

TS4300 Tape Library



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IBM TS4300 Tape Library

Welcome to the IBM TS4300 tape library documentation, where you can find information about how to install, maintain, and use the TS4300 tape library.

Last updated:

- [Overview](#)
The overview of the features and functions of the IBM® TS4300 tape library is useful for high-level evaluation of the product and planning for the implementation of the product.
- [Planning](#)
The library requires an environment able to accommodate the appropriate space, power, location, and other technical specifications. Use this section as a reference for onsite requirements to allow for optimum operation of the library.
- [Installing](#)
Use this section to follow the procedures to install and configure your library.
- [Managing](#)
Four user roles are described, and each user role has its specific functions.
- [Troubleshooting](#)
Use the information in this section to troubleshoot any issues with your library setup and configuration.
- [Upgrading and servicing](#)
In this section, you can follow the procedures to add, remove, and replace library components.
- [Reference](#)
This section provides information about the Help pages, REST API, LTO Media, and other reference documentation.
- [Notices](#)
This information was developed for products and services that are offered in the US. This material might be available from IBM® in other languages. However, you might be required to own a copy of the product or product version in that language in order to access it.
- [Glossary](#)
This glossary defines the special terms, abbreviations, and acronyms that are used in this publication. If you do not find the term that you are looking for, refer to the index or to the *Dictionary of Computing*, 1994.

Getting started

- [Overview](#)
- [Planning](#)
- [Installing](#)
- [Managing](#)

Common tasks

- [Upgrading and servicing](#)
- [Handling the cartridges](#)
- [Methods of cleaning drives](#)
- [HBA requirements](#)

Troubleshooting and support

- [Troubleshooting](#)
- [IBM tape storage support](#)
- [IBM Support home page](#)

More information

- [Minimum firmware levels for common library features](#)
- [REST API for scalable tape libraries](#)
- [Related publications](#)
- [IBM TS4300 Tape Library SCSI Reference](#)
- [IBM Community \(Community platform\)](#)
- [IBM Support content \(Product support\)](#)
- [IBM Spectrum Archive Single Drive Edition documentation](#)
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Overview

The overview of the features and functions of the IBM® TS4300 tape library is useful for high-level evaluation of the product and planning for the implementation of the product.

- [What's New](#)
Read about what is new or changed in the latest release of the IBM® TS4300 Tape Library.
- [Introduction](#)
The IBM® TS4300 tape library provides compact, high-capacity, low-cost solutions for simple, unattended data backup. The installation begins with the 3U

high Base Module, with capacity for up to 40 tape cartridges and 3 half-height LTO™ tape drives, or one full-height and one half-height tape drive. An additional 40 Cartridges and more Drives can be added by installing expansion modules above and below the base module. Earlier Libraries could add 6 expansion modules for a total maximum library stack of 7 modules (21U). Later libraries could add up to 15 expansion modules for a total library stack of 16 modules (48U). A 21U Library cannot be converted to a 48U Library. 48U and 21U libraries have different PNs:

- [Structure and supported library configurations](#)
The TS4300 tape library supports a single base module tabletop configuration or a scalable rackmount configuration.
- [User interfaces](#)
This library has two user interfaces: the Management GUI and the Operator Panel.
- [Multi-Factor Authentication](#)
The TS4300 has the option to use a one-time password for multi-factor authentication of local users and access through the REST API.
- [Safeguarded Tape - Driveless logical libraries](#)
The cartridge archive feature of the TS4300 enables a user to store cartridge in a logical library that is not accessible by a SCSI host or other applications.
- [Certificate chains](#)
The TS4300 supports certificate chains when creating custom certificates with the TS4300 tape library.
- [Tape drives](#)
The library supports LTO6 and later tape drives. Each drive requires a SAS or Fibre Channel cable.
- [Drive features](#)
- [Tape cartridges](#)
The TS4300 supports multiple generations of LTO media.
- [Library functions](#)
The library provides many specific functions, such as random or sequential operating mode, encryption, library sharing, path failover, and alerts and logging.

What's New

Read about what is new or changed in the latest release of the IBM® TS4300 Tape Library.

New information in this release

- See New Machine type models
- See Support for LTO-10

Introduction

The IBM® TS4300 tape library provides compact, high-capacity, low-cost solutions for simple, unattended data backup. The installation begins with the 3U high Base Module, with capacity for up to 40 tape cartridges and 3 half-height LTO™ tape drives, or one full-height and one half-height tape drive. An additional 40 Cartridges and more Drives can be added by installing expansion modules above and below the base module. Earlier Libraries could add 6 expansion modules for a total maximum library stack of 7 modules (21U). Later libraries could add up to 15 expansion modules for a total library stack of 16 modules (48U). A 21U Library cannot be converted to a 48U Library. 48U and 21U libraries have different PNs:

- 21U Base Chassis: H6FNK
- 21U Chassis CRU: CG56W
- 48U Base Chassis: 79KJK
- 48U Chassis CRU: 3VJVV

The library provides the following capabilities:

- I/O magazines to allow individual cartridge handling to be done independent of the library.
- Mixed media types
- Integrated management tools
- Remote management with the management GUI
- Remote monitoring with Simple Network Management Protocol (SNMP)
- Multipath architecture
- Host-based path failover
- Sequential Mode option

Table 1. Minimum and maximum storage configurations

Configuration	Capacity	
Minimum 1 Module Library Base Module only	Cartridges	40 ² 35 with 5-slot I/O ¹
	Half height ³ Tape Drives	3
	Full height ⁴ Tape Drives	1
	Half height ³ /Full height ⁴ Tape Drive Mix	1/1
Maximum 7 Module Library (21U) Base Module + 6 Expansion Modules	Cartridges	280 ² (275 with 5-slot I/O ¹)
	Half height ³ Tape Drives	21
	Full height ⁴ Tape Drives	7
	Half height ³ /Full height ⁴ Tape Drive Mix	19/1 up to 7/7
Maximum	Cartridges	640 (635 with 5-slot I/O ¹)
	Half height ³ Tape Drives	48

Configuration	Capacity	
Base Module + 15 Expansion Modules	Full height ⁴ Tape Drives	16
	Half height ³ /Full height ⁴ Tape Drive Mix	46/1 up to 16/16

- ¹Every module can contain a 5-slot I/O station. If a module is configured with a 5-slot I/O station, then there are only 35 remaining I/O slots in that module.
- ²For libraries with serial numbers before 7800K0K, capacity in lowest module for a 5-slot I/O station is 32 slots and for a 4-slot I/O station is 28 slots.
- ³Half-height tape drives can be installed in any drive bay in a module.
- ⁴Full-height tape drives must be installed in the lowest two bays of a module. Installing a full-height drive in the top two bays of a module is not supported.

Structure and supported library configurations

The TS4300 tape library supports a single base module tabletop configuration or a scalable rackmount configuration.

Machine type models

With the introduction of LTO-10 support, IBM has introduced a new Machine Type and Model (MTM) for the TS4300 tape library. The new MTM enhances serviceability by enabling **Service Expert Care** for newly deployed libraries. See [Service Expert Care Overview](#) for more information.

Firmware and Component Compatibility

- There are no firmware differences between the existing and new machine types.
- Most Customer Replaceable Units (CRUs), unless specifically noted, are interchangeable between MTM 3555 and 5544.

Drive Support by MTM

The new MTMs also define drive compatibility within TS4300 libraries:

- **MTM 5544**
 - **Base module:** 5544-L8A
 - **Expansion modules:** 5544-E8A
 - **Supported Drives:** LTO-8, LTO-9, LTO-10
- **MTM 3555**
 - **Base modules:** 3555-L3A
 - **Expansion modules:** 3555-E3A
 - **Supported Drives:** LTO-6, LTO-7, LTO-8, LTO-9
 - **Important:** MTM 3555 will **not support LTO-10 or later generations**. Expansion module (3555-E3A) **cannot be converted** for migration to a 5544 library.

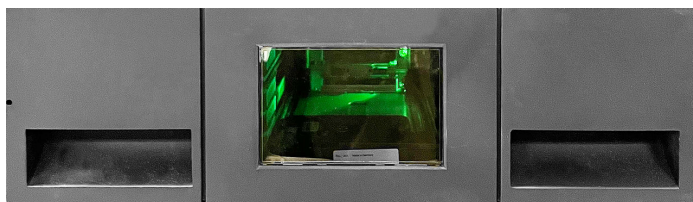
Supported library configurations

All libraries start with a Base Module. For more capacity, up to fifteen Expansion Modules can be added as needed to support customer requirements. The Expansion Modules are distributed above and below the Base Module.

Figure 1. Base Module

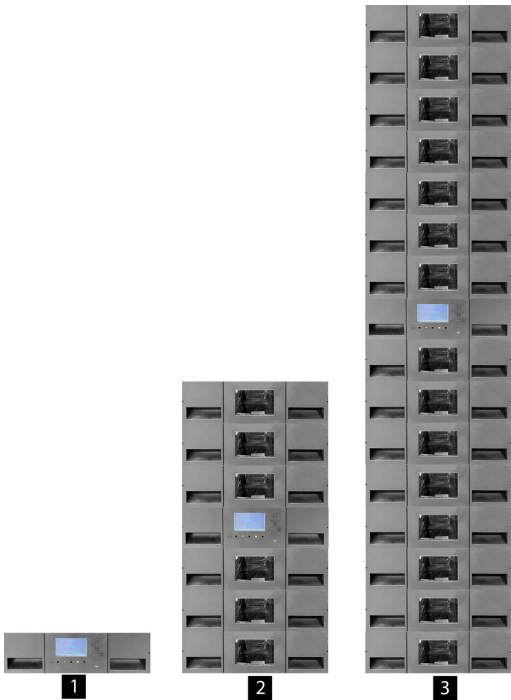


Figure 2. Expansion Module



The total maximum height of a fully expanded library depends on the library type. Older libraries had a maximum height of 21U. Newer Libraries can be expanded up to 48U. Refer to [Figure 3](#). The first example is a one module library **1**, it consists of just the base module. The second is a 21U library **2**. The base module is fourth from the bottom, and is surrounded by six expansion modules. The maximum 21U configuration cannot be built in any other way. The third example is a full 48U library **3**. In this configuration, the base module is roughly in the middle with seven expansion modules above and eight below, fifteen expansion modules total. The maximum 48U configuration cannot be built any other way.

Figure 3. Configuration comparison



- [Components](#)
 - [Element Numbering](#)
- The element numbering in the TS4300 provides a unique identifier for important library elements.

Components

- [Front panel](#)
- [Rear panel](#)
- [Magazines](#)
- [Accessor](#)
- [Power supply](#)

Front panel

Figure 1. Front panel

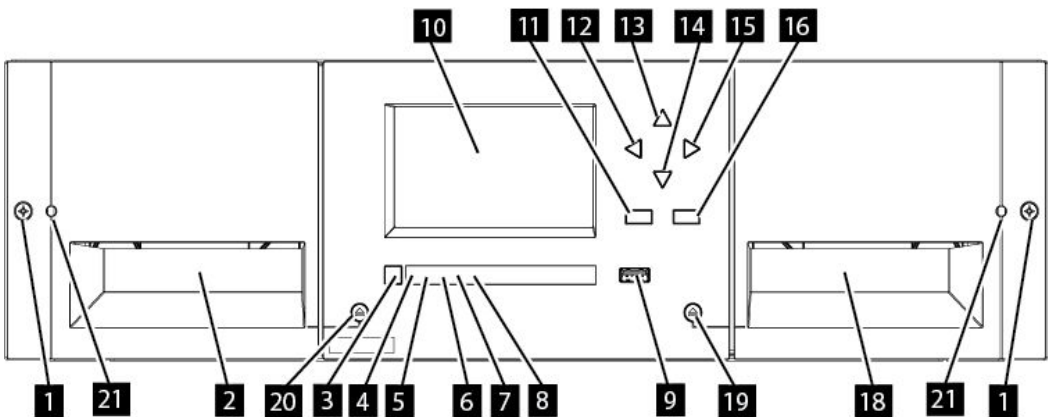


Table 1. Front panel descriptions

Number	Item	Comments
1	Screw holes for attachment to a rack	
2	Left magazine access handle	

Number	Item	Comments
3	Power	Base Module only
4	Ready LED, Green	Base Module only
5	Unit Identification (UID) LED, Blue	Base Module only
6	Clean LED, Amber	Base Module only
7	Attention LED, Amber	Base Module only
8	Error LED, Amber	Base Module only
9	USB port	Base Module only
10	Operator Panel display	Base Module only
11	Back/Return button	Base Module only
12	Navigation button - Left	Base Module only
13	Navigation button - Up	Base Module only
14	Navigation button - Down	Base Module only
15	Navigation button - Right	Base Module only
16	Enter button	Base Module only
18	I/O station/Right magazine access handle	
19	Right magazine button	
20	Left magazine button	
21	Manual magazine release hole	

Rear panel

Figure 1. Rear panel

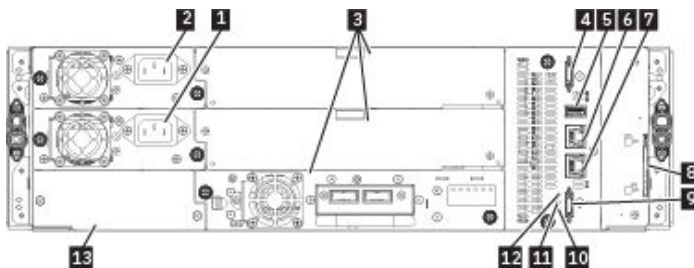


Table 1. Rear panel descriptions

Number	Item	Comments
1	Power supply 1	Standard on Base Module Optional on Expansion Module (required if drives are present)
2	Power supply 2	Optional on Base Module and Expansion Modules
3	Tape drive bays	Full high drives take up 2 bays and can only be installed in the lower two drive bays.
4	Upper Expansion Module connection port	
5	USB port	Base Module only
6	Ethernet port B	Base Module only (secondary port for service usage)
7	Ethernet port A	Base Module only
8	Module alignment mechanism	
9	Lower Expansion Module connection port	
10	Unit Identifier LED, Blue	
11	Controller Error LED, Yellow	
12	Controller Health Status LED, Green	
13	Product Serial Number, Tag location	

Magazines

Each module contains two magazines, holding up to 40 cartridges.

Figure 1. Left magazine

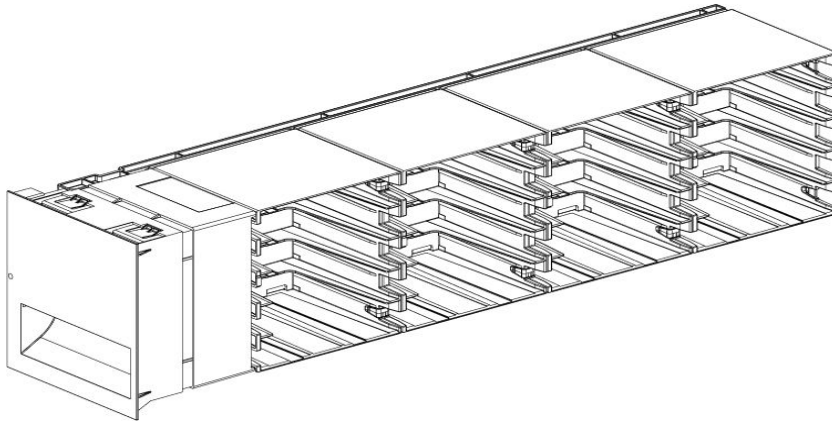
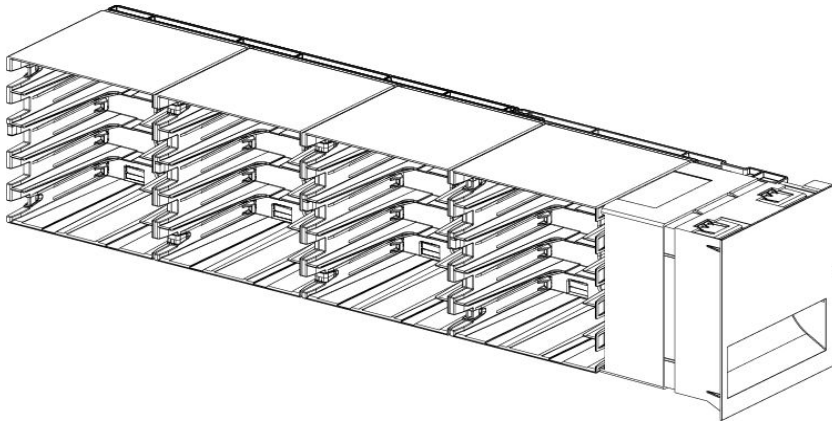


Figure 2. Right magazine



The library assigns each slot in a magazine a unique number to indicate its location. This numbering is shown on the Cartridges page of the Management GUI.

Table 1. Numbering of storage slots

Front of the Left Magazine	5	10	15	20	Drives	25	30	35	40	Front of the Right Magazine
	4	9	14	19		24	29	34	39	
	3	8	13	18		23	28	33	38	
	2	7	12	17		22	27	32	37	
	1	6	11	16		21	26	31	36	

Numbering of storage slots in a module starts in the bottom front of the left magazine and goes up each column towards the rear of the magazine. Numbering of the slots in the module continues in the bottom rear slot of the right magazine and goes up each column to the top of the front of the magazine.

The last 5 slots in the front of the right magazine of each module can be configured as an I/O Station. Each Module can have its own I/O station or all modules in a library can use the same I/O station in one of the modules. To enable or disable I/O Stations, go to Library > Modules and Magazines > Actions > Enable or Disable I/O Station in the Management GUI.

Important: Ensure that no tapes are in the slots before the I/O Station is enabled or disabled.

Note: For libraries with serial numbers before 7800K0K, the slots in the lowest row (1, 6, 11, 16, 21, 26, 31, 36) of the bottom module are inaccessible, and the I/O station will only contain 4 slots. These libraries will have a maximum of 32 slots in the bottom module, but all higher modules will have all 40 slots.

Accessor

The accessor is composed of several components: robotic assembly, spooling mechanism, and bar code reader.

- The robotic assembly has fingers that enable it to grab tape cartridges and move them to and from the I/O station, storage slots, and drives.
- The spooling mechanism has a cable that extracts and retracts based on movement of the robotic assembly. This cable provides communication between the robotic assembly and the library main board.
- The high-speed bar code reader is a part of the Base Module. The bar code reader provides inventory feedback to the host application, Operator Panel display, and Management GUI by reading cartridge bar code labels. The library stores the customized inventory data in memory. Library firmware supports a 6 or 8 character volume serial number (VOLSER) on the bar code label on the tape cartridge. It is highly recommended to use bar code labeled cartridges. See [Bar code label](#).

Note: For libraries with S/N 7800K0K and higher, review the [Minimum firmware levels for common library features](#).

Power supply

The library provides a single power supply with each library. However, a secondary redundant power supply for the base module can be added. In addition, each expansion module with drives installed requires a power supply. See [Optional features](#). Remember: For a single module (expansion or base) having two power supplies, the second power supply is deemed as redundant. However, if two or more modules have their individual power supply, then there is no redundant power supply.

Figure 1. Power supply rear panel LEDs

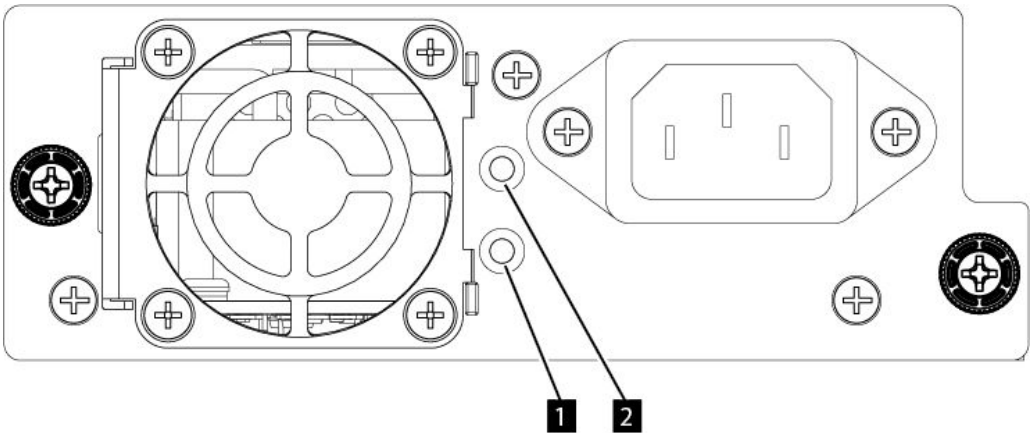


Table 1. Power supply LEDs

Number	Color	Description
1	Green	Module powered ON.
2	White	AC power is connected.

Element Numbering

The element numbering in the TS4300 provides a unique identifier for important library elements. These numbers are used in library interfaces and software to address and locate a particular library element. The following library elements are numbered:

- Modules (Library Base and Expansion modules)
- Slots (storage and I/O)
- Drives

Library Element Numbering

Three different numbering systems are used to identify elements in the library. These different number schemes offer flexibility in communicating the expandable configuration of the library to the customer, to service, and to attached systems.

1. Logical element numbering
2. Physical element numbering
3. SCSI element addressing

Logical Numbering, also referred to as 'Logical ID' or just 'ID', is the primary method used in library interfaces and logs to identify each unique element. Elements are numbered from the bottom up in sequential fashion, as they appear in the configured library.

Figure 1. Logical Numbering Example for a 3-module library

Logical Numbering for 9U Configuration	Lefthand Slots				Modules	Righthand Slots				Drives
	0.1	0.10	0.20	0.30		0.20	0.30	0.40	0.50	
	0.4	0.5	0.64	0.75		0.24	0.25	0.34	0.55	
	0.8	0.9	0.10	0.100		0.30	0.30	0.40	0.50	
	0.10	0.11	0.12	0.13		0.40	0.41	0.42	0.43	
	0.14	0.15	0.16	0.17		0.50	0.50	0.60	0.70	
	0.20	0.20	0.30	0.40		0.20	0.30	0.40	0.50	
	0.4	0.5	0.64	0.75		0.24	0.25	0.34	0.55	
	0.8	0.9	0.10	0.100		0.30	0.30	0.40	0.50	
	0.10	0.11	0.12	0.13		0.40	0.41	0.42	0.43	
	0.14	0.15	0.16	0.17		0.50	0.50	0.60	0.70	
	0.20	0.20	0.30	0.40		0.20	0.30	0.40	0.50	

Physical Element Numbering

A Physical Number, abbreviated as "Phy Num" or "PNUM", is also assigned to each element. Unlike Logical Numbering, the PNUM is based on an element's position in a physical library configuration, from the bottom up. PNUMs are used by the software for internal use only and are typically useful in complex troubleshooting. The PNUM are often listed next to the Log ID, in parentheses, as a diagnostic aid in library logs or interfaces.

Figure 2. Physical Numbering Example for a 3-module library

Physical Numbering for 9U Configuration	Lefthand Slots				Modules	Righthand Slots				Drives
	100	170	170	170		100	170	170	170	
	104	104	174	174		104	104	174	174	
	108	108	178	178		108	108	178	178	
	112	112	172	172		112	112	172	172	
	116	116	176	176		116	116	176	176	
	120	120	120	120		120	120	120	120	
	124	124	124	124		124	124	124	124	
	128	128	128	128		128	128	128	128	
	132	132	132	132		132	132	132	132	
	136	136	136	136		136	136	136	136	
	140	140	140	140		140	140	140	140	

SCSI Element Addressing

SCSI Element Addressing, defined by industry SCSI standards, assigns identifiers to library elements that are used by software applications. Element Addresses are derived from PNUM, but altered as defined by SCSI specifications.

- Drive element addresses start at 1 with the bottom drive that is installed in the library
- I/O slot element addresses start at 101 with the bottom I/O slot in the library
- Cartridge Slot element addresses start with 1001 at the bottom slot in the library
- Modules are not assigned a SCSI address

SCSI element addresses appear in logs and library interfaces along with Element IDs and PNUMs.

Figure 3. SCSI addressing example for a 3-module library

SCSI Addressing for 9U Configuration	Lefthand Slots				Modules	Righthand Slots				Drives
	1000	1000	1000	1000		100	100	100	100	
	1004	1004	1004	1004		104	104	104	104	
	1008	1008	1008	1008		108	108	108	108	
	1012	1012	1012	1012		112	112	112	112	
	1016	1016	1016	1016		116	116	116	116	
	1020	1020	1020	1020		120	120	120	120	
	1024	1024	1024	1024		124	124	124	124	
	1028	1028	1028	1028		128	128	128	128	
	1032	1032	1032	1032		132	132	132	132	
	1036	1036	1036	1036		136	136	136	136	
	1040	1040	1040	1040		140	140	140	140	

Library Elements Numbering Details

These three numbering scheme present differently across the three numbered elements of a library: modules, slots, and drives.

Library Module Numbering

Modules have Logical IDs and Physical Numbers. They do not have SCSI Element addresses. Module numbering can be viewed in the Library Menu of the Navigation Dock in the Management GUI.

Module Logical ID: Module IDs are assigned during configuration in the library start-up process. Modules are numbered from bottom to top starting with '1'. Each Module ID, including the base module, is assigned based on its position in the library.

Example: in a 5-module library, the bottom module ID is 1 and the top module ID is 5. If a module is defective or was removed for repair, the numbering of the modules does not change until the library is restarted. When the library is started again, it goes through a configuration process that includes renumbering of modules

Module Physical Number (PNUM): The physical number is based on the position of the module relative to the base module. In a 21U Library, the base always has a PNUM of 4. In a 48U library, the base always has a PNUM of 9. Expansion modules above the base module have higher PNUMs. Expansion modules below the base module have lower PNUMs. Refer to [Differences between 21U and 48U libraries](#) to determine if the library is a 21U or 48U library.

Cartridge Slot and I/O Magazine Slot Numbering

Slot numbering uses all three numbering systems to identify slots inside the library: Logical ID, Physical Number, and SCSI Element address. Slot numbering can be viewed in the graphical library view or in the Management GUI.

Cartridge Slot Logical ID: The slot ID is generated by combining the Module Logical ID of the module where the slot is and the position of the slot in the module. The position ranges from 1 to 40 and are assigned sequentially, from bottom to top, left to right. Refer to Figure 1 for a visual representation.

The format is [Module].[Slot]. Example: ID 2.7 is Module 2, slot 7.

The Slot ID determination is not dependent on I/O Station configuration. A particular slot will always have the same ID, independent if it is a standard storage slot or an I/O magazine slot. This avoids having to renumber of all slots in a library if I/O Station slots are enabled or disabled in any module.

Cartridge Slot Physical Number (PNUM): Slot Physical Numbers are sequential numbers that are assigned relative to a full library stack. They start at 1 with the first possible slot at the bottom of a full library stack. They end with the last possible slot at the top of a full library stack. Default slot PNUMs in the base modules are different in a 21U versus a 48U Library. The PNUM of the first slot in a 48U base module is 321. The PNUM of the first slot in a 21U Library base module is 121. Slots in expansion modules above the base module have higher PNUMs. Slots in expansion modules below the base have lower PNUMs. Refer to [Differences between 21U and 48U libraries](#) to determine if the library is a 21U or 48U library.

Cartridge Slot SCSI element address: SCSI element addresses are counted in the same order as the Slot PNUM. SCSI element addresses are separately assigned to I/O slots and cartridge slots for each library partition. SCSI initiators can change SCSI element addresses by using the element assignment mode page. SCSI element addresses are counted in the same order as the Slot PNUM. Slot PNUM and element addresses might not be contiguous if mail slots are enabled in the middle of a partition.

Drive Numbering

Drive numbering uses all three numbering systems to identify drives inside the library: Logical ID, Physical Number, and SCSI Element address. Drive numbering can be viewed in the graphical library view or in the Management GUI.

Drive Logical ID: Drives are numbered from bottom to top, starting with 1. Only drives that are present in the library are counted. Adding or removing drives can result in a change of drive logical numbers.

Drive Physical Number (PNUM): Drive PNUMs start with the lowest drive bay (drive sled connector) in a library. The numbering proceeds upward to the highest drive bay. Drives have the PNUM of the drive bay in which they are installed. Full High tape drives occupy two drive bays, but they are numbered by using the lower bay where they plug into the library. The PNUM of the upper bay behind a full high drive is never assigned to a drive. Assignment of World Wide Name (WWN) or World Wide Identifier (WWID) and serial number spoofing is based on the drive PNUM.

Drive SCSI element address: SCSI element addresses are separately assigned for each library partition. SCSI initiators can change element addresses by using the element assignment mode page. SCSI element addresses are numbered in the same order as the Drive IDs. Gaps are not allowed in SCSI element addresses.

Adding or Removing a Drive: When drives in the library are added or removed, the renumbering of the drives may not be immediate or automatic. When a drive is physically removed, the drive remains in the library configuration, but the drive is described as "removed" and is not accessible to the host. Persistence of a drive number after removal is done to maintain connectivity with software that is configured to the drives. The software anticipates the original drive or a new drive will be installed shortly.

The drives are renumbered under the following conditions:

- Logical and Physical Numbering is updated automatically when a drive is installed, and cartridges can be loaded or unloaded from the added drives.
- SCSI Element addressing does not change until a partitioning wizard is run to move the added drive into a partition.
- The "Reset the List of Known Drives and Modules" (Settings > Library > Advanced) function is used. Resetting the "list of known drives and modules" causes the library to inventory the drives and modules that are physically present. This operation alters the list of SCSI element addresses reported to hosts and renumbers the drives and modules. This operation cannot be undone. After the operation completes, use one of the logical library wizards to modify logical libraries as needed.
- Power down or reset does not change drive numbering, but factory reset changes updates the numbering when the partitioning wizard runs as part of the reset process.

Other Library Elements

Library controller cards and power supplies are not numbered individually. Their identifier is the module number in which they are located. Some modules might contain two power supplies, an upper one and a lower one. The library does not provide any identification to differentiate between an upper and lower power supply.

Logical Libraries

Configuring logical libraries does not change the ID or PNUM, but it does change the SCSI element addresses.

User interfaces

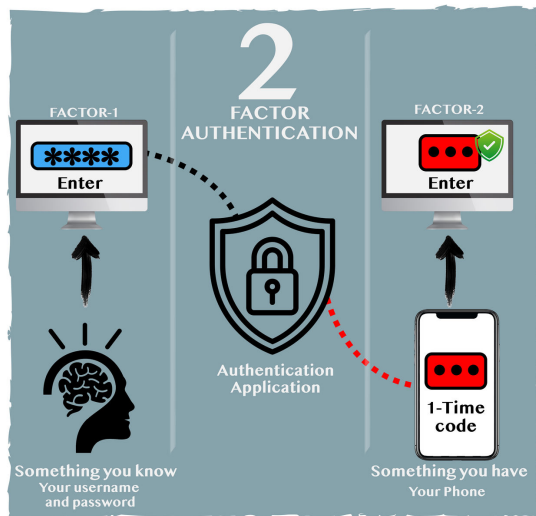
This library has two user interfaces: the Management GUI and the Operator Panel.

- [The Management GUI](#) - With the Management GUI, you can monitor, configure, and control the library from a web browser. The Management GUI hosts a dedicated, protected Internet site that displays a graphical representation of the library. For information on network connectivity, see [Network connectivity](#).
- [The Operator Panel](#) - With the Operator Panel, you can monitor, configure, and control the library from the front panel. Functions are limited to those applicable to being in front of the library.

Multi-Factor Authentication

The TS4300 has the option to use a one-time password for multi-factor authentication of local users and access through the REST API.

Figure 1. How it works



The TS4300 Tape Library supports multi-factor authentication (MFA) using authenticator apps that comply with RFC 6238 and the SHA-1 algorithm. This includes widely used apps such as:

- Google Authenticator
- Microsoft Authenticator
- 1Password
- Authenticator browser extensions

The TS4300 supports per-user Multi-Factor Authentication (MFA), allowing each user to register their preferred authenticator app—provided it complies with the RFC 6238 standard and uses the SHA-1 algorithm.

When multi-factor authentication is enabled on the library, a local user first logs into the library with a user name and password. Subsequently, the user is sent a one-time password to enter into a secondary screen. Library administrators can force local users to use multi-factor authentication.

If the user's regular login credentials and the one-time code are valid, the user gains access to the library.

Refer to [Setting up Multi-factor authentication](#).

Safeguarded Tape - Driveless logical libraries

The cartridge archive feature of the TS4300 enables a user to store cartridge in a logical library that is not accessible by a SCSI host or other applications.

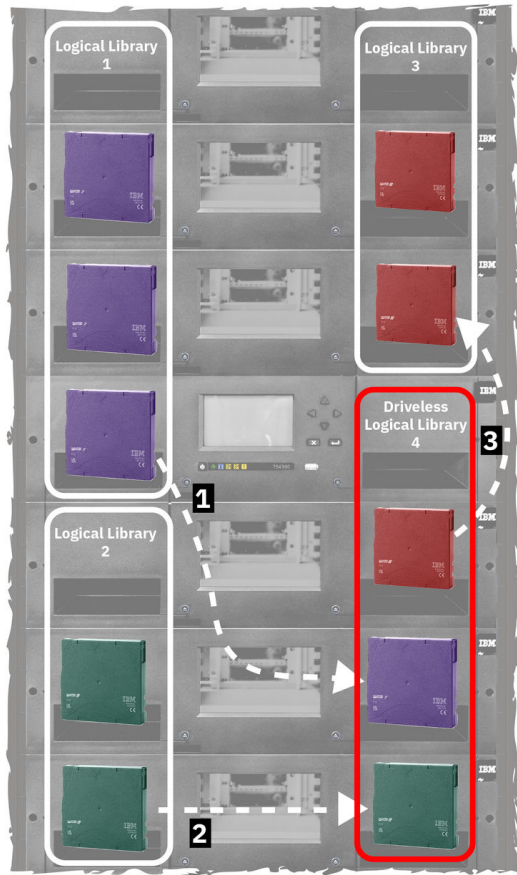
The threat of ransomware attacks are increasing. The best protection is to store backup or archive data on tape and physically put the tape on a shelf completely inaccessible to any network. Driveless logical libraries becomes the secured shelf that is inaccessible to any network.

Driveless logical libraries are not visible to backup applications. The library can be configured to move cartridges to a vault partition when the backup application issues a move to an I/O slot. Refer to **1** and **2** in Vault partitions.

Only administrators for whom two factor authentication is configured, can retrieve cartridges from a vault partition. Refer to **3** in Vault partitions.

Go to **Library > Logical Library** in the management GUI to set up driveless logical libraries.

Figure 1. Driveless logical library



Certificate chains

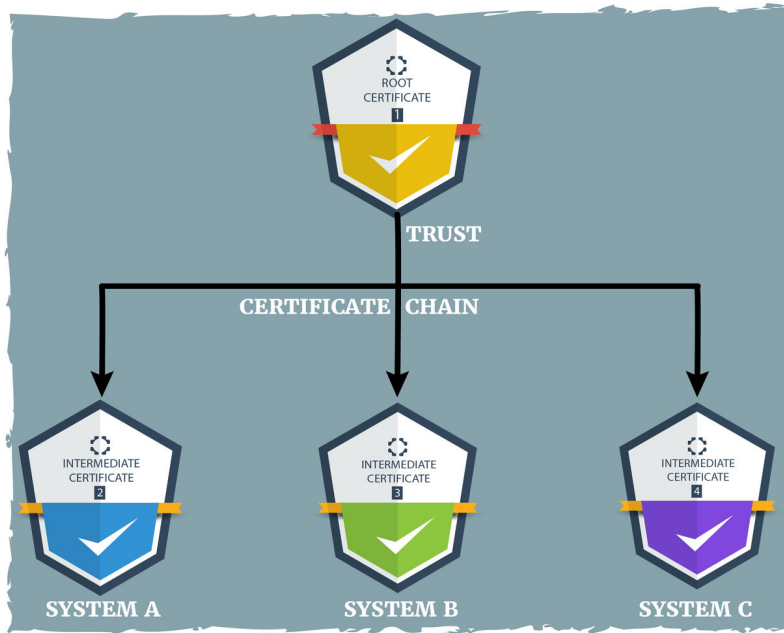
The TS4300 supports certificate chains when creating custom certificates with the TS4300 tape library.

A certificate chain is a collection of intermediate certificates (refer to **2**, **3**, and **4** in [Certificate chain](#)) that are trusted by Certificate Authority (CA) or root certificate **1**.

The TS4300 supplies the library certificate along with the certificate chain to the CA when establishing secure communications.

Go to **Settings > Security > GUI** to create and configure certificates.

Figure 1. Certificate chain



Tape drives

The library supports LTO6 and later tape drives. Each drive requires a SAS or Fibre Channel cable.

Table 1. Drive Support by MTM

Machine Type	Base Unit	Expansion Units	Supported LTO Generations
5544	L8A	E8A	LTO-8, LTO-9, LTO-10
3555	L3A	E3A	LTO-6, LTO-7, LTO-8, LTO-9

For minimum and maximum storage configurations, see [Table 1](#).

Table 2. Drive information and performance specification for full-height drives

Generation	LTO™ 10	LTO 9	LTO 8	LTO 7	LTO 6
Inquiry	ULT3580-TDA ULTRIUM-TDA	ULT3580-TD9 ULTRIUM-TD9	ULT3580-TD8 ULTRIUM-TD8	ULT3580-TD7 ULTRIUM-TD7	ULT3580-TD6 ULTRIUM-TD6
Interface (speed)	FC (32 Gb)	FC (8 Gbps) SAS (12 Gbps)	FC (8 Gbps)	FC (8 Gbps)	FC (8 Gbps)
Native data rate	400 MB/s (LA, PA)	400 MB/s (L9) 360 MB /s (L8)	360 MB/s (L8) 300 MB/s (M8) 300 MB/s (L7)	300 MB/s (L7) 160 MB/s (L6) 140 MB/s (L5)	160 MB/s (L6) 140 MB/s (L5) 120 MB/s (L4)
Sustained data rate (L6, L7, L8 and L9 compressed at 2.5:1 compression; L5 and earlier compressed at 2:1 compression)	FC 1200 MB/s (LA, PA)	FC 750 Mb/s (L9) 750 Mb/s (L8) SAS 1000 MB/s (L9) 900 MB/s (L8)	FC 750 MB/s (L8) 750 MB/s (M8) 750 MB/s (L7)	FC 750 MB/s (L7) 400 MB/s (L6) 280 MB/s (L5)	FC and SAS 400 MB/s (L6) 280 MB/s (L5) 240 MB/s (L4)
Burst data rate	3200 MB/s FC (LA, PA)	800 MB/s FC 1200 MB/s SAS	800 MB/s FC	800 MB/s FC	800 MB/s FC 600 MB/s SAS
Nominal load-to-ready time	12 seconds (LA, PA)	17 seconds	15 seconds	15 seconds	12 seconds
-Initialized tape	NA	17 seconds	NA	NA	NA
-Uninitialized tape ²	NA	40-120 minutes	NA	NA	NA
Nominal unload time	27 seconds (LA, PA)	30 seconds	24 seconds	20 seconds	17 seconds
Average space record time from load point	73 seconds (PA) 65 seconds (LA)	45 seconds	59 seconds	56 seconds	62 seconds
Average rewind time (REWIND command)	75 seconds (PA) 62 seconds (LA)	55 seconds	59 seconds	60 seconds	NA
Average rewind time (part of UNLOAD command, dependent on mount activity)³					

Generation	LTO™ 10	LTO 9	LTO 8	LTO 7	LTO 6
Less than 5 Gb of contiguous data transferred	NA	55 seconds	59 seconds	60 seconds	NA
5 Gb to 50 Gb of contiguous data transferred	NA	110 seconds	59 seconds	60 seconds	NA
All other types of mount activity	NA	165 seconds	59 seconds	60 seconds	NA
¹ By using the built-in data-compression capability of the tape drive, greater data rates than the native data transfer rate are achieved. However, the actual throughput is a function of many components, such as the host system processor, disk data rate, block size, data compression ratio, SAS bus capabilities, and system or application software. ² Cartridge initialization time can vary. See Media optimization for more information. ³ See Archive mode unthread for more information. Remember: • All sustained data rates depend on the capabilities of the interconnect. • Drive performance varies with media generation and drive interface (SAS/FC).					

