the documentation that came with the server for tape-drive installation instructions. If you do not have this documentation, use the general instructions in this section to install the drive.

Installation guidelines

Before you remove or replace a device, read the following information:

- Read the safety information that begins on page iii and "Handling static-sensitive devices." This information will help you work safely.
- Observe good housekeeping in the area where you are working. Place removed covers and other parts in a safe place.
- Do not attempt to lift an object that you think is too heavy for you. If you have to lift a heavy object, observe the following precautions:
  - Make sure that you can stand safely without slipping.
  - Distribute the weight of the object equally between your feet.
  - Use a slow lifting force. Never move suddenly or twist when you lift a heavy object.
  - To avoid straining the muscles in your back, lift by standing or by pushing up with your leg muscles.
- Make sure that you have an adequate number of properly grounded electrical outlets for the server and all attached devices.
- Back up all important data before you make changes to disk drives.

Handling static-sensitive devices

Attention: Static electricity can damage electronic devices. To avoid damage, keep static-sensitive devices in their static-protective packages until you are ready to install them.

To reduce the possibility of damage from electrostatic discharge, observe the following precautions:

- Limit your movement. Movement can cause static electricity to build up around you.
- The use of a grounding system is recommended. For example, wear an electrostatic-discharge wrist strap, if one is available.
- Handle the device carefully, holding it by its edges or its frame.
- Do not touch solder joints, pins, or exposed circuitry.
- Do not leave the device where others can handle and damage it.
- While the device is still in its static-protective package, touch it to an unpainted metal surface for at least 2 seconds. This drains static electricity from the package and from your body.
- Remove the device from its package and install it immediately without setting down the device. If it is necessary to set down the device, put it back into its static-protective package. Do not place the device on a metal surface.
- Take additional care when you handle devices during cold weather. Heating reduces indoor humidity and increases static electricity.

Preinstallation requirements

You need the following items to install the drive:

- A SAS host bus adapter that is correctly installed and configured in a host server
- An available 5.25-inch, half-height bay
- Backup application software that supports the drive
- Phillips screwdriver
- Flat-blade screwdriver, if the server has slotted screws
- Torx screwdriver, if the server has torx screws

Unpacking and acclimating the drive

Before you unpack the contents of the drive package, inspect the shipping container for damage. If the shipping container is damaged, notify your carrier immediately.

Keep the packaging that comes with the drive in case you have to return it for service or warranty replacement.

Acclimation time is required if the temperature of the drive when it is unpacked is different from the temperature of its operating environment (measured at the front of the bezel near the air intake area as shown in Figure 3). The recommended acclimation time is 4 hours after the drive has been unpacked or 1 hour after any condensation that you can see has evaporated, whichever is greater. When you acclimate the drive, apply the following measures:

- If the drive is colder than its operating environment and the air contains sufficient humidity, condensation might occur in the drive and damage it. When the drive has warmed to the operating temperature range (greater than 10°C or 50°F) and no danger of condensation is present (the air is dry), warm the drive more quickly by powering it on for 30 minutes. Use a diagnostic tape to test the drive before you insert a tape that contains data.
- If the drive is hotter than its operating environment, the tape can stick to the drive head. When the drive has cooled to the operating temperature range (less than 40°C or 104°F), cool the drive more quickly by applying airflow for 30 minutes. Power-on the drive and use a diagnostic tape to test it before you insert a tape that contains data.

If you are uncertain about whether the temperature of the drive is within the recommended operating range or the humidity is sufficient to cause condensation, acclimate the drive for the full 4 hours.

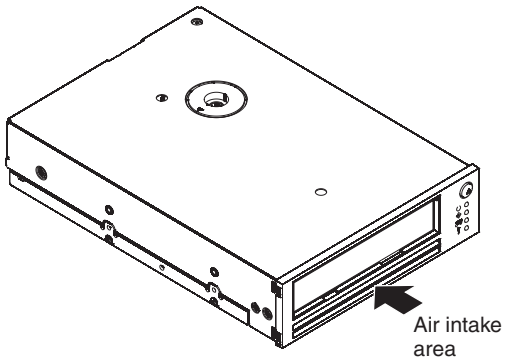


Figure 3. Air intake area

Parts inventory

Make sure that you received the following parts:

- Tape drive
- Mounting screws
- Cleaning cartridge
- SAS cable

Installing the drive

To install the drive, complete the following steps:

1. Read the safety information that begins on page iii and “Installation guidelines” on page 7.
2. Make sure that the server is turned off and that the power cord is disconnected.
3. Unpack and acclimate the drive. See “Unpacking and acclimating the drive” on page 8 for more information.
4. Make sure that you have acclimated and inspected your cartridges. See “Acclimating and storing cartridges” on page 13 for more information.
5. Set the features switch.

   The drive has eight factory-set feature switches by which the drive can be configured for use in a library. The switch positions are labeled 1 through 8. The on and off positions are marked on each switch.

   Note: The default setting for each feature switch is the off position.

Table 3. Feature switch definitions

Switch	Off function (default)	On function
1	Library interface at 38 400 baud (non-polled)	Library interface at 9600 baud (polled)
2	Library interface uses one stop bit	Library interface uses two stop bits
3	Reserved	Reserved
4	Switch 1 active	Library interface at 115 000 baud rate
5	Enable the library drive interface	Enable the autoloader drive interface
6	Reserved for future library interface changes	Reserved for future library interface changes
7	Enables head brush ERP [1]	Disable head brush ERP
8	Reserved	Reserved

[1] The head brush error recovery procedure (ERP) is the final effort that the drive makes in some cases to recover from what would otherwise become a permanent read or write error. The drive does this by removing any debris that might have accumulated on the read/write head by use of the brush. To brush the head requires that the tape be unthreaded to expose the head. This forces the loader to be cycled to enable the tape to be re-threaded. Disabling the head brush ERP prevents this final effort by the drive to prevent a permanent error; as a result, if the drive subsequently invokes the head brush ERP, it will instead immediately report the permanent error.

6. Install the drive in the bay, using the drive-installation instructions that came with the server. If you do not have the server documentation, install the drive by completing the following steps, and then continue with step 7:

a. Locate an available bay in which to install the drive; then, remove the filler panel from the bay. You can install the drive either horizontally or vertically, depending on the bay.
b. If the server has drive rails that must be attached to the tape drive before you slide it into the server, attach the rails to the drive.

   Note: Use only the metal rails. Do not use the plastic drive rails.
c. Align the drive-bay screw holes with the threaded holes in the tape-drive housing. When you mount the drive, follow these guidelines:
   - Make sure that no objects such as screw heads, cables, or adjacent devices are pressing against the frame.
   - Make sure that nothing blocks the ventilation slots on the bottom and rear of the drive.

     Attention: Use only the screws that come with the drive. Other screws might be too long and might damage the drive.
d. Insert a screw through each of the drive-bay holes into the threaded holes in the drive and tighten the screws with a screwdriver.

Important: See your server documentation for cable-routing information.

e. Connect the SAS cable to the connector on the SAS adapter.
f. Connect the SAS connector to the drive.
g. Connect the power cable to the drive.