Table 3. Drive information and performance specification for half-height drives

Generation	LTO 9	LTO 8	LTO 7	LTO 6	
Inquiry	ULT3580-HH9 ULTRIUM-HH9	ULT3580-HH8 ULTRIUM-HH8	ULT3580-HH7 ULTRIUM-HH7	ULT3580-HH6 ULTRIUM-HH6	
Interface (speed)	FC (8 Gbps) SAS (12 Gbps)	FC (8 Gbps) SAS (6 Gbps)	FC (8 Gbps) SAS (6 Gbps)	FC (8 Gbps) SAS (6 Gbps)	
Native data rate	300 MB/s (L9) 300 MB/s (L8)	300 MB/s (L8) 300 MB/s (M8) 300 MB/s (L7)	300 MB/s (L7) 160 MB/s (L6) 140 MB/s (L5)	160 MB/s (L6) 140 MB/s (L5) 120 MB/s (L4)	
Sustained data rate (L6, L7, L8 and L9 compressed at 2.5:1 compression; L5 and earlier compressed at 2:1compression)	FC 700 Mb/s (L9) 700 Mb/s (L8) SAS 720 MB/s (L9) 720 MB/s (L8)	FC 700 Mb/s (L8) 700 Mb/s (M8) 700 Mb/s (L7) SAS 600 MB/s (L8) 540 MB/s (M8) 500 MB/s (L7)	FC 700 Mb/s (L7) 400 Mb/s (L6) 280 Mb/s (L5) SAS 500 MB/s (L7) 400 MB/s (L6) 280 MB/s (L5)	FC and SAS 400 MB/s (L6) 280 MB/s (L5) 240 MB/s (L4)	
Burst data rate	800 MB/s FC 1200 MB/s SAS	800 MB/s FC 600 MB/s SAS	800 MB/s FC 600 MB/s SAS	800 MB/s FC 600 MB/s SAS	
Nominal load-to-ready time	16 seconds	15 seconds	15 seconds	12 seconds	
-Initialized tape	16 seconds	NA	NA	NA	
-Uninitialized tape ²	40-132 minutes	NA	NA	NA	
Nominal unload time	56 seconds	24 seconds	20 seconds	17 seconds	
Average space record time from load point	65 seconds	59 seconds	56 seconds	62 seconds	
Average rewind time (REWIND command)	62 seconds	59 seconds	60 seconds	NA	
Average rewind time (part of UNLOAD command, dependent on mount activity)³					
Less than 5 Gb of contiguous data transferred	62 seconds	59 seconds	60 seconds	NA	
5 Gb to 50 Gb of contiguous data transferred	124 seconds	59 seconds	60 seconds	NA	
All other types of mount activity	186 seconds	59 seconds	60 seconds	NA	
¹ By using the built-in data-compression capability of the tape drive, greater data rates than the native data transfer rate are achieved. However, the actual throughput is a function of many components, such as the host system processor, disk data rate, block size, data compression ratio, SAS bus capabilities, and system or application software. ² Cartridge initialization time can vary. See Media optimization for more information. ³ See Archive mode unthread for more information. Remember: • All sustained data rates depend on the capabilities of the interconnect. • Drive performance varies with media generation and drive interface (SAS/FC).					

- [Control path drives](#)
A control path is a logical path to the library.
- [Mixed drives](#)
All supported generations of LTO tape drives and cartridges can be in the same physical library and within a single module.
- [Drive sled back panels](#)
Indicator LEDs are included on all drive sled back panels.
- [Physical and logical addresses of drives](#)
The library assigns each tape drive a unique address to indicate its physical and logical location.

Control path drives

A control path is a logical path to the library.

A control path is the path for **SCSI Medium Changer** commands that are sent by a server to control a specific logical library. The library has no direct SCSI connection to a host server. When a software host server communicates with the library, it sends the communication by way of a tape drive. The tape drive is designated as a control path drive.

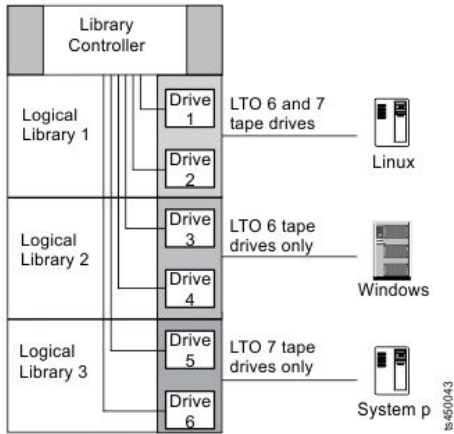
Mixed drives

All supported generations of LTO tape drives and cartridges can be in the same physical library and within a single module.

This library supports a mixture of LTO drive types in a logical library. Some independent software vendors (ISVs) support mixed drive types within a logical library and other do not. Some ISVs that support mixed drive types might have restrictions. For details, contact your ISV.

[Figure 1](#) shows examples of methods for mixing LTO drive types in a logical library.

Figure 1. Mixed drives in a logical library



Drive sled back panels

Indicator LEDs are included on all drive sled back panels.

Six indicator LEDs are included on all drive sleds as shown.

Figure 1. Drive sled indicators

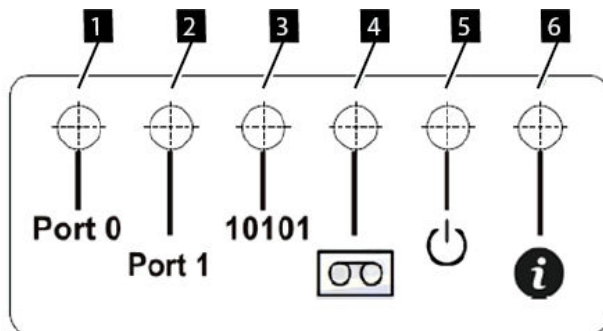


Table 1. Drive sled indicators

Number	Description
1	Port 0 activity
2	Port 1 activity
3	Library communication
4	Cartridge present
5	Power
6	Beacon /UID

Figure 2. Half-height SAS dual port

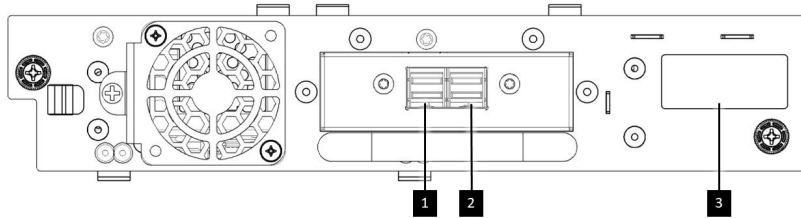


Table 2. Half-height SAS dual port

Number	Description
1	SAS port 0
2	SAS port 1
3	Drive sled indicators

Figure 3. Half-height FC single port

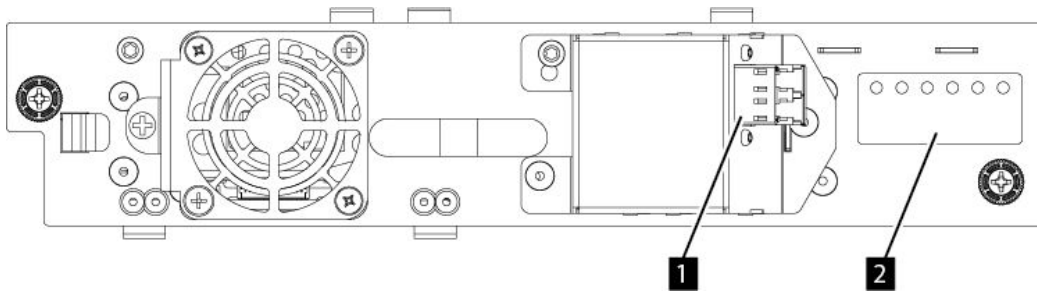


Table 3. Half-height FC single port

Number	Description
1	FC port 0
2	Drive sled indicators

Figure 4. Full-height SAS dual port - LTO-10

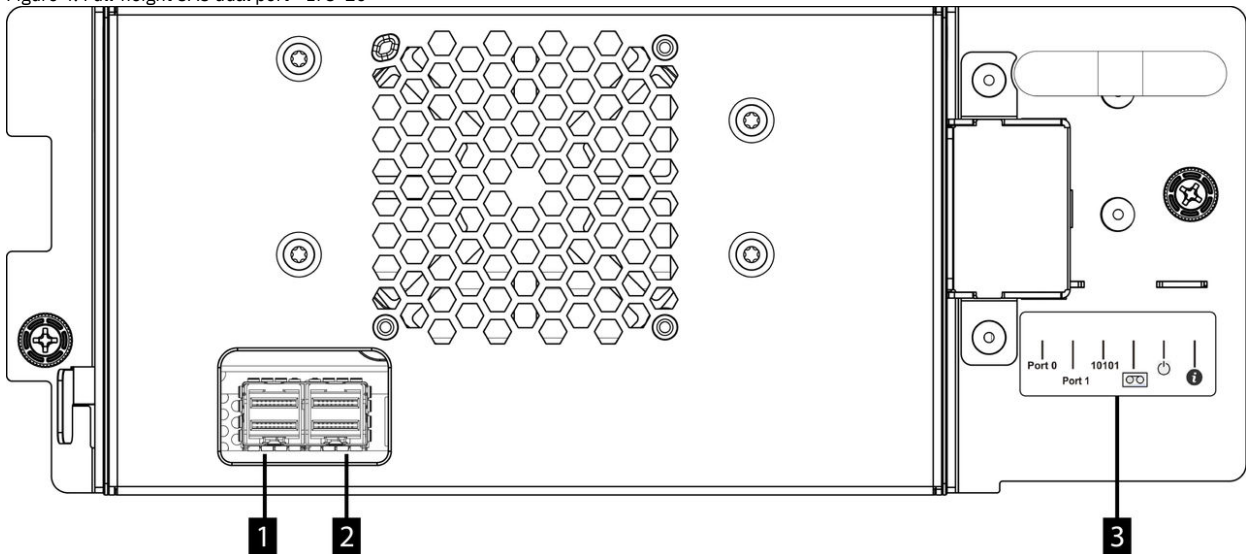


Figure 5. Full-height SAS dual port

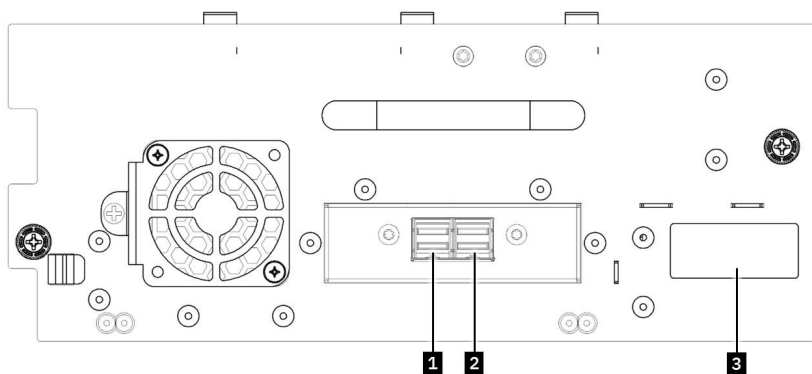


Table 4. Full-height SAS dual port

Number	Description
1	SAS port 0
2	SAS port 1
3	Drive sled indicators

Figure 6. Full-height FC dual port LTO-10

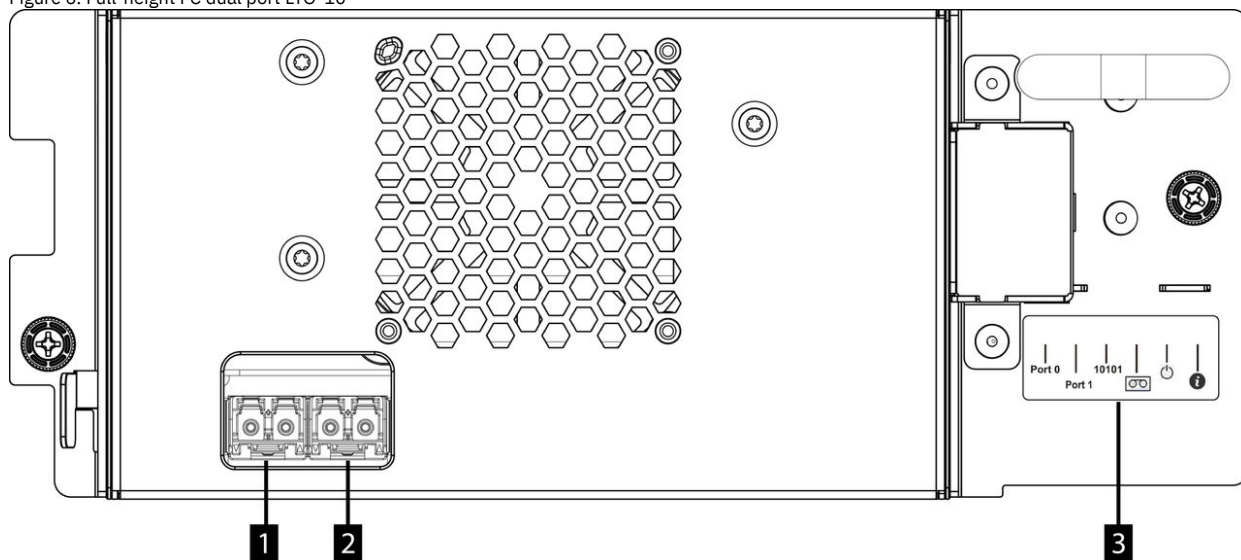


Figure 7. Full-height FC dual port

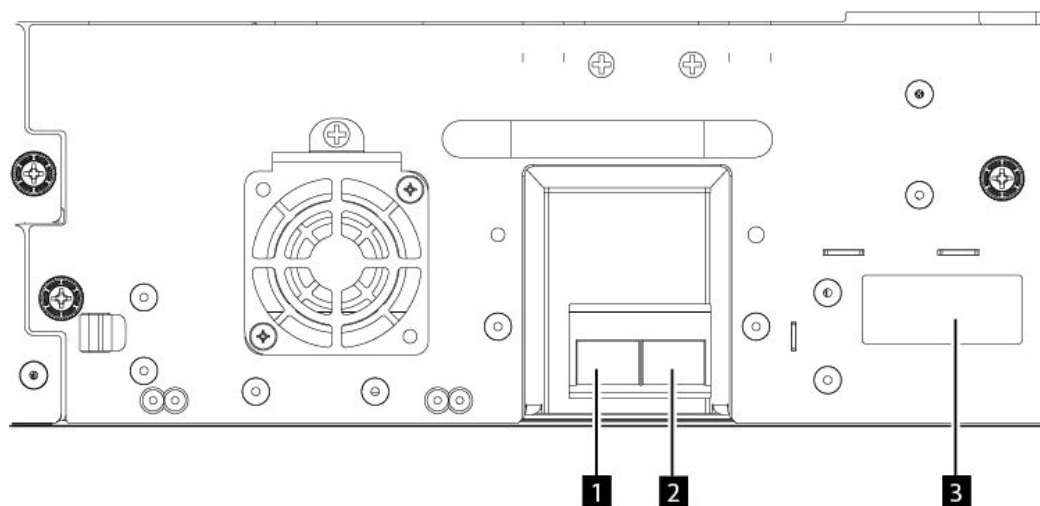


Table 5. Full-height FC dual port

Number	Description
--------	-------------

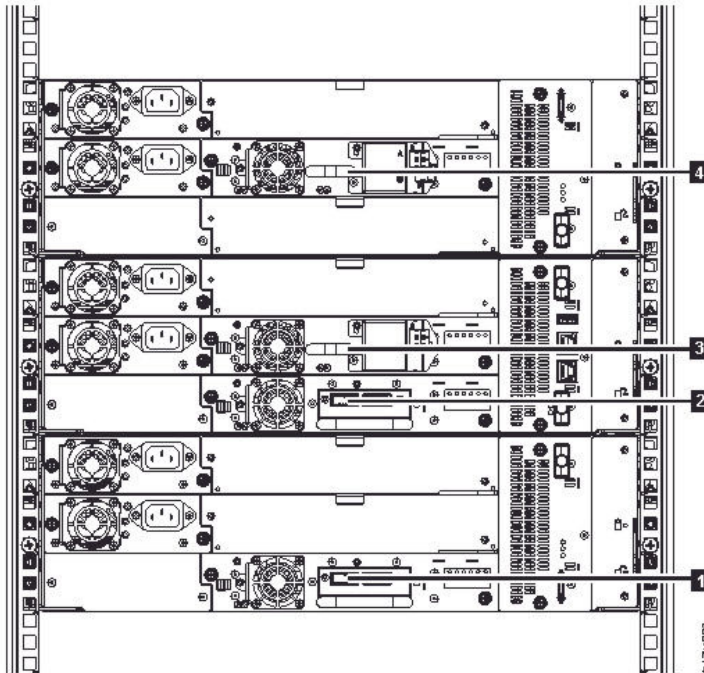
Number	Description
1	FC port 0
2	FC port 1
3	Drive sled indicators

Physical and logical addresses of drives

The library assigns each tape drive a unique address to indicate its physical and logical location.

The library assigns each tape drive a unique address to indicate its physical location, which is shown in [Figure 1](#). The physical numbering is bottom up on all drives. This information is shown on the Drives page of the Management GUI.

Figure 1. Physical numbering of drives



The library assigns each tape drive a SCSI element address that consists of a value that defines a logical location in the library to the SCSI interface. It is assigned and used by the application when the host server processes SCSI commands. The SCSI element address for a drive is unique to the location of the drive. It does not vary based on other drives in the library. See [Library partitioning](#).

Drive features

- [Media optimization](#)
Media optimization is a new feature for the LTO-9 tape drive with L9/LZ media. Media optimization is not applicable to LTO-10 or newer.
- [New Media Optimization Wizard](#)
- [Recommended access order \(RAO\) open function](#)
RAO enables tape control applications to accelerate the retrieval of a certain number of files from a single tape thereby reducing the seek time between those files.
- [Archive mode unthread](#)
- [Speed matching](#)
To improve system performance, the drive uses a technique that is called *speed matching* to dynamically adjust its native (uncompressed) data rate to the slower data rate of a server.
- [Channel calibration](#)
System performance is optimized by *channel calibration*.
- [Data cartridge capacity scaling](#)
Capacity scaling enables faster random access to data.
- [Power management](#)
- [Encryption](#)
The LTO™ tape drive supports host Application Managed Encryption (AME), with T10 encryption methods.

Media optimization

Media optimization is a new feature for the LTO-9 tape drive with L9/LZ media. Media optimization is not applicable to LTO-10 or newer.

The increased number of tracks used to write data on tape requires greater precision. Media optimization creates a referenced calibration for each cartridge that enables the tape drive's intelligent alignment to optimize data placement. LTO-9 media optimization enhances LTO tape long-term media durability.

It is important to consider when media optimization will be performed:

- Media optimization will be performed on first load of L9/LZ media during initialization.
- Recommendation is to perform first load in the location of deployment, which should be in a stable environment that meets the recommended environmental specification.
- Media optimization is a one-time operation that can be completed on any drive in the environment, enabling the media to be used across all tape drives without further optimization.

Other considerations for media optimization:

- Media optimization averages 20 minutes per first load of a cartridge to a tape drive. Although most media optimizations will complete within 30 minutes some media optimizations may take up to 2 hours.
- Interruption of the process is not recommended.
- A different mount will not necessarily improve the time to complete the one-time optimization.

An update to software may be required. Contact your software application provider for more details. Customized software, not provided as a standard market product, may require modification to ensure the software can handle the extended first mount time.

New Media Optimization Wizard

The wizard provides an interactive way to run a bulk new tape initialization with multiple cartridges and drives through the WebGUI.

While the optimization process is running, the library is exclusively reserved for this procedure. No other operations can be started in parallel.

You can start the 'LTO 9 New Media Optimization' Wizard by selecting Cartridges > LTO 9 New Media Optimization.

Select Cartridges

The wizard provides a list where cartridges can be selected. After selected, the cartridges will be moved to the 'Selected Cartridges' list on the right side of the Wizard window. Pressing the button "Select All" selects all listed cartridges. Unidentified cartridges are also shown.

Cartridges display one of three different initialization statuses:

1. An 'X' icon is shown if the cartridge is LTO 9 but not yet initialized.
2. A green arrow icon is shown if it is already initialized.
3. 'N/A' is shown if the state is unknown, due to non-LTO 9 media or not previously loaded to a drive. Note: If a cartridge was never loaded to a drive, the cartridge generation cannot be recognized without a valid barcode label.

Select Drives screen

The next screen provides the list of those drives that will be used for the initialization process, only LTO 9 drives and newer. The drives must be powered on and ready to appear in the list. One drive or multiple drives can be selected. Pressing "Select All" selects all listed drives.

Finish screen

After the selection of the drives, the wizard is now ready to be run. At the 'Finish Page', all previously provided data is listed again before the execution can be triggered.

After the user confirms all data as valid, they can start the wizard by pressing "Finish". The wizard shows the current progress of the single tasks.

While the bulk media optimization is running, the wizard shows the current progress of the single tasks. The following states for the tasks are shown:

- Media optimization completed
- Media optimization in progress
- Media optimization not yet started
- Aborted

Abort bulk media optimization

The finish page provides the option to abort the bulk media optimization. If the bulk media optimization is aborted, the media optimization for all loaded cartridges completes. When all cartridges are moved back to their source slot, the abort is finished.

Recommended access order (RAO) open function

RAO enables tape control applications to accelerate the retrieval of a certain number of files from a single tape thereby reducing the seek time between those files.

A feature of the LTO-9 full-height drives is the ability to accept a list of User Data Segments and reorder those User Data Segments into a recommended access order that minimizes the locate portion of the time to read those User Data Segments. This sorted list is called a Recommended Access Order (RAO) list. A User Data Segment (UDS) is defined as a grouping of contiguous logical objects (i.e., logical blocks and filemarks) and is described by partition number, beginning logical object identifier, and ending logical object identifier.

The RAO implementation in LTO produces the best results for performance enhancement when there is little variability in block size or data compression ratio. When the variability in compression ratio or block sizes increase, the accuracy of the locate estimates may be reduced and any potential performance enhancements may be diminished.

Archive mode unthread

The time that is required for an unload depends on how the cartridge has been used during the mount. This is based on the current position and how far from the beginning of tape (BOT) the media has been moved since mount. For details on unload performance, see [Tape drives](#).

Archive mode unthread is not applicable to LTO-10 or newer.

Speed matching

To improve system performance, the drive uses a technique that is called *speed matching* to dynamically adjust its native (uncompressed) data rate to the slower data rate of a server.

With speed matching, the drive operates at different speeds when it is reading or writing the Ultrium 7 or later cartridge format. Native data rates are shown in the table.

Table 1. Performance parameters for full height drives

	Generation 10 PA media	Generation 10 media	Generation 9 media	Generation 8 media	Generation 7 media
Speed matching data rates (MB/sec)	407	407	408	365.0	306.0
	387	387	385	341.0	287.52
	368	368	366	318.0	268.56
	349	349	347	306.4	250.66
	330	330	325	273.0	231.86
	311	311	305	249.5	213.06
	292	291	284	226.0	194.26
	274	272	263	203.0	175.46
	255	253	244	180.0	157.67
	236	234	223	157.5	138.52
	218	214	203	135.0	120.11
	199	195	177	112.0	101.46
	181	176			
	162	157			

Table 2. Performance parameters for half height drives

	Ultrium Generation Media		
	Generation 9 media	Generation 8 media	Generation 7 media
Speed matching data rates (MB/sec)	284	306.4	306.0
	263	273.0	287.52
	244	249.5	268.56
	223	226.0	250.66
	203	203.0	231.86
	177	180.0	213.06
	-	157.5	194.26
	-	135.0	175.46
	-	112.0	157.67
	-	-	138.52
	-	-	120.11
	-	-	101.46
	-	-	
	-	-	

If the server's net (compressed) data rate is between two of the preceding native data rates, the drive calculates the appropriate data rate at which to operate. Speed matching dramatically reduces backhitch, the condition that occurs when a tape stops, reverses, and restarts motion. A backhitch is usually the result of a mismatch between the data rates of the server and the drive.

Channel calibration

System performance is optimized by *channel calibration*.

System performance is further optimized by a feature that is called *channel calibration*, in which the drive automatically customizes each read/write data channel to compensate for variations in such things as the recording channel's transfer function, the media, and characteristics of the drive head.

Data cartridge capacity scaling

Capacity scaling enables faster random access to data.

The **SET CAPACITY SCSI** command enables a customer to capacity scale a data cartridge to enable faster random access. As an example, a customer can capacity scale a data cartridge to 20% of its normal length that improves the average access time by almost a factor of 5. However, it also reduces the native capacity of the tape to 80 GB 160 GB 300 GB 500 GB 1.2 TB.

Power management

The LTO tape drives feature a power management function. This function controls the drive's electronics so that part of the electronics completely turns OFF when circuit functions are not needed for the drive's operation.

Encryption

The LTO™ tape drive supports host Application Managed Encryption (AME), with T10 encryption methods.

Data encryption is supported by LTO Ultrium™ 4 and later data cartridges only.

The encryption-enabled drive contains the necessary hardware and firmware to encrypt and decrypt host tape application data. Encryption policy and encryption keys are provided by the host application. A drive digital certificate is installed at manufacturing time. Each drive receives a unique serial number and certificate. The T10 Application can validate each drive instance by checking the drive's digital certificate.

For details, see the *IBM® Tape Device Drivers Encryption Support* documentation, and the *IBM LTO Ultrium Tape Drive SCSI Reference* documentation.

Tape cartridges

The TS4300 supports multiple generations of LTO media.

Tape media is available in the following types:

- Data cartridge
- WORM (Write Once, Read Many) cartridge
- Cleaning cartridge

All generations contain 1/2-inch, dual-coat, magnetic tape.

Table 1. Media drive compatibility

Tape Cartridge	LTO-10 Drive	LTO-9 Drive	LTO-8 Drive	LTO-7 Drive	LTO-6 Drive
Ultrium 10	Read/write				
Ultrium 9		Read/write			
Ultrium 8		Read/write	Read/write		
Ultrium M8			Read/write		
Ultrium 7			Read/write	Read/write	
Ultrium 6				Read/write	Read/write

Table 2. Media Information

LTO Generation	Native Data Capacity	Application Design Capacity	Bar code Label ¹	Load/Unload Cycles	Recording Format ²	Color
Ultrium 10	40 TB (36.37 TiB) 100 TB (90.94 TiB) at 2.5:1 compression	38.4 TB	xxxxxxPA		Reads and Writes data on 15,104 tracks, 32 tracks at a time.	Black
Ultrium 10	30 TB (27.29 TiB) 75 TB (68.21 TiB) at 2.5:1 compression	29 TB	xxxxxxLA WORM: xxxxxxLH		Reads and Writes data on 15,104 tracks, 32 tracks at a time.	Black
Ultrium 9 ³	18 TB (45 TB at 2.5:1 compression)	17.4 TB	xxxxxxL9 WORM: xxxxxxLZ	20,000	Reads and writes data on 8960 tracks, 32 tracks at a time.	Teal WORM: Teal and Silvery gray
Ultrium 8	12 TB (30 TB at 2.5:1 compression)	11.6 TB	xxxxxxL8 WORM: xxxxxxLY	20,000	Reads and writes data on 6656 tracks, 32 tracks at a time.	Burgundy WORM: Burgundy and Silvery gray

LTO Generation	Native Data Capacity	Application Design Capacity	Bar code Label ¹	Load/Unload Cycles	Recording Format ²	Color
Ultrium M8⁴	9 TB (22.5 TB at 2.5:1 compression)	8.37 TB	xxxxxxM8	20,000	Reads and writes data on 3584 tracks, 32 tracks at a time.	Purple
Ultrium 7	6 TB (15 TB at 2.5:1 compression)	NA	xxxxxxL7 WORM: xxxxxxLX	20,000	Reads and writes data on 3584 tracks, 32 tracks at a time.	Purple WORM: Purple and Silvery gray
Ultrium 6	2.5 TB (6.25 TB at 2.5:1 compression)	NA	xxxxxxL6 WORM: xxxxxxLW	20,000	Reads and writes data on 2176 tracks, 16 tracks at a time.	Black WORM: Black and Silvery gray

¹You can order tape cartridges with the bar code labels included, or you can order custom labels.

²When tape is processed in the cartridges, Ultrium™ tape drives use a linear, serpentine recording format.

³Cartridge initialization time may vary. For more information, see [Media optimization](#).

⁴LTO type M8 cartridge

For additional information, see LTO media.

Library functions

The library provides many specific functions, such as random or sequential operating mode, encryption, library sharing, path failover, and alerts and logging.

- **Encryption**
All supported tape drives in this library support encryption.
- **Library sharing**
The library can be configured into one or more logical libraries that can be shared by multiple applications.
- **Control path failover, Data path failover, and load balancing**
The path failover feature ensures the use of a redundant communication path when the primary path fails.
- **Alerts and logging**
The library sends alerts about the library and attached tape drives, and offers audit-logging to track user actions.
- **Random and Sequential Logical Library modes**
A Logical Library can be configured in one of two modes: Random and Sequential.

Encryption

All supported tape drives in this library support encryption.

The encryption enabled drive contains the necessary hardware and firmware to encrypt and decrypt host tape application data. Encryption policy and encryption keys are provided by the host application or host server. A drive digital certificate is installed at manufacturing time. Each drive receives a unique serial number and certificate. The T10 application might validate each drive instance by checking the drive's digital certificate.

The library provides these options.

1. Encryption disabled
2. Application Managed Encryption (AME) is the default
3. Library Managed Encryption (LME). LME is a built-in feature that is enabled by using a purchased license. The LME feature can be ordered from the factory, or you can order it as a field upgrade. To order a feature, contact your IBM Sales Representative or Business Partner. See [Optional Features](#). For configuration details, see [Configuring Library Managed Encryption](#).

The default is Application Managed Encryption.

Note: All encryption settings must be configured or reverified in the drive after any library or drive reset. A new drive might be added or an existing drive might be swapped with another drive.

Library sharing

The library can be configured into one or more logical libraries that can be shared by multiple applications.

It is advantageous to be able to share a single physical library between heterogeneous or homogeneous applications. However, some applications (and some servers) do not allow for sharing a library between systems.

The library Management GUI provides two methods for logical library configuration.

1. A quick configuration for a simple one logical library configuration Manage Logical Library (Basic Mode)
2. An advanced configuration action for a multiple logical library configuration Manage Logical Library (Expert Mode)

Note: When any number of drives are loaded, a warning message appears when the Manage Logical Library (Expert Mode) wizard is accessed.

The second method gives the ability to create configurations that enable the library to process commands from multiple heterogeneous applications (such as an IBM® System p application and a Windows™ application) and multiple homogeneous applications (for example, the same application run by several System p servers). See [Advanced library configuration](#).

Control path failover, Data path failover, and load balancing

The path failover feature ensures the use of a redundant communication path when the primary path fails.

Command failures and time outs are costly. You want your library to run smoothly and efficiently. Path failover capabilities allow the IBM® device driver to resend a command to an alternate path. The alternate path can include another host bus adapter (HBA), Storage Area Network (SAN), or library control path drive. The device driver initiates error recovery and continues the operation on the alternate path without interrupting the application.

Path failover and load balancing are built-in features that are enabled by using a purchased license. The path failover feature can be ordered from the factory, or you can order it as a field upgrade. The path failover feature (FC 1682) is activated on the Management GUI. To order features, contact your IBM® Sales Representative or Business Partner. See [Optional features](#).

Two types of path failover capabilities exist: *control path failover (CPF)* and *data path failover (DPF)*. *Control* refers to the command set that controls the library (the **SCSI Medium Changer** command set on LUN 1 of the tape drives). *Data* refers to the command set that carries the customer data to and from the tape drives (the SCSI-3 Stream Commands (SSC) device on LUN 0 of the tape drives). Path failover means the same thing in both. Path failover is where redundancy is in the path from the application to the intended target (the library accessor or the drive mechanism), the device driver transparently fails over to another path in response to a break in the active path.

Both types of failover include host-side failover when configured with multiple HBA ports into a switch. But CPF includes target-side failover through the control paths that are enabled on more than one tape drive. DPF includes target-side failover for the dual-ported tape drives that are supported by the library.

DPF includes load balancing of the HBAs because the channel is a data-intensive path (the control path carries little data, so load balancing is not an issue). The dynamic load balancing support optimizes resources for devices that have physical connections to multiple HBAs in the same machine. When an application opens a device where multiple HBA paths are configured, the device driver determines which path has the HBA with the lowest usage and assigns that path to the application. When another application opens a different device with multiple HBA paths, the device driver again determines the path with the lowest HBA usage and assigns that path to the second application. The device driver updates the usage on the HBA assigned to the application when the device is closed. Dynamic load balancing uses all HBAs whenever possible and balances the load between them to optimize the resources in the machine.

Both CPF and DPF require the use of the IBM device driver. They are supported exclusively with products that bear the IBM logo on the operating systems that is indicated in [Table 1](#).

[Table 1](#) summarizes the differences between CPF, DPF, and load balancing.

Table 1. Differences between CPF and DPF

Characteristic	CPF	DPF and Load Balancing
Device type	SMC ¹	SSC ²
LUN ³	LUN 1	LUN 0
Host-side failover	Yes	Yes ⁶
Target-side failover	Yes	Yes ⁶
IBM Device driver required	Yes	Yes
Supported operating systems ⁴	AIX®, SuSE Linux, Red Hat Enterprise Linux, Solaris, Windows	AIX, SuSE Linux, Red Hat Enterprise Linux, Solaris, Windows ⁵ (DPF only)
Order feature to obtain license	Yes	Yes
Notes: 1. SMC = SCSI-3 Medium Changer Specification (library) 2. SSC = SCSI-3 Stream Commands (drive) 3. LUN = logical unit number 4. See Host connectivity for details. 5. Load balancing is not supported on Windows 6. Full-height tape drives only		

For information about using these features, see the *IBM Tape Device Drivers Installation and User's Guide* (GA32-0565).

Alerts and logging

The library sends alerts about the library and attached tape drives, and offers audit-logging to track user actions.

- **TapeAlert Support:** The tape library is compatible with TapeAlert technology, which provides error and diagnostic information about the drives and the library to the host application. The library provides this error and diagnostic information as TapeAlert flags that are reported to the application by the **SCSI LOG SENSE** command. See [TapeAlert flags](#).
- **Email (SMTP - Simple Mail Transfer Protocol) Notifications:** The library can configure email notification of library events. The library must have network access to an SMTP server. See [Locating Management functions](#).
- **Remote Logging (rsyslog):** The library can send syslog (system log) notifications to a configured remote (rsyslog) server. When system events occur, the TS4300 tape library creates a log of these events. With this notification feature configured, the library sends a notification of the event to the syslog server. The syslog server keeps its own log of system events. (The syslog server is a customer-provided server.) See [Locating Management functions](#).
- **SNMP Support:** The Simple Network Management Protocol (SNMP) allows the library to send alerts over a LAN network to a monitoring server. Occasionally, the library might encounter situations that you want to know about. These situations can be conditions that affect the library performance, such as an open door that causes the library to stop. You might also want to log user actions, such as a cartridge move or export that is initiated from the Management GUI. SNMP messages can alert you of these conditions.

The library provides a standard TCP/IP protocol that is called SNMP to send alerts about conditions over a TCP/IP LAN network to an SNMP monitoring server. These alerts are called SNMP traps. Using the information that is supplied in each SNMP trap, the monitoring server (together with customer-supplied software) can alert operations staff of possible problems or operator interventions that occur. Many monitoring servers can be used to send email or pager notifications when they receive an SNMP alert. See the manual for your network management application.

The monitoring server must be loaded with systems management software that can receive and process the trap. SNMP supports a get and get-response mechanism for an operator to gather more information about a problem or query the library about its status. Through a monitoring server, the operator enters a "get" using SNMP to request information about the library. A get-response is the information that is provided in response to the get. This type of support generally requires an up-to-date library Management Information Base (MIB). The SNMP server's MIB contains units of information that specifically describe an aspect of a system, such as the system name, hardware number, or communications configuration.

IBM provides the MIBs that are supported by the library. They include

- IBM TS4300 MIB
 - Type of information:
 - The status of each drive in the library
 - A list of all cartridges in the library
 - The last trap or TapeAlert message that was sent by the library.
- IBM AUTOMATION QUERY MIB
 - Type of information:
 - Library configuration

The library MIBs can be obtained through the SNMP Notifications Settings page on the Management GUI. See [Locating Management functions](#). An operator cannot change library settings by using SNMP. Settings are changed by using the Management GUI.

SNMP Notification Levels

SNMP provides various levels of notification about specific library events and user actions.

- Inactive – No events are sent.
- Critical – Only critical events are sent.
- + Warnings – Only critical and warning events are sent.
- + Configuration – Only critical, warning, and configuration events are sent.
- + Information – All events are sent.

Simple Network Management Protocol (SNMP) audit logging provides logging information about specific tape library user actions. To configure SNMP, see [Locating Management functions](#).

Random and Sequential Logical Library modes

A Logical Library can be configured in one of two modes: Random and Sequential.

Random Mode

Random Mode is intended to be used by host applications that support SCSI media changer devices. Random Mode is the default.

In Random mode,

- The host application chooses the cartridges that are moved to the drive.
- I/O slots provide the flexibility for the user to add and remove cartridges and the host application is automatically notified of these changes.
- Multiple drives can be assigned to provide parallel processing data operations and redundancy in case of failure.

Sequential Mode

Sequential Mode is intended to be used by host applications that aren't supporting SCSI media changer devices but need to get another cartridge loaded if the current cartridge is full.

In Sequential Mode,

- The library predefines the sequential order that the cartridges are moved to the drive.
- I/O slots are hidden as they aren't assignable to a logical library with sequential mode enabled.
- Only one drive can be assigned to a logical library with sequential mode enabled.
- There's no control path drive and no media changer device is configured to the host server.

Options to consider when Sequential Mode is chosen:

- Basic Function - To initiate use of cartridges, the user issues a **Move Cartridge** command to the drive through the Management GUI. After the load, the host application can begin data I/O activity. When the host application unloads the drive, the library moves the next cartridge into the drive. This behavior is implicit, unless otherwise defined by selection of another option.
- Loop Option - If a move sequence ends because no more cartridges are available in the current logical library, the sequence starts again by loading the first cartridge of the logical library. This option can be chosen with or without the Autoload function.
- Autoload Option - If enabled, the library loads the first cartridge of the logical library to the Sequential Mode tape drive during library startup after inventory scan is finished. This option changes the implicit behavior of the Basic function. This option can be chosen with or without the Loop option.

If storage slots are configured to I/O slots after assignment to a Sequential Mode logical library, they are still considered valid available slots and are used for movements. This option stays until you run the expert wizard again, and then these I/O slots no longer appear in the list of available slots. Finishing the expert wizard then sets the new slot assignment and these I/O slots can no longer be used for movements.

To enable sequential mode, click the Enable Sequential Mode check box in the Manage Logical Library (Basic Mode) Wizard or Manage Logical Library (Expert Mode) Wizard.

Planning

The library requires an environment able to accommodate the appropriate space, power, location, and other technical specifications. Use this section as a reference for onsite requirements to allow for optimum operation of the library.

Save your settings in the [Library Configuration Forms](#).

- [Operating environmental specifications](#)
The environmental specifications relates to the customer ambient (outside the tape library) environment.
- [Environmental and shipping specifications for tape cartridges](#)
Recommended conditions for shipping cartridges are described.
- [Gas and particulate exposure table](#)
- [Acclimation](#)
Server and storage equipment (racks and frames) must be gradually acclimated to the surrounding environment to prevent condensation.
- [License materials available for download](#)
Click on the specific topic in order to access the download page.
- [Library Layout and Location requirements](#)
Information for planning the installation and layout of your library, including various specifications for optimal performance.
- [Power cords](#)
Electrical and safety information, and feature codes for purchasing power cords.
- [Network requirements](#)
The library supports an independent customer network.
- [Host requirements](#)
The drive is supported by a wide variety of servers, operating systems, and adapters. Many ways to determine the servers and software that supports this drive are available.
- [Optional features](#)

Operating environmental specifications

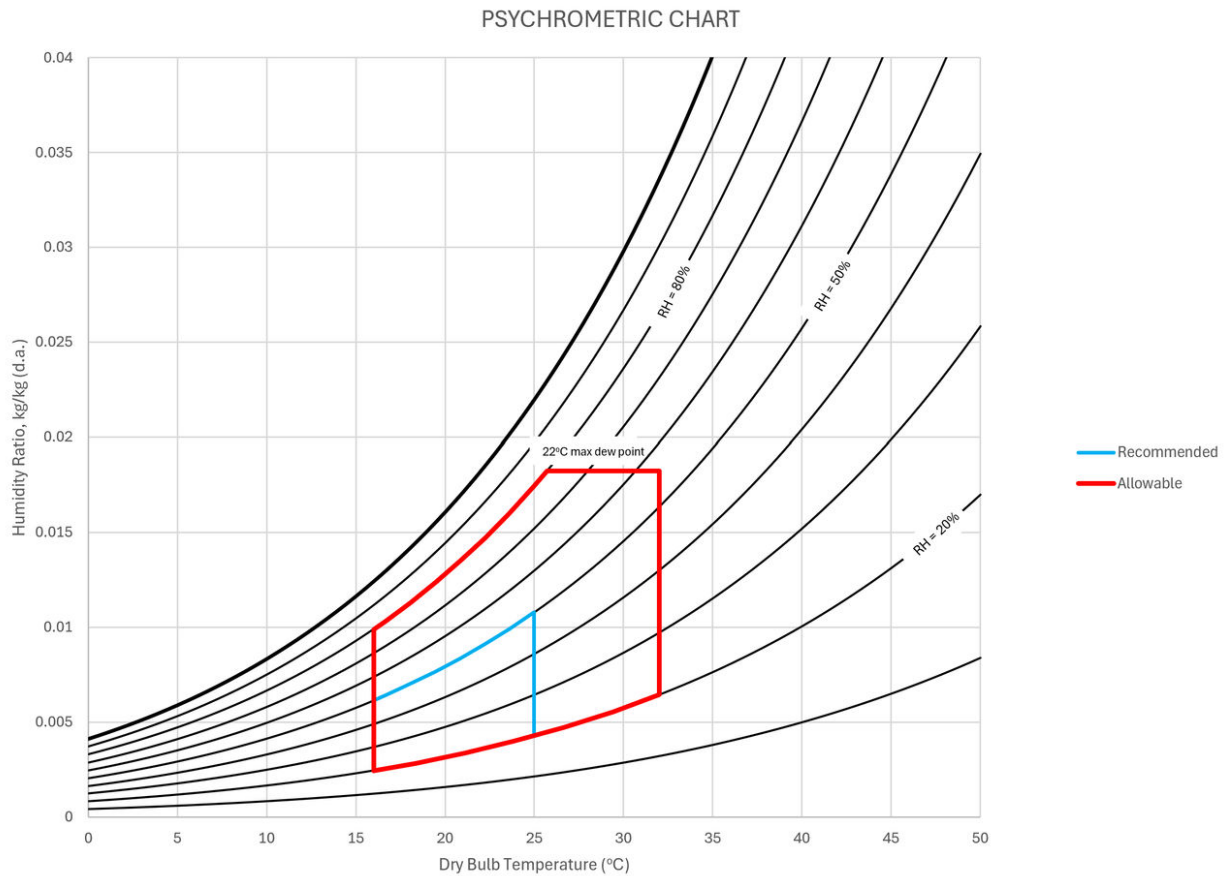
The environmental specifications relates to the customer ambient (outside the tape library) environment.

For the ambient measurement, the customer must provide their own temperature and humidity sensors in the location where the library is going to be located.

Figure 1. Equipment environment specifications

TAPE MEDIA	PRODUCT OPERATION (EQUIPMENT POWERED ON)							PRODUCT POWER OFF			
	Dry-bulb temperature			Humidity Range, non-condensing			Maximum dew point temperature	Maximum elevation	Dry-bulb temperature	Relative Humidity	Maximum wet bulb temperature
	Allowable ¹	Recommended ²	Maximum rate of change	Allowable	Recommended	Maximum rate of change					
LTO-6 and later	16 to 32°C (60 to 90°F)	16 to 25 °C (60 to 77 °F)	5 °C/hour (9 °F/hour)	20% to 80% RH	20% to 50% RH	5% RH/hour with no condensation	22 °C (72 °F)	3050 m (10,000 feet)	5 to 45 °C (40 to 113 °F)	8% to 80% RH	26 °C (79 °F)
Notes: 1. Derate maximum dry-bulb temperature by 1°C / 300 m above 900 m (1.8°F / 1,000 feet above 3,000 feet). 2. Derate maximum recommended dry-bulb temperature by 1°C / 300 m above 1,800 m (1.8°F / 1,000 feet above 6,000 feet).											

Figure 2. Psychrometric chart showing recommended and allowable operating environments



Environmental and shipping specifications for tape cartridges

Recommended conditions for shipping cartridges are described.

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

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

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

Table 1. Environment for storage and shipping the IBM® tape cartridge

Environmental specifications			
Environmental factor	Allowable storage	Recommended storage	Shipping
Temperature	16 to 32°C (61 to 90°F)	16 to 25°C (61 to 77°F)	-23 to 49°C (-9 to 120°F)
Relative humidity (noncondensing)	20 to 80%	20 to 50%	5 to 80%
Maximum wet bulb temperature (does not apply to 3592 JE tape cartridges)	26°C (79°F)	N/A	26°C (79°F)
Maximum dew point temperature (applies only to 3592 JE tape cartridges)	22°C (72°F)	N/A	22°C (72°F)
Magnetic field	Stray magnetic field at any point on tape not to exceed 50 oersteds (4000 ampere/meter).		

Gas and particulate exposure table

Table 1. Gas and particulate contamination

Contaminate	Requirement
Gaseous contamination	Severity level G1 as per ANSI/ISA 71.04-1985, ¹ which states that the reactivity rate of copper coupons shall be less than 300 Angstroms per month (Å/month, $\approx 0.0039 \mu\text{g}/\text{cm}^2$ - hour weight gain). ² In addition, the reactivity rate of silver coupons shall be less than 300 Å/month ($\approx 0.0035 \mu\text{g}/\text{cm}^2$ - hour weight gain). ³ The reactive monitoring of gaseous corrosivity should be conducted approximately 5 cm (2 inches) in front of the rack on the air inlet side at one-quarter and three-quarter frame height off the floor or where the air velocity is much higher.

Contaminate	Requirement
Particulate contamination	Data centers must meet the cleanliness level of ISO 14644-1 class 8. For data centers without airside economizer, the ISO 14644-1 class 8 cleanliness might be met simply by the choice of the following filtration: • The room air might be continuously filtered with MERV 8 filters. • Air entering a data center might be filtered with MERV 11 or preferably MERV 13 filters. For data centers with airside economizers, the choice of filters to achieve ISO class 8 cleanliness depends on the specific conditions present at that data center. The deliquescent relative humidity of the particulate contamination should be more than 60% RH.⁴ Data centers must be free of zinc whiskers.⁵
Notes: 1. ANSI/ISA-S71.04. 1985. <i>Environmental conditions for process measurement and control systems: Airborne contaminants</i>, Instrument Society of America, Research Triangle Park, NC, 1985. 2. The derivation of the equivalence between the rate of copper corrosion product thickness growth in Å/month and the rate of weight gain assumes that Cu₂S and Cu₂O grow in equal proportions. 3. The derivation of the equivalence between the rate of silver corrosion product thickness growth in Å/month and the rate of weight gain assumes that Ag₂S is the only corrosion product. 4. 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. 5. Surface debris is randomly collected from 10 areas of the data center on a 1.5 cm (0.6 inch) diameter disk of sticky electrically conductive tape on a metal stub. If examination of the sticky tape in a scanning electron microscope reveals no zinc whiskers, the data center is considered free of zinc whiskers.	

Acclimation

Server and storage equipment (racks and frames) must be gradually acclimated to the surrounding environment to prevent condensation.

When server and storage equipment (racks and frames) is shipped in a climate where the outside temperature is below the dew point of the destination (indoor location), there is a possibility that water condensation can form on the cooler inside and outside surfaces of the equipment when the equipment is brought indoors.

Sufficient time must be allowed for the shipped equipment to gradually reach thermal equilibrium with the indoor environment before you remove the shipping bag and energize the equipment. Follow these guidelines to properly acclimate your equipment:

- Leave the system in the shipping bag. If the installation or staging environment allows it, leave the product in the full package to minimize condensation on or within the equipment.
- Allow the packaged product to acclimate for 24 hours.¹ If there are visible signs of condensation (either external or internal to the product) after 24 hours, acclimate the system without the shipping bag for an additional 12 - 24 hours or until no visible condensation remains.
- Acclimate the product away from perforated tiles or other direct sources of forced air convection to minimize excessive condensation on or within the equipment.

¹ Unless otherwise stated by product-specific installation instructions.

Note: Condensation is a normal occurrence, especially when you ship equipment in cold-weather climates. All IBM® products are tested and verified to withstand condensation that is produced under these circumstances. When sufficient time is provided to allow the hardware to gradually acclimate to the indoor environment, there should be no issues with long-term reliability of the product.

License materials available for download

Click on the specific topic in order to access the download page.

[License Agreement for Machine Code](#)

[IBM TS4300 Release 6.1](#)

Library Layout and Location requirements

Information for planning the installation and layout of your library, including various specifications for optimal performance.

For tabletop installation - Tabletop installations (one Base Module) require no additional hardware.

For rackmount installation - If possible, install the Base Module in the middle of the rack to provide space for the allowed seven Expansion Modules above it and eight Expansion Modules below it. See [Structure and supported library configurations](#) for details.

Recommended room size:

- 67.5 cubic meters, or
- A 6 ft perimeter around the system (including 24 inches service door clearance).

- Assumes ventilation of 0.4 ACH (Air Changes per Hour) for 9 ft ceilings or 0.33 ACH for 11 ft ceilings.

Security

The equipment must be located so that access to the equipment can be controlled and monitored. Consider all of these recommended security measures when you're determining where to locate your tape library.

Library location

You're responsible for the security of this library, the cartridges that are contained within the library, and shelf-resident cartridges. To prevent unauthorized access to data, IBM recommends locating the library and all shelf-resident cartridges in an area where access is controlled.

Onsite security measures

You're also responsible for evaluating, selecting, and implementing security features, administrative procedures, and appropriate controls in application systems and communication facilities.

Security Note: Customer data on LTO Tape cartridges is not accessible over the library network interface. The library network interface is only used for library status and control. Data from Tape cartridges is transmitted to the host through an independent SAS or FC interface. If there are security concerns with library control and status data, the user can install the library on a private, rather than a public network.

Data security

Data security is accomplished through the Management GUI. See [Locating Management functions](#).

Location requirements

Choose a location that meets the criteria in [Table 1](#).

Table 1. Location requirements

Criteria	Definition
Rack requirements	Standard 19-inch rack (minimum depth of 1.02. meter) with an appropriate # of Us (Rack Units) of clearance for the planned module quantity (See Table 2 for details.) <u>Older Racks (IBM PN: 00VJ949.)</u> Minimum Rack Post Spacing: 688.34 mm (27.1 In.) Maximum Rack Post Spacing: 904.24 mm (35.6 In.) <u>Newer Racks (PN: 02YA102.)</u> Minimum Rack Post Spacing: 594.36 mm (23.4 In.) Maximum Rack Post Spacing: 871.22 mm (34.3 in In.)
Rack space requirements	3U for the Base Module and 3U for each Expansion Module
Power source	- AC Power Voltage: 100 - 240 VAC - Line Frequency: 50 - 60 Hz - Library is located near AC outlet. The AC power cord must be always easily accessible.
Air quality	- Place the library in an area with minimal sources of particulate contamination. - Avoid areas near frequently used doors and walkways, stacks of supplies that collect dust, printers, and smoke-filled rooms. - Excessive dust and debris can damage tapes and tape drive.

Technical specifications for this library can be referenced in the following tables.

Physical specifications

Table 2. Physical specifications

Characteristic	Product alone	Packaged
Height	132.2 mm (5.20 in)	330 mm
Width	482 mm (18.97 in) ¹	635 mm
Depth	912.6 mm (35.9 in) ²	1168 mm
Weight	Base module: 20 Kg Expansion module: 13 Kg	Base module: 25 Kg Expansion module: 19 Kg
¹ Includes front covering of rack rails, allowing for magazine opening clearance.		
² From the front of the bezel to the back of the fan on an inserted drive sled.		

Figure 1. Front bezel height

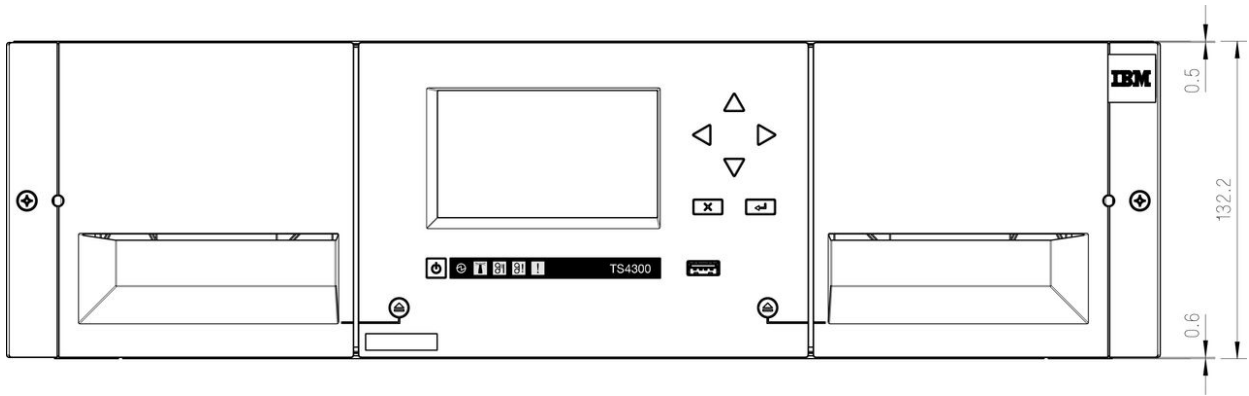
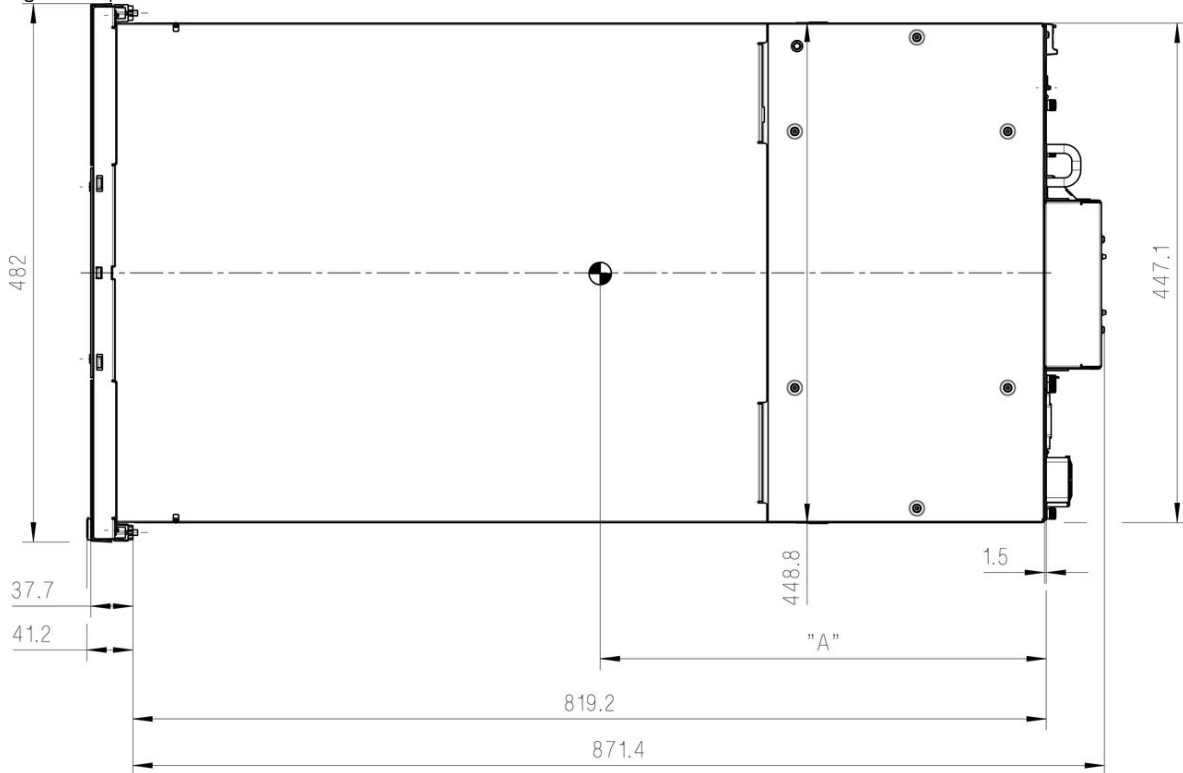


Figure 2. Depth from front of the bezel to back of the fan on an inserted drive sled



Electrical specifications for one module (base or expansion)

Table 3. Electrical specifications for one module (base or expansion)

Characteristic	Specification
Maximum current	3.7 A
Voltage	100 - 240 V 50/60 Hz
Maximum power consumption	370 W

Acoustical specifications

Table 4. Acoustical specifications

Parameter	Measurement
Idling acoustical noise sound power level LwAD in Bels (1 Bel = 10 dB)	6.6
Maximum acoustical noise sound power level LwAD in Bels (1 Bel = 10 dB)	6.8

Power cords

Electrical and safety information, and feature codes for purchasing power cords.



To avoid electrical shock, a power cord with a grounded attachment plug is provided. Use only properly grounded outlets.

[Table 1](#) lists the power cord part number, feature code, the country, or region where the power cord is used, and the plug's standard reference. The last column in the table contains an index number that you can match to a specific receptacle type in [Figure 1](#).

All power cords use an appliance coupler that complies with the International Electrotechnical Commission (IEC) Standard 320, Sheet C13.

If the power cord that you receive does not match your receptacle, contact your local dealer.

Power cords that are used in the United States and Canada are listed by Underwriter's Laboratories (UL), are certified by the Canadian Standards Association (CSA), and comply with the plug standards of the National Electrical Manufacturers Association (NEMA). For other worldwide geographies, plug standards are listed in [Table 1](#).

Table 1. Power cords

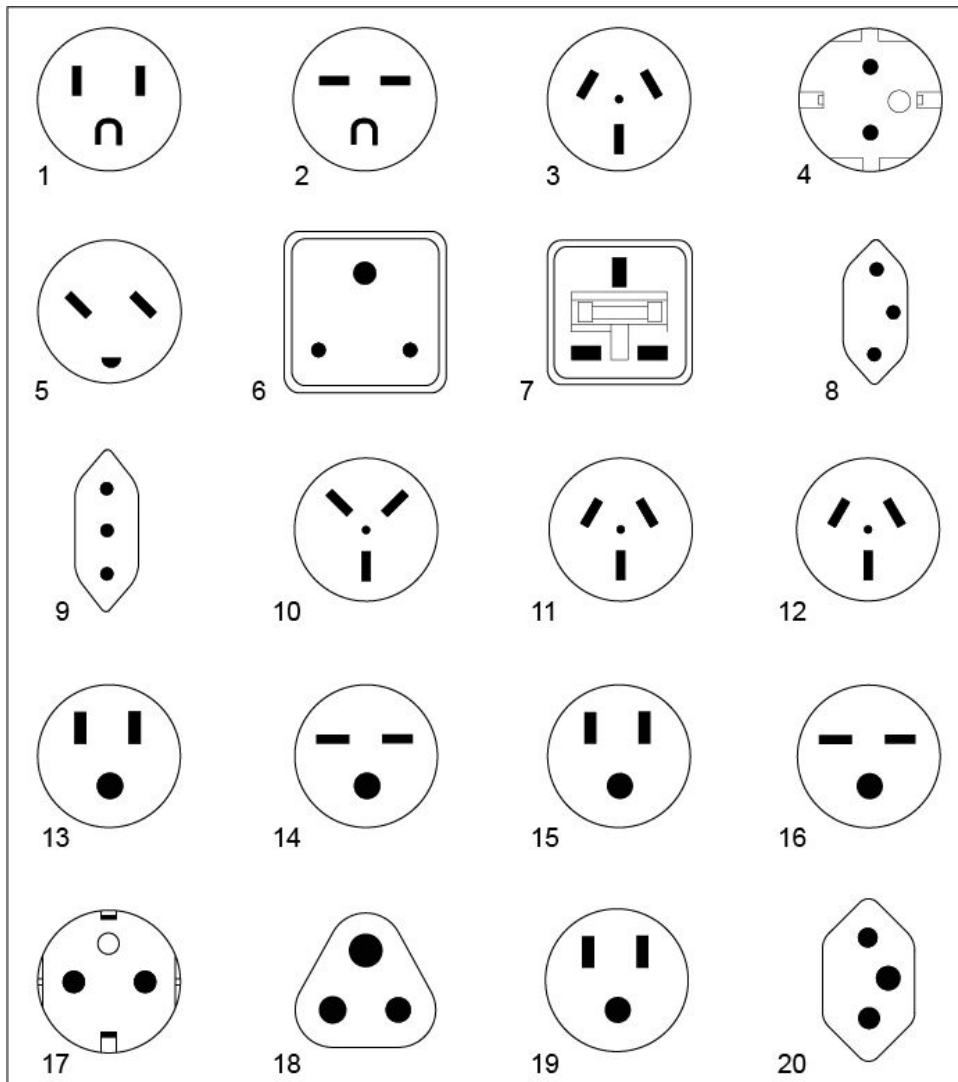
Description, Feature Code (FC), and Part Number (P/N)	Plug Standard Reference	Country or Region	Index Number in Figure 1
US/Canada 2.8 m, 125 V - FC 9800 - P/N 95P2344	NEMA 5-15P	Aruba, Bahamas, Barbados, Bermuda, Bolivia, Brazil, Canada, Cayman Islands, Colombia, Costa Rica, Curacao, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Japan, Liberia, Mexico, Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Saudi Arabia, South Korea, Suriname, Taiwan, Trinidad Tobago, Venezuela, US	1
Chicago 1.8 m, 125 V - FC 9986 - P/N 39M5080	NEMA 5-15P	Chicago, U.S.A.	1
US/Canada 2.8 m, 250 V - FC 9833 - P/N 95P2353	NEMA 6-15P	Aruba, Bahamas, Barbados, Bermuda, Bolivia, Brazil, Canada, Cayman Islands, Costa Rica, Curacao, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Japan, Liberia, Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Suriname, Taiwan, Thailand, Trinidad Tobago, Venezuela, US	2
Australia 2.8 m, 250 V - FC 9831 - P/N 95P2352	AS 3112 NZS 198	Australia, China, Colombia, New Zealand, Papua New Guinea, Paraguay, Uruguay, Western Samoa	3
France, Germany 2.8 m, 250 V - FC 9820 - P/N 95P2345	CEE 7 - VII	Afghanistan, Algeria, Andorra, Angola, Aruba, Austria, Belgium, Benin, Brazil, Bulgaria, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo-Brazzaville, Curacao, Czech Republic, Democratic Republic of Congo, Denmark, Egypt, Finland, France, French Guiana, Germany, Greece, Guinea, Hungary, Iceland, Indonesia, Iran, Ivory Coast, Jordan, Kenya, Korea, Lebanon, Luxembourg, Macau, Malagasy, Mali, Martinique, Mauritania, Mauritius, Monaco, Morocco, Mozambique, Netherlands, Netherlands Antilles, New Caledonia, Niger, Norway, Poland, Portugal, Romania, Russia, Saudi Arabia, Senegal, Spain, Sweden, Sudan, Syria, Togo, Tunisia, Turkey, Yugoslavia, Zaire, Zimbabwe, Vietnam	4
Denmark 2.8 m, 250 V - FC 9821 - P/N 95P2346	DK2-5A	Denmark	5
South Africa 2.8 m, 250 V - FC 9829 - P/N 95P2350	SABS 164	Bangladesh, Burma, Pakistan, South Africa, Sri Lanka	6

Description, Feature Code (FC), and Part Number (P/N)	Plug Standard Reference	Country or Region	Index Number in Figure 1
United Kingdom • 2.8 m, 250 V • FC 9825 • P/N 95P2347	BS 1363	Antigua, Bahrain, Bermuda, Brunei, Channel Islands, China (Hong Kong S.A.R.), Cyprus, Fiji, Ghana, Guyana, India, Iraq, Ireland, Jordan, Kenya, Kuwait, Malaysia, Malawi, Malta, Nepal, Nigeria, Oman, Polynesia, Qatar, Sierra Leone, Singapore, Tanzania, Uganda, UK, United Arab Emirate (Dubai), Yemen, Zambia	7
Switzerland • 2.8 m, 250 V • FC 9828 • P/N 95P2349	SEV S/N 416534	Liechtenstein, Switzerland	8
Italy • 2.8 m, 250 V • FC 9830 • P/N 95P2351	CEI 23- 16	Chile, Ethiopia, Italy, Libya, Somalia	9
Israel • 2.8 m, 250 V • FC 9827 • P/N 95P2348	S11-32-1971	Israel	10
Argentina • 2.8 m, 250 V • FC 9834 • P/N 95P2354	IEC 83-A5	Argentina, Brazil, Colombia, Paraguay, Trinidad Tobago, Uruguay	11
China • 2.8 m, 250 V • FC 9840 • P/N 95P2355	CCEE	People's Republic of China	12
Taiwan LV* • 2.8 m, 125 V • FC 9835 • P/N 23R3263	CNS 10917-3	Taiwan	13
Taiwan HV** • 2.8 m, 250 V • FC 9841 • P/N 23R6120	CNS 10917-3	Taiwan	14
Japan LV* • 2.8 m, 125 V • FC 9842 • P/N 23R6121	JIS C8303, C8306	Japan	15

Description, Feature Code (FC), and Part Number (P/N)	Plug Standard Reference	Country or Region	Index Number in Figure 1
Japan HV** • 2.8 m, 250 V • FC 9843 • P/N 39M5186	JIS C8303, C8306	Japan	16
Korea HV** • 2.8 m, 250 V • FC 9844 • P/N 23R6123	KS C8305, K60884-1	Korea	17
India HV** • 2.8 m, 250 V • FC 9845 • P/N 23R6124	IS 6538	India	18
Brazil LV* • 2.8 m, 125 V • FC 9846 • P/N 39M5233	InMetro NBR 6147	Brazil	19
Brazil HV** • 2.8 m, 250 V • FC 9847 • P/N 23R6126	InMetro NBR 14136	Brazil	20
Rack PDU • FC 9848 • P/N 23R6328			
* Low Voltage ** High Voltage			

[Figure 1](#) shows the plugs that are used by the power cords in [Table 1](#). Match the index number that is beside each plug to the index number in the table.

Figure 1. Types of receptacles



Network requirements

The library supports an independent customer network.

It is the customer's responsibility to provide the proper length Ethernet cable for this connectivity. For MTM 5544-L8A and newer, CAT6 Ethernet is required.

The base module controller card has two Ethernet ports, which offer primary and redundant customer network connectivity. See [Rear panel](#).

These connections allow remote viewing and management of the library with the Management GUI.

Note: Have your network settings handy to use for entering on the Operator Panel. Your network settings can also be stored as hardcopy on [Library Configuration Forms](#).

The secondary Ethernet port might be used for service. Three models are available for connection:

- No Ethernet port - Service personnel can connect a laptop to the customer network to use the Management GUI.
- Dedicated secondary Ethernet port - The secondary network port that is dedicated only for service personnel to connect a laptop directly to the library.
- Secondary Ethernet port - The secondary network port can be disconnected and service personnel can use it to connect a laptop directly to the library.

IP range selection

For internal communication between modules, the tape library uses an Ethernet connection with an internal IP address range. To prevent any conflict between the internal IP address range and the external IP addresses, you must select the internal IP range. Choosing the Internal IP address range, and also entering the external IP address information is part of the initial setup of the library.

Supported browsers

IBM supports higher versions of the browsers if the vendors don't remove or disable functions that the product relies upon. For browser levels higher than the versions that are certified with the product, customer support accepts usage-related and defect-related service requests. As with operating system and virtualization environments, if IBM support can't re-create the issue in the lab, the client might be asked to re-create the problem on a certified browser version to

determine whether a product defect exists. Defects aren't accepted for cosmetic differences between browsers or browser versions that don't affect the functional behavior of the product. If a problem is identified in the product, defects are accepted. If a problem is identified with the browser, IBM might investigate potential solutions or workarounds that the client can implement until a permanent solution becomes available.

Supported interfaces

This tape library supports the Gigabit Ethernet interface in either auto negotiation or fixed modes of 10 Mbps, 100 Mbps, and 1 Gbps by using half or full duplex. The library supports the following TCP/IP protocols:

IPv4 and IPv6 support

This tape library supports Internet Protocol (IP) addresses in both IPv4 and IPv6 format. Both the integrated management console (IMC) and the management GUI allow the definition of IPv4 and IPv6 addresses. The key proxy determines the IP version that is used and presents the correct IP address and parameters to the IP Stack.

Simple Network Management Protocol (SNMP)

SNMP traps are supported for drive and library events. SNMP management query functions are supported by using a standard Management Information Block (MIB).

Hyper Text Transfer Protocol (HTTP)

An embedded web server provides a management GUI for library management and query capabilities.

Secure Socket Layer (SSL)

The tape library supports SSL, a protocol for transmitting private documents through the internet.

Key Management Interoperability Protocol (KMIP)

Used for communicating with the IBM® Security Lifecycle Key Manager and other security key management software.

Simple Mail Transfer Protocol (SMTP)

The tape library supports SMTP for sending email alerts.

Network Time Protocol (NTP)

The tape library supports NTP for external time-and-date synchronization.

Lightweight Directory Access Protocol (LDAP)

The tape library supports LDAP for centralized authentication.

Domain Name System (DNS)

The tape library supports DNS for flexible IP addressing.

Dynamic Host Configuration Protocol (DHCP)

The library supports DHCP for automatically providing an Internet Protocol (IP) host with its IP address and other related configuration information, such as the subnet mask and default gateway.

Host requirements

The drive is supported by a wide variety of servers, operating systems, and adapters. Many ways to determine the servers and software that supports this drive are available.

- **[SAS interface](#)**
LTO drives can have a dual port 12 Gbps SAS (Serial Attached SCSI) host interface. The SAS interface speed varies with the generation of the LTO™ drive. For more information on SAS speed of different generation drives, see [Tape drives](#).
- **[Fibre Channel interface](#)**
The fibre channel interface varies with the generation of the drive.
- **[Compatible configurations](#)**
For a comprehensive list of compatible configurations, see the IBM® Interoperation Center (SSIC) at <http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss>.
- **[HBA requirements](#)**
The library requires attachment to supported SAS or FC HBAs.
- **[Supported device drivers](#)**
Device drivers enable the drive to interact with various servers.
- **[Application software](#)**

SAS interface

LTO drives can have a dual port 12 Gbps SAS (Serial Attached SCSI) host interface. The SAS interface speed varies with the generation of the LTO™ drive. For more information on SAS speed of different generation drives, see [Tape drives](#).

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. Its full-duplex signal transmission supports up to 12.0 Gbps. In addition, SAS drives can be hot-plugged.

SAS drives auto-negotiate speed. There are no configurable topologies thus no feature switches associated with SAS.

Fibre Channel interface

The fibre channel interface varies with the generation of the drive.

Fibre Channel technology combines the best features of traditional input/output interfaces with the best features of networking interfaces. The technology offers a transport mechanism for delivering commands, and provides high performance by allowing processing to be done in the hardware.

The Fibre Channel connector is a Small Form-Factor Pluggable (SFP), dual-port, multimode optical transceiver that consists of an industry standard duplex LC-type connector.

You can establish Fibre Channel connections between Fibre Channel ports that are in the tape library, one or more servers, and the connecting network. The network can consist of such elements as switches, hubs, bridges, and repeaters.

Compatible configurations

For a comprehensive list of compatible configurations, see the IBM® Interoperation Center (SSIC) at <http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss>.

Compatible servers and software

Note: These attachments can change throughout the lifecycle of the product.

For complete IBM storage interoperability information for the tape drive in a storage area network (SAN) configuration, see the IBM Interoperation Center (SSIC) at <http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss>. The SSIC has details on supported operating systems, servers, switches, and adapters.

Note:

1. IBM does not provide application software with the drive. To order software, contact your IBM sales representative, IBM Business Partner, or an independent software provider.
2. If you attach your drive to a server with non-IBM software, contact your software vendor for a matrix of compatible hardware, software, firmware revisions, and adapters.

Note: Dependent on the use of Random or Sequential Mode, the drive might require an HBA with multiple LUN supports. Also, multiple LUN supports must be enabled on the host computer. When multiple LUN supports are not enabled, the host computer can see the tape drive, but not the library.

HBA requirements

The library requires attachment to supported SAS or FC HBAs.

The library requires attachment to supported SAS or FC HBAs. See [Host connectivity](#).

	Static Sensitive Risk of damage to devices • A discharge of static electricity damages static-sensitive devices or micro circuitry. • Proper packaging and grounding techniques are necessary precautions to prevent damage.
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Follow these general guidelines.

- Check with a system administrator before the host computer is powered off.
- For a SAS library, confirm availability or install a SAS HBA that supports multiple LUNs.
- For a direct-attach Fibre Channel library, confirm availability of installation of an FC HBA.
- For connection of a Fibre Channel library through a compatible switch, verify that sufficient ports are available.

Persistent binding to ensure SCSI ID assignment

When a server is booted, devices are discovered and assigned SCSI target and LUN IDs. It is possible for these SCSI assignments to change between boots. Some operating systems do not guarantee that devices are always allocated the same SCSI target ID after rebooting. Also, some software depends on this association, so you do not want it to change. The issue of SCSI ID assignment is addressed by persistent binding.

Supported device drivers

Device drivers enable the drive to interact with various servers.

To properly install an IBM® device driver (if required), refer to the [IBM Tape Device Drivers Installation and User's Guide](#). For applications that use other device drivers, see [Application software](#) to determine which drivers to use.

IBM maintains the levels of device drivers and driver documentation for the drive on the web. You can access this material at <http://www.ibm.com/support/fixcentral>.

Tip: If you do not have Internet access and you need information about device drivers, contact your sales representative.

Remember: The device driver for System i™ servers is included in the OS/400® operating system.

Application software

Industry-leading compatible software offerings provide storage and tape management software for the LTO™ tape drives. Supporting software and applications must be obtained separately from IBM®, IBM Business Partners, or independent software vendors (ISV). For a list of compatible software and additional information, refer to the ISV Matrix that is available at [Independent Software Vendor \(ISV\) matrix for 3592 and LTO](#).

To download a free version of Adobe™ Reader, go to the [Adobe Acrobat website](#).

Optional features

Refer to [Table 1](#) for features that are available for the tape library. To order extra features, contact your IBM® sales representative or Business Partner.

Table 1. Optional features

Feature Code	Description
1411	Fibre wrap tool
1412	SAS wrap tool
1413	Mini SAS-HD tape Drive Support
1682	Path Failover
1899	First Power Supply
1900	Extra Power Supply
7002	Rack Mount Kit
8106	Right Side Magazine
8109	Left Side Magazine
5500	Mini-SAS/Mini-SAS 4x Interposer Enables attachment of a single tape drive to a host with HD applications (from HD HBA with SFF-8644 to Drive with SFF-8088 connector).
5502	2 m Mini-SAS/Mini-SAS 1x Cable Enables attachment of a single tape drive to a host with HD applications (from HD HBA with SFF-8088 to tape drive (LTO-4 - LTO-8) with SFF-8088 connector).
5507	4 m Mini-SAS HD/Mini-SAS 1x Cable Enables attachment of a single tape drive to a host with HD applications (from HD HBA with SFF-8644 to drive (LTO-4 - LTO-8) with SFF-8088 connector. From tape drive (LTO-9) with SFF-8644 to HBA with SF-8088).
5509	3 m Mini-SAS HD/Mini-SAS 2x Cable Enables attachment of one or two tape drives to a host with HD applications (from HD HBA with SFF-8644 to drives (LTO-4 - LTO-8) with SFF-8088 connectors. From tape drive (LTO-9) with SFF-8644 to HBA with SF-8088). This cable fans out to enable connection of two devices to one HBA port.
5900	Encryption Configuration
AGK1	10 m OM3 fiber Cable (LC)
AGK2	25 m OM3 fiber Cable (LC)
AGKB	3 m Mini-SAS HD/Mini-SAS HD 1X Cable (from HBA with SFF-8644 to tape drive (LTO-9) with SFF-8644)
AGKC	3 m Mini-SAS HD/Mini-SAS HD 2X Cable This cable fans out to enable connection of two devices to one HBA port. (from HBA with SFF-8644 to tape drive (LTO-9) with SFF-8644)
AGKD	1.5 m Mini-SAS HD/Mini-SAS HD 1X Cable (from HBA with SFF-8644 to tape drive (LTO-9) with SFF-8644)
AGKF	LTO™ 6 HH Fibre Channel Drive (Type: LTO Ultrium 6-H)
AGKG	LTO 6 HH SAS Drive (Type: LTO Ultrium 6-H)
AGKH	LTO 6 FH Fibre Channel Drive (Type: LTO Ultrium 6)
AGKJ	LTO 7 HH Fibre Channel Drive (Type: LTO Ultrium 7-H Fibre Channel)
AGKK	LTO 7 HH SAS Drive (Type: LTO Ultrium 7-H SAS)
AGKL	LTO 7 FH Fibre Channel Drive (Type: LTO Ultrium 7)
AGKM	LTO 8 HH Fibre Channel Drive (Type: LTO Ultrium 8-H Fibre Channel)
AGKN	LTO 8 HH SAS Drive (Type: LTO Ultrium 8-H SAS)
AGKP	LTO 8 FH Fibre Channel Drive (Type: LTO Ultrium 8)
AGLA	LTO 9 HH Fibre Channel Drive (Type: LTO Ultrium 9-H Fibre Channel)
AGLB	LTO 9 HH SAS Drive (Type: LTO Ultrium 9-H SAS)
AGLC	LTO 9 FH Fibre Channel Drive (Type: LTO Ultrium 9 Fibre Channel)
AGLD	LTO 9 FH SAS Drive (Type: LTO Ultrium 9 SAS)
AGLE	LTO 10 FH Fibre Channel Drive (Type: LTO Ultrium 10 Fibre Channel)
8002	Cleaning Cartridge L1 UCC
8905	Ultrium 9 Data Cartridges (5-pack)
8806	LTO 8 Data Cartridges (5-pack)
5521	LTO M8 Data Cartridges (20-pack)
8706	LTO 7 Data Cartridges (5-pack)

Feature Code	Description
8605	LTO 6 Data Cartridges (5-pack)
9800 - 9847	Power cords
9848	Rack Power Distribution Unit (PDU) power cord

Installing

Use this section to follow the procedures to install and configure your library.