7. Reinstall the server covers.
8. Connect the power cord and turn on the server.
9. After power-on self-test (POST) is completed, make sure that the front panel status LEDs are as follows:
   - Ready: lit
   - Activity: off
   - Clean: off
   - Fault: off
10. Run the stand-alone diagnostic test. See “Service mode 1: Stand-alone diagnostics (self-test)” on page 23 for more information.
11. Install the device driver. For information about installing device drivers, see the instructions that are provided in the `drivers` folder on the IBM *Documentation* CD.
12. Slide a tape cartridge into the slot until the drive accepts the cartridge and loads it. A brief delay occurs while the drive identifies the cartridge type and state and moves the tape to the data area; then, the ready LED lights. See “Loading a cartridge” on page 11 for more information.
13. Use a backup software application to perform a sample backup-and-restore operation. The activity LED turns on when data is written to or read from the tape.
14. At the end of the operation, press the unload button to unload the cartridge from the drive.

Chapter 3. Using the drive

This chapter provides information about using the tape drive.

Working with cartridges

This section provides information about working with data cartridges and cleaning cartridges.

If a power cycle or reset occurs while a cartridge is loaded, the drive will rewind the tape. This process can take several minutes. When the tape is rewound, press the unload button to eject the cartridge.

Notes:

1. If the cartridge is already in the ejected position and you want to reload it, remove the cartridge; then, load it.
2. If the cartridge is already loaded and you cycle the power (turn it off; then on), the drive reloads the cartridge.

Loading a cartridge

To insert a tape cartridge, complete the following steps:

1. Make sure that the server is turned on.
2. Make sure that the cartridge has been acclimated to your environment. See “Acclimating and storing cartridges” on page 13 for more information.
3. Make sure that the write-protect switch on the tape cartridge is correctly set. See “Write-protect switch” on page 14 for more information.
4. Grasp the cartridge so that the write-protect switch faces you (see Figure 4).
5. Slide the cartridge into the tape load compartment until the drive accepts the cartridge and loads it. A brief delay occurs while the drive identifies the cartridge type and state and moves the tape to the data area; then, the ready LED lights.

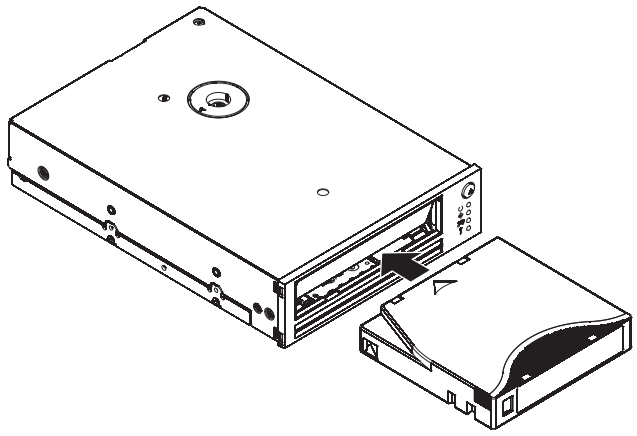


Figure 4. Inserting a cartridge into the drive

Unloading a cartridge

This section describes unloading a cartridge under normal operating conditions. If the cartridge does not unload, use the procedure in “Emergency cartridge unloading” on page 12 to unload the cartridge.

The drive writes pertinent information to the cartridge memory before it is ejected.

To unload a tape cartridge:

1. Make sure that the drive is turned on.
2. Press the unload button. The drive rewinds the tape and partially ejects the cartridge. The activity LED flashes while the tape rewinds; then, the activity LED and the ready LED turns off.
3. When the cartridge is partially ejected, grasp the cartridge and remove it.

Emergency cartridge unloading

If you cannot unload a cartridge using the procedure in “Unloading a cartridge” on page 11, press and hold the unload button for 20 seconds. The drive performs the following tasks:

- Unloads the cartridge from the drive
- Creates a dump and saves a copy of it in memory
- Restarts the drive

If the cartridge cannot be unloaded, complete the following steps:

1. Make sure that you have issued the necessary application commands to unload the cartridge. This is to ensure that a halt condition in the application is not preventing the cartridge from being unloaded.
2. Power-cycle the drive.

   Note: It can take as long as 5 minutes for the cartridge to rewind and unload.

If none of these procedures unloads the cartridge, contact IBM Support.

Data cartridges

Figure 5 shows an IBM LTO Ultrium 400 GB data cartridge and its components.

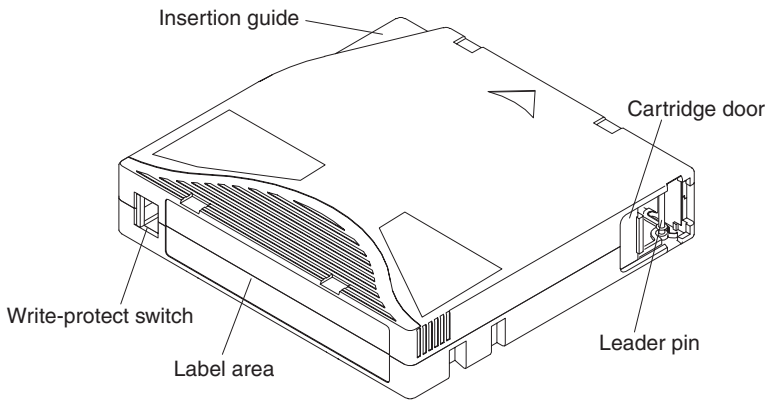


Figure 5. The IBM LTO Ultrium 400 GB data cartridge

The cartridge door protects the tape from contamination when the cartridge is out of the drive. Behind the door, the tape is attached to a leader pin. When the cartridge is inserted into the drive, a threading mechanism pulls the pin (and tape) out of the cartridge, across the drive head, and onto a nonremovable take-up reel. The head can then read or write data from or to the tape.

The write-protect switch prevents data from being written to the tape cartridge. For more information, see “Write-protect switch” on page 14.

The label area provides a location to place a label.

The insertion guide is a large, notched area that prevents the cartridge from being inserted incorrectly.

Cartridge compatibility

The drive uses LTO3 Ultrium tape cartridges and LTO3 cleaning cartridges. For a list of recommended media for IBM drives, go to http://www.ibm.com/systems/support/ and search for “MIGR-39931”.

The drive can read and write tapes that were created by its predecessor, the IBM Ultrium Internal Tape Drive (Generation 2). The drive has the following capabilities and limitations:

- Reads and writes Generation 2 cartridges to Generation 2 format
- Reads Generation 1 cartridges
- Cannot write Generation 3 cartridges to Generation 2 format
- Cannot write Generation 2 cartridges to Generation 3 format
- Cannot write to Generation 1 cartridges

The drive reads tapes that have been written by other licensed Ultrium 3 drives. It also writes to tapes that can be read by other licensed Ultrium 3 drives.

Handling the cartridges

Attention: Do not insert a damaged tape cartridge into the drive. A damaged cartridge can interfere with the reliability of the drive and might void the warranties of the drive and the cartridge. Before you insert a tape cartridge, inspect the cartridge case, cartridge door, and write-protect switch for problems.

Incorrect handling or an incorrect environment can damage a cartridge or its magnetic tape. To avoid damage to a tape cartridge and to ensure the continued high reliability of your drive, follow the following guidelines:

- Do not drop the cartridge. If the cartridge is dropped, do not use it.
- Do not handle tape that is outside the cartridge. Handling the tape can damage the surface of the tape, which might interfere with read or write reliability. Pulling on tape that is outside the cartridge can damage the tape and the brake mechanism in the cartridge.
- Do not stack more than six cartridges.
- Do not degauss a cartridge that you intend to reuse. Degaussing makes the tape unusable.