Table 1. Installation Precautions

 	Product Weight Caution: The weight of this part or unit is between 18.1 and 33.6 kg (40 and 74 lb). It takes two persons to safely lift this part or unit. (C009) Caution: The weight of this part or unit is between 33.6 and 46.3 kg (74 and 102 lb). It takes three persons to safely lift this part or unit. (C010) Risk of personal injury Before a module is lifted or moved • Observe local health and safety requirements and guidelines for manual material handling. • Remove all tapes to reduce the weight and to prevent cartridges from falling into the robotics path and damaging the library. • Remove all tape drives to reduce the weight. • Obtain adequate assistance to lift and stabilize the module during installation or removal. Risk of damage to devices When a module is placed into or the module is removed from a rack • Extend the rack's leveling jacks to the floor. • Ensure that the full weight of the rack rests on the leveling jacks. • Install stabilizing feet on the rack. • Extend only one rack component at a time.
	• Do not expose the library to moisture. • Do not place a module on either the ends or sides as this action might cause damage.

- [Unpacking the Base Module and Expansion Modules](#)
Procedure for safely unpacking the Base and Expansion Modules.
- [Identifying Library Module components](#)
Use the packing slip that is included with your module to identify the module components.
- [Installing a tabletop module](#)
Installation of a one module library (Base Module only) can be completed without special hardware.
- [Removing inner foam from base module](#)
There is a foam packing placed inside each base module to protect the accessor from damage while shipping. When installing the modules, this foam packing must be removed.
- [Preparing top and bottom modules](#)
Use these steps to prepare the top and bottom modules for installation.
- [Installing modules in a rack](#)
Rackmount installation procedure.
- [Aligning and connecting modules](#)
Aligning the modules ensures that the accessor can move freely between the modules.
- [Installing a tape drive](#)
Tape drives come already installed in the library modules.
- [Connecting cables](#)
Procedures to connect Fibre Channel, SAS, USB, and Ethernet cables.
- [Powering on the library](#)
Steps to power on the library.
- [The Initial setup process](#)
When you turn on the library for the first time, the Initial Setup process starts automatically. Click Next to start the process.
- [Initial configuration and customization](#)
After the initial setup is completed by using the Operator Panel, an administrator can log on to the Management GUI to complete the library configuration with the Initial Configuration Wizard.
- [Labeling and loading tape cartridges](#)
The library can power on without cartridges, but needs cartridges before it can complete data read and write operations, or any tests or operations that transfer cartridges.
- [Verifying the installation](#)
Verify that the library has the current firmware revision, and save the configuration settings. This action can be helpful if the library requires service.
- [Advanced library configuration](#)
To create and manage multiple logical libraries, utilize the advanced logical library function.

- [Verifying the host connection](#)
Procedure to verify the connection between the host computer and the library.
- [Registering for support notification](#)
Support notification registration provides email notification when new firmware levels are updated and are available for download and installation.

Unpacking the Base Module and Expansion Modules

Procedure for safely unpacking the Base and Expansion Modules.

About this task

Before any modules are unpacked, clear a work surface near the targeted rack or table for installation.

Attention: If the temperature in the room where the library operates varies by 15° C (30° F) from where the module was stored, allow it to acclimate for at least 12 hours before it is unpacked.

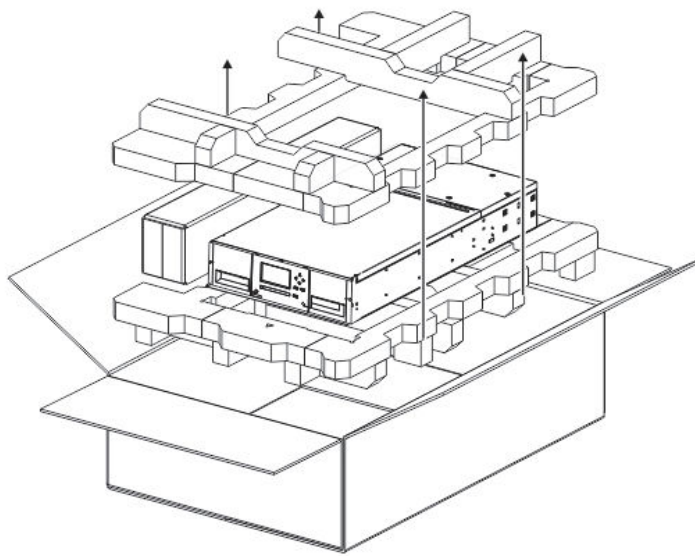
Unpacking a Base Module or Expansion Module

Procedure

1. Before a module is opened or removed from the box, inspect the container for shipping damage.
2. If you notice any damage, report it to the shipping company immediately.
3. Remove the module from the box.

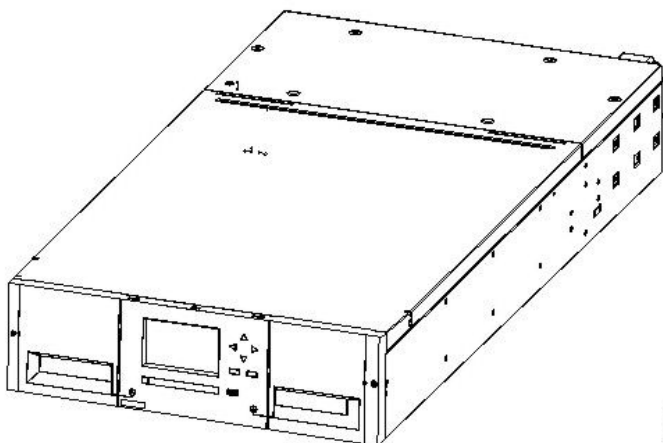
Important: Lift the module out of the box by the long sides, not by the display.

Figure 1. Removing the module from the box



4. Check that all components for assembling the module are in the box. See [Identifying Library Module components](#).

Figure 2. The module after removal from the box



Attention: Do not place a module on either the ends or sides as this action can damage the module.

Identifying Library Module components

Use the packing slip that is included with your module to identify the module components.

The TS4300 is not shipped with a rack mount kit (IBM FC: 7002) and/or power cord (IBM FC: 9800-9848) unless it is ordered.

1. Locate one or more packing slips for your module.
2. Verify that you received each item that is listed on the packing slips.

Note: Order the power cord that matches the electrical requirements of the country or area. Power cord FC 9848 must be ordered with the rack mount kit if a rack-based power supply is used.

For SAS libraries, you must provide SAS cabling with the correct configuration for your HBA. For Fibre Channel libraries, you must provide one Fibre Channel cable for each tape drive. See [Optional features](#).

Installing a tabletop module

Installation of a one module library (Base Module only) can be completed without special hardware.

Before you begin

When unpacking a tabletop module, confirm that you received the following components:

1. Base Module
2. Power cord (IBM FC: 9800-9848 are not a part of the shipment unless ordered. For more information see, [Optional features](#).)
3. Feet kit

About this task

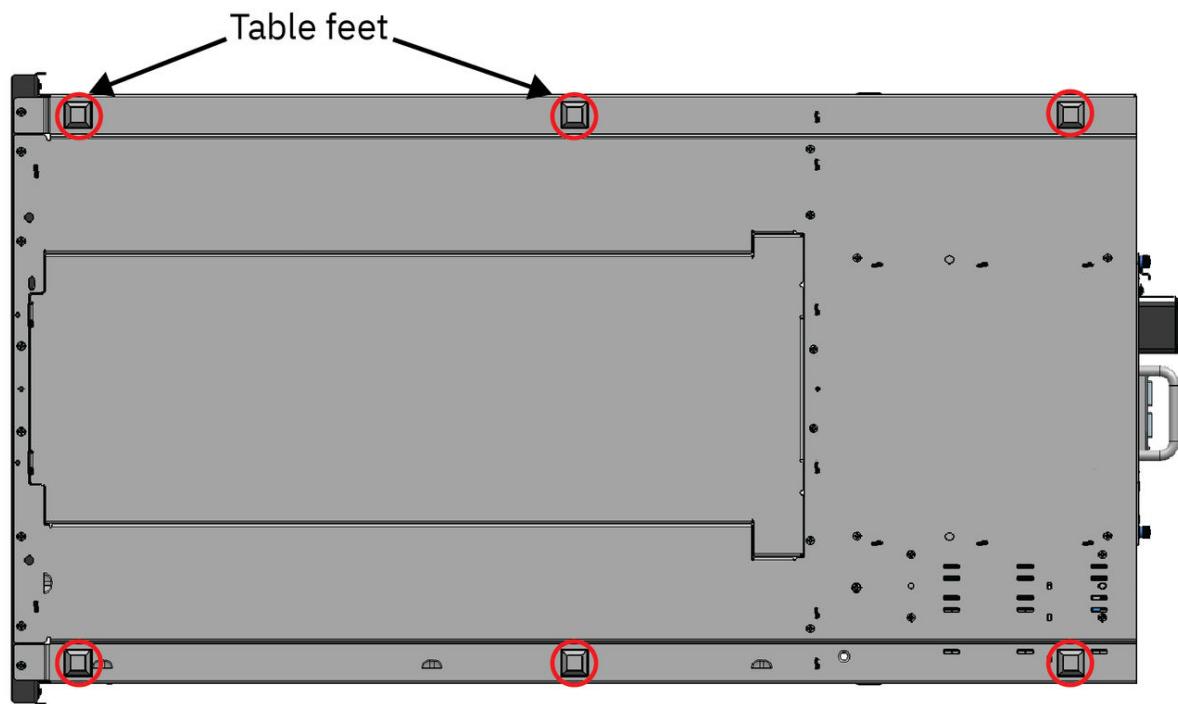
This procedure is meant to help the user in installing table feet to the module.

Important: Do not add feet to a rack-mounted module.

Procedure

1. Remove the Base Module from the box.
 2. Put the packing foam which came with the shipment on the table.
 3. Place the module top side down over the packing foam on the table.
 4. Add feet to the base of the module. See [Figure 1](#).
- Attention: Ensure that the table feet does not cover any air holes at the base of the module.

Figure 1. Table feet



5. Place the module at the required location, with top side up. Ensure that it is level.
6. Open the cover and remove the foam packing from inside the enclosure. See [Removing inner foam from base module](#).
7. Replace the cover.
8. Plug in the power cord and the connecting cables.

Removing inner foam from base module

There is a foam packing placed inside each base module to protect the accessor from damage while shipping. When installing the modules, this foam packing must be removed.

About this task

Remember: The foam packing is only available inside a base module.
Follow these instructions to remove foam packing from a module.

Procedure

1. Unlatch the top of the module by using your fingers or a small tool, one on each side of the lid, and press inward. When the lid opens, remove it by pulling it forward. See [Figure 1](#).

Figure 1. Unlatching the top of the module

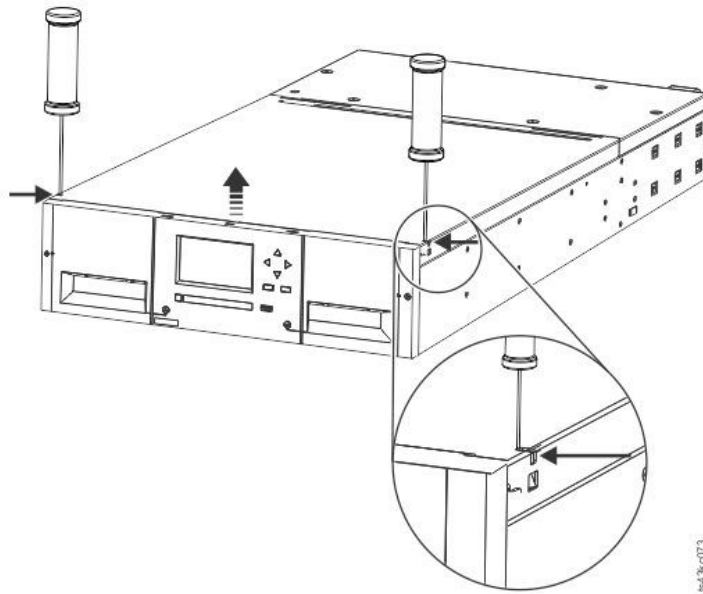
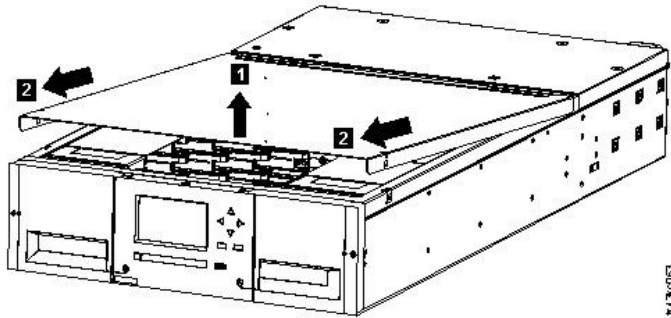
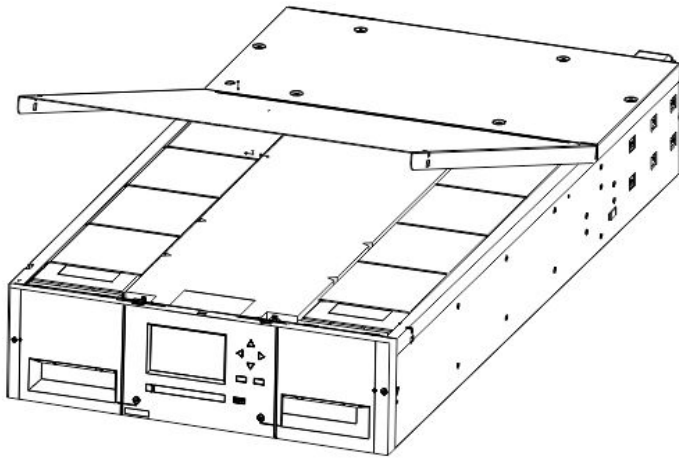


Figure 2. Removing the top of the module



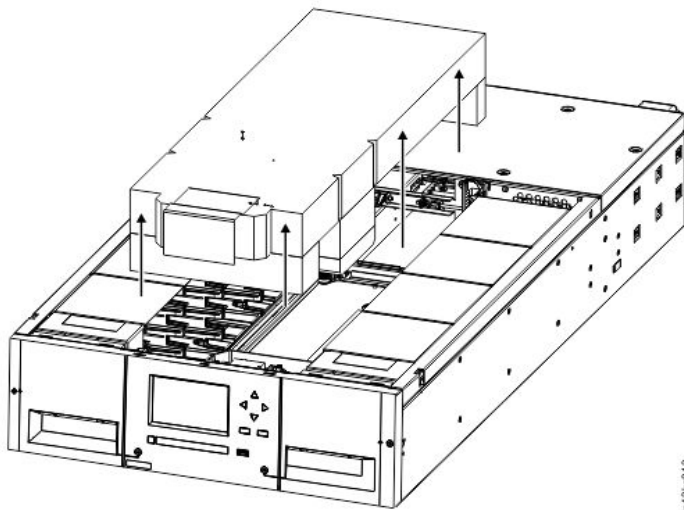
2. Remove the foam packing from the inside of the module.

Figure 3. The module is opened to show the foam packing.



3. After the packing is removed, the internal components are shown.

Figure 4. The foam packing is removed, and the internal components are shown - Base Module.



4. Install the top cover if you do not plan to add modules above this module.
5. Save the packaging materials for future use.
6. If you are adding extra modules, go to [Preparing top and bottom modules](#).

Preparing top and bottom modules

Use these steps to prepare the top and bottom modules for installation.

Skip this step if you are installing a Base Module only without an Expansion Module.

The Base Module has a removable top and bottom covers.

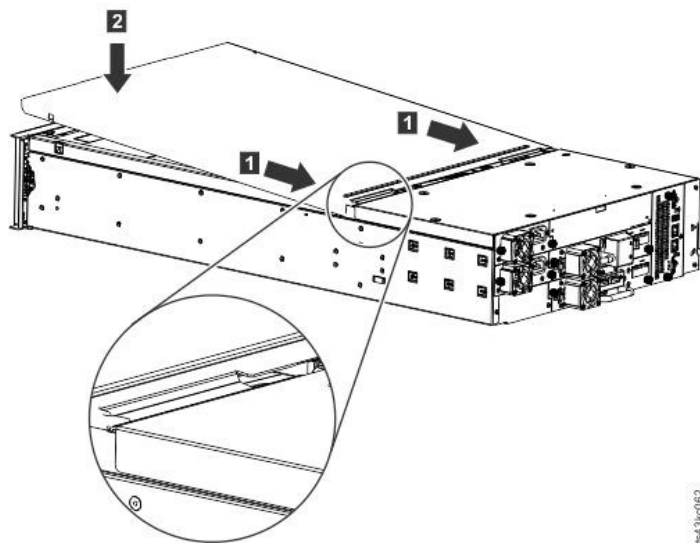
Installing Expansion Modules above the Base Module

If you are installing one or more Expansion Modules above the Base Module, move the top cover from the Base Module to the Expansion Module that is installed at the top of the library.

To move the library top cover plate from the Base Module to an Expansion Module

1. Remove the library top cover plate from the Base Module. See Step 5 in [Unpacking the Base Module and Expansion Modules](#).
2. Install the top cover on the Expansion Module that is installed on the top of the library.
 - a. Place the Expansion Module on a work table.
 - b. With the front of the top cover raised approximately 12 cm, engage the rear of the cover at the Expansion Module pivot point at the back of the opening.
 - c. Lower the front of the top cover until the latches engage on both sides.

Figure 1. Lowering the front of the top cover



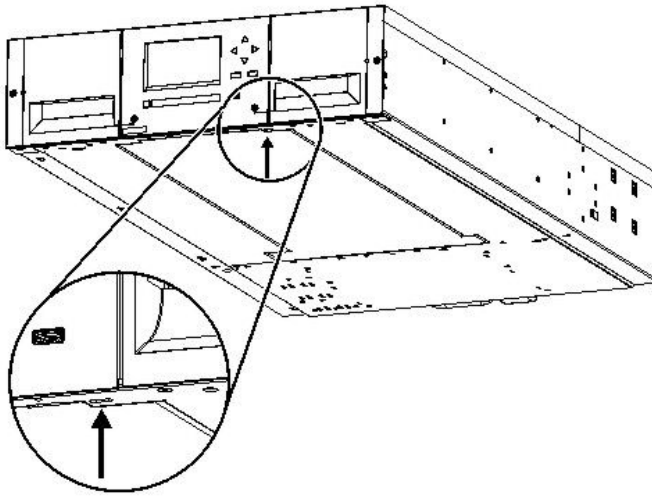
Installing Expansion Modules below the Base Module

If you are installing one or more Expansion Modules below the Base Module, move the bottom cover from the Base Module to the Expansion Module that is installed at the bottom of the library

To move the library bottom cover plate from the Base Module to an Expansion Module

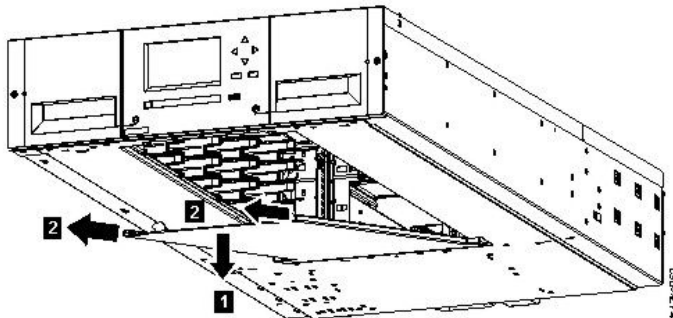
1. Remove the library bottom cover plate from the Base Module.
 - a. Place the Base Module on a work table.
 - b. Lift the unit front end by about 16 cm (use unit rear as a pivot edge).
 - c. Support the bottom cover with one hand. Insert a small flathead screwdriver or Torx screwdriver into the hole and slide about 4 mm sideways to the left to unlock the spring loaded lock. See [Figure 2](#).
Important: Do NOT turn the module upside-down to complete this step.

Figure 2. Unlocking the spring loaded lock



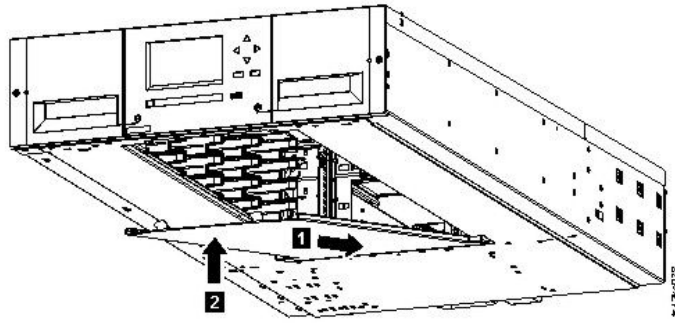
- d. Lower the cover front end by about 10 cm (1) and pull gently forward (2) to disengage from the pivot point at the unit center.

Figure 3. Removing the cover



2. Install the library bottom cover plate to an Expansion Module.
 - a. Place the Expansion Module on a work table.
 - b. Lift the unit front end by about 16 cm (use unit rear as a pivot edge).
 - c. Insert the bottom cover at the center
 - d. Lift the cover front edge until hard stop and it locks in at the unit front. The bottom cover fits only one way.

Figure 4. Lifting the cover and locking it



Installing modules in a rack

Rackmount installation procedure.

About this task

Modules are easy to install in racks that are compliant to the EIA 310A Standard, when at least 1 meter deep. You need a #2 Phillips screwdriver for this process. Note: Install modules from the bottom to the top. Refer to [Structure and supported library configurations](#) for the correct configuration of Base and Expansion Modules.

View the videos for a demonstration on how to install the modules:

Installing the First Module in the IBM 4300 Tape Library

IBM TS4300 Tape Library

Installing the first module

Updated: 01/02/24

0:00 / 2:01 1x

Installing an expansion module in the TS4300 Tape Library

IBM TS4300 Tape Library

Installing an expansion module

Updated: 01/02/24

0:00 / 3:09 1x

To locate the rail locations when multiple modules are installed.

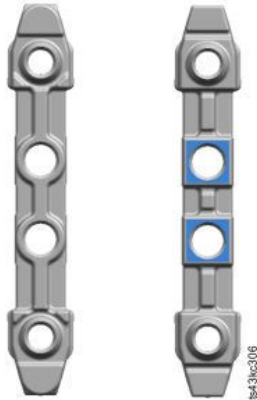
1. Locate the bottom of the lowest full U where the lowest module is installed.
2. Continue identifying the locations for any additional module 3U higher.

To install the rails into the rack, starting from the lowest rack location.

- a. Locate the four universal rack connectors, four Philips screws, and two rackmount rails (LH and RH).

Note: The universal rack connectors have two sides, for round hole and square hole racks. The square-hole side might be painted.

Figure 1. Universal rack connector



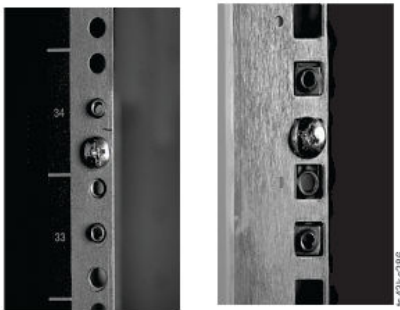
- b. On the inside of the racks, facing out, mount the connectors at the appropriate height to the right and left rack posts. Mount them in the middle hole of the height unit (the middle of a height unit is the hole between two wide and neighboring division bars) in both front and back. The four screw holes must align with the holes on your rack. If they do not, the blocks are not in the correct location. See [Figure 2](#) and [Figure 3](#).

Note: If the connectors are installed incorrectly, the screws on the connectors do not match the holes on the frames. The circles in the graphics highlight the mismatch.

Figure 2. Incorrect connector locations



Figure 3. Correct connector locations



- c. Repeat step b on the right and left rack posts in the rear of the rack.
- d. Mount the LH Rackmount rail to the connectors. See [Figure 4](#).
- e. Repeat step d with the RH Rackmount Rail.

Figure 4. Mounting the rails to the connectors

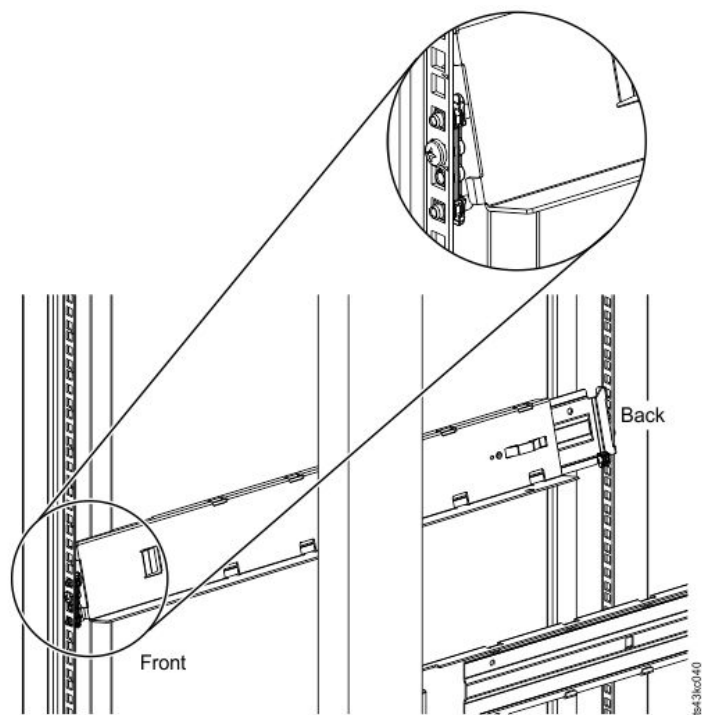
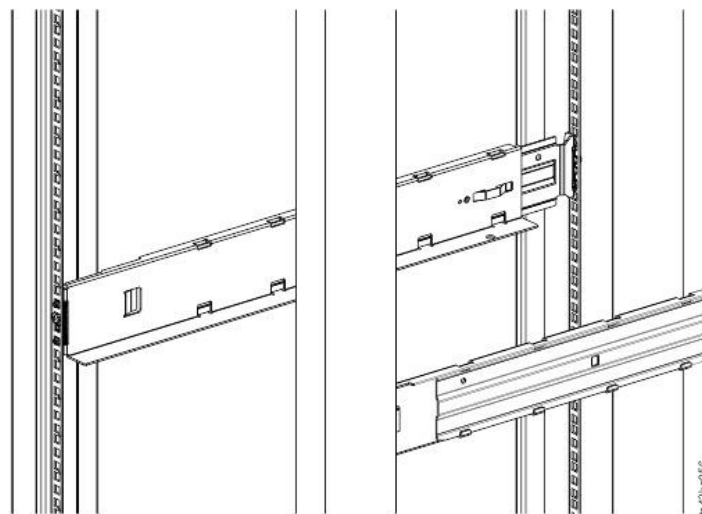
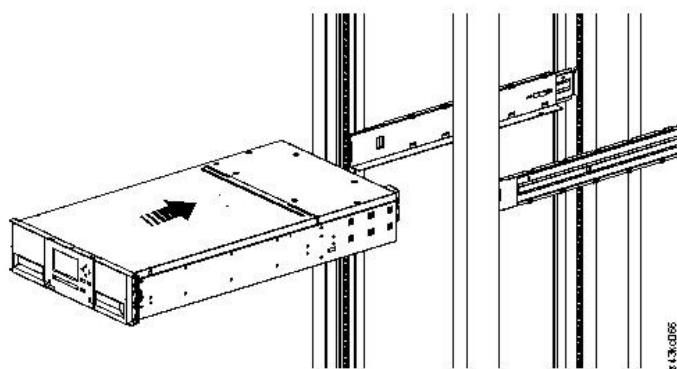


Figure 5. Side rails installed



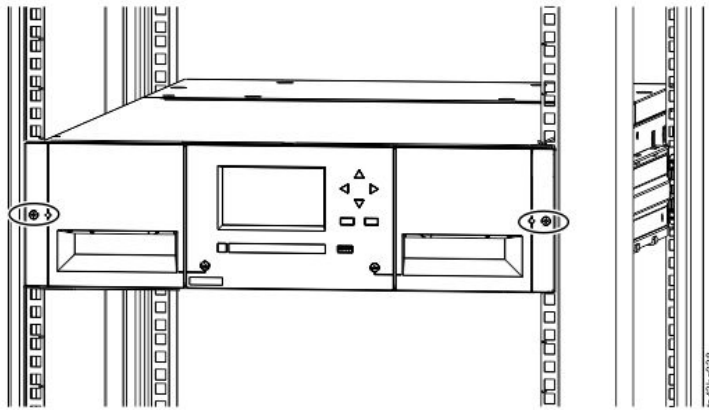
3. Place the library at the front of the rack on the support angles of the rails and push it into the rack to the back stop.

Figure 6. Sliding the library into the rack



4. If you are installing multiple modules, verify that this module is installed directly above or below its adjacent module and is contained within the correct 3U volume. Remove the tape that is covering the alignment pin lock/unlock lever on the rear of each module. The gap between modules must be less than 4 mm.

Figure 7. Library in the rack



Important: Each module must be on its own rails.

5. With a Phillips screwdriver, loosely screw the module to the front of the rack, one screw on each side. See the circled areas in [Figure 7](#).
6. Align the module as needed. Then, tighten the screws on each side of the module. See [Aligning and connecting modules](#).
7. Repeat steps 2 - 6 to install the rest of the modules into the rack.

Aligning and connecting modules

Aligning the modules ensures that the accessor can move freely between the modules.

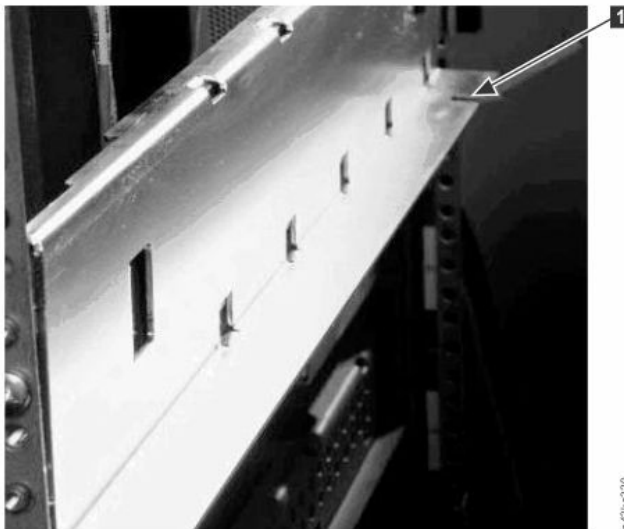
About this task

Skip this step if the library does not have Expansion Modules.

Aligning the modules ensures that the accessor can move freely between the modules. The library cannot operate unless the alignment mechanisms of the upper modules are in the locked position, and the alignment mechanism of the lowest module is unlocked.

1. From the front of the library, loosen the screws on each of the modules where they are attached to the rails two full turns.
2. From the back of the library, starting with the bottom pair of modules, align each module with the module below it. Repeat for each pair of modules. Refer to [Figure 3](#).
 - a. Move the alignment lever of the upper of the pair of modules to the locked or engaged position. If you encounter resistance, adjust the position of the upper module so the pin in the alignment mechanism moves into the mating hole in the lower module. If you still encounter resistance, check to see if the rack rails are installed correctly. Check that the hole for the alignment pin is on the left rail (looking from the front) toward the back of the rack. See **1** in [Figure 1](#).

Figure 1. Hole for alignment pin



Note: If a blue alignment lever lock is attached to the rear of the module, slide it to the left, then move the alignment lever. The lever lock has an internal spring, so hold it while the alignment lever is moved, and it automatically springs back into place after the lever is moved. See [Figure 2](#).

Figure 2. Alignment lever lock

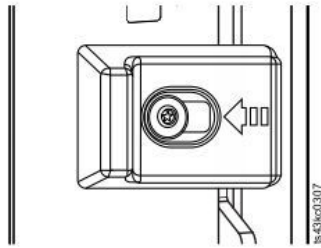


Figure 3. Alignment lever locked or engaged to lower module

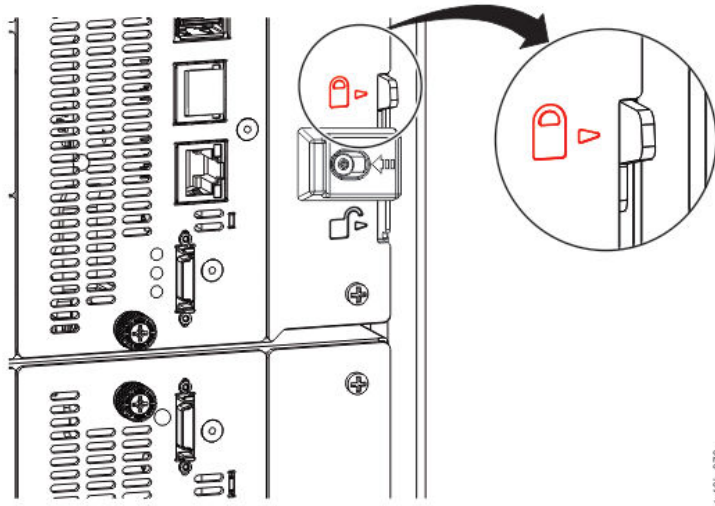
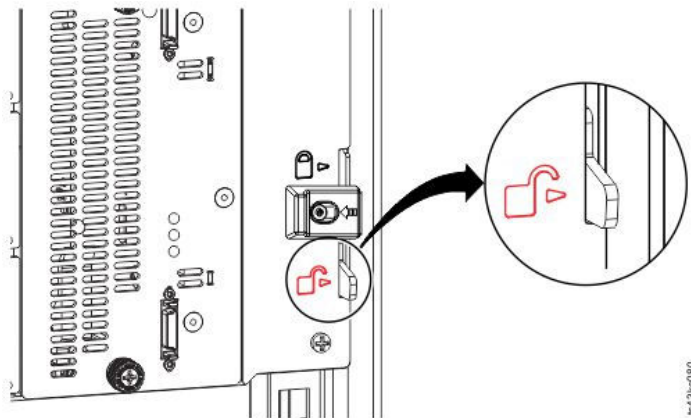
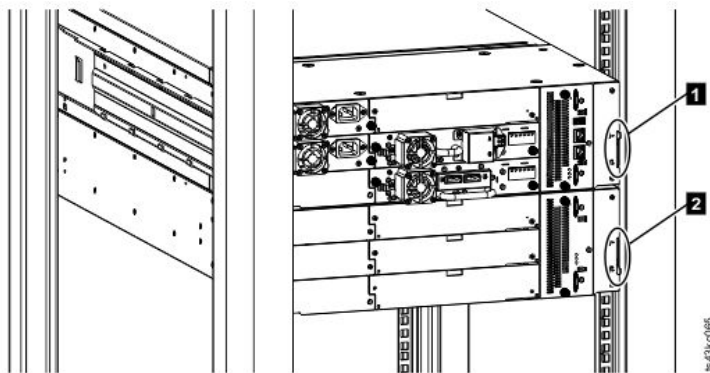


Figure 4. Alignment lever unlocked or disengaged



3. Verify that the lowest module in the library has its alignment lever is in the unlocked or disengaged position.

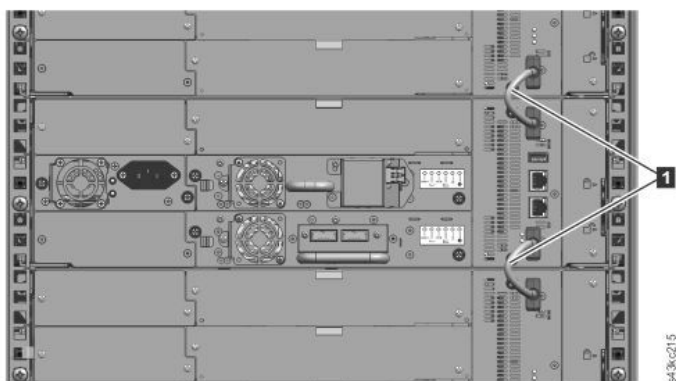
Figure 5. Two modules in rack, seen from the rear



1	Locked
2	Unlocked

- From the front of the library, tighten the Philips screws on each of the modules to secure the modules to the rack.
- From the back of the library, connect the modules of each pair to its adjacent module by using the expansion interconnect cables (1) as shown in [Figure 6](#). Note: The top module's top connector and the bottom module's bottom connector has nothing plugged into them.

Figure 6. Connected modules



Installing a tape drive

Tape drives come already installed in the library modules.

Remember:

- Half-height tape drives can be installed in any drive bay in a module.
- Full-height tape drives must be installed in the lowest two bays of a module. Installing a full-height drive in the top two bays of a module is not supported.

For detailed instructions, see [Adding, removing, or replacing a tape drive](#).

Connecting cables

Procedures to connect Fibre Channel, SAS, USB, and Ethernet cables.

About this task

Connecting Fibre Channel cables

- Remove the FC port caps if necessary. Attach one end of the FC cable to port 0 on the tape drive.

Figure 1. Full-height FC dual port

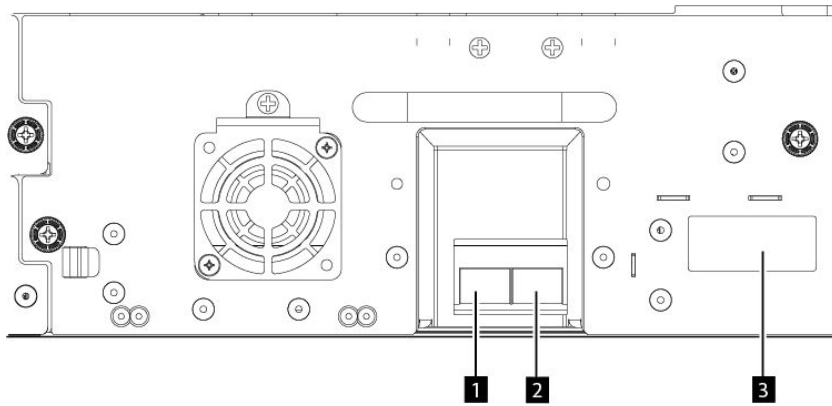


Table 1. Full-height FC dual port

Number	Description
1	FC port 0
2	FC port 1
3	Drive sled indicators (see Drive sled back panels)

Figure 2. Half-height FC single port

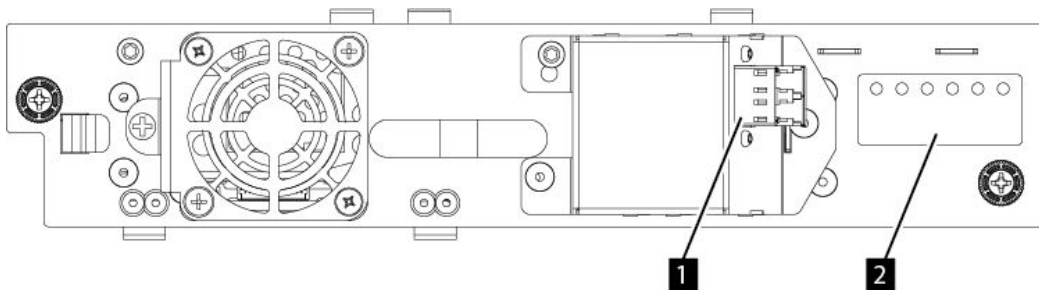


Table 2. Half-height FC single port

Number	Description
1	FC port 0
2	Drive sled indicators (see Drive sled back panels)

2. Attach the other end of the FC cable to a switch or HBA.
3. Repeat the same process with port 1 if you have a dual port drive.

Connecting SAS cables

1. Attach the end of the SAS cable into the connector on the HBA. If you are using a SAS fanout/Interposer cable, the end of the cable with only one connector must be plugged into the HBA.
2. Connect the drive end of the cable.
 - If you are using a cable with a single connector on each end, attach the other end into the connector on the tape drive.
 - If you are using a SAS fanout/Interposer cable, attach one mini-SAS connector into the connector on each tape drive. The unused ends of the SAS fanout/Interposer cable are single channel and not suitable for use with disk arrays. Use the other ends to connect tape drives, or coil and secure them to the rack to minimize stress on the connectors.

Figure 3. Full-height SAS dual port

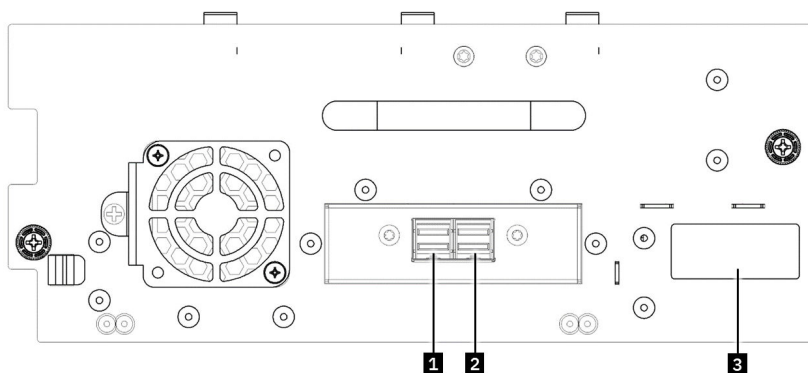


Table 3. Full-height SAS dual port

Number	Description
1	SAS port 0
2	SAS port 1
3	Drive sled indicators (see Drive sled back panels)

Figure 4. Half-height SAS dual port

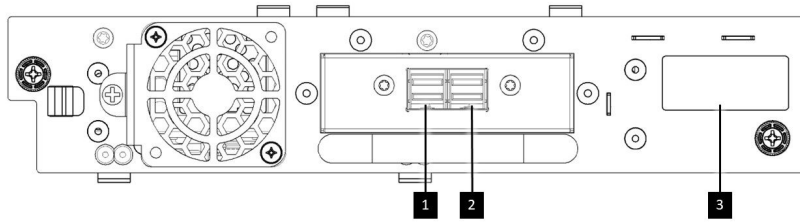


Table 4. Half-height SAS dual port

Number	Description
1	SAS port 0
2	SAS port 1
3	Drive sled indicators (see Drive sled back panels)

Important: SAS signal rates require clean connections between the HBA and tape drive. Do not use adapters or converters between the HBA and the tape drive. For reliable operation, use a SAS cable length of maximum 6 meters for 6 Gbps or slower SAS speed. For 12 Gbps SAS speed, use a SAS cable length of maximum 3 meters.

Connecting USB cables

Two USB ports are on the library, one in the front and one in the rear. USB connections are used by service personnel for diagnostic and service procedures. Attach one end of the USB cable to your notebook or other device and the other end to the front or rear USB port of the library.

Important: USB cable lengths of more than 3 meters are NOT supported for the front or rear USB ports.

Connecting Ethernet cables

To use the Management GUI, connect an Ethernet cable from the bottom Ethernet port on the Base Module controller to your network. See [Rear panel](#) for the location of the Ethernet ports.

Remember: Ethernet port A (bottom Ethernet port) is the primary port. The second Ethernet port, Port B, is for redundancy.

Powering on the library

Steps to power on the library.

About this task

1. Plug the power cables into the power connectors on each module and into power outlets.

Notes:

- The library has dual redundant power supplies. To increase redundancy, plug each power cord into a different AC power circuit.
- A power supply is required in expansion modules if drives are installed.

2. Power on the library by pressing Power on the Base Module just below the Operator Panel and hold for 5 seconds. See [Front panel](#) for the location of the Power button. When the library is powered on, it
 - a. Inventories the tape cartridges in the magazines,
 - b. Checks the firmware version on all modules,
 - c. Configures the tape drives.
 - d. Confirms the presence of the existing modules,
 - e. Searches for any new modules.
 - f. When the library is powered on for the first time, the Initial Setup starts. See [The Initial setup process](#).

The Initial setup process

When you turn on the library for the first time, the Initial Setup process starts automatically. Click Next to start the process.

The initial setup process guides you through the most fundamental settings of the library. The process includes setting the Internal IP range, setting library network configuration, configuring date and time, and setting the administrator PIN. Once you set the IP range, you can skip the remaining items and stop the process at any time. From there, you can start the setup wizard from the Management GUI to complete more configuration items.

Notes on navigation and entering data into the Operator Panel

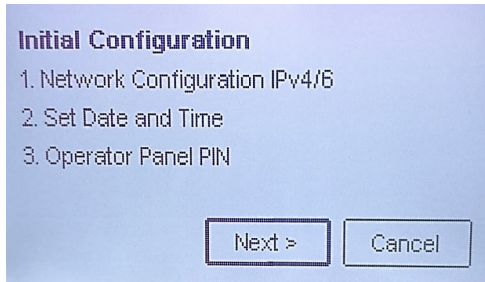
- The arrow keys on the front panel are used to select numeric and alphanumeric characters and symbols. Capital and lowercase letters, numbers, and punctuation are available to use.

- The right button under the arrows is Enter, which is pressed before you enter text.
- The left button under the arrows is Back/Return, which is used to delete entries.

See [Figure 1](#).

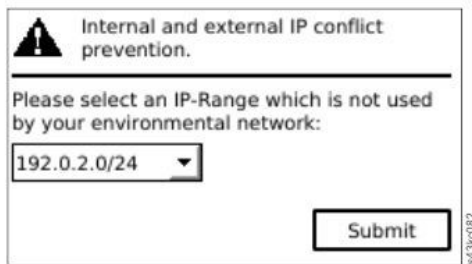
When the library starts up for the first time, the initial setup automatically begins. See [Figure 1](#)

Figure 1. Initial setup screen



1. Enter the IP address for your library. See [IP range selection](#). This step cannot be skipped.

Figure 2. IP address selection



2. Press Enter to unlock the Operator Panel.
Note: If you wait too long to make your selection, the unit auto calibrates. The auto calibration finishes and returns you to the login screen.
3. When you are logged in, the initial configuration process begins with Network Settings.
4. Follow the prompts to set date and time, and administrator PIN.
5. When the initial setup is complete, the display returns to the Operator Panel main screen.

To check your configuration at any time, go to Configuration > Initial System Setup on the Operator Panel. On the Management GUI, go to Setting > Library.

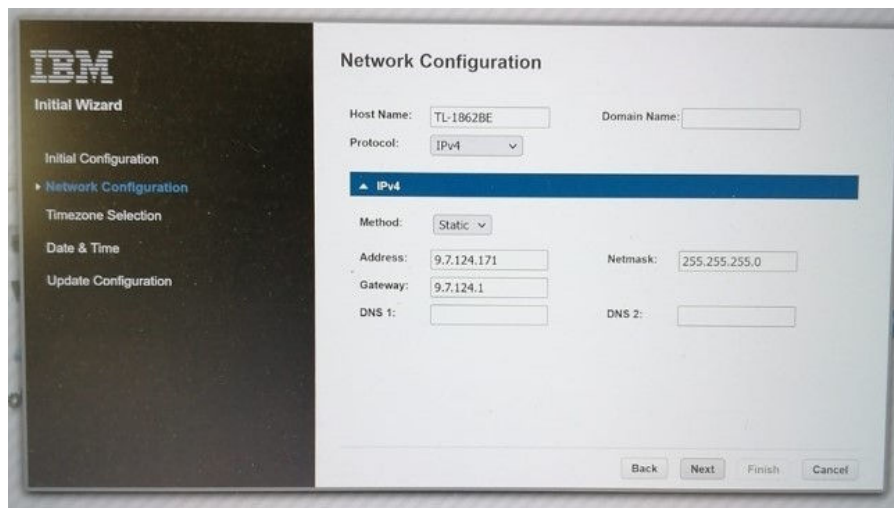
Initial configuration and customization

After the initial setup is completed by using the Operator Panel, an administrator can log on to the Management GUI to complete the library configuration with the Initial Configuration Wizard.

Upon the first login with the user role `administrator` and password `adm001`, you must change your password. Your new password must have these characteristics:

- 8 characters long
- At least one lowercase alphabet character
- At least one uppercase alphabet character
- At least one numeric character
- No more than two consecutive characters

The Initial Configuration Wizard guides you through basic configuration settings.



The library has many features to customize it for your organization. Go to [Locating Management functions](#) to customize your library with these features.

- Enabling or disabling the I/O station.
- Naming the library with the Manage Logical Library function.
- Creating or managing Logical Libraries. See [Library sharing](#) for more information.
- Selecting Random or Sequential Mode. See [Random and Sequential Logical Library modes](#) for more information.
- Enabling and configuring SNMP network management.
- Setting up email event notification.
- Setting up encryption.
- Configuring the date and time.
- Enabling or disabling Library Auto Clean. See [Methods of cleaning drives](#).

Labeling and loading tape cartridges

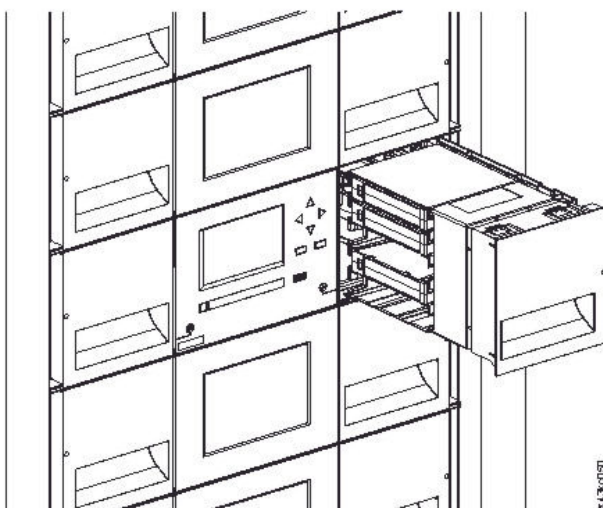
The library can power on without cartridges, but needs cartridges before it can complete data read and write operations, or any tests or operations that transfer cartridges.

Bar code labels are highly recommended in production environments to improve inventory time in the library and ease cartridge-handling processes outside the library. See [Bar code label](#).

The I/O station

If the I/O station is enabled, you can use it to load cartridges into the library. Press the magazine button for less than 3 seconds. When the button LED starts flashing fast, pull out the I/O station. The right magazine will only pull out part way to reveal five slots.

Figure 1. Open I/O station seen from the left

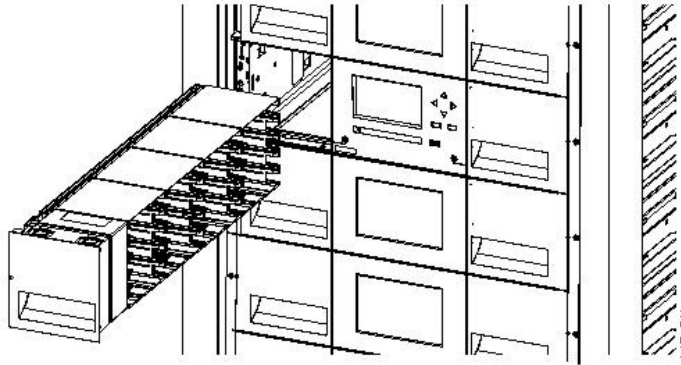


Bulk loading magazines

1. Unlock the magazine by pressing the magazine button for more than 3 seconds, wait for the button to flash fast and then pull out the magazine.
 - a. From the Operator Panel or Management GUI, select the module and then select Open Magazine. You can also press the release button on the front panel of the module to release the magazine.
 - b. Wait until the magazine is unlocked, and then pull out the magazine.

Note: Wait for the Operator Panel/Management GUI message to say the magazine is unlocked before the magazine is pulled out.

Figure 2. Magazine pulled out



2. Load the tape cartridges into the magazine.

Important: For libraries with serial numbers before 7800K0K, the slots of the lowest row of the bottom module are inaccessible and can contain a 4-slot I/O station only, so do not load cartridges into these slots.
3. Insert the magazine into the unit.
4. Push the magazine handle slowly until the magazine release latch snaps into place. The magazine locks into place.

Important: Push the magazine fully into place until the latch snaps into place.
5. Repeat steps 1 - 3 for each of the other magazines.

See [Accessing cartridges](#).

Verifying the installation

Verify that the library has the current firmware revision, and save the configuration settings. This action can be helpful if the library requires service.

Verify that the library has the current firmware revision. The library firmware revision is displayed at Library > Actions > Properties.

1. Verify library firmware and update if needed: Library > Actions > Update Library Firmware
2. Run Library Verify.
3. Save the configuration settings to a file on your computer from the Management GUI: Settings > Library > Advanced > Save Configuration File.

Having a backup of the library configuration is helpful when the library is recovering from a configuration error or needs service.

Advanced library configuration

To create and manage multiple logical libraries, utilize the advanced logical library function.

- [Overview](#)

Overview of advanced features such as multipath architecture, multiple logical libraries, and multiple control paths.
- [Library partitioning](#)

Libraries that contain at least two drives can configure two logical libraries. It is possible to configure up to 21 logical libraries in the library.

Overview

Overview of advanced features such as multipath architecture, multiple logical libraries, and multiple control paths.

Multipath architecture

The multipath architecture feature of this tape library allows Open Systems applications to share the robotics of the library. See [Library sharing](#).

The library features storage area network (SAN) ready multipath architecture. This architecture allows homogeneous or heterogeneous Open Systems applications to share the library's robotics without middleware or a dedicated server (host) acting as a library manager. The SAN-ready multipath architecture makes sharing possible by partitioning the library's storage slots and tape drives into logical libraries. Servers can then run separate applications for each logical library. This partitioning capability extends the potential centralization of storage that the SAN enables. Partitioning also provides investment protection if your application does not support the mixing of drive generations and media in the same logical library.

The multipath architecture of this library is designed to provide the capability to share the library robotics. The sharing is accomplished first by partitioning the library into multiple logical libraries (up to the number of drives installed). Then, each logical library is assigned its own separate and distinct drives, storage slots, and control paths. Input/output (I/O) slots are shared on a first-come-first-serve basis. This type of partitioning is designed to allow heterogeneous applications to share the library robotics independent of each other. Cartridges under library control are not shared between logical libraries, nor are they allowed to be moved between logical libraries. An example of heterogeneous sharing is a Microsoft™ Windows™ application that is using the drive and storage slots of one logical library, while a UNIX® application uses the drive and slots of another logical library. See [Mixed drives](#).

Multiple logical libraries

A library can be partitioned into multiple logical libraries to enable simultaneous data backup and restore tasks from different applications. For example, you can create multiple logical libraries so that is processes

- Commands from Application 1 (about Department A) in Logical Library 1
- Commands from Application 2 (about Department B) in Logical Library 2
- Commands from Application 3 (about Department C) using Sequential Mode in Logical Library 3

In this configuration, the tape drives and cartridges of each logical library are dedicated to that library and are not shared among other libraries and applications. Commands that are issued by the applications travel to the library through unique control paths or sequential mode processing by the library. So, the data processing for Department A is confined to the tape drives and cartridges of Logical Library 1. Processing for Department B is confined to the tape drives and cartridges of Logical Library 2, and so forth.

For applications that do not support mixed drive types and media within the same logical library, partitioning the library into multiple logical libraries provides the capability to keep them separate. For example, you can partition the following tape drives and their media into multiple and separate logical libraries:

- LTO™ 8
- LTO 7
- LTO 6

Multiple control paths

With this tape library's multipath architecture, in addition to creating multiple logical libraries, you can configure any logical library to have more than one control path. A control path is a logical path into the library through which the library receives standard **SCSI Medium Changer** commands to control the library operations. Note: No SCSI Medium Changer is configured when the logical library is enabled as Sequential Mode

Multiple control paths reduce the possibility of a failure in one control path to cause the entire library to become unavailable. Also, when you configure more control paths, more library-sharing configurations and options are possible. Access to the library is on a first-come, first-served basis. Each control path for a logical library can accept commands while the library is in use by another control path.

Multiple control paths for control path failover

This tape library offers an optional control path failover feature. See [Library sharing](#) and [Control path failover, Data path failover, and load balancing](#).

Use of the control path failover feature further reduces the possibility of a failure in one control path to cause the entire library to become unavailable.

The control path failover feature (feature code 1682) enables the host device driver to resend a command to a different control path for the same logical library.

Library partitioning

Libraries that contain at least two drives can configure two logical libraries. It is possible to configure up to 21 logical libraries in the library.

Partitioning of libraries

With full-height or half-height physical drives, physical numbering is bottom up for all drives. Important: A full-height drive can be installed in a module in the lower two slots only.

Configuration of a 1-logical library system

A one logical library system contains all drives present in any drive positions, and it contains all the slots.

Configuration of multiple logical libraries

A library with multiple logical libraries must have a drive for each logical library and at least five slots. Drives can be in any location in the library. It is best to have drives that are located near the slots that are assigned to the same logical library to minimize accessor movement and maximize performance.

SCSI element-addressing

A logical library assigns SCSI element addresses to drives, storage slots, I/O slots, and the accessor. For each element type (drive, storage, I/O), the SCSI element address can be viewed on the Management GUI.

While SCSI addressing follows the same method as physical location-numbering, this action depends on the Advanced Logical Library configuration.

Drive numbering is from bottom to top. Storage slot-numbering is from left magazine (front to back, bottom to top) to right magazine (back to front, bottom to top). IO slot-numbering is from bottom to top. Accessor is single number.

Note: When the number of drives in your library are reduced, update the logical library configuration. This action removes all event notifications that indicate a drive is missing.
Updating the logical library configuration might change the SCSI element addressing.

Verifying the host connection

Procedure to verify the connection between the host computer and the library.

About this task

To verify the connections between the host computer and the library

1. Install the application software and drivers that are compatible with the library. Backup software packages might require extra software or licensing to communicate with the robotics.
2. Verify the connection between the library and the host by using the host server's operating system utilities. Or, use the IBM® Tape Diagnostic Tool (ITDT) to verify the communication between library and host. See [IBM Tape Diagnostic tool \(ITDT\)](#).

See [Host connectivity](#), for compatible servers and software.

Registering for support notification

Support notification registration provides email notification when new firmware levels are updated and are available for download and installation.

To register for support notification, visit the web at: <http://www-01.ibm.com/software/support/einfo.html>.

Enter your user name and password on the [Library Configuration Forms](#).

Note: Library firmware and tape drive firmware are verified and released together. When the latest firmware is updated, verify that all installed components such as the tape drive and library are at the latest levels noted on the Support website. Mixing different levels of library and tape drive firmware is not supported and might cause unpredictable results.

IBM® suggests that you update library and drive firmware when new levels become available. For instructions on updating library and drive firmware, see [Update Library Firmware](#).

Now you are ready to use your library.

Managing

Four user roles are described, and each user role has its specific functions.

- Administrator - This role provides access to the administrator functions on the Management GUI. There is a default administrator password **adm001** for the first login. The administrator password can be changed on the Local Users page.
- Monitor - This role allows access to library status information and does not allow access to configuration, maintenance, or operation features. Setting a monitor password restricts access to status information to only those users who know the monitor password. Passwords for the Monitor role can be set or changed by the administrator.
- Superuser - This role has same access rights as the Administrator role, except the ability to access the Local Users and Remote Authentication (LDAP Authentication and Kerberos Authentication) pages. In addition, it is possible to do cartridge moves and open magazines and I/O Stations. Passwords for the Superuser role can be set or changed by the administrator.
- Service - This role provides access to the service functions on the Management GUI. Passwords for the Service role can be set or changed by the administrator.

Notes:

- Monitor, Superuser, and Service user IDs must be enabled by the library administrator. These accounts are disabled by default.
- For a complete description of the menu items available to each user role, see [Management GUI functions and roles](#).
- [Tape Media warranty information](#)
IBM provides a limited lifetime warranty for IBM 3592 and IBM LTO Tape media products.
- [Cartridge quality and maintenance](#)
Cartridge quality and maintenance.
- [code_signing.html](#)
- [The Management GUI](#)
With the Management graphical user interface (GUI), you can monitor, configure, and operate most library functions from a web browser.
- [Setting up Multi-factor authentication](#)
To start the process, a user must check the Two-Factor authentication box.
- [The Operator Panel](#)
With the Operator Panel, you can monitor, configure, and operate library functions from the library front panel.
- [Locating Management functions](#)
This table provides the menu navigation to assist with library setup and configuration.

Tape Media warranty information

IBM provides a limited lifetime warranty for IBM 3592 and IBM LTO Tape media products.

Refer to the following web pages [3592 Tape Cartridge](#) or [IBM LTO Ultrium Tape Cartridge](#).

For warranty support in the Americas email ibmmmedia@us.ibm.com and for warranty support in Asia/Pacific or Europe/Middle East/Africa contact an IBM Media Authorized Distributor:

North America:

Accutech: <https://www.accutechdata.com>

Dexxon Digital Storage: <https://www.digitalstorage.com>

Asia/Pacific:

E-Globaledge: <https://www.e-globaledge.com/en/products/storage/tapestorage/>

Europe/Middle East/Africa:

Dexxon Groupe: <https://plus.dexxon.eu/index.php/fr>

Wellow Business Services: <https://www.wellow.co.uk>

Cartridge quality and maintenance

Cartridge quality and maintenance.

The IBM® tape cartridge provides high performance and reliability with IBM magnetic tape cartridge drives when the cartridge is properly handled and stored. Repeated handling or inadvertent mishandling can damage the physical parts of the cartridge and make it unusable.

The magnetic tape inside the cartridge is made of highly durable materials. However, the tape wears after repeated cycles in the tape system. Eventually, such wear can cause an increase in tape errors.

Track the error data available by monitoring both the cartridge and your tape system performance. By monitoring error data, you can identify and replace cartridges that are no longer acceptable for continued use.

Proper maintenance of your cartridge helps to keep IBM magnetic tape cartridge systems operate in a reliable and efficient manner.

Attention: Do not degauss a cartridge tape. Degaussing the tape erases the servo tracks and make the cartridge unusable. An attached host can be used to run a Data Security Erase if the data on the tape must be physically erased. This action physically overwrites the data on the tape without damaging the servo tracks.

Code signature verification

Signature verification is available to ensures the authenticity of new IBM tape library firmware releases.

Here are the three steps for signature verification:

1. Download from Fix Central: public key, firmware code, and signature file
2. Open Terminal session.
3. From the directory where you downloaded the Fix Central run the following command.

```
openssl dgst -verify <pub.key> -keyform PEM -sha256 -signature <file.sig> -binary <libraryFirmware.afwz>
```

The command will result with a success message.

```
Verified OK
```

Take the following steps, if you receive any other response:

- Delete the files that you downloaded.
- Download a new set of files from Fix Central.
- If the command fails repeatedly, try doing the verification on a different device.

The Management GUI

With the Management graphical user interface (GUI), you can monitor, configure, and operate most library functions from a web browser.

When possible, use the Management GUI as the primary library interface. The web interface provides access to more features, includes online help, and is intuitive to use.

Before the Management GUI can be used, you need to log in and configure the library network settings with the Operator Panel. This action can be done during Initial Setup. See [The Initial setup process](#).

Logging in with the Management GUI

1. Open a supported web browser and enter the IP address of the library in the browser's address bar.
2. Type in the username (`administrator` or other administrator-created user) and the password. Click Login.

Note: For initial login, type `administrator` and the password `adm001`. You **must** change the password after the initial login. Your new password must have these characteristics:

- 8 characters long
- At least one lowercase alphabet character
- At least one uppercase alphabet character
- At least one numeric character
- No more than two consecutive characters

Note: Only one person (on Operator Panel or Management GUI) can be logged in to the library at a time. If another person is already logged in when you try to log in, a dialog box appears asking if you want to log off the other user.

The Library main screen on the Management GUI

The library main screen is organized into the following regions:

Figure 1. Management GUI main screen

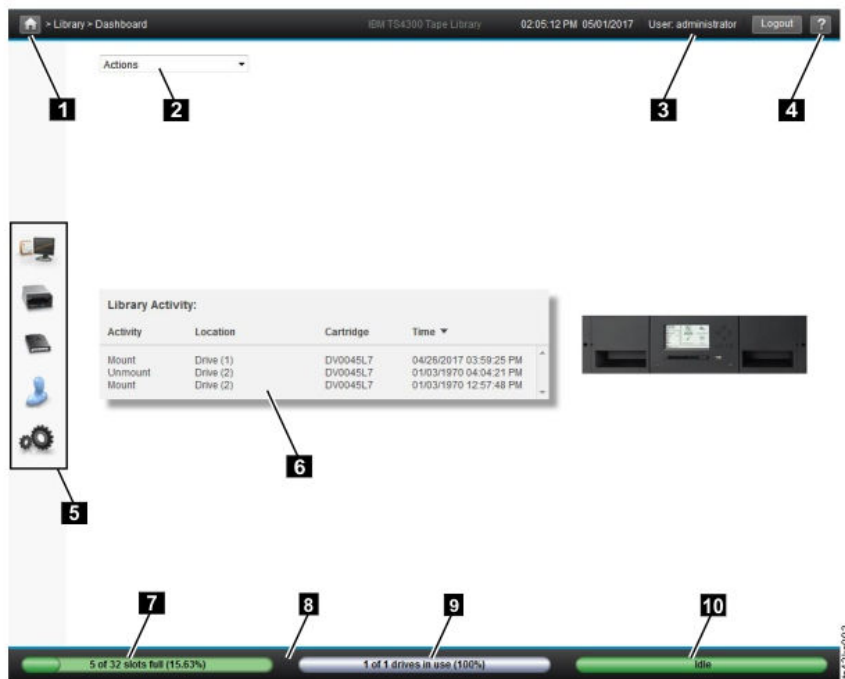


Table 1. Main screen elements

	Element
1	Home icon > Current Navigation
2	Actions > dependent on current navigation
3	User logged in
4	Help
5	Navigation Dock
6	Overview - dependent on current navigation
7	Cartridge Capacity - Shows how many cartridge slots are available and how many of those have cartridges in them
8	Status Bar
9	Drive Activity - Shows how many drives are present in the library and how many of those are in use (have cartridges loaded)
10	Library Status

Tips:

1. For specific management function navigation, see [Locating Management functions](#).
2. For additional information, see online help pages in the Management GUI. The help pages are updated with firmware updates and often contain up-to-date technical details that might not be contained in this document. To access Management GUI help, click ? on the right side of the Management GUI top banner.
3. For information about user role permissions, see [Management GUI functions and roles](#).

Navigation Dock

Table 2. Navigation Dock

Navigation Dock Icons	Element	Extra menus
	Library	• Dashboard • Modules and Magazines • Logical Libraries • Events
	Drive	Drives and Ports
	Cartridges	Cartridges and Slots
	Access	• Local Users • Local Password Policies • LDAP Authentication • Kerberos Authentication
	Settings	• Library • Network • Notifications • Security

Status icons

Status icons indicate the following conditions.

Table 3. Status icons

Icon	Description
	The green OK icon indicates that the library is fully operational and that no user interaction is needed.
	The yellow exclamation point Warning icon indicates that user attention is necessary, but that the device can still finish most operations.
	The red X Error icon indicates that user intervention is needed and that the device can't finish some operations.

Setting up Multi-factor authentication

To start the process, a user must check the Two-Factor authentication box.

Login to the system with your normal login credentials. Go to **Access > Local Users**, select your login account, and select **Modify User Password** from the **Actions** menu.

Refer to the Figure **Two-factor authentication check-box**: Check the Two-Factor authentication box and click the **Modify** button.

Figure 1. Two-factor authentication check-box

Modify User Password

User

Name: aurelius

Password:

Verify Password:

Two-factor authentication: ☒

Password rules:

- ✗ at least 8 character(s).
- ✗ at least 1 uppercase letter(s) (A-Z).
- ✗ at least 1 lowercase letter(s) (a-z).
- ✗ at least 1 digit(s) (0-9).
- ✗ not more than 2 identical consecutive character(s).
- ✗ Passwords Match

Modify **Cancel**

At the Authenticator Setup screen, you can do a screen capture of the QR code or scan the QR code with your phone, depending on the requirements of your authenticator app.

Figure 2. Authenticator setup

Setup authenticator app

i You can protect your account by one time passwords. Please setup the one time password protection to continue.

Scan the QR code

Use an authenticator app or browser extension to scan the QR code. Enter the generated TOTP to verify the setup.



Seed: [Show Seed](#)

Custom Seed (optional):

TOTP:

System Time: 04:16:55 PM 08/04/2025

Timezone: America/Mexico_City

OK **Cancel**

The next step of the process will depend on your authentication application of choice.

Just as an example, consider the process for the 3rd-party application 1Password.

1. Create a 1Password Account at 1Password.com.
2. Install 1Password on the device that you will use for authentication.
3. Create a 1Password vault and item for the TS4300. Make sure that the login credentials match your TS4300 account.
4. Log into the TS4300 GUI and set your account to Two-Factor authentication.
5. At the Authenticator Setup screen, do a screen capture of the QR code and paste it into the 1Password entry for the TS4300.
6. You will get a Time-Based One-Time Password (TOTP) from 1Password. If you are using a laptop or desktop, copy this to your device clipboard.
7. In the TS4300 Authenticator Setup screen, paste the the value in **TOTP** field and click **OK**.

Now every time you login, go to 1Password and get a TOTP to complete the Two-Factor authentication process to log into the TS4300.

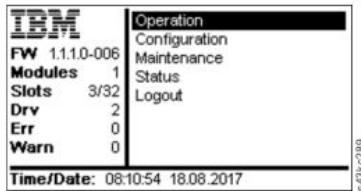
The Operator Panel

With the Operator Panel, you can monitor, configure, and operate library functions from the library front panel.

The Operator Panel has a Power button, an LCD display, six navigation buttons, and five LEDs. To use the Operator Panel, you must use the six navigation buttons (up/down, left/right, Enter, Back). The Operator Panel is **not** a touchscreen. See [Front panel](#) for the location of the navigation buttons.

Operator Panel screens

Figure 1. Operator Panel main screen



Operator Panel main screen layout

- Left Pane - Displays the library status (firmware revision, number of modules, number of slots, number of drives, number of errors, number of warnings).
- Center Pane - Provides access to operate, configure, and log out of the library and to view more status information (Operation, Configuration, Maintenance, Status).
- Bottom Pane - Displays more status information (library status, time/date, IPv4, or IPv6 address). The status pane displays one status information for 10 seconds and then switches to the next status item.

Table 1. Operator Panel menu tree

Operation	Configuration	Maintenance	Status	Logout
Move Cartridge from Drive to Home Slot Move Cartridge	Initial System Setup Date & Time Network Settings User Accounts Reset	Library Tests View Events Drive Service Logs Download Library Logs Download Drive Firmware Upgrade Library Firmware Upgrade LCD Adjustment	Network Settings Library Drive	Logout

The Operator Panel provides a subset of menu items that are compared to the full capability of the Management GUI. For the operations that are available on the Operator Panel, see [Locating Management functions](#).

Accessing the library with the Operator Panel

The Operator Panel can be accessed in two ways, with a PIN or without one.

1. If the Operator Panel screen saver is on, press Enter.
2. If no PIN is configured, press Enter.
3. If a PIN is configured, enter the PIN, then select Login and press Enter.

Status icons

Figure 2. Front panel LEDs



Table 2. Front panel LEDs

LEDs	Color	Descriptions
Ready	Green	Steady when power is on, flashing with tape Ready drive or library robotic activity.
Unit Identification (UID)	Blue when activated	The UID LEDs are controlled by the user through the Library>Actions>Turn Identifier Light On or Off GUI function. The UIDs on the Operator Panel and base module back panel are activated and deactivated together. In addition, UIDs on drives and expansion module back panels can be activated separately. The UIDs are helpful for locating components of the library in a data center.

LEDs	Color	Descriptions
Clean	Amber	On, when a tape drive-cleaning operation is recommended.
Attention	Amber	Flashing if the library detected a condition for which user attention is necessary, but the library can still complete most operations.
Error	Amber	On, if an unrecoverable tape drive or library error occurs. A corresponding error message is displayed on the LCD screen. User intervention is required as the library is not capable of completing some operations.

Locating Management functions

This table provides the menu navigation to assist with library setup and configuration.

Table 1. Locating Management functions

Task	Menu Navigation	
	Operator Panel	Management GUI
Advanced settings	Not available with this interface	Settings > Library > Advanced
Auto Calibration	Not available with this interface	Settings > Library > Auto Calibration
Auto Clean	Not available with this interface	Library > Logical Libraries > Actions > Manage Logical Library (Expert Mode) See Methods of cleaning drives .
Cartridge, eject from a drive	Operation > Move Cartridge from Drive to Home Slot	Drives > Actions > Eject Cartridge from Drive
Cartridge Inventory, rescan	Not available with this interface	Cartridges > Actions > Inventory Library
Cartridges, list	Not available with this interface	Cartridges
Cartridges, move	Operation > Move Cartridge	Cartridges > Actions > Move Cartridges
Cartridges, graphical view	Not available with this interface	Cartridges > Actions > Graphical View
Certificates, create, backup, restore	Not available with this interface	Settings > Security > GUI
Cleaning, tape drive	Not available with this interface	Drives > Actions > Clean Drive See Methods of cleaning drives .
Configuration, save and restore	Not available with this interface	Settings > Library > Advanced
Configuration, reset	Not available with this interface	Settings > Library > Advanced
Configuration file, restore	Not available with this interface	Settings > Library > Advanced
Configuration file, save	Not available with this interface	Settings > Library > Advanced
Date and time, configure	Configuration > Date & Time	Settings > Library > Date and Time
Diagnostics, run Demo Mode	Maintenance > Library Tests	Library > Actions > Tests
Diagnostics, run Library Verify	Not available with this interface	Library > Actions > Tests
Diagnostics, run Drive test	Maintenance > Library Tests	Library > Actions > Tests
Diagnostics, run Slot to Slot exerciser	Not available with this interface	Library > Actions > Tests
Drive firmware, update	Maintenance > Drive Firmware Upgrade (requires FAT32 format USB drive)	Drive > Actions > Update Drive Firmware
Drives and Modules, reset the list	Not available with this interface	Settings > Library > Advanced
Drive status	Status > Drive	Drives
Drive service logs, download	Maintenance > Drive Service Logs Download (requires FAT32 format USB drive)	Drives > Actions
Drive, modify port settings	Not available with this interface	Drives > Actions
Email Notification	Not available with this interface	Settings > Notifications
Encryption, configure	Not available with this interface	Settings > Security > Encryption See Configuring Library Managed Encryption .
Encryption Connectivity Check	Not available with this interface	Settings > Security > Encryption
Encryption (LME) license key, add or delete	Not available with this interface	Settings > Library > Licensed Features
Encryption, reset	Not available with this interface	Settings > Security > Encryption
Factory/Manufacturing reset	Configuration > Reset > Full Factory Reset	Settings > Library > Advanced
Help	Not available with this interface	Click the ? at the upper right of the Management GUI screen. See 4 on Figure 1 .
Identifier light, turn On or Off	Not available with this interface	Library > Actions > Turn Identifier Light On or Off
Initial Setup	Configuration > Initial System Setup	Settings > Library > Initial Configuration Wizard
Inventory List	Not available with this interface	Cartridges
I/O Station, enable or disable	Not available with this interface	Library > Modules and Magazines > Actions > Enable or Disable I/O Station
I/O Station, open	See Accessing cartridges .	Library > Modules and Magazines > Actions > Unlock I/O Station
Kerberos Authentication, configure	Not available with this interface	Access > Kerberos Authentication
Key Path Diagnostic	Not available with this interface	Settings > Security > Encryption See Key Path Diagnostics .
LCD Adjustment	Maintenance > LCD Adjustment	Not available with this interface
LDAP Authentication, configure	Not available with this interface	Access > LDAP Authentication

Task	Menu Navigation	
	Operator Panel	Management GUI
Library firmware, update	Maintenance > Library Firmware Upgrade (requires FAT32 format USB drive)	Library > Actions > Update Library Firmware
Library logs, download	Maintenance > Library Logs Download (requires FAT32 format USB drive)	Library > Actions > Export Library Logs
Library logs, view or clear	Maintenance > View Event Ticket Logs	Library > Events > Actions
Library Information	Status	Library > Actions
Library Managed Encryption, configure	Not available with this interface	Settings > Security > Encryption See Configuring Library Managed Encryption .
Library Verify, run	Maintenance > Library Tests	Library > Actions > Tests > Library Verify
List of Known Drives and Modules, reset	Not available with this interface	Settings > Library > Advanced
Logical Libraries, graphical view	Not available with this interface	Library > Logical Libraries > Actions > Graphical View
Logical Libraries, Manage (Basic Mode)	Not available with this interface	Library > Logical Libraries > Actions > Manage Logical Library (Basic Mode)
Logical Libraries, Manage (Expert Mode)	Not available with this interface	Library > Logical Libraries > Actions > Manage Logical Library (Expert Mode)
Logical Libraries, Mode configure	Not available with this interface	Library > Logical Libraries > Actions > Manage Logical Library (Basic Mode) or Manage Logical Library (Expert Mode) See Random and Sequential Logical Library modes .
Logical Libraries, Mode status	Not available with this interface	Library > Logical Libraries
Magazines, open	See Accessing cartridges .	Library > Modules and Magazine > Actions > Unlock Magazine
Network settings	Configuration > Network Settings	Settings > Network > Ethernet
Notifications, configure	Not available with this interface	Settings > Notifications
Operator Panel, session lock timeout	Not available with this interface	Settings > Security > GUI
Password Policy	Not available with this interface	Access > Local Password Policies
Path Failover license key, add or delete	Not available with this interface	Settings > Library > Licensed Features
Port Settings, modify	Not available with this interface	Drives > Actions > Modify Port Settings
Remote Logging (rsyslog), configure	Not available with this interface	Settings > Notifications > Remote Logging (rsyslog)
Reset, rediscover devices	Not available with this interface	Settings > Library > Advanced
Reset Internal IP Range	Configuration > Reset > Reset Internal IP Range	Not available with this interface
Reset Library	Not available with this interface	Library > Actions > Reset Library
Reset Drive	Not available with this interface	Drives > Actions > Reset Drive
Sequential mode, configure	Not available with this interface	Library > Logical Libraries > Actions > Manage Logical Library (Basic Mode) or Manage Logical Library (Expert Mode) See Random and Sequential Logical Library modes .
SNMP, configure	Not available with this interface	Settings > Notifications > SNMP
SNTP (Simple Network Time Protocol) Synchronization, configure	Not available with this interface	Settings > Library > Date and Time > SNTP (Simple Network Time Protocol) Synchronization
SSL, enable or disable	Not available with this interface	Settings > Security > GUI > Secure Communication
Session Timeout	Not available with this interface	Settings > Security > GUI > Session Timeout
Time Zone, set	Not available with this interface	Settings > Library > Date and Time > Time Zone
Unit Identification (UID), set	Not available with this interface	Library > Actions > Turn Identifier Light On or Off
Users, Access recovery	Configuration > User Accounts	Not available with this interface
Users, Modify User Passwords	Not available with this interface	Access > Local Users > Actions > Modify User Passwords
Users, Modify Role Permissions	Not available with this interface	Access > Local Users > Actions > Modify Role Permissions
Users, Modify Operator Panel PIN	Configuration > User Accounts	Access > Local Users > Actions > Modify Operator Panel PIN
Users, Add	Not available with this interface	Access > Local Users > Add User For information about different roles, see Managing .
Users, Remove	Not available with this interface	Access > Local Users > Actions > Remove User

- **Default settings**
The library is set to default settings when first purchased. Many of these settings can be customized.
- **Methods of cleaning drives**
Automatic cleaning of tape drives is disabled by default in the library. However, automatic cleaning of tape drives is recommended for this library. It is also possible to initiate manual or host cleaning methods.
- **Accessing cartridges**
Each magazine has a button that provides an easy way to open a magazine.
- **Configuring Library Managed Encryption**
Library-Managed Encryption (LME) is a built-in feature that is enabled by using a purchased license.