Acclimating and storing cartridges

- Before you use a cartridge, let it acclimate to the normal operating environment for 1 hour. If condensation is visible on the cartridge, wait an additional hour.
- Make sure that all surfaces of a cartridge are dry before you insert it.
- Do not expose the cartridge to moisture or direct sunlight.
- Do not expose a recorded or blank cartridge to magnetic fields of greater than 100 oersteds (for example, terminals, motors, video equipment, X-ray equipment, or fields that exist near high-current cables or power supplies). Such exposure can cause the loss of recorded data or make the blank cartridge unusable.

- Whenever possible, store cartridges on end.

Inspecting a cartridge

Before you use a cartridge, complete the following steps:

- Inspect the packaging to detect rough handling.

Note: When you inspect a cartridge, open only the cartridge door. Do not open any other part of the cartridge case. The upper and lower parts of the case are held together with screws; separating them destroys the usefulness of the cartridge.

- Inspect the cartridge for damage before you use or store it.
- Inspect the rear of the cartridge (the part that is loaded first into the tape load compartment) and make sure that there are no gaps in the seam of the cartridge case (see Figure 6). If there are gaps in the seam, do not use the cartridge.

Figure 6. Checking for gaps in the seams of a cartridge

- If you suspect that the cartridge has a problem, copy any data onto a good cartridge immediately for possible data recovery. Discard the cartridge.

For more information about inspecting cartridges, go to http://www.ibm.com/support/docview.wss?uid=ssg1S1001388.

Write-protect switch

The position of the write-protect switch on the tape cartridge determines whether you can write to the tape. If the switch is set to the locked position (solid red), data cannot be written to the tape. If the switch is set to the unlocked position (black void), data can be written to the tape.

If possible, use application software to write-protect your cartridges rather than manually setting the write-protect switch. This enables the software to identify a cartridge that no longer contains current data and is eligible to become a scratch (blank) data cartridge. Do not write-protect scratch (blank) cartridges; the drive will not be able to write new data to them.

If you want to manually set the write-protect switch, slide it to one position or the other (see Figure 5 on page 12).

Cleaning cartridge

A specially labeled IBM LTO Ultrium cleaning cartridge comes with the tape drive to clean the drive. The drive automatically determines when the tape head needs to be cleaned.

When the cleaning is finished, the drive ejects the cartridge.

An IBM cleaning cartridge can be used 50 times.

Operation mode and the service modes

The tape drive is in operation mode when you are using it to read from and write to a tape.

Use the service modes to perform diagnostics, create and copy memory dumps, and make and unmake field microcode replacement tapes. You can put the drive into a service mode only while no cartridge is loaded in the tape drive. To put the drive in service mode, press and hold the unload button for approximately 6 seconds. (See “Using the service modes” on page 23 for more information.) The ready LED flashes rapidly while the drive is in a service mode. To return the drive to operation mode, press the unload button for approximately 15 seconds or wait approximately 15 seconds for service mode to timeout.

Status LEDs

This section provides information about the status LEDs when the drive is in operation mode. For information about the LEDs when the drive is in a service mode, see “Using the service modes” on page 23.

Ready: This LED indicates when the tape drive is ready for operation.

Activity: The activity LED indicates that the tape drive is performing tasks such as recording data or rewinding a cartridge.

Clean: When the clean LED is lit, it indicates that the drive heads need to be cleaned. In most cases, the drive will continue to function, but it should be cleaned as soon as possible. See “Cleaning the drive head” on page 19 for more information.

Fault: The fault LED flashes to indicate an unrecoverable drive or cartridge error (for example, an over-temperature condition). An unrecoverable error causes the drive to be unable to function unless initiator, operator, or service intervention is applied. An unrecoverable cartridge (media) failure is usually the result of a defective cartridge or cartridge state. One of the following actions will clear the flashing fault LED:

- If there is a cartridge in the drive, emergency eject the cartridge. See “Emergency cartridge unloading” on page 12.
- Turning the drive off and then on.
- Cooling the drive to within operating temperatures. See problem 2 in Table 5 on page 20 for more information.

See “Solving drive problems” on page 20 for more information.

Use Table 4 to determine the meaning of the LEDs while the drive is in operation mode.

Table 4. Status LEDs in Operation mode

Ready	Activity	Clean	Fault	Description	Corrective action
Lit for 2 seconds	Lit for 2 seconds	Lit for 2 seconds	Lit for 2 seconds	Power-on LED test	No action is required.
Flashing [1]	Off	Off	Off	Power-on self-test (POST) in progress	No action is required.
Off	Off	Lit or Off [2]	Off	A cartridge is not loaded	Load a supported cartridge. See “Loading a cartridge” on page 11 for more information.
Lit	Off	Lit or off [2]	Off	Cartridge loaded, no activity	No action is required.
Lit	Flashing	Lit or off [2]	Off	Data cartridge loaded, activity	No action is required
Off	Flashing	Lit	Off	Cleaning cartridge loaded, activity	No action is required.
Off	Off	Lit	Off	Cleaning cartridge loaded, cleaning failed	Retry the cleaning operation with a different cleaning cartridge. See “Cleaning cartridge” on page 15 for more information.
Off	Flashing	Lit or off [2]	Off	Cartridge is loading or unloading	No action is required.
Off	Off	Lit or off [2]	Flashing slowly	Unrecoverable drive failure has occurred	See problem 1 in Table 5 on page 20 for more information.
Flashing	Off	Lit or off [2]	Off	Firmware download in progress	No action is required.
Off	Flashing	Flashing	Off	Incorrect firmware update tape used	See “Updating firmware” on page 19 for more information.
Flashing	Flashing	Lit or off [2]	Off	Firmware update is in progress	No action is required.
Flashing slowly	Flashing slowly	Lit or off [2]	Flashing slowly	Firmware update failed	Retry the operation. See “Updating firmware” on page 19 for more information. If the firmware update procedure fails again, contact IBM Support.
Off	Off	Lit or off [2]	Lit	Maximum operating temperature exceeded	See Table 5 on page 20 for more information.
Flashing rapidly	Off or flashing rapidly	Off or flashing rapidly	Off	Diagnostic test is in progress	No action required.
Off	Off	Flashing slowly	Off	Media failure	Retry the operation with a different tape. See “Data cartridges” on page 12 for more information. If the problem remains, see problem 4 in Table 5 on page 20

Table 4. Status LEDs in Operation mode (continued)

Ready	Activity	Clean	Fault	Description	Corrective action
Off	Flashing slowly	Flashing slowly	Off	Incorrect media in drive	Remove the tape cartridge and load a supported tape cartridge. See “Cartridge compatibility” on page 13 for more information. If the problem remains, see problem 3 in Table 5 on page 20

[1] LEDs are lit for 2 seconds during the startup process.

[2] When the clean is lit, it indicates that the drive heads need to be cleaned. In most cases the drive will continue to function, but it should be cleaned as soon as possible.

Chapter 4. Maintaining the drive and solving problems

This section provides information about cleaning the drive heads, updating the drive firmware, solving problems, using the service modes, and replacing the drive in a server.