Default settings

The library is set to default settings when first purchased. Many of these settings can be customized.

Table 1. Default settings

Parameter	Default	Configuration Reset Default Settings
User Accounts		
Administrator login	User = administrator Management GUI Password = adm001	NOT reset
Local user accounts	Local Default Users = administrator Number of Custom User = 0	x
User Account Settings		
Password rules	Min. number of characters 8 Min. number of uppercase alphabetic characters 1 Min. number of lowercase alphabetic characters 1 Min. number of numeric characters 0 Min. number of special characters 2 Max. number of identical consecutive characters 3 Max. number of failed logins 90 Max. number of days before PW must be changed 3 Number of PW changes before it can be used again	x
Management GUI Restricted Login	Disabled	x
Allow I/O Station/Magazine access by monitor role	Disabled	x
Session Locking	Disabled	x
Remote Authentication (LDAP) Configuration	Disabled	NOT reset
Network configuration (eth0)		
Host name	Blank	NOT reset
IP address	(dhcp)	NOT reset
Subnet mask	(dhcp)	NOT reset
Default gateway	(dhcp)	NOT reset
Auto Negotiate	Enabled	NOT reset
Speed	Auto	NOT reset
IPv4	Enabled	NOT reset
DHCPv4	Enabled	NOT reset
IPv6		NOT reset
IPv6 Prefix	Enabled	NOT reset
Static v6	Disabled	NOT reset
IPv6 Method	Disabled	NOT reset
DHCPv6	Disabled	NOT reset
DNS1 and DNS2 Configuration for IPv4	(dhcp)	NOT reset
DNS1 and DNS2 Configuration for IPv6	Disabled	NOT reset
Network Access Services		
Primary Network Interface (eth0)	Enabled	NOT reset
Secondary Network Interface (eth1)	Disabled	NOT reset
HTTPS	Disabled	NOT reset
Self Signed SSL Certificate	No file	NOT reset
Internal IP (eth2)		
Internal network IP	IP Range defined with Operator Panel	NOT reset
I/O Station/Magazine		
I/O Station	Enabled	x
I/O Station/Magazines Allow Access by monitor role	Disabled	x
Logical Libraries	Disabled	All Logical libraries are deleted
NTP/SNTP Setting	Disabled	NOT reset
Date	Blank or existing	NOT reset
Time	Blank or existing	NOT reset
Time Zone	GMT	NOT reset
Sequential Mode	Disabled	x
Email Notifications (SMTP)	Disabled	x
SNMP		
SNMP v1, v2	Disabled	x
Licensed Features (need license key for enablement)		
Encryption	Disabled	NOT reset
Path Failover	Disabled	NOT reset
SCSI Defaults		
Product Name - Marketing Name	TS4300	x

Parameter	Default	Configuration Reset Default Settings
Library Product ID - INQUIRY Product ID String	3573-TL	x
Library Vendor ID - INQUIRY Vendor ID String	IBM	x
SCSI element addressing	Starting element addresses: Drives = 1 I/E Elements = 101 Storage Slots = 1001	x
Miscellaneous settings		
Barcode format returned to host	Align left	x
Barcode length returned to host	Eight leftmost characters	x
Language settings	English	NOT reset
Auto Clean	Disabled	x
Media Barcode Compatibility Check	Enabled	x
Empty Slot/Unlabeled Cartridge Detection	Enabled	x
Management GUI Timeout	30 minutes	x
Drive Defaults		
Drive speed and topology settings	Automatic/Automatic	x
Odometer	Enabled	NOT reset

Methods of cleaning drives

Automatic cleaning of tape drives is disabled by default in the library. However, automatic cleaning of tape drives is recommended for this library. It is also possible to initiate manual or host cleaning methods.

The head of every tape drive in the tape library must be kept clean to prevent errors that are caused by contamination. To help you keep the drives clean, IBM provides a cleaning cartridge with the library. The library uses the cleaning cartridge to clean the drive with whatever cleaning method that you choose. In all methods, cleaning is done after the data cartridge is unloaded from the drive and before the next load.

If you put the cleaning cartridge into a storage slot that is assigned to a logical library, it is visible to any hosts that are associated with that logical library. If you don't want the cleaning cartridge visible to any hosts, put it into a storage slot that is not assigned to any logical libraries.

It is the operator's responsibility to monitor cleaning cartridge usage and replace cleaning cartridges as necessary. This tape library provides multiple ways to monitor and manage cleaning cartridges. If SNMP traps are enabled, a trap is generated when a cleaning cartridge expires. It is also possible to use the Management GUI to monitor the cleaning cycles that remain on a cleaning cartridge.

Three methods of cleaning are available.

Automatic cleaning

Automatic cleaning enables the library to automatically respond to any tape drive's request for cleaning and to begin the cleaning process. The cleaning process is transparent to any host application that uses the library.

Select Auto Clean to enable the auto cleaning feature. When enabled, the library automatically initiates a cleaning operation when media is unloaded from a drive that requires cleaning instead of creating a warning event when a drive requires cleaning. For reliable operation, enable Auto Clean for each logical library and ensure that the library has a valid cleaning cartridge.

It is preferred to put the cleaning cartridge into a storage slot that is not assigned to a logical library. If you put the cleaning cartridge into a storage slot that is assigned to a logical library, it is visible to any hosts that are associated with that logical library. If you don't want the cleaning cartridge to be visible to any hosts, put it into a storage slot that is not assigned to any logical libraries.

When a cleaning operation is initiated, the library first attempts to use an unexpired cleaning cartridge from the same logical library as the tape drive. If the logical library does not contain an unexpired cleaning cartridge, the library attempts to use an unexpired cleaning cartridge from a storage slot that is not assigned to a logical library. The library does not use a cleaning cartridge from a different logical library. When auto cleaning is enabled, ensure that each logical library has an unexpired cleaning cartridge. Or, place at least one unexpired cleaning cartridge into a storage slot that is not assigned to a logical library.

After the initial configuration, Auto Clean can be turned on or off by accessing the Logical Library Wizard Expert Mode.

1. Go to Library > Logical Libraries > Actions > Manage Logical Library (Expert Mode).
2. Select the logical library, then click Edit.
3. Click Next to go to the General Settings screen.
4. Check or clear Auto Clean, then click Next on the subsequent screens.
5. If a change was made, click Finish and the Logical Libraries are reconfigured. If no changes were made, click Cancel.

Note: IBM recommends enabling the Auto Clean function on the library. With the Auto Clean function enabled, drive cleaning occurs automatically. The only time Auto Cleaning must be disabled is when your backup application requires that it has control.

Manual cleaning

Manual cleaning requires that you select a menu option from the Management GUI to clean one or more of the tape drives. Manual cleaning is always supported.

Host cleaning

Host cleaning enables the backup application to define and control the cleaning process. Automatic and manual cleaning use the CLNxxx VOLSER. It is mandatory to put the cleaning cartridge into a storage slot that is assigned to a logical library. The host needs to "recognize" that the cleaning cartridge is available for use.

Note: For tape cartridge information, see [Tape cartridges](#).

Accessing cartridges

Each magazine has a button that provides an easy way to open a magazine.

See [Front panel](#).

Each module can be configured to have a portion of the right magazine that is designated as an I/O station or this option can be disabled.

- To open the I/O station, press the magazine button for less than 3 seconds.
- To open the entire magazine, press the magazine button for more than 3 seconds.

Notes:

1. If a magazine is opened, no other magazines or I/O stations can be opened.
2. If during the magazine open process the magazine is not opened within 30 seconds, the magazine locks.
3. The user must pull out the magazine, as the magazine does not eject.

The LED also provides an indicator of the current state of that magazine.

Table 1. Magazine state

Magazine state	LED state	Description
Closed	Steady ON	I/O station is enabled.
Closed	Slow Flash	Magazine open is in process.
Closed	Fast Flash	Magazine is opened.
Closed	OFF	I/O station is not enabled.
Opened	OFF	Magazine is opened.

Configuring Library Managed Encryption

Library-Managed Encryption (LME) is a built-in feature that is enabled by using a purchased license.

The LME feature can be ordered from the factory, or you can order it as a field upgrade. To order a feature, contact your IBM® Sales Representative or Business Partner. See [Optional Features](#).

Attention: The TS4300 only supports Standard TLS (One-Way Authentication)
Two versions of Library-Managed Encryption are available for configuration.

- [Key Management Interoperability Protocol \(KMIP\) Encryption \(v1.2\)](#)
- [Security Key Lifecycle Manager \(SKLM\) for z/OS® Encryption](#)

Access the wizard from the Actions menu with the Manage Encryption option.

Notes: Before you run the Encryption wizard.

- Confirm that the Library-Managed Encryption license is activated on the Settings > Library > Licensed Features page.
- Verify that the server is available on the network and is configured for use with this library. For information on configuring servers for use with the library, see the server documentation.
Note: See [IBM Guardium Key Lifecycle Manager](#) for information on setup and configuration.
- If Library Encryption settings are cleared and reconfigured, you're required to accept the new certificate on the server when the Library Self-Signed Certificate is used.

Key Management Interoperability Protocol (KMIP) Encryption

1. In the Actions menu, click Manage KMIP Encryption to start the wizard.
2. The Logical Library Selection screen displays the KMIP configuration options that can be set as the default for all logical libraries, or on a per logical library basis. The second section provides the option to copy the KMIP configuration settings to all logical libraries (default) or to specified logical libraries.
3. The Wizard Information screen displays information about the wizard. On this screen, it's also possible to Reset Encryption Settings. If the library configuration is complete and the KMIP server is available on the network, click Next.
4. The Certificate Option screen displays the different certificate options that can be used to establish a secure communication to the KMIP server. You can select from the following options:
 - Library Self-Signed Certificate (default option) - A self-signed certificate that is generated by the library is used.
 - Uploaded Certificate - Upload a PKCS #12 file that includes a certificate and corresponding key.
 - Generate Certificate Request (CSR) - A CSR is generated by the library that must be signed by a CA server. This method requires a CA certificate that must be provided during the wizard steps.
 - Certification Configuration
 - Library Self-Signed Certificate – skip to the next step.
 - Uploaded Certificate
 - Upload the PKCS #12 file in the certificate area on the Certificate Option screen.
 - If this file requires a password, it must be provided in the Certificate Password input field. If no password, the field can be left empty.
 - After successfully upload of the certificate, click Next.
 - Generate Certificate Request (CSR)
 - The Certificate Authority Information screen displays prerequisites for using the KMIP certificate. When the prerequisites are met, click Next.

- The Certificate Authority Certificate Entry screen displays instructions for obtaining the CA certificate for the KMIP server. Follow the instructions to copy the CA certificate from the Management Console. Paste the CA certificate into the wizard and then click Next.
- The Library Certificate Information screen displays information about the next wizard steps. Click Next.
- The KMIP Client Configuration screen provides options for two types of server authentication.
 - If your KMIP server uses a client username and password for authentication, enter the username and password that were specified on the KMIP Management Console for the library.
 - If your KMIP server uses certificate validation for authentication, select Enable KMIP Certificate only authentication. Select this option if you use a KMIP server that doesn't support a client username and password. This default method is used when KMIP is used with the IBM Security Key Lifecycle Manager.
 - In the KMIP Server Configuration screen, enter the IP address or fully qualified hostname and port number for up to ten KMIP servers. Also, choose which key server type services the encryption keys. You can select from the following options:
 - IBM SKLM - IBM Security Lifecycle Manager 2.6.0 or higher KMIP server.
 - KMIP Compatible - Key server that is supporting the OASIS standard key management interoperability protocol (KMIP).
 - To verify access to the KMIP servers, click Connectivity Check.
 - Check at the KMIP server side that the server accepts the certificate of the library.
 - The Setup Summary screen displays the settings that are collected by the wizard. Verify that the settings are correct and that no errors are in the Done column.
 - If you need to modify any settings or fix any issues, either click Back to reach the applicable screen or Cancel to leave the wizard to fix the issues and return later.
 - If the settings are correct and no errors are reported, click Finish.

When the wizard finishes, the Library Managed Encryption (KMIP) encryption mode is selectable in the Logical Library Wizard (Expert Mode) on the Library > Logical Libraries page.

Security Key Lifecycle Manager (SKLM) for z/OS Encryption

1. Go to the Library menu. Then, go to Logical Libraries. Select Actions, then select Manage SKLM for z/OS Encryption.
2. Enter the IP address and the port of the SKLM z/OS server, then click Modify.
3. Go back to Actions and select Manage Logical Library (Expert Mode).
4. On the Expert Logical Library Wizard screen, click General Settings.
5. Next to Encryption Mode, choose Library Managed Encryption (SKLM for z/OS) (Licensed).
6. Click Next, and then click Finish Configuration.
7. A message appears when the Logical Library was successfully enabled for SKLM for z/OS.
8. Go to Settings > Security > Encryption. The Security Encryption Status and the Logical Library Encryption Status shows Library Managed Encryption (SKLM for z/OS) as Enabled.

Key Path Diagnostics

The Key Path Diagnostic test checks all communication paths to ensure that a key can be transmitted from the encryption key servers to the drive to properly encrypt and decrypt the tape cartridges.

The test consists of two parts. The first part, the drive test, verifies whether the communication between library and drive is working properly. This test is run only on the drives that are configured to library-managed encryption (LME).

The second part verifies the communication between the library and the encryption key servers. If the secondary ethernet port is enabled and configured, the tests are run on both ports separately.

The test consists of four subtests:

- Ping

This test checks if the key server can be reached. If ICMP requests are blocked on the server side, this test fails as well. Therefore, the following tests are run regardless the result of the ping test.
- SSL/TLS

This test tries to establish a SSL/TLS connection with the key server. If this test fails, the following tests are skipped because they would also fail. This test is skipped if SSL/TLS is not enabled.
- Key Server Login

This test is run only in combination with a KMIP encryption server since SKLM currently does not support login. If this test fails, the following Key Retrieval test is skipped because it would also fail.
- Key Retrieval

This test requests a key from the encryption server. For SKLM servers, a key from the key pool is requested. On other servers, the library acquires a specific diagnostic key.

Troubleshooting

Use the information in this section to troubleshoot any issues with your library setup and configuration.

Attention: This library is designed to operate when installed in a rack with the rack rail kit or on a tabletop. Operating the library without installing it correctly in the rails might cause errors. Placing any weight on top of the library might also cause errors. Expanded library configurations on tabletops are not supported.

- [READ and FOLLOW before replacing drives](#)
- [Understanding fault indicators](#)
When the library has a fault, there are messages and indicators that alert the user to the problem.
- [Locating faulty Components and Resolving Issues](#)
Library fault indicators often identify the part that has a problem.
- [Locate a failing component by using the Unit Identification \(UID\) LED](#)
UID (Unit Identification) LEDs are blue LEDs that assist users and service personnel to find a library or a library component in a large collection of IT equipment. UID LEDs are in 3 places:
- [Identifying a failed power supply](#)
- [Running library tests](#)
The library provides tests to verify library operations.
- [Library Element Numbering Details](#)
- [Troubleshooting Guide](#)
Refer to this table of symptoms or errors that might occur with the tape library and the installed tape drives.
- [Pre-call checklist](#)
If you have questions or problems with the library, complete these steps before a call to IBM technical support is placed.
- [Contacting IBM technical support](#)
Follow the procedures to contact IBM technical support.
- [Diagnostic information](#)
This section provides various diagnostic tools and information.

READ and FOLLOW before replacing drives

If you need to determine whether to replace a drive, first read [Overall concept](#). Afterward, follow the [Basic steps](#).

Overall concept

1. Determine if the drive will boot into a "good" state.
 - a. Stop the drive activity.
 - b. If a cartridge is in the drive, eject it.
 - c. Power cycle the drive.
 - d. Remove the drive and reinstall it.
 - e. Check for faulty cables or connections.
2. Determine if the drive is the problem or something else.
 - a. Clean the drive.
 - b. Retry the failing operation with another cartridge or another drive.
 - c. Check specific error codes to see if they point to the drive or something else.
 - d. Run a drive test to determine if the drive is good or bad.
 - e. If the drive is good, check for issues with other components in the system.

Basic steps

This procedure is for users who need detailed guidance on troubleshooting steps. It does not replace product documentation but is a focused fault-isolation guide.

A. Bring the drive to a known good state (Ready, Idle, and Empty)

1. Stop all host or library activity on the drive. Wait for the drive to be "ready and Idle".
 - Close down all applications or jobs. (Some processes may take 90 min. to stop).
 - The library or application interface should show the drive is ready and idle.
 - If visible, the drive Ready/Activity LED will be lit but not flashing.
2. If there is a cartridge in the drive, eject it. (Wait at least 10 minutes for this to complete).
 - Use the library or application interface or push the drive eject button.
 - When the cartridge is ejected, the drive should be ready, idle, and empty.
3. If the cartridge doesn't eject, or the drive will not come ready and Idle, power cycle the drive. Wait for the drive to be ready and idle (up to 90 minutes). If there is a cartridge, eject it.
 - Turn off power to the device or the drive, wait 15 seconds and then restore power.
 - The drive will go through its boot process.
 - If a cartridge is present, it will be rewound slowly, which could take up to 90 min.
 - After rewind, the drive should be ready and Idle with cartridge not ejected.
 - Eject the cartridge. After ejecting, the drive should be ready, idle, and empty.

Note: A drive reset may be used as an alternative to a power cycle, but if the drive is hung or the reset does not recover the drive, then a power cycle must be done anyway. To reset the drive, use the library or application interface. If the drive eject button is visible, the drive may be reset by holding down the reset button for 10 seconds.

4. If the drive is not showing an error code, but will not become ready and Idle, then remove it from the system, review the install procedures, and install it again.
5. Check all cables for damage or bad connections and make sure all connection LEDs are lit.

If the drive does not become ready, idle and empty, then replace the drive. Otherwise continue with the next section.

B. Determine if the problem is the drive hardware or something else

1. Clean the drive by loading a cleaner cartridge.
 - Check to see if the application or library indicates the drive needs cleaning.

- If the drive SCD is visible and shows a solid “C” code, the drive needs to be cleaned.
 - Cleaning the drive is always a good action before you decide to replace it.
2. Retry the operation with another cartridge or try the cartridge on another drive.
 - Track failing cartridges and replace them, if they are bad, instead of the drive.
 3. If there is a persistent error condition, check product documentation for the meaning of any code and correct the situation.
 - Take a drive dump and save product logs immediately after the error and determine the specific error code or save the information for service support to determine the issue.
 - The issue could be cooling, power, firmware, media, an encryption issue, a write protected cartridge, etc. Take corrective action for the specific error code before replacing the drive.
 4. If you suspect that drive is bad, run a drive test.
 - The preferred drive test is the IBM Tape Diagnostic Test Tool (ITDT) “Standard test”.
 - Be sure and use a known good cartridge for the drive test.
 - Alternatively, libraries and applications usually contain drive test functions.
 - If the drive front panel is available, the built-in tape drive diagnostics self-test #1 can be run.
- If the drive fails the test with a known good, cartridge replace the drive. Otherwise, continue with the next step.
5. If the tape operations fail, but the tape drive is good, the issue may be something else in the system.
 - Check setup and troubleshooting documentation for other components in the system: disk drives, adapter cards, switches, etc.
 - Check software set up, configuration and troubleshooting documentation.
 - Load the latest recommended firmware and device drivers for the tape drive and other components in the system.

If you are not able to fix the problem, call service support and have the drive logs available.

Understanding fault indicators

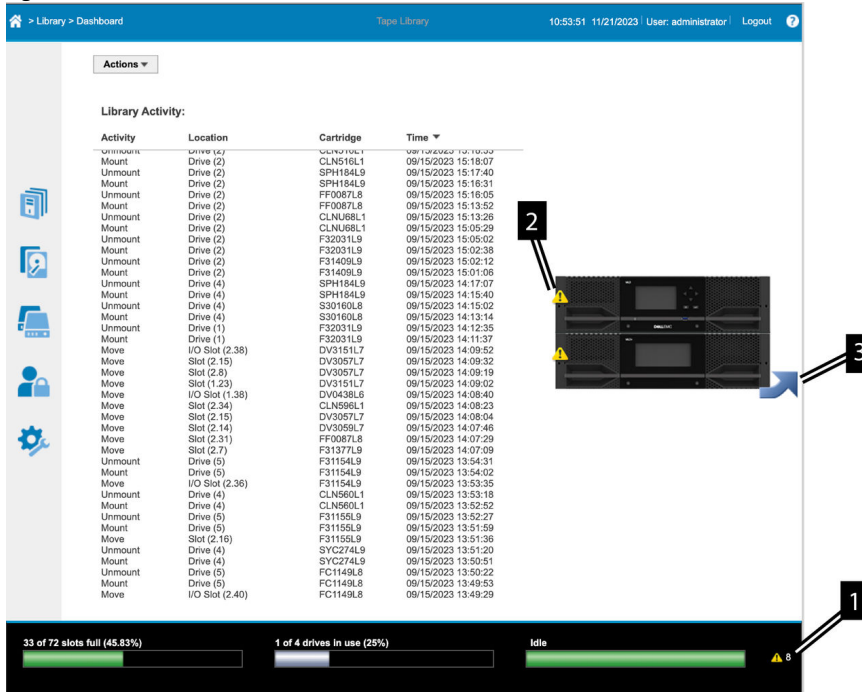
When the library has a fault, there are messages and indicators that alert the user to the problem.

The library base module has error and warning LEDs on the front panel (see Figure 56 and table 33). Many of the library components have status LEDs which are visible on the rear of the library. The Management GUI provides fault indicators.

The library also produces warning and error event codes. Error events are more serious than warning events and have greater impact on library function. The event codes help explain the fault, isolate the components that are involved, and provide information on how to resolve the issue.

Fault indicators in the management GUI can be found in the following places:

Figure 1. GUI screen



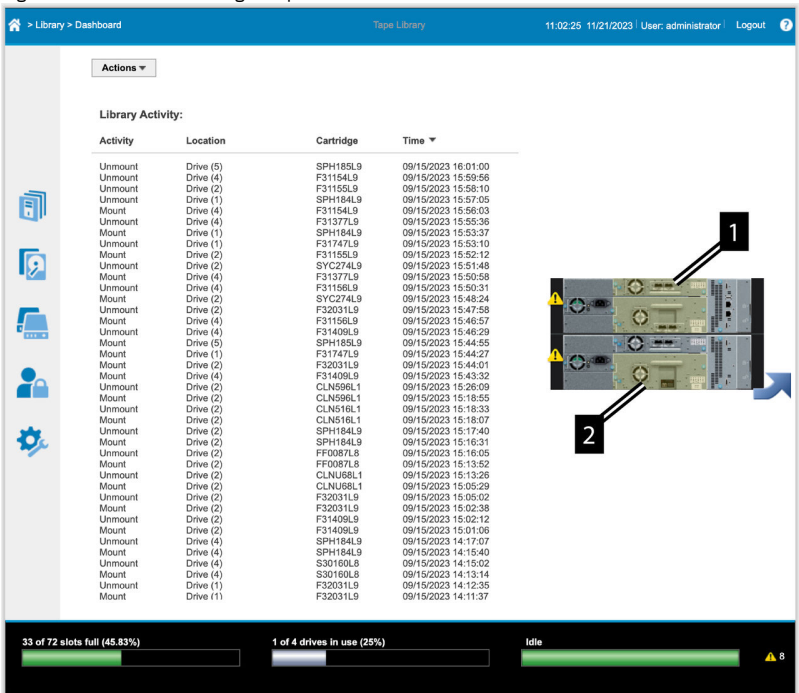
1. The lower-right status pod on the library GUI shows the library fault status. See 1 in [Figure 1](#)

The color of the status bar indicates if there is an error (red) or warning (yellow). Also, a red "X" (error) or a Yellow Triangle (warning) displays if there is a current fault. A numeral displays to indicate the number of current faults. Click the error or warning icon to see the issues, get the component number at fault, and resolve the problem. The status bar will be green and there will be no warning or error icons when the library is functioning normally.

2. The graphic display of the library on the right half of the GUI library dashboard displays a warning or error icon on a component that has an issue. See 2 in [Figure 1](#)
If a module shows a fault on the front, click the arrow on the library graphic. See 3 in [Figure 1](#). The library graphic will rotate and show the rear panels, so that you can determine which component has the fault.

Referring to [Figure 2](#), notice that the drives (See 1, and 2) are highlighted in yellow. Place the cursor over the highlighted drives, a pop-up appears to describe the issue.

Figure 2. GUI screen showing rear panels



3. Error and Warning Events are listed in the library section of the GUI (Library > Events)
4. Errors and Warnings can also be viewed in the library logs. These logs can be exported that use the action menu in the GUI library dashboard.
5. Errors and Warnings are found in various GUI Component menus. See the User's Guide and Library Help pages for more details.

When the library generates an attention event or an error event, support staff can be notified immediately by setting up email event notification or SNMP trap notification. The type of event that generates email notification or SNMP trap notification can be selected to limit the number of events to a specific priority level.

Locating faulty Components and Resolving Issues

Library fault indicators often identify the part that has a problem.

Use the graphical image or component ID to identify the faulty part. Warning and error events in the Management GUI have a troubleshooting button at the bottom of the screen that provides a solution suggestion to resolve the issue. Warning and error events in the library logs have a section to describe the suggested solution. See [Figure 1](#) and [Figure 2](#).

Figure 1. Component Identification and troubleshooting help in a Management GUI Warning Event

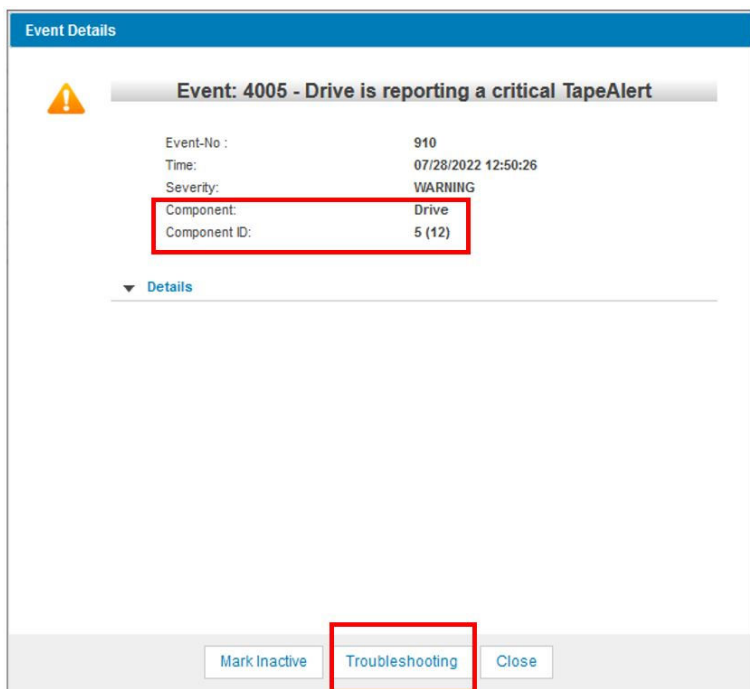


Figure 2. Component Identification and Solution Suggestion in the library logs

```

|----- Event 2022 - Drive has been hot removed while in active status as control path drive -----
Ticket-No:      64
Time:           02/26/2018 04:45:30 PM
State:          Pending
Closed:         No
Severity:       CRITICAL
Component:      DRIVE
Component-Id:   18
Solution Suggestion: Reinsert the removed drive at the same position as it was removed

```

Note: Many Library Faults produce an event code, but there are also many that will not. The troubleshooting guide helps resolve issues for various types of problems, whether they have an event code or not.

Locate a failing component by using the Unit Identification (UID) LED

UID (Unit Identification) LEDs are blue LEDs that assist users and service personnel to find a library or a library component in a large collection of IT equipment. UID LEDs are in 3 places:

1. On each library base module front panel. See [Table 1](#).

Table 1. Front panel LEDs

LEDs	Color	Descriptions
Ready	Green	Steady when power is on, flashing with tape Ready drive or library robotic activity.
Unit Identification (UID)	Blue when activated	The UID LEDs are controlled by the user through the Library>Actions>Turn Identifier Light On or Off GUI function. The UIDs on the Operator Panel and base module back panel are activated and deactivated together. In addition, UIDs on drives and expansion module back panels can be activated separately. The UIDs are helpful for locating components of the library in a data center.
Clean	Amber	On, when a tape drive-cleaning operation is recommended.
Attention	Amber	Flashing if the library detected a condition for which user attention is necessary, but the library can still complete most operations.
Error	Amber	On, if an unrecoverable tape drive or library error occurs. A corresponding error message is displayed on the LCD screen. User intervention is required as the library is not capable of completing some operations.

2. On the back of each module (base and expansion), on the module controller See [Figure 1](#) and [Table 2](#).

Figure 1. Rear panel

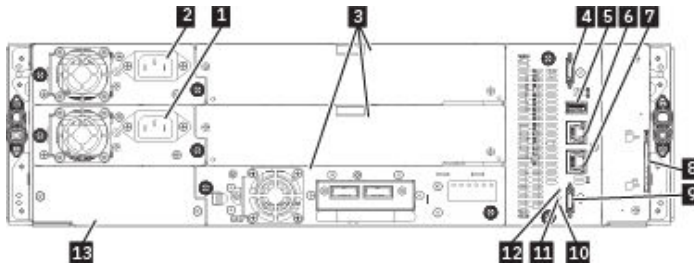


Table 2. Rear panel descriptions

Number	Item	Comments
1	Power supply 1	Standard on Base Module Optional on Expansion Module (required if drives are present)
2	Power supply 2	Optional on Base Module and Expansion Modules
3	Tape drive bays	Full high drives take up 2 bays and can only be installed in the lower two drive bays.
4	Upper Expansion Module connection port	
5	USB port	Base Module only
6	Ethernet port B	Base Module only (secondary port for service usage)
7	Ethernet port A	Base Module only
8	Module alignment mechanism	
9	Lower Expansion Module connection port	
10	Unit Identifier LED, Blue	
11	Controller Error LED, Yellow	
12	Controller Health Status LED, Green	
13	Product Serial Number, Tag location	

3. On the back of each tape drive. See [Figure 2](#) and [Table 3](#).

Figure 2. Drive sled indicators

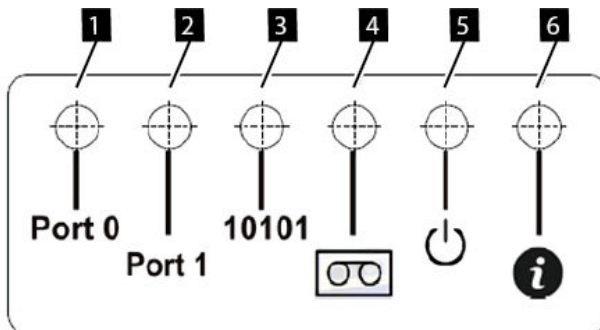


Table 3. Drive sled indicators

Number	Description
1	Port 0 activity
2	Port 1 activity
3	Library communication
4	Cartridge present
5	Power
6	Beacon /UID

Note: The Library Front Panel UID and the base module LCC UID are linked. They turn on and off together.

The Front Panel UID helps a user find the library in the front of a rack. The UID on the controllers and Drives in the rear of the library help identify a component within a library. When a component experiences an error, a user with superuser, service, or administer privileges can turn on the UID for that component. The UID helps to physically locate the components in a complex assortment of IT equipment. UID menus are in the actions button at the top of the library dashboard. See the help pages for instructions on turning on and off the Unit Identifier LEDs.

Identifying a failed power supply

When a power supply is in a fault condition, error messages identify which module has the faulty supply.

The library graphic on the GUI Library Dashboard shows which module has the faulty supply. Power Supplies do not have a UID, but the UID for the module with the failing power supply can be turned on to identify the location of the failing supply. If a module has a single power supply, that it needs to be replaced.

The lights on the back of the power supply indicate which one is in a fault condition. The White LED and Green LED are lit, when the power supply is operating normal. The White LED indicates that the AC power cord is plugged in and the power supply is getting AC power. The green LED indicates that the power supply is producing DC power.

If two redundant power supplies are installed in a module, the library cannot determine which supply has the fault. In this case, the lights on the power supplies must be used to determine which one has the fault.

If the White LED is off, make sure that the power supplies are inserted properly and double check AC power source and power cords. Replace the power supply if the White light does not come on when the power cord is plugged in.

When the White LED is on and the library is powered on, the Green LED should also be on. If it does not, replace the power supply.

Running library tests

The library provides tests to verify library operations.

- On the Management GUI, go to Library > Actions > Tests and choose the library test that you want to run.
 - Library Verify
 - Demo Mode
 - Drive Test
 - Slot to Slot ExerciserA description of these tests can be found in the Library Help pages ("?" icon in the top right corner of the GUI).
- On the Operator Panel, go to Maintenance > Library Tests to run tests from the Operator Panel.
 - Demo Mode
 - Drive Diagnostics

Library Element Numbering Details

Library Element Numbering

Element numbering provides a unique identifier for important library elements like modules, cartridge slots, and drives. These numbers are used in library interfaces and software to locate a particular library element. Some library elements are components that can be replaced like drives and modules. Some elements are not individual components, like slot locations for cartridges.

The following library elements are numbered:

- Modules (base and expansion)
- Cartridge Slots (storage and I/O)
- Drives

Library controller cards and power supplies are not numbered separately. Their identifier is the module number in which they are located. Some modules might contain two power supplies, an upper one and a lower one. The firmware does not provide any identification to differentiate between an upper and lower power supply.

3 different numbering systems are used to identify elements in the library:

1. **Logical Numbering** - Referred to as "Logical ID" and abbreviated as "Log ID" or just "ID". This numbering system is the simplest and most commonly used system for identifying library elements in logs and library interfaces. Elements are numbered from the bottom up in sequential fashion, as they appear in the configured library. Numbering starts with 1, not zero.
2. **Physical Numbering** - Abbreviated as "Phy Num" or "PNUM". PNUMs are also assigned from the bottom up, starting with 1. Unlike Logical numbering, they are based on an element's position in a maximum library configuration (one that has the maximum number of modules and drives installed). Elements in the base module have default PNUMs. Elements above the base module have higher PNUMs. Elements below the base module have lower PNUMs. Since 21U libraries and 48U libraries have different maximum configurations, their PNUMs are different.
Note: PNUMs are for software internal use only. They are used in applications where each element needs a stable identification that does not change when components or modules are added to or taken out of the library. They are often listed with the Log ID as a diagnostic aid in library logs or interfaces
3. **SCSI Element Addressing** - Referred to as "Element Addresses". Element addresses are a standard numbering system that is defined in SCSI specifications that help software applications identify elements in the tape library. Element Addresses are derived from PNUM but are altered as defined by SCSI specifications. SCSI element addresses are assigned to tape drives, storage slots, and input/output (IO) mailbox slots.
Starting element addresses are defined as follows for these 3 elements:
 - Drive element addresses start at 1 with the bottom drive that is installed in the library
 - Mail slot element addresses start at 101 with the bottom mail slot in the library
 - Cartridge Slot element addresses start with 1001 at the bottom slot in the library

When a library is partitioned, each logical library is assigned drives, slots, and mail slots. Each element in the logical library is numbered beginning with the starting addresses that are shown earlier. PNUMs do not change when a library is partitioned, but SCSI Element addresses do.

Module Numbering

Modules have Logical IDs and Physical Numbers. They do not have SCSI Element addresses.

Module Logical ID

Module IDs are assigned during configuration in the library start-up process. Only modules that are connected in the stack are counted. Modules are numbered from bottom to top starting with '1'. Each module ID (including the base module) depends only on the position in the stack. In a 5-module library stack, for example, the bottom module ID is 1 and the top ID is 5. If a module is defective or was removed for repair, the numbering of the modules does not change until the library is started again. When the library is started again, it goes through a configuration process that includes renumbering of modules.

Module Physical Number (PNUM)

Each base and expansion module also has a physical number. The physical number is based on the position of the module relative to the base module. In a 21U Library, the base always has a PNUM of 4. In a 48U library, the base always has a PNUM of 9. Expansion modules above the base module have higher PNUMs. Expansion modules below the base module have lower PNUMs.

Magazine and Cartridge Slot Numbering

Slot numbering uses all 3 numbering systems to identify slots inside the library: Logical ID, Physical Number, and SCSI Element address.

Cartridge Slot Logical ID

The slot ID has the following format:

Module	dot	Slot
Logical Number of the module (base module or expansion module) from bottom to top.		Logical Number of slot in unit rising from front left to front right magazine and from bottom to top in each magazine.
Range 1 – 16		Range 1 - 40

For example, ID 2.7 is Module 2, slot 7

The slot Logical ID designation is not dependent on mail slot configuration. Slot IDs are not renumbered if mail slots are enabled or disabled

Cartridge Slot Physical Number (PNUM)

Slot Physical Numbers are sequential numbers that are assigned relative to a full library stack. They start at 1 with the first possible slot at the bottom of a full library stack. They end with the last possible slot at the top of a full library stack. Default slot PNUMs in the base modules are different in a 21U versus a 48U Library. The PNUM of the first slot in a 48U base module is 321. The PNUM of the first slot in a 21U Library base module is 121. Slots in expansion modules above the base module have higher PNUMs. Slots in expansion modules below the base have lower PNUMs.

Cartridge Slot SCSI element address

SCSI element addresses are separately assigned to mail slots (import export elements) and storage slots (storage elements) for each library partition. SCSI initiators can change SCSI element addresses by using the element assignment mode page. SCSI element addresses are counted in the same order as the Slot PNUM. Slot PNUM and element addresses might not be contiguous if mail slots are enabled in the middle of a partition.

Drive Numbering

Drive numbering uses all 3 numbering systems to identify drives inside the library: Logical ID, Physical Number, and SCSI Element address.

Drive Logical ID

Drives are numbered from bottom to top, starting with 1. Only drives, which are present in the stack are counted. Adding or removing drives can result in a change of drive logical numbers. See the section on drive renumbering for details.

Drive Physical Number (PNUM)

Drive PNUMs start with the lowest drive bay (drive sled connector) in a full module stack. The numbering proceeds upward to the highest drive bay. Installed drives have the PNUM of the drive bay in which they are installed. Full High tape drives take up two bays but they are numbered by using the lower bay where they plug into the library. The PNUM of the upper bay behind a full high drive is never assigned to a drive. Since 21U and 48U Libraries have different full module stack heights, the PNUMs are assigned differently. The lowest drive bay of the base module in a 48U library has PNUM 25. The lowest drive bay of the base module in a 21U library has PNUM 10. Drives above the base module are numbered higher. Drives below the base module are numbered lower. Assignment of WWI's and serial number spoofing is based on the physical drive number.

Drive SCSI element address

SCSI element addresses are separately assigned for each library partition. SCSI initiators can change element addresses by using the element assignment mode page. SCSI element addresses are numbered in the same order as the Drive IDs. Gaps are not allowed in SCSI element addresses.

Drive renumbering considerations:

When drives in the library are changed, the renumbering of the drives may not be immediate or automatic. Some drive numbers can remain in the library configuration after they are removed. Persistence of a drive number after removal is done to maintain connectivity with software that is configured to the drives. It is expected that the original drive or a new drive might be inserted again. The renumbering of drives during drive addition or removal is described in the following sections.

Drive numbering during drive addition:

- Logical and Physical Numbering is updated automatically when the drive is inserted, and cartridges can be loaded or unloaded from the added drives.
- SCSI Element addressing does not change until a partitioning wizard is run to move the added drive into a partition.

Drive numbering during drive removal:

When a drive is physically removed, the drive remains in the library configuration, but the drive is described as "removed" and is not accessible to the host. The removed drive maintains the same Logical Numbering, Physical Numbering, and SCSI element addressing in the library configuration until:

1. Another drive is inserted in the same position as the removed drive.
2. A partitioning wizard is used to remove the drive from its current partition.
3. The "Reset the List of Known Drives and Modules" (Settings > Library > Advanced) function is used. Resetting the "list of known drives and modules" causes the library to rediscover only the drives and modules that are physically present. This operation alters the list of SCSI element addresses reported to hosts and renumbers the drives and modules. This operation cannot be undone. After the operation completes, use one of the logical library wizards to modify logical libraries as needed.

NOTES:

- If a removed drive is reinstalled, the library removes indicators that it is removed and sets the access bit so the host can use it again.
- The library reports a removed drive to the SCSI host if it is still in the library configuration, but the access bit is not set.
- Power down or reset does not change drive configuration, but factory reset changes it through the partitioning wizard that runs when it starts up again.

The following chart shows the Logical IDs, PNUMs, and Element Addresses for a full 48U library.

Modules	Drives		Left Slots		Right Slots
Log ID (PNUM)	Log ID (PNUM)	[Elem Addr]	Log ID (PNUM)	[Elem Addr]	Log ID (PNUM) [Elem Addr]
Expansion: 16 (16)	HH	48 (48) [48]	16.1-16.20 (601-620) [1601-1620]	16.21-16.40 (621-640) [1621-1640]	
	HH	47 (47) [47]			
	HH	46 (46) [46]			
Expansion: 15 (15)	HH	45 (45) [45]	15.1-15.20 (561-580) [1561-1580]	15.21-15.40 (581-600) [1581-1600]	
	HH	44 (44) [44]			
	HH	43 (43) [43]			
Expansion: 14 (14)	HH	42 (42) [42]	14.1-14.20 (521-540) [1521-1540]	14.21-14.40 (541-560) [1541-1560]	
	HH	41 (41) [41]			
	HH	40 (40) [40]			
Expansion: 13 (13)	HH	39 (39) [39]	13.1-13.20 (481-500) [1481-1500]	13.21-13.40 (501-520) [1501-1520]	
	HH	38 (38) [38]			
	HH	37 (37) [37]			
Expansion: 12 (12)	HH	36 (36) [36]	12.1-12.20 (441-460) [1441-1460]	12.21-12.40 (461-480) [1461-1480]	
	HH	35 (35) [35]			
	HH	34 (34) [34]			
Expansion: 11 (11)	HH	33 (33) [33]	11.1-11.20 (401-420) [1401-1420]	11.21-11.40 (421-440) [1421-1440]	
	HH	32 (32) [32]			
	HH	31 (31) [31]			
Expansion: 10 (10)	HH	30 (30) [30]	10.1-10.20 (361-380) [1361-1380]	10.21-10.40 (381-400) [1381-1400]	
	HH	29 (29) [29]			
	HH	28 (28) [28]			
Base: 9 (9)	HH	27 (27) [27]	9.1-9.20 (321-340) [1321-1340]	9.21-9.40 (341-360) [1341-1360]	
	HH	26 (26) [26]			
	HH	25 (25) [25]			
Expansion: 8 (8)	HH	24 (24) [24]	8.1-8.20 (281-300) [1281-1300]	8.21-8.40 (301-320) [1301-1320]	
	HH	23 (23) [23]			
	HH	22 (22) [22]			
Expansion: 7 (7)	HH	21 (21) [21]	7.1-7.20 (241-260) [1241-1260]	7.21-7.40 (261-280) [1261-1280]	
	HH	20 (20) [20]			
	HH	19 (19) [19]			
Expansion: 6 (6)	HH	18 (18) [18]	6.1-6.20 (201-220) [1201-1220]	6.21-6.40 (221-240) [1221-1240]	
	HH	17 (17) [17]			
	HH	16 (16) [16]			
Expansion: 5 (5)	HH	15 (15) [15]	5.1-5.20 (161-180) [1161-1180]	5.21-5.40 (181-200) [1181-1200]	
	HH	14 (14) [14]			
	HH	13 (13) [13]			
Expansion: 4 (4)	HH	12 (12) [12]	4.1-4.20 (121-140) [1121-1140]	4.21-4.40 (141-160) [1141-1160]	
	HH	11 (11) [11]			
	HH	10 (10) [10]			
Expansion: 3 (3)	HH	9 (9) [9]	3.1-3.20 (81-100) [1081-1100]	3.21-3.40 (101-120) [1101-1120]	
	HH	8 (8) [8]			
	HH	7 (7) [7]			
Expansion: 2 (2)	HH	6 (6) [6]	2.1-2.20 (41-60) [1041-1060]	2.21-2.40 (61-80) [1061-1080]	
	HH	5 (5) [5]			
	HH	4 (4) [4]			
Expansion: 1 (1)	HH	3 (3) [3]	1.1-1.20 (1-20) [1001-1020]	1.21-1.40 (21-40) [1021-1040]	
	HH	2 (2) [2]			
	HH	1 (1) [1]			

The following chart shows the Logical IDs, PNUMs, and Element Addresses for a partial 21U Library. It has a mix of full high and half high drives and is partitioned into two logical libraries.

Modules	Drives		Left Slots	Right Slots	
Log ID (PNUM)	Log ID (PNUM)	[Elem Addr]	Log ID (PNUM) [Elem Addr]	Log ID (PNUM) [Elem Addr]	
Expansion: 4 (5)	HH	6 (14) [3]	4.1-4.20 (161-180 [1041-1060]	4.21-4.40 (181-200) [1061-1080]	Library Partition 1
Base: 3 (4)	HH	5 (12) [2]	3.1-31.20 (121-140) [1001-1020]	3.21-3.40 (141-160) [1021-1040]	
	FH				
		4 (10) [1]			
Expansion: 2 (3)	HH	3 (9) [3]	2.1-2.20 (81-100) [1041-1060]	2.21-2.40 (101-120) [1061-1080]	Library Parttion 2
Expansion: 1 (2)	HH	2 (6) [2]	1.1-1.20 (41-60) [1001-1020]	1.21-1.40 (61-80) [1021-1040]	
	FH				
		1 (4) [1]			

Troubleshooting Guide

Refer to this table of symptoms or errors that might occur with the tape library and the installed tape drives.

About this task

The table provides actions to correct the problems. If replacement parts are needed, go to [Replacement parts](#). See [Contacting IBM technical support](#).

Table 1. Resolving errors

Problem	Solution
Event code/Attention information on Management GUI or Library	
Event code that is shown on Event Ticket on the Management GUI.	- Look up the error code. See Event Codes. - Try to resolve the failure. - If necessary, power cycle the library.
Failure/Attention Indication on Operator Panel display.	Review tickets on the Check Event Ticket Log on Management GUI.
Attention LED is lit on the front or the rear of the Base Module.	Review tickets on the Check Event Ticket Log on Management GUI.
Failure/Attention Indication on Management GUI Library Dashboard	Tap the icon to see information about the event.
Attention LED and Cleaning LED are lit.	This problem is likely caused by a drive that requires cleaning. Check Event Ticket Log on Management GUI.
Single Character Display (SCD) is shown on drive.	- Review tickets on the Check Event Ticket Log on Management GUI. - Use SCD. See Drive Single Character Display.
The Attention LED is lit but the Cleaning LED isn't lit after a cartridge load.	The library was unable to complete the requested operation with the selected tape cartridge. - Use cartridges that are compatible with the drive type. - Use the correct type of cartridges for the operation. For example, use a cleaning cartridge for cleaning. - Make sure that you're using a Universal cleaning cartridge.
The Cleaning LED is lit after a cleaning cartridge was used.	The cleaning cartridge is expired. (A cleaning cartridge expires after 50 cleaning cycles). Replace the cleaning cartridge.
A particular cartridge sets off the Attention LED and possibly the Cleaning LED.	Retry the operation with a different cartridge. If the Attention LED is cleared, and then immediately redisplay each time that a particular cartridge is reloaded, that cartridge must be suspected as defective. - Export the cartridge and load a known good cartridge. In some cases, a cartridge can be worn out, the memory is defective, or was formatted as a Firmware Upgrade cartridge. - Any cartridge that is suspected of being defective or contaminated must NOT be reused in any drive. - If the bad cartridge is a cleaning cartridge, it might be expired.

Problem	Solution
The Library displays some of the following behaviors: - GUI Library Dashboard Displays 2 base Units. - Library boot hangs on "Configuring Drives (Unconfigured Offline) - Library Status Pod shows: "Connection lost to module" (Unconfigured Offline) - Event 2004 – Library startup process failed - Pop-up message: "Unconfigured module found" - Event 4163 Drive Sled discovery timeout	Check to see if a 21U Library Controller Card (LCC) has been put into a 48U Library Resolution: - Power down the system and replace the 21U LCC with a 48U LCC CRU. - When the system powers up, some drives may not come ready. If this happens, power down the system, unplug all power cords attached to the library, plug back all the power cords and power the library back up again. The drives should come ready.
"Configuration backup file invalid" pop-up message displays when a configuration is restored.	Check to make sure that the configuration file you are restoring is a valid saved configuration file. Note: You cannot restore a 21U Library configuration file to a 48U Library. You cannot restore a 48U Library configuration file to a 21U Library.
Event Notification on Host, SNMP, or Email	
Host receives error message.	- Use ITDT. See IBM Tape Diagnostic tool (ITDT). - Use Sense Data. See Sense data.
SNMP Monitoring system receives trap.	Check Event Ticket Log on Management GUI.
Event is received by email notification.	Check Event Ticket Log on Management GUI.
Cartridge Movement Problems	
Cartridge failing to load and unload properly	Note: - The tape drive must rewind the tape before it is ejected. The amount of time for this procedure can vary, depending on how the tape was used. See Tape drives. - The tape drive performs Media optimization on the first load of a cartridge. The amount of time for this procedure can vary. See Tape drives. Follow these instructions for removing tape from the tape drive: - Stop all host activity. - Check drive status by using any of the following methods: SCD display ITDT - Indicator lights on a library if the drive is installed in a library - If the drive is in the middle of performing an operation, wait until the drive is idle before attempting any further steps. - Attempt to unload the cartridge. - Power down the drive. - Disconnect the host cable from the drive. - Power on the drive, and wait until the tape drive is idle or ready. - Attempt to unload the cartridge. Follow these steps to inspect a cartridge for damage: - Check that the leader pin is attached and properly seated by opening the cartridge door and observing the pin's placement. See Repositioning a leader pin. - Inspect the cartridge case, the cartridge door, and the write-protect switch for damage. - Inspect the rear of the cartridge (the part that you load first into the tape load compartment) and ensure that there are no gaps in the seam of the cartridge case. See 1 in Figure 1 and 4 in Figure 2. If there are gaps, the leader pin might be dislodged. Go to Repositioning or reattaching a leader pin. - Try loading or unloading another tape cartridge. - If it fails, contact your service representative for more problem determination. - If it is successful, discard the cartridge that originally failed. Notes: - If a damaged or mishandled cartridge is the problem, see Handling the cartridges for instructions about handling the media. It is possible that your other cartridges might also be damaged. - If your cartridge does not eject properly, contact your service representative.

Problem	Solution
Tape is stuck in drive.	Try the following steps, in this order, to remove the stuck tape. Note: The tape drive must rewind the tape before it's ejected. This procedure can take up to ten minutes or more, depending on how much tape must be rewound. When the tape is rewound, the eject cycle takes fewer than 16 seconds. The Ready light flashes while the tape rewinds. Wait for the tape to finish rewinding before another operation is attempted. 1. Stop all Host Activity. 2. Attempt to unload or move the cartridge to a slot. 3. Power down the library, disconnect the cable from the drive, power on the library, and wait until the tape drive is idle or ready. Attempt to Move Cartridge to Slot. 4. Attempt a Eject Cartridge from Drive as an emergency unload operation. Important: Inspect the tape cartridge that was stuck. Damage or misplaced labels on the cartridge might cause the load/unload failure. Discard any tape cartridge that is found to have issues.
Cartridge can't be removed from storage slot.	1. Unlock the magazine and extend it to access the storage slot. 2. Grasp the cartridge and remove it from the storage slot. Some tapes need to be inserted and removed several times to condition them for free movement in and out of the magazine. 3. Check the bar code label and verify that it's secure to the cartridge. 4. Check the cartridge for damage.
Other Library Problems	
Device doesn't power on.	• Check all power cord connections. • Check the LEDs on the power supplies. • Make sure that Power on the front panel was pressed, and the green Ready LED is lit. • Make sure that the outlet has power. Try another working outlet. • Replace the power cord.
Device doesn't power off	• Press the power button and hold for 5 seconds • Check if the green LEDs on the power supplies are off. If not, press and hold Power button for 10 seconds • If that does not work, disconnect AC power cable on the base unit.
No message appears on the Operator Panel display.	• Check all power cord connections. • Check the LEDs on the power supplies. • Make sure that Power on the front panel was pressed, and the green Ready LED is lit. • Make sure that the outlet has power. Try another working outlet.
Can't load the cleaning cartridge.	• Make sure that you're using an LTO cleaning cartridge. • Make sure that the cleaning cartridge isn't expired. A cleaning cartridge expires after 50 cleaning cycles.
User account locked.	From the Configuration > User Accounts > Access Recovery page, you can receive a temporary administrator password for login to the Management GUI that is valid for two hours.
Tape Drive or Media Problems	
Can't write to or read from tape.	• Make sure that the cartridge isn't a WORM cartridge that was already used. • Make sure that the cartridge is write enabled (move the write-protect switch to the enabled position). • Make sure that the data cartridge is compatible with the drive model. See Tape cartridges. • Make sure that you're using an LTO cartridge that isn't degaussed. CAUTION: Don't degauss LTO cartridges! • Make sure that the cartridge wasn't exposed to harsh environmental or electrical conditions and isn't physically damaged in any way. • Many backup applications don't read or write to cartridges that were created with a different backup application. In this case, you might need to run an erase, format, or label operation on the cartridge. • Make sure that you understand any data protection or overwrite protection schemes that your backup application might be using, which might prevent you from writing to a specific cartridge. • Retry the operation with a different, known good tape. • Clean the tape drive.
A cartridge that is recently imported from a different environment is causing issues.	Media that is moved from one environment to another can cause issues until it acclimates to the new conditions. A cartridge must be acclimated for at least 24 hours before it's used, particularly if it was stored at a substantially different temperature or level of humidity than the device.
The library displays incorrect bar codes.	• Verify that the label is properly applied. • Verify that the label isn't soiled.
Cleaning or data cartridge incompatible with drive.	• Check the event log to see which cartridge is incompatible. • Make sure that you're using data and cleaning cartridges that are compatible with the drive and model of your device. • Make sure that you're using the correct cartridge type for the operation. The device automatically unloads incompatible cartridges, and the Attention LED flashes. • Export the media.
Connection Problems	

Problem	Solution
Fibre Channel connection problems	Check Drive Status screen to check the link connection for your tape drive. - For each available port, run a drive Wrap Test. - Unplug the Fibre Channel cable, then plug in the Fibre Channel wrap tool. - Go to Library > Actions > Tests > Drive test and run the Fibre Channel wrap test. - If the drive test fails, follow the Pre-call checklist. - If the FC Wrap Test passes, continue with the next steps. - Check that the Fibre Channel speed is set to either match the HBA/switch speed or set to Automatic - Verify that cables aren't damaged. - Verify that cables are securely connected on both ends. - Verify Host Connectivity. - Use ITDT to debug the problem.
SAS connection problems	Check Drive Status screen to check the connection for your tape drive. - For each available port, run a drive Wrap Test. - Unplug the SAS cable, then plug in the SAS wrap tool. - Go to Library > Actions > Tests > Drive test and run the SAS wrap test. - If the drive test fails, follow the Pre-call checklist. - If the SAS Wrap Test passes, continue with the next steps. - Verify that cables aren't damaged. - Verify that cables are securely connected on both ends. - Verify Host Connectivity. - Use ITDT to debug the problem.
Can't connect to the Management GUI.	- Verify that the Ethernet cable is connected to the Base Module's controller card and to the LAN. - Verify that the link LED on the RJ45 (LAN) connector is lit when the device is turned on. If the LED isn't lit, the device isn't communicating with the LAN. See your network administrator for help. - Verify that the device is configured with a valid static network address or DHCP is enabled so the device can obtain a network address. If DHCP is used, write down the device's network address from the Operator Panel login screen. If a valid DHCP address isn't available, the library isn't communicating with the DHCP server. See your network administrator for help. - Enter the library's IP address into the address bar of a web browser that is connected to the same LAN as the device. If the Management GUI page doesn't display, ping the device's IP address. If the ping fails, check that no firewalls or other obstructions to network traffic exist between the computer with the web browser and the device. See your network administrator for help.
Can't connect to Key Management Server for LME.	- Run the Encryption Connectivity Check or Key Path Diagnostics and review the results message. See Locating Management functions. - Validate that the server configuration properties file includes support for TLS 1.2. See the encryption server documentation. - If SKLM v2.7 or higher is used and you're using the Library Self-Signed Certificate. For one time only, you might need to reset your encryption settings to clear out old versions of the self-signed certificate, reconfigure encryption, then accept the new self-signed certificate on the encryption server. See Configuring Library Managed Encryption. - Check that your certificate algorithm is supported by your version of the server.
Host application reporting SCSI timeout	Note: - The tape drive must rewind the tape before it is ejected. The amount of time for this procedure can vary, depending on how the tape was used. See Tape drives. - The tape drive performs media optimization on the first load of a cartridge. The amount of time for this procedure can vary. See Tape drives. The procedure for SCSI timeouts varies depending on whether timeout is consistent or intermittent, and on your drive configuration. Follow these steps to troubleshoot a SCSI timeout: - Stop all Host Activity. - Check drive status by using any of the following methods: SCD display ITDT - Indicator lights on a library if the drive is installed in a library - If the drive is in the middle of performing an operation, wait until the drive is idle before attempting any further steps. - Validate that the drive has the latest firmware. - Check with software application provider for any updates. - Check whether the tape drive power is on. - Power down the drive. - Verify that the SAS or FC cable is connected properly to the server and to the tape drive. - Replace SAS or FC cable if it shows any signs of damage. - Power on the drive and wait until the tape drive is idle or ready.

Pre-call checklist

If you have questions or problems with the library, complete these steps before a call to IBM technical support is placed.

1. If you suspect the tape drive needs to be replaced, first go to the section called [READ and FOLLOW before replacing drives](#)
 2. Verify that you exhausted all troubleshooting options. See [Troubleshooting Guide](#).
 3. Collect library logs. See [Locating Management functions](#).
 4. Verify that the library and drive firmware is at the most recent level. See [Locating Management functions](#).
 5. Verify that your device drivers are at the most recent level.
 - For the current release of IBM® device drivers, see <http://www.ibm.com/support/fixcentral>.
 - For the current release of device drivers by independent software vendors (ISVs), go to the appropriate third-party website.
 6. Verify whether your hardware and software configuration is supported.
 7. Check the hardware and connections:
 - Ensure that the host interface cable connector does not contain bent or recessed pins.
 - Ensure that all retention screws for the host interface cable and terminator are securely tightened.
 - Verify the host connection. See [Verifying the host connection](#).
- If you still have a problem after these steps are completed, see [Contacting IBM technical support](#).

Contacting IBM technical support

Follow the procedures to contact IBM technical support.

Important: This tape library is a customer installed unit. The customer is responsible for the setup and maintenance of the tape library. The customer is charged for service if a service contract is not in place.

- Complete the steps in [Pre-call checklist](#) before a call is placed to IBM® technical support.
- Before IBM technical support is called, the customer is responsible for following published LTO™ diagnostic procedures, including any needed update to the current level of firmware.
- The IBM Support Center assists with problem determination and can initiate shipment of a replacement part, if needed, to the customer's location. Transportation costs, both ways, are paid by IBM. The replacement part becomes the property of the customer in exchange for the failed part, which becomes the property of IBM. The customer is responsible for packing the failed part into the shipping carton that contained the replacement part. Failure to return the failed part to IBM within 30 days results in a bill sent to the customer for the new list price. The customer is responsible for installing and setting up all replacement parts.
- Failure to use the carton in which the replacement part was received, or failure to properly pack the returned part, can result in charges that are incurred for damage to the failed part during shipment.
- Before you call technical support, follow these steps that help you take full advantage of your call.
 1. Be prepared to provide
 - Machine type and Model name
 - Serial number of the library
 - Hardware configuration, including firmware versions, drive types, modules
 - Type of host, operating system version, device driver information, software application, and version, clock speed, RAM, network type, network version
 - A brief description of the problem, including Event Ticket information.
 2. Review all documentation carefully. (Experience demonstrates that most questions are answered in your documentation).
 3. Be prepared to explain whether the software or hardware worked properly anytime in the past. Have you changed anything recently?
 4. Pinpoint the exact location of your problem, if possible. Note the steps that led to the problem. Can you duplicate the problem or is it a one-time occurrence?
 5. Note any host error messages displayed. Write down the exact error message.
 6. If possible, call while at your computer, with the library installed and turned on.
- The IBM Support Center assists with problem determination and initiates shipment of a replacement part, if needed, to your location. To contact IBM technical support:
 - In the US: 1-800-IBM_SERV (1-800-426-7378).
 - All other Countries or Regions: <http://www.ibm.com/planetwide/>.
 - Select your country, then under Technical Support, click Open Service Request.

Diagnostic information

This section provides various diagnostic tools and information.

- **[IBM Tape Diagnostic tool \(ITDT\)](#)**

The IBM Tape Diagnostic Tool (ITDT) is an independent tool that provides diagnostics on tape drives and libraries. ITDT has multiple functional capabilities and is a quick, convenient, and efficient method for drive firmware updates. As a note, drive memory dump retrievals are completed by the tool as well.
- **[Event codes](#)**

Events are used in the library Ticket and Event system to store all types of events with a unique event code and event description.
- **[TapeAlert flags](#)**

This section is intended to provide information to the reader about the tape drive by using TapeAlert technology.
- **[Sense data](#)**

When a drive encounters an error, it provides sense data as a response to the host.
- **[Drive Error Codes: Single-character display \(SCD\)](#)**

SCD drive error codes give descriptions of the errors and messages that pertain to the drive.

IBM Tape Diagnostic tool (ITDT)

The IBM Tape Diagnostic Tool (ITDT) is an independent tool that provides diagnostics on tape drives and libraries. ITDT has multiple functional capabilities and is a quick, convenient, and efficient method for drive firmware updates. As a note, drive memory dump retrievals are completed by the tool as well.

The IBM® Tape Diagnostic tool (ITDT):

- Runs quick or extended diagnostic tests on tape drives. If the library is online to the server/host where the tool resides, ITDT communicates with the drive through the library to load and unload a test cartridge, exercising some library functions.
- Retrieves firmware memory dumps from tape drives and libraries.
- Completes a firmware update on tape drives or libraries. See note about library firmware update.
- Tests the performance of the environment by completely writing a cartridge and measuring performance.
- Retrieves and displays cartridge information.
- Verifies the encryption environment.
- Does not require special device drivers.
- Is available for most major platforms.
- Scans the host interface and finds and displays for selection all IBM LTO devices. The tool does not display non-IBM devices.

The IBM Tape Diagnostic tool (ITDT) is available as a command line utility and a graphical user interface (GUI) version.

- The IBM Tape Diagnostic Tool (ITDT) is started by entering the executable file from the directory where the tool is located. The Help feature gives a brief explanation of each function and shows the syntax.

Note: Be sure that you have the most current version of ITDT if you are updating firmware on a recent drive type. Before ITDT is used, verify that your library host operating system is at the current released level. This action ensures optimum read/write operations for diagnostic tests.

IBM maintains the current levels of ITDT on the web. Go to <http://www.ibm.com/support/fixcentral> and follow these steps to access this material.

1. From the Fix Central web page, choose the Select Product tab, select System Storage from the Product Group list.
2. Select Tape Systems from the System Storage list.
3. Select Tape drivers and software from the Tape systems list.
4. Select IBM Tape Diagnostic Tool ITDT from the Tape drivers and software list.
5. Select the appropriate operating system from the Platform list and click Continue.
6. Select the appropriate version from the list.

Additional information about the IBM Tape Diagnostic Tool (ITDT) is included in the [IBM® Tape Device Drivers Installation and User's Guide](#).

Event codes

Events are used in the library Ticket and Event system to store all types of events with a unique event code and event description.

Event Reporting System

These event codes are shown on the user interfaces as the resulting code for any type of event at the highest level of information. No internal error code is shown at this level.

Events are sent by the library to different recipients like SNMP targets or email notification. These events have a common structure and unique codes for every type of event.

The event code system is used for the following events:

- Error event (2XXX)
- Warning event (4XXX)
- Configuration event (8XXX)
- Informational event (9XXX)

Event code structure

Example event code

Event: 2057 - Robotics shipping lock in incorrect position

The event log with the library also includes a date and time stamp for each event. Press the associated time stamp to see the event code and a description of the event. The date and time format can be changed in the Date/Time Format section in the Management GUI.

- **mm.dd.yyyy**
- **dd.mm.yyyy**
- **yyyy.mm.dd**

The time format can be set for 12 hours or 24 hours.

- 12 hour: **hh.mm.ss am/pm**
- 24 hour: **hh.mm.ss**

Where

- **yyyy** is the year.
- **mm** is the month.
- **dd** is the current day.
- **hh** is hours.

- **mm** is minutes.
- **ss** is seconds.

Resolving an error code

1. Record the error information that is displayed on the Operator Panel display or Management GUI screen.
2. If possible, cycle library power and retry the operation.
 - If the error does not recur, run Library Verify before normal library operation is continued.
3. If the error recurs, click the event to see its details. If available, click Troubleshooting on the Event Ticket Details screen to get suggestions on how to fix the error. Click OK to close the Event Ticket Details screen.
4. When the proposed solution is applied, run Library Verify before normal library operation is continued.

Complete the steps in [Resolving an error code](#) before you complete the User Action that is listed in the various Event Codes.

- [Main error events](#)
- [Warning events](#)
- [Configuration Change events](#)
- [Informational events](#)

Main error events

Table 1. Main error events

Event Code	Message Text and Description	Details and Solution
2000	Move Cartridge failed.	Verify the source and destination elements and retry the move operation.
2002	The initial module discovery (detection of expansion modules) failed.	Ensure that all modules are powered and have the interconnection cables properly attached. Also, ensure that the module alignment locks (at the rear of module) are in the correct positions.
2003	The library's temperature exceeded the critical temperature threshold.	Check to ensure that • The drive cover plates are installed where no drive exists. • All power supplies are installed. • The ambient room temperature is within limits.
2004	The Library Startup process failed.	• Verify that magazines are closed, cartridges are fully seated, and that no accessor obstructions exist. • Verify that all modules are powered and any expansion modules are cabled correctly with the interconnect cable. • Verify that a top and bottom cover is properly installed on the library. • Verify that the module alignment locks (at rear of module) are in the proper position. • If the accessor moves front to back, but not vertically, the accessor shipping lock might be positioned incorrectly and must be moved to either the fully locked or fully unlocked position. • If the error persists, review library events for information or restart the library.
2005	Cable to accessor is broken.	Ensure that the spooling cable is fully seated in the base module and connected correctly to the accessor assembly.
2009	Library test failed due to accessor problem.	• Review test requirements and retry the test. • If the test continues to fail, check for accessor obstructions or other accessor problems. • For proper operation, the accessor must be able to reach the bottom of the library. Verify that no obstructions are at the bottom of the library or on the bottom cover of the library in the path of the accessor. 1. To check for obstructions at the bottom of the library, first power off the library by pressing Power for 5 seconds and select the Default Park location. 2. When the library is powered off, remove the left magazine of the lowest library module, and verify that the entire area of the bottom cover is free of any objects that might obstruct the accessor's path. 3. After any obstructions are cleared, replace the magazine, power the library on, and after the library finishes initialization and inventory, verify that no further critical events were generated.
2010	Library test failed due to spooling mechanism defect.	Ensure that the spooling mechanism is fully seated in the base module and installed correctly to the accessor assembly.
2012	Multiple bottom covers detected.	Remove all bottom covers except for the bottom module in the library.
2013	Multiple top covers detected.	Remove all top covers except for the top module in the library.
2014	Bottom cover is missing.	Install the bottom cover on the bottom module of the library, also check the module interconnect cabling and module power cabling. If the base module can't detect both a top and bottom cover, the accessor doesn't move.
2015	Top cover is missing.	Install the top cover on the top module of the library. Also, check the module interconnect cabling and module power cabling. If the base module can't detect both a top and bottom cover, the accessor doesn't move.

Event Code	Message Text and Description	Details and Solution
2016	Unit to unit not locked.	Ensure that the alignment mechanism is engaged in every module that is above another module in the library.
2017	Communication errors during stack discover process.	- Ensure that all modules are powered and have the interconnect cable properly attached. - Ensure that the module alignment locks (at the rear of module) are in the correct positions.
2021	Database access error.	Restore a configuration backup and run a power cycle.
2022	Drive was hot-removed.	Reinsert the removed drive at the same position as it was removed.
2023	Internal Software error.	Check for a new system Software version for upgrade.
2024	Unhandled Exception.	Check for a new system Software version for upgrade.
2027	Move failed pulling cartridge from slot.	- Check for labels or cartridge misalignments that can prevent the cartridge from coming out of the slot or drive. - For proper operation, the accessor must be able to reach the bottom of the library. Verify that no obstructions exist at the bottom of the library or on the bottom cover of the library in the path of the accessor. - To check for obstructions at the bottom of the library, first power off the library by pressing Power for 5 seconds and select the Default Park location. - When the library is powered off, remove the left magazine of the lowest library module, and verify that the entire area of the bottom cover is free of any objects that might obstruct the accessor's path. - After obstructions are cleared, replace the magazine, power the library on, and after the library finishes initialization and inventory, verify that no further critical events were generated.
2028	Move failed inserting cartridge to slot.	- Check for labels or cartridge misalignments that can prevent the cartridge from coming out of the slot or drive. - For proper operation, the accessor must be able to reach the bottom of the library. Verify that no obstructions exist at the bottom of the library or on the bottom cover of the library in the path of the accessor. - To check for obstructions at the bottom of the library, first power off the library by pressing Power for 5 seconds and select the Default Park location. - When the library is powered off, remove the left magazine of the lowest library module, and verify that the entire area of the bottom cover is free of any objects that might obstruct the accessor's path. - After obstructions are cleared, replace the magazine, power the library on, and after the library finishes initialization and inventory, verify that no further critical events were generated.
2029	Initialization failure due to accessor front to back positioning error.	- Check for obstructions in the pathway of the accessor such as a cartridge that is sticking out. - Verify the module alignment and frame alignment. Check whether the accessor is stuck in lock mechanism. - Move the accessor apart from lock mechanism and enable lock mechanism correctly.
2032	Initialization failure due to accessor rotation positioning error.	Check for obstructions in the vertical pathway of the accessor, such as a cartridge that is sitting in the shuttle of the accessor or any other impedence to accessor movement.
2033	Initialization failure due to accessor vertical positioning error.	- Check for obstructions in the vertical pathway of the accessor such as a cartridge that is sticking out. - For proper operation, the accessor must be able to reach the bottom of the library. Verify that no obstructions exist at the bottom of the library or on the bottom cover of the library in the path of the accessor. - To check for obstructions at the bottom of the library, first power off the library by pressing Power for 5 seconds and select the Default Park location. - When the library is powered off, remove the left magazine of the lowest library module, and verify that the entire area of the bottom cover is free of any objects that might obstruct the accessor's path. - After obstructions are cleared, replace the magazine, power the library on, and after the library finishes initialization and inventory, verify that no further critical events were generated.
2034	Cable to spooling mechanism is broken during initialization.	Ensure that the spooling mechanism is fully seated in the base module and connected correctly to the accessor.
2035	Initialization failure due to accessor gripper positioning error.	Check for obstructions in the vertical pathway of the accessor, such as a cartridge that is sitting in the shuttle of the accessor or any other impedence to accessor movement.
2036	Unintended process termination.	Restart or power cycle system.
2037	Accessor firmware version upgrade failed.	Restart or power cycle system.
2038	Lost connection to Module.	- Ensure that all modules are powered and have the interconnect cable properly attached. - Restart or power cycle the system.

Event Code	Message Text and Description	Details and Solution
2039	Cartridge was left in accessor gripper, unable to be moved to any open location.	• Enable I/O station and ensure that empty slots are available in the I/O station. • Power-cycle the library. • If still failing, open covers and remove the cartridge manually from gripper.
2040	Library Verify test failed with critical error.	An unidentified failure occurred. Contact your IBM service representative.
2041	Library Verify test failed because of unit lock failed.	Ensure that the alignment mechanism is engaged in every module that is above another module in the library.
2042	Library Verify test failed because top cover is missing.	• Install the top cover on the top module of the library. • Check the module interconnect cabling and module power cabling. • If the base module can't detect both a top and bottom cover, the accessor doesn't move.
2043	Library Verify test failed because bottom cover is missing.	• Install the bottom cover on the bottom module of the library. • Check the module interconnect cabling and module power cabling. • If the base module can't detect both a top and bottom cover, the accessor doesn't move.
2045	Library Verify test failed because move media test failed.	• Check for obstructions in the pathway of the accessor such as a cartridge that is sticking out. • Verify module alignment and frame alignment. • Check if accessor is stuck in lock mechanism, move the accessor apart from lock mechanism and enable lock mechanism correctly.
2046	Library Verify test failed because drive communication test failed.	• Remove and reseal the drive canister to ensure that the drive is fully seated. • If the issue persists, reset the drive. • Use the library Management GUI to pull a drive support ticket and check the device analysis section for help (HPE Library and Tape Tools must be installed to view support ticket).
2047	Library Verify test failed because the bar code scanning test failed.	• Verify that no obstruction is in front of the bar code scanning module on the cartridge table on the accessor. • If the error persists replace the accessor. • For proper operation, the accessor must be able to reach the bottom of the library. Verify that no obstructions are at the bottom of the library or on the bottom cover of the library in the path of the accessor. 1. To check for obstructions at the bottom of the library, first power off the library by pressing Power for 5 seconds and select the Default Park location. 2. When the library is powered off, remove the left magazine of the lowest library module, and verify that the entire area of the bottom cover is free of any objects that might obstruct the accessor's path. 3. After obstructions are cleared, replace the magazine, power the library on, and after the library finishes initialization and inventory, verify that no further critical events were generated.
2052	An open magazine was detected in one or more modules.	• Ensure that all magazines are inserted and properly locked. • Don't open magazines by using the emergency release while the library is operating and the accessor is moving.
2053	An open top cover was detected.	• Ensure that the top cover is inserted and properly locked. • Don't open top cover by using the emergency release while the library is operating and the accessor is moving.
2054	An open bottom cover was detected.	• Ensure that the bottom cover is inserted and properly locked. • Don't open bottom cover by using the emergency release while the library is operating and the accessor is moving.
2055	An open unit lock was detected.	• Ensure that all unit locks are properly locked. • Don't open unit locks by using the emergency release while the library is operating and the accessor is moving.
2056	Initialization failure due to picker push pull positioning error.	Check for obstructions in the horizontal pathway of the accessor such as a cartridge that is sticking out or a cable that is impeding progress.
2057	Startup failure due to shipping lock in incorrect position.	1. Get access to the picker assembly and manually move the shipping lock lever to either locked or unlocked position. 2. After the shipping lock is moved to the one of the correct positions, restart the library.
2061	Move failed pulling cartridge from drive.	Check for labels or cartridge misalignments that would prevent the cartridge from coming out of the drive.
2062	Move failed inserting cartridge to drive.	Check for labels or cartridge misalignments that would prevent the cartridge from moving into the drive.
2063	Move failed positioning picker in front of drive.	Check for obstructions in the vertical or horizontal pathway of the accessor. Examples might include a cartridge that isn't seated completely in a slot, an accessor isn't sitting horizontally level, or a problem with the accessor spooling cable that is impeding progress.
2064	Library test failed with critical error.	An unidentified failure occurred. Contact your IBM service representative.