Cleaning the drive head

Use only an IBM LTO Ultrium Cleaning Cartridge to clean the drive heads.

Clean the drive heads whenever the clean LED is lit. It is not recommended that you clean the drive head on a periodic basis; clean it only when the drive requests to be cleaned.

To clean the drive heads, insert the cleaning cartridge into the tape load compartment (see Figure 4 on page 11). The drive performs the cleaning automatically in less than 2 minutes and then ejects the cartridge.

An IBM LTO Ultrium Cleaning Cartridge is effective for 50 uses.

Notes:

1. The drive will automatically eject an expired cleaning cartridge.
2. Mark the cleaning cartridge after each use to track how many times it has been used.

Updating firmware

IBM periodically releases new firmware to fix problems or provide functional enhancements. To download the latest firmware updates, complete the following steps.

Note: Changes are made periodically to the IBM website. The actual procedure might vary slightly from what is described in this document.

1. Go to http://www-947.ibm.com/support/entry/portal/.
2. In the **Search within all of support & downloads** text field at the bottom of the screen, type `tape files` and press Enter.
3. In the list of search results, click the link **Tape Files (index) - Software for tape drives and libraries**.

For information about updating firmware by using a field microcode replacement (FMR) tape, see “Service mode 6: Make a field microcode replacement tape” on page 27.

Creating a memory dump

If an error occurs while the drive is in operation mode, a drive dump is automatically generated. Also, you can force a drive dump. A drive dump overwrites any existing dump data that has not been copied to a tape or flash memory, and any interruption of power to the tape drive causes any dump data that is in memory to be lost.

To force a drive dump while the drive is in operation mode, press and hold the unload button for 12 seconds. When you force a drive dump, any cartridge that is in the drive is ejected, the drive is reset, and the dump data is written to memory.

You can also force a drive dump by using service mode 2. See “Service mode 2: Force a drive dump” on page 24 for more information.

Solving drive problems

The following table describes the problems that might occur with the tape drive.

Some applications use TapeAlert flags to diagnose problems. See Appendix B, “TapeAlert flags,” on page 33 for more information.

Table 5. Troubleshooting information

Problem	Problem number	Description	Corrective action
The fault LED is flashing slowly.	1	An unrecoverable error has occurred. The drive cannot function unless initiator, operator, or service intervention is applied. An unrecoverable error is usually the result of a hardware error condition.	Complete the following steps: 1. Power cycle the drive; then, retry the operation. 2. Verify that the latest firmware is installed. See “Updating firmware” on page 19 for more information. 3. Run standalone diagnostics. See “Service mode 1: Stand-alone diagnostics (self-test)” on page 23 for more information. 4. If the problem remains, replace the drive. See “Replacing a drive” on page 28 for more information.
The fault LED is lit.	2	The drive has reached its maximum operating temperature.	Complete the following steps: 1. Turn off the drive until the temperature of the drive has returned to the normal operating temperature range. See “Environmental specifications” on page 31. 2. Make sure that the room temperature is within specifications. See “Environmental specifications” on page 31 for more information. 3. Make sure that the air intake area under the cartridge door is not blocked. See Figure 3 on page 8 for the location of the air intake area. 4. If the problem remains, replace the drive. “Replacing a drive” on page 28 for more information.
The activity, clean, and fault LEDs are flashing slowly.	3	Incorrect media has been inserted into the drive.	If the drive does not eject the cartridge, press the unload button to eject the cartridge from the drive and replace it with the correct media (see “Cartridge compatibility” on page 13).

Table 5. Troubleshooting information (continued)

Problem	Problem number	Description	Corrective action
The clean and fault LEDs are flashing slowly.	4	A media failure has occurred.	Complete the following steps: 1. Press the unload button to eject the cartridge from the drive. 2. Remove the cartridge from the drive and inspect it for damage and debris. 3. Make sure that the write-protect switch on the cartridge is in the unlocked position.
The drive will not load a tape cartridge.	5	One of the following conditions has occurred: • There is a problem with the tape drive. • The wrong type of cartridge is being loaded. • A tape cartridge is already loaded. • The tape cartridge was inserted incorrectly. • The drive has no power. • The drive has exceeded its maximum operating temperature. • The tape cartridge is defective.	Take one or more of the following actions: • Make sure that there is no problem with the drive. See “Status LEDs” on page 15 for more information. • Make sure that you are using a supported cartridge. See “Cartridge compatibility” on page 13 for more information. • If a tape cartridge is already loaded, press the unload button. If the cartridge is not ejected, turn off the power to the drive; then, turn it back on. After the ready status LED is lit, press the unload button to eject the cartridge. • If the tape cartridge was inserted incorrectly, reinsert it correctly. See “Loading a cartridge” on page 11 for more information. • Make sure the drive has power by verifying that the ready LED is lit. • Let the drive cool, and then retry the operation. • Inspect the cartridge for damage. Go to “Inspecting a cartridge” on page 14 for more information. If the cartridge is not damaged, insert a different tape cartridge. If the problem occurs with multiple cartridges, the drive is defective. Replace the drive. See “Replacing a drive” on page 28 for more information.

Table 5. Troubleshooting information (continued)

Problem	Problem number	Description	Corrective action
The drive will not unload the tape cartridge.	6	The tape cartridge or drive is defective. **Note:** The drive must rewind the tape before the cartridge is unloaded. It can take up to 10 minutes for the tape to rewind.	Complete the following steps: 1. Press the unload button. If the cartridge is not ejected, continue with step 2. 2. Verify that the latest firmware is installed. See “Updating firmware” on page 19 for more information. 3. Press and hold the unload button for 20 seconds. If the cartridge does not unload, continue with step 4. 4. Turn off the power to the drive; then, turn it back on (note that the mid-tape recovery can take up to ten minutes to complete). If the cartridge still is not ejected, replace the drive. See “Replacing a drive” on page 28.
The clean LED is lit.	7	The tape head needs to be cleaned.	See “Cleaning the drive head” on page 19 for more information.
The drive reported an LDI or RS-422 communication problem with the drive.	8	The LDI or RS-422 circuitry might be defective.	See “Service mode 1: Stand-alone diagnostics (self-test)” on page 23 for information about running the drive diagnostics. If the test runs successfully but the problem remains, see the documentation for your server.
The drive does not respond to server commands.	9	A server or drive error has occurred.	Press and hold the unload button for 20 seconds to force a drive dump. The drive will save the dump and then restart to enable communication to the drive to occur. Do not cycle power, because this will erase the contents of the dump.
The backup application is reporting a problem	10	The backup application has a problem with the drive.	Complete the following steps. Retry the operation after you complete each step. 1. Clean the drive. See “Cleaning the drive head” on page 19. 2. Verify that you are using the correct cartridge and that the cartridge is not damaged. 3. Try the operation with a different cartridge. 4. Make sure that the cartridge is not write-protected.
The activity LED flashes slowly.	11	Normal operation is occurring.	Typically, no action is required because a flashing activity LED means that normal operation is occurring. However, if a cartridge was loaded when the drive was turned on, the drive completes POST when it is turned on and slowly rewinds the tape (the process takes approximately 13 minutes). When the activity LED stops flashing, the drive is ready for read or write operations.

Using the service modes

Use the unload button and status LEDs to access and manipulate the service modes. The drive does not accept commands from the server while it is in service mode. While in service mode, the drive indicates the service function that is to be executed using the LEDs.

The drive cannot be put into service mode while a cartridge is loaded. If a cartridge is loaded in the drive, the unload button is interpreted as an unload cartridge request, and pushing the button again has no affect.

To access service mode, complete the following steps:

1. Make sure that the drive is unloaded.
2. Press and hold the unload button (approximately 6 seconds) until the ready LED begins flashing rapidly, which indicates that the drive is in service mode.

The following service modes are provided:

Service mode 1: Stand-alone diagnostics.
See “Service mode 1: Stand-alone diagnostics (self-test).”

Service mode 2: Force a drive dump
See “Service mode 2: Force a drive dump” on page 24.

Service mode 3: Copy dump to tape
See “Service mode 3: Copy dump data to tape” on page 25.

Service mode 4: Copy dump to flash memory
See “Service mode 4: Copy dump data to flash memory” on page 26.

Service mode 5: Erase flash memory
See “Service mode 5: Erase flash memory” on page 26.

Service mode 6: Make field microcode replacement tape
See “Service mode 6: Make a field microcode replacement tape” on page 27.

Service mode 7: Unmake field microcode replacement tape
See “Service mode 7: Unmake a field microcode replacement tape” on page 28.

Service mode 8: Not supported.
IBM does not support the function that is provided by service mode 8.

Service mode 1: Stand-alone diagnostics (self-test)

Notes:

1. This test runs for approximately 5 minutes.
2. Press the unload button at any time to end the test.
3. The self test does not affect server operation.
4. You can use either LTO 2 cartridges or LTO 3 data cartridges.
5. Do not use a write-protected cartridge. The drive will unload write-protected cartridges.

Attention: Do not use a cartridge that has data written on it. The self test will overwrite any data that is on the cartridge.

To run the drive diagnostics, complete the following steps:

1. Make sure that there is no cartridge in the drive.
2. Press and hold the unload button until the ready LED flashes rapidly. Press and hold the unload button until the ready LED flashes rapidly.

   Note: The drive will return to operation mode if you do not perform the next step within 15 seconds.
3. Insert a blank data cartridge into the drive. After a few minutes, the cartridge will unload and then load again. At the end of the self-test, the cartridge is ejected. If the test is successful, the drive returns to operation mode and the status LEDs indicate one of the following conditions.

	Test successful	**Test successful; drive needs cleaning**	**Test successful; error present before running test**
Ready	Off	Lit	Lit
Activity	Off	Off	Off
Clean	Off	Lit	Off
Fault [1]	Off	Off	Lit
[1] The fault LED is off if the test runs successfully even though an error was present before the test was run. The fault LED is lit if the test runs successfully and there were errors before the test was run.			

   If the drive fails the test, the status LEDs indicate one of the following conditions.

	Media failure	**Incorrect media inserted in drive**	**Unrecoverable drive failure**
Ready	Off	Lit	Lit
Activity	Off	Flashing slowly	Off
Clean	Off	Flashing slowly	Off
Fault	Off	Flashing slowly	Flashing slowly

4. Remove the cartridge from the drive.

Service mode 2: Force a drive dump

To create a memory dump, complete the following steps:

1. Make sure that there is no cartridge in the drive.
2. Press and hold the unload button until the ready LED flashes rapidly.

   Note: The drive will return to operation mode if you do not perform the next step within 15 seconds.

Attention: If the fault LED is flashing slowly, dump data is stored in memory. Running service mode 2 will overwrite the existing dump data. To avoid overwriting the dump data, copy the data to tape. See “Service mode 3: Copy dump data to tape” on page 25.

3. Press the unload button again to start service mode 2. The status LEDs indicate one of the following conditions.

LED	Service mode 2	Service mode 2; drive dump data in memory	Service mode 2; drive dump data in flash memory
Ready	Off	Off	Off
Activity	Flashing slowly	Flashing slowly	Flashing slowly
Clean	Off	Off	Off
Fault	Off	Flashing slowly	Lit

4. Press the unload button twice to start the drive dump. The drive dump is complete when the ready LED is lit indicating that the drive has returned to Operation mode.
5. To verify that the dump data is in memory, complete the following steps:
   a. Make sure that there is no cartridge in the drive.
   b. Press and hold the unload button until the ready LED flashes. Make sure that the LEDs are in one of the following states:
      - Ready: flashing rapidly
      - Activity: off
      - Clean: off
      - Fault: flashing slowly
   c. If the fault LED is not flashing, repeat the service mode 2 procedure.
   d. Wait 15 seconds for the drive to return to operation mode.

Service mode 3: Copy dump data to tape

To copy dump data to a tape cartridge, complete the following steps:

1. Make sure that there is no cartridge in the drive.
2. Press and hold the unload button until the ready LED flashes rapidly.

   Note: The drive will return to operation mode if you do not perform the next step within 15 seconds.
3. Press the unload button 2 times to start service mode 3. The status LEDs indicate one of the following conditions.

LED	Service mode 3	Service mode 3; dump data in memory	Service mode 3; dump data in flash memory
Ready	Flashing rapidly	Flashing rapidly	Flashing rapidly
Activity	Flashing rapidly	Flashing rapidly	Flashing rapidly
Clean	Off	Off	Off
Fault	Off	Flashing slowly	Lit

   Note: The drive will return to operation mode if you do not perform the next step within 15 seconds.
4. Insert a blank data cartridge.
5. When the cartridge is ejected, remove the cartridge from the drive. The ready LED will be lit, indicating that the drive has returned to operation mode.

Service mode 4: Copy dump data to flash memory

To copy dump data to flash memory, complete the following steps:

1. Make sure that there is no cartridge in the drive.
2. Press and hold the unload button until the ready LED flashes rapidly.

   Note: The drive will return to operation mode if you do not perform the next step within 15 seconds.
3. Press the unload button three times to start service mode 4. The status LEDs indicate one of the following conditions.

   Attention: If the fault LED is lit, there is dump data already saved in flash memory. To avoid overwriting the dump data currently in flash memory, contact IBM Support.

LED	Service mode 4	Service mode 4; dump data in memory	Service mode 4; dump data in flash memory
Ready	Off	Off	Off
Activity	Off	Off	Off
Clean	Flashing rapidly	Flashing rapidly	Flashing rapidly
Fault	Off	Flashing slowly	Lit

4. Press the unload button twice to copy the dump data to flash memory. The copy is complete when the ready LED is lit, indicating that the drive has returned to Operation mode.
5. To verify that the dump data is in flash memory, complete the following steps:
   a. Make sure that there is no cartridge in the drive.
   b. Press and hold the unload button until the ready LED flashes rapidly. Make sure that the status LEDs are in the following states:
      - Ready: flashing rapidly
      - Activity: off
      - Clean: off
      - Fault: lit
   c. If the fault LED is off, repeat the service mode 4 procedure.
   d. Wait 15 seconds for the drive to return to operation mode.

Service mode 5: Erase flash memory

To erase flash memory, complete the following steps:

1. Make sure that there is no cartridge in the drive.
2. Press and hold the unload button until the ready LED flashes rapidly.

   Note: The drive will return to operation mode if you do not perform the next step within 15 seconds.
3. Press the unload button four times to start service mode 5. The status LEDs indicate one of the following conditions.

	Service mode 5	Service mode 5; dump data in memory	Service mode 5; dump data in flash memory
Ready	Flashing rapidly	Flashing rapidly	Flashing rapidly

	Service mode 5	Service mode 5; dump data in memory	Service mode 5; dump data in flash memory
Activity	Off	Off	Off
Clean	Flashing rapidly	Flashing rapidly	Flashing rapidly
Fault	Off	Flashing slowly	Lit

4. Press the unload button twice to start erasing flash memory.
5. The erasure is complete when the ready LED is lit, indicating that the drive has returned to operation mode.
6. To verify that the flash memory was erased, complete the following steps:
   a. Make sure that there is no cartridge in the drive.
   b. Press and hold the unload button until the ready LED flashes rapidly. Make sure that the status LEDs are in the following states:
      - Ready: flashing rapidly
      - Activity: off
      - Clean: off
      - Fault: off
   c. If the fault LED is lit, repeat the service mode 4 procedure.
   d. Wait 15 seconds for the drive to return to operation mode.

Service mode 6: Make a field microcode replacement tape

To make a field microcode replacement tape, complete the following steps:

1. Make sure that there is no cartridge in the drive.
2. Press and hold the unload button until the ready LED flashes rapidly. The status LEDs will indicate one of the following conditions.

	Service mode 1; no dump data in memory	Service mode 1; dump data in memory	Service mode 1; dump data in flash memory
Ready	Flashing rapidly	Flashing rapidly	Flashing rapidly
Activity	Off	Off	Off
Clean	Off	Off	Off
Fault	Off	Flashing slowly	Lit

Note: The drive will return to operation mode if you do not perform the next step within 15 seconds.

3. Press the unload button five times to start service mode 6. The status LEDs indicate one of the following conditions.

	Service mode 6; no dump data in memory	Service mode 6; dump data in memory	Service mode 6; dump data in flash memory
Ready	Off	Off	Off
Activity	Flashing rapidly	Flashing rapidly	Flashing rapidly
Clean	Flashing rapidly	Flashing rapidly	Flashing rapidly
Fault	Off	Flashing slowly	Lit

4. Insert a blank data cartridge.
5. When the cartridge is ejected, remove the cartridge from the drive. The ready LED is lit, indicating that the drive has returned to operation mode.

Service mode 7: Unmake a field microcode replacement tape

To unmake a field microcode replacement tape, complete the following steps:

1. Make sure that there is no cartridge in the drive.
2. Press and hold the unload button until the ready LED flashes rapidly. The status LEDs indicate one of the following conditions.

	Service mode 1; no dump data in memory	**Service mode 1; dump data in memory**	**Service mode 1; dump data in flash memory**
Ready	Flashing rapidly	Flashing rapidly	Flashing rapidly
Activity	Off	Off	Off
Clean	Off	Off	Off
Fault	Off	Flashing slowly	Lit

Note: The drive will return to operation mode if you do not perform the next step within 15 seconds.

3. Press the unload button six times to start service mode 7. The status LEDs indicate one of the following conditions.

	Service mode 7; no dump data in memory	**Service mode 7; dump data in memory**	**Service mode 7; dump data in flash memory**
Ready	Flashing rapidly	Flashing rapidly	Flashing rapidly
Activity	Flashing rapidly	Flashing rapidly	Flashing rapidly
Clean	Flashing rapidly	Flashing rapidly	Flashing rapidly
Fault	Off	Flashing slowly	Lit

4. Insert the FMR cartridge to be erased. The drive will timeout if the cartridge is not inserted within 15 seconds.
5. When the cartridge is ejected, remove the cartridge from the drive. The ready LED is lit, indicating that the drive has returned to operation mode.

Service mode 8: Not used

This service mode is not used.

Replacing a drive

The drive is a Tier 1 customer replaceable unit (CRU). Replacement of Tier 1 CRUs is your responsibility. If IBM installs a Tier 1 CRU at your request, you will be charged for the installation.

For more information about the terms of the warranty and getting service and assistance, see the *Warranty information* document that came with the tape drive.

If you are instructed to return a component, follow all packaging instructions, and use any packaging materials for shipping that are supplied to you.

Table 6 lists the replaceable components.

Table 6. CRU and Option part numbers

Description	CRU part number	Option part number
IBM Internal Half High LTO Gen 3 SAS Tape Drive	46X5663	43W8478
IBM External Half High LTO Gen 3 SAS Drive, with US line cord	95Y8021	3628L3X
IBM External Half High LTO Gen 3 SAS Drive, with no line cord	95Y8021	3628N3X
Mounting screw	42C3934	
SAS cable, internal	44E8878	
Mini-SAS cable, external, 3 m x 4 plug	39R6532	
US line cord, 3 ft, 10 A / 125 V	39M5081	

Removing the drive

To remove the drive, complete the following steps:

1. Read the safety information that begins on page iii and “Installation guidelines” on page 7.
2. Make sure that the server is turned off and that the power cord is disconnected.
3. Remove the server covers, using the instructions that came with the server.
4. Disconnect the SAS and power cables from the drive.
5. Remove the drive from the bay, using the drive-installation instructions that came with the server.

Installing the drive

To install the drive, complete the following steps:

1. Read the safety information that begins on page iii and “Installation guidelines” on page 7.
2. Make sure that the server is turned off and that the power cord is disconnected.
3. Install the drive in the bay, using the drive-installation instructions that came with the server.
4. Connect the SAS connector to the drive.
5. Connect the power connector to the drive.
6. Reinstall the server covers, using the instructions that came with the server.
7. Connect the power cord and turn on the server.

Appendix A. Specifications

The tape drive has the following physical, power, and environmental specifications.

Physical specifications

Specification	Measurement
Width	146.0 mm (5.74 in.) without bezel
	148.6 mm (5.85 in.) with bezel
Length	205.0 mm (8.07 in.) without bezel
	210.0 mm (8.26 in.) with bezel
Height	41.0 mm (1.6 in.) without bezel
	42.7 mm (1.7 in.) with bezel
Weight (without a cartridge)	1.6 kg (3 lb. 5 oz.)

Power specifications

Specification	5 V dc	12 V dc
Tolerance	± 10%	± 10%
Minimum supply current (steady state)	1.9 A	0.2 A
Maximum supply current (steady state)	3.4 A	1.1 A

Acoustical specifications

Specification	Measurement
Operating	5.8 bel
Idle	5.0 bel

Environmental specifications

Specification	Measurement		
	Operating (see Note 3)	Storage	Shipping
Drive temperature	10 to 40°C (50 to 104°F)	-40 to 60°C (-40 to 140°F)	–40 to 60°C (–40 to 140°F)
Relative humidity (noncondensing)	20 to 80%	10 to 90%	10 to 90%
Wet bulb temperature (maximum)	26°C (78.8°F)	26°C (78.8°F)	26°C (78.8°F)
Note: Measured in front of the bezel, near the air intake area (see Figure 3 on page 8).			

Other specifications

Specification	Measurement
Maximum altitude for operating and storage	3048 m (10 000 ft)
Maximum altitude for shipping	12192 m (40 000 ft)

Appendix B. TapeAlert flags

Some backup applications support TapeAlert flags, which are used to identify problems with the drive. The following table lists the TapeAlert flags that are supported by the drive.

Table 7. Supported TapeAlert flags

Flag number	Flag parameter (in hex)	Flag	Description	Action required
3	03h	Hard error	This error is set for any unrecoverable read, write, or positioning error. (This flag is set in conjunction with flags 4, 5, and 6.)	See the “Action required” column for flag 4, 5, or 6 in this table.
4	04h	Media	This error is set for any unrecoverable read, write, or positioning error that is due to a faulty tape cartridge.	Replace the tape cartridge.
5	05h	Read failure	This error is set for any unrecoverable read error where isolation is uncertain and failure might be due to a faulty tape cartridge or to faulty drive hardware.	If flag 4 is also set, the cartridge is defective. Replace the tape cartridge.
6	06h	Write failure	This error is set for any unrecoverable write or positioning error where isolation is uncertain and failure might be due to a faulty tape cartridge or to faulty drive hardware.	If flag 9 is also set, make sure that the write-protect switch is set so that data can be written to the tape. If flag 4 is also set, the cartridge is defective. Replace the tape cartridge.
8	08h	Not data grade	This error is set when severe servo errors occur while a tape cartridge is being loaded.	Replace the tape cartridge.
9	09h	Write protect	This error is set when the drive detects that the tape cartridge is write-protected.	Make sure that the write-protect switch is set so that the drive can write data to the tape.
10	0Ah	No removal	This error is set when the drive receives an unload command after the server prevented the tape cartridge from being removed.	See the documentation for your operating system.
11	0Bh	Cleaning media	This error is set when you load a cleaning cartridge into the drive.	No action is required.
12	0Ch	Unsupported format	This error is set when you load an unsupported cartridge type into the drive or when the cartridge format has been corrupted.	Use a supported tape cartridge.
15	0Fh	Cartridge memory chip failure	This error is set when a cartridge memory (CM) failure is detected on the loaded tape cartridge.	Replace the cartridge.

Table 7. Supported TapeAlert flags (continued)

Flag number	Flag parameter (in hex)	Flag	Description	Action required
16	10h	Forced eject	This error is set when you manually unload the tape cartridge while the drive was reading or writing.	No action required.
18	12h	Tape directory corrupted in the cartridge memory	This error is set when the drive detects that the tape directory in the cartridge memory has been corrupted.	Reread all data from the tape to rebuild the tape directory.
20	14h	Clean now	This error is set when the drive detects that it needs cleaning.	Clean the drive. See “Cleaning the drive head” on page 19.
21	15h	Clean periodic	This error is set when the drive detects that it needs routine cleaning.	Clean the drive as soon as possible. The drive can continue to operate, but you should clean the drive soon. See “Cleaning the drive head” on page 19.
22	16h	Expired clean	This error is set when the drive detects a cleaning cartridge that has expired.	Replace the cleaning cartridge.
23	17h	Invalid cleaning tape	This error is set when the drive expects a cleaning cartridge and the loaded cartridge is not a cleaning cartridge.	Use a valid cleaning cartridge.
30	1Eh	Hardware A	This error is set when a hardware failure occurs which requires that you reset the drive to recover.	If resetting the drive does not recover the error, use drive sense data.
31	1Fh	Hardware B	This error is set when the drive fails its internal self tests.	Use the drive sense data.
32	20h	Interface	This error is set when the drive detects a problem with the SAS or LDI (RS-422) interface.	Use the drive sense data.
33	21h	Eject media	This error is set when a failure occurs that requires you to unload the cartridge from the drive.	Unload and reload the tape cartridge.
34	22h	Download fail	This error is set when an FMR image is unsuccessfully downloaded to the drive.	Make sure that it is the correct image. Download the FMR image again.
36	24h	Drive temperature	This error is set when the temperature of the drive sensor indicates that the temperature is exceeding the recommended temperature of the enclosure (see “Physical specifications” on page 31).	Use the drive sense data.

Table 7. Supported TapeAlert flags (continued)

Flag number	Flag parameter (in hex)	Flag	Description	Action required
37	25h	Drive voltage	This error is set when the drive detects that the externally supplied voltages are either approaching the specified voltage limits or are outside the voltage limits (see “Physical specifications” on page 31).	Use the drive sense data.
39	27h	Diagnostics required	This error is set when the drive detects a failure that requires diagnostics to isolate the problem.	Use the drive sense data.
51	33h	Tape directory invalid at unload	This error is set when the tape directory on the tape cartridge that was previously unloaded is corrupted. The file-search performance is degraded.	Rebuild the tape directory by reading all the data.
52	34h	Tape system area write failure	This error is set when the tape cartridge that was previously unloaded could not write its system area successfully.	Copy the data to another tape cartridge, then discard the old cartridge.
53	35h	Tape system area read failure	This error is set when the tape system area could not be read successfully at load time.	Copy the data to another tape cartridge, then discard the old cartridge.
55	37h	Loading failure	The error is set when the drive is unable to load the media and thread the tape.	Remove the cartridge, inspect it as specified in the product manual, and retry the operation. If the problem remains, contact IBM Support.
56	38h	Unrecoverable unload failure	The drive is unable to unload the media.	Do not attempt to extract the tape cartridge. Contact IBM Support.

Appendix C. Getting help and technical assistance

If you need help, service, or technical assistance or just want more information about IBM products, you will find a wide variety of sources available from IBM to assist you. This section contains information about where to go for additional information about IBM and IBM products, what to do if you experience a problem with your system, and whom to call for service, if it is necessary.

Before you call

Before you call, make sure that you have taken these steps to try to solve the problem yourself:

- Check all cables to make sure that they are connected.
- Check the power switches to make sure that the system and any optional devices are turned on.
- Use the troubleshooting information in your system documentation, and use the diagnostic tools that come with your system. Information about diagnostic tools is in the *Problem Determination and Service Guide* on the IBM *Documentation* CD that comes with your system.
- Go to the IBM support website at http://www.ibm.com/supportportal/ to check for technical information, hints, tips, and new device drivers or to submit a request for information.

You can solve many problems without outside assistance by following the troubleshooting procedures that IBM provides in the online help or in the documentation that is provided with your IBM product. The documentation that comes with IBM systems also describes the diagnostic tests that you can perform. Most systems, operating systems, and programs come with documentation that contains troubleshooting procedures and explanations of error messages and error codes. If you suspect a software problem, see the documentation for the operating system or program.

Using the documentation

Information about your IBM system and preinstalled software, if any, or optional device is available in the documentation that comes with the product. That documentation can include printed documents, online documents, readme files, and help files. See the troubleshooting information in your system documentation for instructions for using the diagnostic programs. The troubleshooting information or the diagnostic programs might tell you that you need additional or updated device drivers or other software. IBM maintains pages on the World Wide Web where you can get the latest technical information and download device drivers and updates. To access these pages, go to http://www.ibm.com/supportportal/ and follow the instructions. Also, some documents are available through the IBM Publications Center at http://www.ibm.com/shop/publications/order/.

Getting help and information from the World Wide Web

On the World Wide Web, the IBM website has up-to-date information about IBM systems, optional devices, services, and support. The address for IBM System x and xSeries information is http://www.ibm.com/systems/x/. The address for IBM BladeCenter® information is http://www.ibm.com/systems/bladecenter/. The address for IBM IntelliStation® information is http://www.ibm.com/systems/intellistation/.

You can find service information for IBM systems and optional devices at http://www.ibm.com/supportportal/.

Software service and support

Through IBM Support Line, you can get telephone assistance, for a fee, with usage, configuration, and software problems with System x and xSeries servers, BladeCenter products, IntelliStation workstations, and appliances. For information about which products are supported by Support Line in your country or region, see http://www.ibm.com/services/supline/products/.

For more information about Support Line and other IBM services, see http://www.ibm.com/services/, or see http://www.ibm.com/planetwide/ for support telephone numbers. In the U.S. and Canada, call 1-800-IBM-SERV (1-800-426-7378).

Hardware service and support

You can receive hardware service through your IBM reseller or IBM Services. To locate a reseller authorized by IBM to provide warranty service, go to http://www.ibm.com/partnerworld/ and click **Find Business Partners** on the right side of the page. For IBM support telephone numbers, see http://www.ibm.com/planetwide/. In the U.S. and Canada, call 1-800-IBM-SERV (1-800-426-7378).

In the U.S. and Canada, hardware service and support is available 24 hours a day, 7 days a week. In the U.K., these services are available Monday through Friday, from 9 a.m. to 6 p.m.

IBM Taiwan product service

台灣 IBM 產品服務聯絡方式：
台灣國際商業機器股份有限公司
台北市松仁路 7 號 3 樓
電話：0800-016-888

IBM Taiwan product service contact information:
IBM Taiwan Corporation
3F, No 7, Song Ren Rd.
Taipei, Taiwan
Telephone: 0800-016-888

Appendix D. Notices

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Important notes

This product is not intended to be connected directly or indirectly by any means whatsoever to interfaces of public telecommunications networks, nor is it intended to be used in a public services network.

Processor speed indicates the internal clock speed of the microprocessor; other factors also affect application performance.

CD or DVD drive speed is the variable read rate. Actual speeds vary and are often less than the possible maximum.

When referring to processor storage, real and virtual storage, or channel volume, KB stands for 1024 bytes, MB stands for 1,048,576 bytes, and GB stands for 1,073,741,824 bytes.

When referring to hard disk drive capacity or communications volume, MB stands for 1,000,000 bytes, and GB stands for 1,000,000,000 bytes. Total user-accessible capacity can vary depending on operating environments.

Maximum internal hard disk drive capacities assume the replacement of any standard hard disk drives and population of all hard disk drive bays with the largest currently supported drives that are available from IBM.

Maximum memory might require replacement of the standard memory with an optional memory module.

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Some software might differ from its retail version (if available) and might not include user manuals or all program functionality.

Particulate contamination

Attention: Airborne particulates (including metal flakes or particles) and reactive gases acting alone or in combination with other environmental factors such as humidity or temperature might pose a risk to the tape drive that is described in this document. Risks that are posed by the presence of excessive particulate levels or concentrations of harmful gases include damage that might cause the tape drive to malfunction or cease functioning altogether. This specification sets forth limits for particulates and gases that are intended to avoid such damage. The limits must not be viewed or used as definitive limits, because numerous other factors, such as temperature or moisture content of the air, can influence the impact of particulates or environmental corrosives and gaseous contaminant transfer. In the absence of specific limits that are set forth in this document, you must implement practices that maintain particulate and gas levels that are consistent with the protection of human health and safety. If IBM determines that the levels of particulates or gases in your environment have caused damage to the tape drive, IBM may condition provision of repair or replacement of tape drive or parts on implementation of appropriate remedial measures to mitigate such environmental contamination. Implementation of such remedial measures is a customer responsibility.

Table 8. Limits for particulates and gases

Contaminant	Limits
Particulate	• The room air must be continuously filtered with 40% atmospheric dust spot efficiency (MERV 9) according to ASHRAE Standard 52.2[1]. • Air that enters a data center must be filtered to 99.97% efficiency or greater, using high-efficiency particulate air (HEPA) filters that meet MIL-STD-282. • The deliquescent relative humidity of the particulate contamination must be more than 60%[2]. • The room must be free of conductive contamination such as zinc whiskers.
Gaseous	• Copper: Class G1 as per ANSI/ISA 71.04-1985[3] • Silver: Corrosion rate of less than 300 Å in 30 days

[1] ASHRAE 52.2-2008 - *Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size*. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

[2] The deliquescent relative humidity of particulate contamination is the relative humidity at which the dust absorbs enough water to become wet and promote ionic conduction.

[3] ANSI/ISA-71.04-1985. *Environmental conditions for process measurement and control systems: Airborne contaminants*. Instrument Society of America, Research Triangle Park, North Carolina, U.S.A.

Documentation format

The publications for this product are in Adobe Portable Document Format (PDF) and should be compliant with accessibility standards. If you experience difficulties when you use the PDF files and want to request a web-based format or accessible PDF document for a publication, direct your mail to the following address:

Information Development
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Research Triangle Park, North Carolina 27709-2195

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Electronic emission notices

When you attach a monitor to the equipment, you must use the designated monitor cable and any interference suppression devices that are supplied with the monitor.

Federal Communications Commission (FCC) statement

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. IBM is not responsible for any radio or television interference caused by using other than recommended cables and connectors or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

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

Industry Canada Class A emission compliance statement

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

Avis de conformité à la réglementation d'Industrie Canada

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

Australia and New Zealand Class A statement

Attention: This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

European Union EMC Directive conformance statement

This product is in conformity with the protection requirements of EU Council Directive 2004/108/EC on the approximation of the laws of the Member States relating to electromagnetic compatibility. IBM cannot accept responsibility for any failure to satisfy the protection requirements resulting from a nonrecommended modification of the product, including the fitting of non-IBM option cards.

Attention: This is an EN 55022 Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

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International Business Machines Corp.
New Orchard Road
Armonk, New York 10504
914-499-1900

European Community contact:
IBM Technical Regulations, Department M456
IBM-Allee 1, 71137 Ehningen, Germany
Telephone: +49 7032 15-2937
E-mail: tjahn@de.ibm.com

Germany Class A statement

Deutschsprachiger EU Hinweis:

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Dieses Produkt entspricht den Schutzanforderungen der EU-Richtlinie 2004/108/EG zur Angleichung der Rechtsvorschriften über die elektromagnetische Verträglichkeit in den EU-Mitgliedsstaaten und hält die Grenzwerte der EN 55022 Klasse A ein.

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Verantwortlich für die Einhaltung der EMV Vorschriften ist der Hersteller:
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Der verantwortliche Ansprechpartner des Herstellers in der EU ist:
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Technical Regulations, Department M456
IBM-Allee 1, 71137 Ehningen, Germany
Telephone: +49 7032 15-2937
E-mail: tjahn@de.ibm.com

Generelle Informationen:

Das Gerät erfüllt die Schutzanforderungen nach EN 55024 und EN 55022 Klasse A.

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This is a Class A product based on the standard of the Voluntary Control Council for Interference (VCCI). If this equipment is used in a domestic environment, radio interference may occur, in which case the user may be required to take corrective actions.

Japan Electronics and Information Technology Industries Association (JEITA) statement

高調波ガイドライン適合品

Japanese Electronics and Information Technology Industries Association (JEITA) Confirmed Harmonics Guideline (products less than or equal to 20 A per phase)

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中华人民共和国“A类”警告声明

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