Event Code	Message Text and Description	Details and Solution
2065	Library startup failed because of robotics initialization issue	- Check for obstructions in the horizontal and vertical pathway of the robotics. - Afterward reset or power cycle system. - If the error persists, review library events for more information
2066	Library startup process failed during inventory scan.	- Verify that magazines are closed, cartridges are fully seated, and that no accessor obstructions exist. - Verify that all modules are powered and any expansion modules are cabled correctly with the interconnect cable. - Verify that a top and bottom cover is properly installed on the library. - Verify that the module alignment locks (at rear of module) are in the proper position. - If the accessor moves front to back, but not vertically, the accessor shipping lock might be positioned incorrectly and must be moved to either the fully locked or fully unlocked position. - If the error persists, review library events for information or restart the library.
2067	For safety reason, the accessor movement was halted in place.	- Ensure that all magazines, top or bottom covers and unit locks are inserted and properly locked. - Don't open magazines by using the emergency release or remove covers or unit locks while the library is operating and the accessor is moving. - Ensure that all modules are powered and have the interconnect cable properly attached.
2068	An emergency stop condition was detected in one or more modules and prevented the accessor from initialization.	- Ensure that all magazines, top or bottom covers and unit locks are inserted and properly locked. - Insert all open magazines and install all necessary covers and unit locks before the library is powered on. - Ensure that all modules are powered and have the interconnect cable properly attached.
2069	Initialization failure due to bar code reader error.	Restart the library and if the error persists, replace the accessor assembly.
2070	Inventory scan failed because of Elevator axis problem.	- Check for obstructions in the vertical pathway of the accessor such as a cartridge that is sticking out. - Verify module alignment and frame alignment. - For proper operation, the accessor must be able to reach the bottom of the library. Verify that no obstructions are at the bottom of the library or on the bottom cover of the library in the path of the accessor. - To check for obstructions at the bottom of the library, first power off the library by pressing Power for 5 seconds and select the Default Park location. - When the library is powered off, remove the left magazine of the lowest library module, and verify that the entire area of the bottom cover is free of any objects that might obstruct the accessor's path. - After obstructions are cleared, replace the magazine, power the library on, and after the library finishes initialization and inventory, verify that no further critical events were generated.
2071	Cartridge on picker when trying to scan.	- Verify that no obstruction is in front of the bar code scanning module on the cartridge table that is on the accessor. - If the error persists, replace the accessor.
2072	Bottom cover was detected at an incorrect position.	Review the stack assembly and place the covers to the proper position.
2073	Top cover was detected at an incorrect position.	Review the stack assembly and place the covers to the proper position.
2074	The library startup failed due to a GPIO error.	Restart or power cycle system.
2075	The library startup failed due to an error when trying to open the accessor serial port.	Restart or power cycle system.
2076	I2C bus signals invalid.	- Remove all drive canisters of the affected chassis and restart the library. - If the problem persists, replace the chassis. If not, add one drive after the other until the problem comes back. - Replace the last drive that was added before it failed again.
2077	Failed to store Calibration Data to Chassis.	Restart or power cycle system. Note: This is a singular ticket and must be resolved manually.
2078	Incompatible Robotics Assembly without Encoder detected	Replace Robotics Assembly with a compatible model with Encoder or upgrade Firmware to a version that supports Encoder-less control.
2079	Couldn't upgrade bar code reader firmware.	Restart the library and if the error persists, replace the accessor.
2080	Cartridge lost while inserting it into slot/drive.	Check the source/destination element and ensure that no obstructions are in the pathway of the accessor.
2085	Communication failure to the Base Module controller board I2C port expander component	This event is reported if read or write access to I2C port expanders on the main library controller is failing. - Reboot the library to see if the error persists. - If the error persists, power off the library and reseal the base module controller. - If the error continues to persist, replace the base module controller.

Event Code	Message Text and Description	Details and Solution
2086	Communication failure to the Expansion Module controller board I2C port expander component.	This event is reported if read or write access to I2C port expanders on expansion controller is failing. - Restart the library to see if the error persists. - If the error persists, power off the library and reseal the expansion module controller. - If the error continues to persist, replace the expansion module controller.
2087	Error accessing the backplane flash memory.	- Restart the library and if the error persists, replace the chassis. - Before the chassis is replaced, ensure that you remove all of your tape cartridges. - If magazines need to be removed to get access to the tape cartridges, first power down the device and then manually release each magazine. Only one magazine must be opened at a time.
2089	Incompatible Robotics Assembly Detected	An incompatible robotics assembly is detected. The robotics assembly was not powered on to avoid damage to the library. Power off the library and replace the robotics assembly with a compatible version.
2092	Locking the Robotics Assembly has failed during power off process	Power up the library. In case of robotics failure, error events are reported at power-up. Look for the proposed solution for these new errors. If no new errors are reported, the 2092 event can be ignored.
2093	Communication to accessor controller couldn't be established.	Restart the library and if the error persists, replace the accessor assembly.
2094	An emergency stop condition was detected in one or more modules and prevented the accessor from running the inventory scan.	- Ensure that all magazines, top or bottom covers and unit locks are inserted and properly locked. - Insert all open magazines and install all necessary covers and unit locks before powering on the library. - Ensure that all modules are powered and have the interconnect cable properly attached.
2095	Inventory scan failed because of accessor positioning problem.	Check for obstructions in the horizontal pathway of the accessor such as a cartridge that is sticking out or lying on the accessor table.
2096	Initializing a communication interface on the library controller failed.	Restart the library, and if the error persists, replace the library controller.
2097	Accessor reinitialization failed.	Restart the library and if the error persists, replace the accessor assembly.
2100	Robotic move to requested position failed.	- Check for obstructions in the pathway of the accessor such as a cartridge that is sticking out. - Verify module alignment and frame alignment. - Check if the accessor is stuck in the lock mechanism. Move the accessor away from the lock mechanism and enable the lock mechanism correctly.
2103	Incorrect stack assembly, too many expansion modules below main library.	Ensure that no more than three expansion modules are mounted and connected below or above main library.
2104	Incorrect stack assembly, too many expansion modules above main library.	Ensure that no more than three expansion modules are mounted and connected below or above main library.
2105	Accessor initialization failed due to horizontal positioning problem.	- Check for obstructions in the horizontal pathway of the accessor such as a cartridge sticking out or lying on the accessor's table. - The accessor shipping lock might be positioned incorrectly and must be moved to either the fully locked or fully unlocked position.
2106	An elevator block was detected and as a result the system was taken offline.	- Check for obstructions in the vertical pathway of the robot, such as a cartridge sticking out. Also, verify alignment of the module and the frame. - Follow these steps to check for any obstructions at the bottom of the library or on the bottom cover of the library: - Turn off the library by pressing the front power button for 5 seconds, and select Default Park location. - Remove the left magazine of the lowest library module. - Remove any objects from the bottom cover that might obstruct the robot's path. - Replace the magazine. - Power on the library. - After the library finishes initialization and inventory, verify that no further critical events were generated.
2113	21U spool detected in a 48U Library. 21U Chassis, Spool, or Accessor replacement parts cannot be installed in a library that has a 48U Configuration.	Check the spool, accessor or Chassis part that was recently installed, and replace with a part that supports the 48U library stack configuration.
2118	A base chassis or controller from another library has been installed. This is not allowed.	A failed base chassis or controller can only be replaced by a new field replacement CRU part. Remove the part that came from the other library and only use a new field replacement CRU part for repairs.
2119	Base chassis and Controller are both replacement CRU parts. They cannot be replaced at the same time.	Reinstall original Base Chassis and Controller and then replace only one part at a time.

Event Code	Message Text and Description	Details and Solution
2120	Firmware Download has been prevented. 1.6.1.0 firmware is the minimum requirement for your library.	1.6.1.0 firmware is the minimum requirement for any library that has 1.6.1.0 or above loaded.

Warning events

An appropriate message is posted on the Operator Control Panel and the Management GUI.

Table 1. Warning events

Event Code	Message Text and Description	Details and Solution
4000	Drive Sled Fan Speed too low.	Ensure that no obstructions are in the fan.
4002	Drive clean request.	Clean the drive with an approved cleaning cartridge.
4003	The drive configuration failed.	Remove and reseal the drive canister and retry the operation.
4004	The drive status request failed.	Remove and reseal the drive canister to ensure that the drive is fully seated. If the issue persists, reset the drive.
4005	Drive is reporting a critical TapeAlert.	Power-cycle the drive, and verify whether the drive reports the same TapeAlert.
4006	A drive reported temperature is above the threshold.	- Verify that the drive fan is spinning, isn't obstructed, and that the ambient temperature is within specification. - Ensure that drive bay cover plates are in place in each location where no drive is installed. The drive cover plates are required for proper airflow.
4008	Cleaning tape expired.	Discard the cleaning cartridge and retry the cleaning operation with a new cleaning cartridge.
4009	Firmware upgrade of one or multiple expansion modules failed.	The Base Module must be able to communicate with a powered on and connected expansion module to complete the upgrade. - Reseat the expansion controller and check the interconnect cable and power connections. - Retry the firmware upgrade.
4010	Incompatible drive.	Remove the incompatible drive. Install only drives that are supported by the library.
4012	Move Cartridge failed due to cartridge issue.	- View the event details to determine which cartridge was involved. - Verify surrounding events that might point to problems with this media in other move operations. - Remove the media from the library, and physically inspect the media to ensure that no physical damage exists. - If the media appears to be undamaged, put the media back into the library and retry the move operation. If the problem persists, retry the operation with a different cartridge in the same drive. - If the problem follows the media, remove the media from use. - If the problem follows the drive, use the library Management GUI to pull a drive support ticket and check the device analysis section for help.
4014	Library test failed due to a Drive issue.	- Verify the test parameters, and retry the test. - If the test fails, check the library event log for specific events that are associated with this drive. - Use the Management GUI to pull a drive support ticket and check the device analysis section for help.
4015	The Power system is degraded. Redundancy is not available.	Ensure that all power supplies are installed properly (up to two per module), and that each power supply is connected to a valid power source.
4016	Back up configuration data to base module failed.	Attempt to save the library configuration, power cycle the library, and retry the operation.
4017	Restore configuration data from Chassis failed.	Attempt to save the library configuration, power cycle the library, and retry the operation.
4019	Drive Firmware bundle upgrade failed.	- Verify that the firmware file is correct for the drives. - Ensure that the drives are in a healthy state with no cartridge in the drive. - Retry the operation.
4020	Database was reset due to a problem that prevented the library from powering up.	- If the library was restored to default settings, restore a saved configuration by using a previously saved config file. - If no config file exists, then proceed in configuring the library.
4021	Drive was hot-removed while in active status as data transfer device.	Tape drives must be disabled (powered-off) before they are removed from the Library. In case of hot removal, this event is created if the drive was no active LUN master. A similar event is defined with higher severity (critical) if the drive was LUN master. - Put the drive back into the library. - Follow the Removing a tape drive procedure to remove the tape drive.
4022	Drive in wrong position.	A full height drive was installed to a drive bay where it is not supported. Full high drives can only be installed in the bottom 2 bays of a module.
4025	Library test failed due to a cartridge error.	Remove the cartridge and inspect it for damage. Retry operation with another cartridge.

Event Code	Message Text and Description	Details and Solution
4028	Library Test failed due to incompatible cartridge.	Check LTO generation for cartridge and drives. Remove cartridges that aren't compatible to your tape drives.
4029	Library Test failed - Cartridge bar code indicates incompatibility with drive.	Check if Media bar code label is matching LTO generation. Replace the label or remove incompatible media from your system.
4030	Move cartridge operation failed due to cartridge error.	Remove the cartridge and inspect it for damage. Retry operation with another cartridge.
4041	Library Verify failed because the power supply redundancy test failed.	Ensure that all power supplies are installed properly (two per module), and that each power supply is connected to a valid power source.
4044	One of the Library tests failed because a source element or destination element isn't accessible.	Verify the source and destination elements and retry the move operation.
4060	Connection to the KMIP server failed.	- Verify the username and password and all needed SSL certificates that are needed for connecting to the KMIP server. - Verify that the KMIP server is reachable within the network. - Verify the IP addresses and host names of the KMIP servers that are entered into the wizard. If this error happens during the connectivity check, the additional information parameter includes further error information that is received from the Cryptsoft KMIP library. It also includes the information if the server wasn't able to ping.
4061	Key is not found on KMIP server.	Verify that the requested key is available on the KMIP server. Check the KMIP server logs for details.
4062	Key creation on KMIP server failed.	Check the KMIP server logs for details about why key creation failed.
4063	KMIP configuration invalid.	Use the KMIP configuration wizard to verify the KMIP configuration.
4064	KMIP feature not licensed.	Disable KMIP or install appropriate license for KMIP feature.
4065	A tape alert flag was reported by a drive.	Look for logged TapeAlert flags and see its description in the TapeAlert flags section.
4067	Cleaning cartridge will soon expire and must be replaced.	Replace the cartridge.
4072	No cleaning cartridge in logical library available for auto cleaning.	- Auto cleaning is enabled, but the logical library contains no labeled cleaning cartridge. The library was unable to complete the auto clean function for one or more drives in this logical library. - Install a valid and labeled cleaning cartridge into the logical library and then complete a load and unload on the drive that needs cleaning to start the auto cleaning.
4073	Medium source element empty.	Check the source slot visually and rescan the inventory. Additionally, check for valid and readable bar code label.
4074	Medium source element empty.	Check the source slot visually and rescan the inventory. Additionally, check for valid and readable bar code label.
4075	Cartridge lost while it was extracted from slot/drive.	Check the source/destination element and ensure that no obstructions are in the pathway of the accessor.
4077	Unlocking the right magazine failed.	- Check if any obstacle is preventing the robot from movement. - Restart the library and retry the operation. - If the error persists, replace the chassis. - If the magazine needs to be removed to get access to the tape cartridges, first power down the device, and then release the magazine manually. Only one magazine can be open at a time.
4078	Unlocking the left magazine failed.	- Check if any obstacle is preventing the robot from movement. - Restart the library and retry the operation. - If the error persists, replace the chassis. - If the magazine needs to be removed to get access to the tape cartridges, first power down the device, and then release the magazine manually. Only one magazine can be open at a time.
4079	Unlocking the I/O station failed.	- Check if any obstacle is preventing the robot from moving. - Reset the library and retry the operation. - If the error persists, replace the chassis. - If the I/O station needs to be removed to get access to the tape cartridges, first power down the device, and then release the magazine manually. Only one magazine can be opened at a time.
4080	Library Verify test failed with warning.	An unidentified failure occurred. Contact your IBM service representative.
4085	Drive command retries expired.	- Run a drive read/write test (Library > Actions > Tests > Drive test) with a known working cartridge. - If the drive test is successful, check in the host for errors that are related with the retries. - If the drive test failed, replace the drive.
4086	Move operation failed.	- Ensure that the network the library is connected to is operating normally. - Ensure that the library is running the current firmware. - Restart the library.

Event Code	Message Text and Description	Details and Solution
4089	Auto calibration of one or more modules failed. Adjustment to calibration target failed.	- The library must be re-calibrated. - Ensure that the library firmware is up-to-date. - This event indicates that one or more of the gray calibration targets on the library magazines couldn't be used in calibration. - Inspect the calibration targets in each module and then repeat the auto-calibration routine with the Management GUI.
4090	Auto calibration of one or more modules failed. Calibration target not found.	- The library must be re-calibrated. - Ensure that the library firmware is up-to-date. - This event indicates that one or more of the gray calibration targets on the library magazines could not be used in calibration. - Inspect the calibration targets in each module and then repeat the auto-calibration routine with the Management GUI.
4091	Auto calibration of one or more modules failed. Adjustment out of range.	- The library must be re-calibrated. - Ensure that the library firmware is up-to-date. - This event indicates that one or more of the gray calibration targets on the library magazines could not be used in calibration. - Inspect the calibration targets in each module and then repeat the auto-calibration routine with the Management GUI.
4093	Could not obtain an IP address from DHCP server.	- Check the network configuration settings and check if the DHCP server is reachable. - Use the network configuration menu or unplug the network cable and plug it in after a few seconds to trigger an automatic reconfiguration of the network interface.
4095	Library test failed. Not enough valid cartridges available for testing.	Load the cartridges into the library.
4098	System time synchronization with SNTP failed.	Check for valid SNTP server address in Time configuration. If correct, ensure that the server is reachable from your network and not blocked by a firewall.
4099	An unexpected reset of accessor was detected.	Ensure that the spooling cable is fully seated in the base module and connected correctly to the accessor assembly. If the error recurs, replace the accessor assembly.
4112	Move Cartridge failed due to cartridge not seating properly.	- Verify surrounding events for drive problems. - Retry the operation with the same source and destination combination. - If the problem persists, retry the operation with a different cartridge in the same drive. If the problem follows the cartridge, the cartridge must be checked for physical damage and no longer used. - Use the library Web GUI to pull a drive support ticket and check the device analysis section for more help.
4113	Move from drive failed.	Check for labels or cartridge misalignments that prevents the cartridge from coming out of the slot or drive.
4117	Drive disabled because no power supply available.	Remove all affected drives, insert, and power up at least one power supply to the failing module. Wait 10 seconds and put the drives back into the module.
4119	Drive disabled because internal IP address unknown.	- Remove affected drive, wait 10 seconds, and put it back into the module. - Restart Library stack.
4120	No empty drive available for system test.	Make sure that at least one empty drive and one compatible cartridge are available.
4121	No compatible media available for system test.	Make sure that at least one empty drive and one compatible cartridge are in the drive.
4122	No cartridge available for slot to slot exerciser test.	Make sure that at least one cartridge and one empty slot are in the library.
4123	No empty slot available for slot to slot exerciser test.	Make sure that at least one cartridge and one empty slot are in the library.
4124	Drive or media statistics couldn't be retrieved when the tape was unloaded.	Check for more warning tickets. Replace media if media-related tape alert flags reported.
4126	Cartridge was found in inaccessible slot of lowermost unit.	Bottom slots from the lowermost unit are inaccessible to the accessor. Place the cartridge in an upper slot.
4127	Drive was restarted because of canister reset.	Verify that the drive is installed properly in its slot and thumb screws are tightened. If the error persists, replace the drive.
4128	The expansion module has detected an installed power supply but this power supply does not provide power.	Ensure that the power supply has a power cord plugged in and is connected to a valid power source. Although the power source is not available, this expansion module can still be used for tape storage. Operation of tape drives is not possible.
4129	Move from drive failed.	Check backup application how to allow media removal from drive. If unsuccessful, try the Force Drive Media Eject option in the Operations menu.
4133	Protection Foam not removed from Base Module	- Power down the library. - Remove top cover and then remove the protection foam. - Install the top cover again and restart the library.
4135	Drive diagnostic failed.	Use another diagnostic tape and run test once more. If still failing, download drive dumps and contact service.
4136	The base module detected an installed power supply but this power supply doesn't provide power.	Ensure that the power supply has a power cord plugged in and is connected to a valid power source.

Event Code	Message Text and Description	Details and Solution
4137	Diagnostic Tape not removed.	Open Magazine or I/O station to remove the diagnostic tape with the OP or Management GUI.
4138	USB over-current detected. The USB port was disabled.	Ensure that the USB device is correctly inserted and that it does not consume more current than specified in manual.
4139	Magazine or I/O Station operation failed.	- Check whether any obstacle is preventing the accessor from movement. - Restart the library and retry the operation. If the error persists, replace the accessor assembly. - If the magazine needs to be removed to get access to the tape cartridges, first power down the device and then release the magazine manually. Only one magazine can be open at a time.
4140	Personality mismatch detected.	Replace either chassis or library controller to ensure that all parts in the stack are matching the personality of the main library controller.
4142	Medium destination element full.	Ensure that your destination slot or drive is empty and try again.
4144	Unit to unit lock of lowermost module is engaged.	Ensure that the alignment mechanism isn't engaged in the lowermost module.
4148	Download of one or multiple drive dumps failed	Check status of selected drives and ensure that they are present and finally initialized before downloading dumps.
4150	Sequential Mode move operation failed.	Check event details for further information.
4151	Download of drive firmware image completed, but firmware revision did not change after restart.	- Check if the uploaded firmware image is matching your drive type and generation. - Ensure that the image file isn't corrupted. - Download a new image from the drive vendor's website if you aren't sure about file integrity.
4152	KMIP Connection refused.	The selected port on the target machine is not open. The connection is refused. Check that the server application is running on the target machine and the firewall is not blocking the selected port. Contact IT Personnel to verify the port settings.
4153	KMIP Server does not trust the client certificate.	Use a client certificate that is signed by a trusted certificate authority (CA) or manually select the untrusted certificate on the server side and trust it (not available on all servers).
4154	KMIP Ping to server failed.	The target machine could not be reached, so no network connection possible. - Verify that the IP address in the settings is correct. - Check that the target machine is powered and connected to the network. - Check the network cable. - Verify that the Firewall setting on the target machine allows ping requests and responses.
4155	KMIP No route to host.	The target machine could not be reached. The network route to the machine isn't available. - Check your IP settings (IP address, Gateway and Netmask) and verify it with your IT personnel. - Check that the Firewall settings on the target machine are correct.
4156	KMIP Handshake failure.	The TLS connection could not be established because of Handshake errors during certificate exchange. - Check the certificates on server and client side for valid entries and that they are still valid and not expired. - Verify that TLS1.2 is enabled on the server. - Check the client and server date/time for current time. - Ask your IT personnel for new and valid certificates.
4157	KMIP Certificate unknown.	The server certificate is unknown because its root certificate is missing or not trusted. Run a new certificate request with your server or certificate authority and import the resulting certificate chain.
4158	KMIP host name lookup failed.	The host name on the network could not be found. It does not exist or is misspelled. - Verify that the entered host name is correct. - Check your DNS address in the network settings. - Contact your IT personnel to verify the entered data.
4159	KMIP certificate verify failed.	The TLS server certificate could not be verified as a valid and trusted certificate. - Check if your server root certificate changed. - Create a certificate request against your server to generate a new client certificate based on the changed server certificates.
4160	Connection to SKLM/GKLM server failed	Retrieving of IPP encryption key failed because connection to SKLM/GKLM server could not be established. Check for availability of server and verify your server settings. Add a secondary fallback server if possible.
4161	Internal encryption key handshake failed	Retrieving IPP encryption key failed because of internal data transfer failure between drive and library. Verify if the latest drive software is installed. If the failure reoccurs, check the library event log for specific events associated with this drive.
4162	for z/OS encryption not licensed	Disable SKLM/GKLM for z/OS encryption or install appropriate license for Library Managed Encryption.

Event Code	Message Text and Description	Details and Solution
4163	Drive sled discovery timeout	Drive sled discovery timeout, status of Drive sleds not available in time. - Ensure that all modules are powered and have the interconnect cable properly attached. - If this event is seen on multiple modules or after ensuring all interconnect cables are properly attached, ensure that the network that the base module is connected to is not experiencing broadcast storms or other abnormal activity. - Reboot or power cycle the system to rediscover the modules.
4164	Inventory has been updated due to an unexpected empty or full slot.	If a move fails due to an unexpected empty or full slot, the slot is rescanned and the inventory is corrected.
4165	Bottom magazine slots in the lowermost unit are not accessible.	The installed accessor does not support access to all 40 slots in the lowermost unit. The bottom slots in the lowermost unit are not accessible, so only 32 slots are available. Install an accessor that supports access to all 40 slots in the lowermost unit.
4166	Drive self-test diagnostic failed	Reset Drive and run the test again. If still failing, download drive dumps and contact service.
4167	Drive primary port diagnostic failed	- Check whether the wrap test connector is correctly connected to the selected port. - Reset drive and run test again. - If the diagnostic still fails, download drive dumps and contact service.
4168	Drive encryption key path diagnostic failed.	- Check the SKLM server configuration and your network settings. - If the diagnostic still fails, download the library logs and contact service.
4173	Encryption Key Path diagnostics failed.	- Check the Key server configuration and your network settings. - If the diagnostic still fails, download the library logs and contact service.
4174	KMIP CA certificate failure.	Check whether you provided the correct CA certificate or the CA certificate on the encryption server was changed.
4175	Failed to create default logical library.	Check that no errors occurred during the startup and that at least one drive is present in the library.

Configuration Change events

Table 1. Configuration Change events

Event Code	Message Text and Description
8000	The configuration of a drive changed.
8001	The drive was added or removed from the system.
8002	A logical library was added/removed or changed.
8003	I/O station was enabled/disabled.
8004	Drive firmware changed due to firmware upgrade.
8005	Host name/domain name changed.
8006	Email configuration settings changed.
8007	Date/time format changed.
8009	Time zone configuration changed.
8011	Network configuration changed.
8012	Expansion Module upgraded.
8013	NTP time server settings changed.
8014	The SSH Access was enabled/disabled.
8016	Library reset default settings started by user.
8017	Library Firmware changed.
8018	The Unlabeled Cartridge Support configuration changed.
8019	Accessor firmware version upgraded.
8022	Management GUI/Operator Panel Timeout configuration changed.
8024	I/O station/Magazine access control configuration changed.
8026	Accessor change detected.
8029	The SNMP configuration changed.
8030	An SNMP target was added.
8031	An SNMP target was deleted.
8033	The Operator Panel module was changed.
8034	Manual Drive reset executed.
8036	New chassis detected.
8037	Chassis was removed.
8040	LDAP Server was added.
8041	LDAP Server was modified.
8042	LDAP Server was deleted.
8043	LDAP User was added.
8044	LDAP User was modified.
8045	LDAP User was deleted.

Event Code	Message Text and Description
8046	Logout prevention configuration changed.
8057	Hardware component added.
8058	Hardware component removed.
8059	Hardware component of Library replaced.
8060	New Expansion Controller detected.
8061	New Base Library Controller detected.
8062	Auto calibration successfully finished.
8064	Password rules configuration changed.
8065	User was added.
8066	User was deleted.
8068	Remote Logging configuration changed Note: Not applicable for 6U WHITEBOX
8069	User password changed
8071	Administrator permission for configuring encryption changed
8072	Kerberos Realm was added
8073	Kerberos Realm was modified
8074	Kerberos Realm was deleted
8075	Kerberos User was added
8076	Kerberos User was modified
8077	Kerberos User was deleted
8079	SKLM/GKLM for z/OS Encryption settings modified
8085	LDAP User Group was added
8086	LDAP User Group was modified
8087	LDAP User Group was deleted
8088	Logical Library/Partition modification and creation settings changed

Informational events

Table 1. Informational Events

Event Code	Message Text and Description
9000	A tape alert flag was reported by a drive.
9001	A drive is present but currently disabled.
9002	The library was powered on.
9003	Move Cartridge command was run.
9004	Inventory scan was completed.
9005	The library was powered down from Front Panel.
9006	The network interface was turned on.
9007	The network interface was turned off.
9008	The System Time was synchronized with an NTP server.
9009	A magazine was unlocked and opened.
9010	A magazine was closed and locked.
9011	An I/O station was unlocked and opened.
9012	An I/O station was closed and locked.
9013	A user logged in at the Management GUI.
9014	A user logged out at the Management GUI.
9015	A user logged in at the Operator Panel interface.
9016	A user logged out at the Operator Panel interface.
9024	Drive support ticket created.
9025	Library test started.
9026	Library test successfully finished.
9027	Library test was stopped by user.
9028	Configuration back up to chassis was successful.
9029	Configuration restore from chassis was successful.
9031	Library health Status was changed to status "OK".
9032	Library health status was changed to status "Warning".
9033	Library health status was changed to status "Critical".
9035	New library chassis detected.
9038	The library was rebooted through user interface.
9041	Key on KMIP server created.
9043	Drive cleaning was started.
9045	Library configuration data failed to duplicate on to the Base Module.
9060	One or multiple configured DNS servers aren't responding.

Event Code	Message Text and Description
9061	User account was locked due to too many invalid login attempts on Management GUI.
9062	Invalid password used for login.
9063	The network port used to contact the encryption server was changed.
9064	Backup of certificate created.
9065	Certificate is restored.
9066	Temporary password generated.
9067	LTO7 formatted cartridge with a Type M bar code detected.
9068	Type M cartridge without a Type M bar code detected.
9069	Sequential Mode load sequence ended because last storage cartridge of logical library was unloaded.
9070	Sequential Mode load sequence restarted (Loop Mode) because last storage cartridge of logical library was unloaded.
9077	User submitted feedback
9078	Unexpected drive reset occurred
9079	Media optimization needed

TapeAlert flags

This section is intended to provide information to the reader about the tape drive by using TapeAlert technology.

All error code and diagnostic information can be accessed from the Management GUI of the library. The drive portion of the Management GUI contains drive error codes. Therefore, it is not necessary to open the Library to access the buttons on the drive. See [Locating Management functions](#) for a complete description of the Management GUI functions and displays.

TapeAlert is a standard that defines status conditions and problems that are experienced by devices such as tape drives, autoloaders, and libraries. The standard enables a server to read TapeAlert messages (called flags) from a tape drive with the SCSI bus. The server reads the flags from Log Sense Page 0x2E. Refer to the *IBM TS4300 Tape Library SCSI Reference* for library and drive TapeAlert Flag information.

This library is compatible with TapeAlert technology, which provides error and diagnostic information about the drives and the library to the server. Because library and drive firmware might change periodically, the SNMP interface in the library does not require code changes if devices add more TapeAlerts that are not supported today. However, if this issue occurs the Management Information Block (MIB) is written to minimize impact to the SNMP monitoring station. At the time of this writing, the TapeAlert flags correctly represent TapeAlerts that are sent. The MIB file must not be taken to mean that all traps that are defined in the MIB are sent by the library or that they will be sent in the future.

- [TapeAlert flags supported by the library](#)
- [TapeAlert flags supported by the drive](#)

TapeAlert flags supported by the library

Parameter Code	Flag name	Type	Description
01d	Library Hardware A	C	The media changer mechanism is having difficulty communicating with the drive: • Turn the media changer OFF, then ON • Restart the operation. • If problem persists, contact Technical Support.
02d	Library Hardware B	W	There is a problem with the media changer mechanism. If the problem persists, contact Technical Support.
04d	Library Hardware D	C	The library has a hardware fault that is not mechanically related or requires a power cycle to recover. • Turn the media changer OFF, then ON. • Restart the operation. • If the problem persists, contact Technical Support.
05d	Library Diagnostics Required	W	The library mechanism might have a hardware fault. Run extended diagnostics to verify and diagnose the problem. Check the library user's manual for device-specific instructions on running extended diagnostic tests.
13d	Library Pick Retry	W	There is a potential problem with the drive ejecting cartridges or with the library picking cartridges from a slot. • No action needs to be taken at this time. • If the problem persists, contact Technical Support.
14d	Library Place Retry	W	There is a potential problem with the library mechanism placing a cartridge into a slot. • No action needs to be taken at this time. • If the problem persists, contact Technical Support.

Parameter Code	Flag name	Type	Description
15d	Library Load Retry	W	There is a potential problem with the drive or the library mechanism loading cartridges, or an incompatible cartridge. This flag is cleared when the next move command is received.
16d	Library Door	C	The operation failed because the library door is open. • Clear any obstructions from the library door. • Close the library door. • If the problem persists, call the library supplier help line.
17d	Library I/O Station	C	There is a mechanical problem with the library media I/O Station.
19d	Library Security	W	Library security is compromised. The door was opened then closed during operation.
20d	Library Security Mode	I	The library security mode was changed. The library was either put into secure mode, or the library exited the secure mode. This is for information purposes only. No action is required.
21d	Library Offline	I	The library was manually turned offline and is unavailable for use.
22d	Library Drive Offline	I	A drive inside the library was taken offline. This is for information purposes only. No action is required.
24d	Library Inventory	C	The library detected an inconsistency in its inventory. • Redo the library inventory to correct inconsistency. • Restart the operation.
28d	Power Supply	W	A redundant power supply failed inside the library. Check the library users manual for instructions on replacing the failed power supply.
33d	Library Capacity Exceeded	C	The total number of volumes exceeds the available number of storage elements. Remove a cartridge from the inventory to recover.
• I = Informational suggestion to user • W = Warning. Remedial action is advised. Performance of data might be at risk. • C = Critical immediate remedial action is required.			

TapeAlert flags supported by the drive

Flag Number	Flag Name	Hex Code	Description	Action Required	Event
1	Read warning	01h	Set when the tape drive is having problems reading data. No data is lost, but there is a reduction in the performance of the tape.	Isolate the fault between drive and tape by following these steps: • Use a known good tape cartridge in the suspect drive. If the drive fails, contact your IBM® Service Representative. • Use the suspect tape cartridge in a known good drive. If the test fails, discard the cartridge.	Warning Event
2	Write warning	02h	Set when the tape drive is having problems writing data. No data is lost, but there is a reduction in the performance of the tape.	Isolate the fault between drive and tape by following these steps: • Use a known good tape cartridge in the suspect drive. If the drive fails, contact your IBM® service representative. • Use the suspect tape cartridge in a known good drive. If the test fails, discard the cartridge.	Warning Event
3	Hard error	03h	Set for any unrecoverable read, write, or positioning error. (This flag is set with flags 4, 5, or 6).	See the Action Required column for Flag Number 4, 5, or 6 in this table. Ensure that tape drive firmware is at the latest version. See Minimum firmware levels for common library features .	Warning Event
4	Media	04h	Set for any unrecoverable read, write, or positioning error that is due to a faulty tape cartridge.	Replace the tape cartridge.	Warning Event
5	Read failure	05h	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 Number 4 is also set, the cartridge is defective. Replace the tape cartridge. If Flag Number 4 is not set, see Error Code 6 in Drive Error Codes: Single-character display (SCD) .	Warning Event

Flag Number	Flag Name	Hex Code	Description	Action Required	Event
6	Write failure	06h	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 Number 9 is also set, make sure that the write-protect switch is set so that data can be written to the tape. If Flag Number 4 is also set, the cartridge is defective. Replace the tape cartridge. If Flag Number 4 is not set, see Error Code 6 in Drive Error Codes: Single-character display (SCD) .	Warning Event
7	Media life	07h	Set when the tape cartridge reaches its end of life (EOL).	1. Copy the data to another tape cartridge. 2. Discard the old (EOL) tape.	Warning Event
8	Not data grade	08h	Set when the cartridge is not data-grade. Any data that you write to the tape is at risk.	Replace the tape with a data-grade tape.	Warning Event
9	Write protect	09h	Set when the tape drive detects that the tape cartridge is write-protected.	Make sure that the cartridge's write-protect switch is set so that the tape drive can write data to the tape.	Warning Event
10	No removal	0Ah	Set when the tape drive receives an UNLOAD command after the server prevented the tape cartridge from being removed.	Refer to the documentation for your server's operating system.	Info Event
11	Cleaning media	0Bh	Set when you load a cleaning cartridge into the drive.	No action is required. Informational message only.	Info Event
12	Unsupported format	0Ch	Set when you load an unsupported cartridge type into the drive or when the cartridge format is corrupted.	Use a supported tape cartridge.	Info Event
14	Unrecoverable snapped tape	0Eh	Set when the tape is snapped/cut or has a mechanical failure.	Do not attempt to extract the old tape cartridge. Call the tape drive supplier's help line.	Warning Event
15	Cartridge memory chip failure	0Fh	Set when a cartridge memory (CM) failure is detected on the loaded tape cartridge.	Replace the tape cartridge. If this error occurs on multiple cartridges, see Error Code 6 in Drive Error Codes: Single-character display (SCD) .	Warning Event
16	Forced eject	10h	Set when you manually unload the tape cartridge while the drive was reading or writing.	No action is required. Informational message only.	Warning Event
17	Loaded media is Read-only format	11h	Set when a write attempt is made on a read-only cartridge. The flag is cleared when the cartridge is ejected (this flag is not supported for Ultrium 1 or Ultrium 2).	No action is required. Informational message only.	Warning Event
18	Tape directory is corrupted in the cartridge memory	12h	Set when the drive detects that the tape directory in the cartridge memory is corrupted.	Reread all data from the tape to rebuild the tape directory.	Warning Event
19	Nearing media life	13h	Set when the tape cartridge is nearing its specified end of life.	1. Copy the data to another tape cartridge. 2. Replace the tape cartridge.	Info Event
20	Clean now	14h	Set when the tape drive detects that it needs cleaning.	Clean the tape drive.	Warning Event
21	Clean periodic	15h	Set when the drive detects that it needs routine cleaning.	Clean the tape drive as soon as possible. The drive can continue to operate, but you must clean the drive soon.	Warning Event
22	Expired clean	16h	Set when the tape drive detects an expired cleaning cartridge.	Replace the cleaning cartridge.	Warning Event
23	Invalid cleaning tape	17h	Set when the drive expects a cleaning cartridge and the loaded cartridge is not a cleaning cartridge.	Use a valid cleaning cartridge.	Warning Event
25	Interface	19h	Set when the tape drive detects a problem with the SCSI, Fibre Channel, or RS-422 interface.	Locate Error Code 8 or 9 in Drive Error Codes: Single-character display (SCD) .	Warning Event
26	Cooling Fan Failure	1Ah	A tape drive cooling fan failed.	Fan failure inside tape drive mechanism or tape drive enclosure.	Warning Event
27	Power Supply	1Bh	A redundant power supply failed inside the tape drive enclosure. Check the enclosure users manual for instructions on replacing the failed power supply.	A redundant power supply failed inside the tape drive enclosure. Check the enclosure users manual for instructions on replacing the failed power supply.	Warning Event
30	Hardware A	1Eh	Set when a hardware failure occurs that requires that you reset the tape drive to recover.	Reset the tape drive. If the error persists even after resetting the drive, note the error code on the single-character display and look for the code in Drive Error Codes: Single-character display (SCD) for appropriate instructions.	Warning Event

Flag Number	Flag Name	Hex Code	Description	Action Required	Event
31	Hardware B	1Fh	Set when the tape drive fails its internal Power-On Self-Tests.	Note the error code on the single-character display and see in Drive Error Codes: Single-character display (SCD) for appropriate instructions.	Warning Event
32	Interface	20h	Set when the tape drive detects a problem with the SCSI, Fibre Channel, or RS-422 interface.	Set when the tape drive detects a problem with the SCSI, Fibre Channel, or RS-422 interface.	Warning Event
33	Eject media	21h	Set when a failure occurs that requires you to unload the cartridge from the drive.	Unload the tape cartridge, then reinsert it and restart the operation.	Warning Event
34	Download fail	22h	Set when the tape drive detects a problem with the SCSI, Fibre Channel, or RS-422 interface.	Ensure that it is the correct FMR image. Download the FMR image again.	Warning Event
35	Drive humidity	23h	Set when the drive's internal humidity sensor indicates that the tape library operating environment might be outside the allowable specifications.	Confirm the drive cooling fan is operational. Confirm that the library operating environment is within allowable specifications. See Error Code 1 in Drive Error Codes: Single-character display (SCD) .	Warning Event
36	Drive temperature	24h	Set when the drive's temperature sensor indicates that the drive's temperature is exceeding the recommended temperature of the library.	See Error Code 1 in Drive Error Codes: Single-character display (SCD) .	Warning Event
37	Drive voltage	25h	Set when the drive detects that the externally supplied voltages are either approaching the specified voltage limits or are outside the voltage limits.	See Error Code 2 in Drive Error Codes: Single-character display (SCD) .	Warning Event
38	Predictive failure	26h	A hardware failure of the tape drive is predicted. Call the tape drive supplier helpline.	Predictive failure of drive hardware	Warning Event
39	Failure	27h	The tape drive might have a fault. Check for availability of diagnostic information and run extended diagnostics if applicable. Check the tape drive user's manual for instructions on running extended diagnostic tests and retrieving diagnostic data.	The drive might have a failure that can be identified by stored diagnostic information or by running extended diagnostics (Send Diagnostics).	Warning Event
49	Diminished Native Capacity	31h	Set when Native Capacity is diminished.	No action is required. Informational message only.	Info Event
51	Tape directory invalid at unload	33h	Set when the tape directory on the tape cartridge that was previously unloaded is corrupted. The file-search performance is degraded.	Use your backup software to rebuild the tape directory by reading all the data.	Warning Event
52	Tape system area write failure	34h	Set when the tape cartridge that was previously unloaded cannot write its system area successfully.	Copy the data to another tape cartridge, and discard the old cartridge.	Warning Event
53	Tape system area read failure	35h	Set when the tape system area cannot be read successfully at load time.	Copy the data to another tape cartridge, and discard the old cartridge.	Warning Event
55	Load Failure	37h	The operation failed because the media cannot be loaded and threaded.	Remove the tape and try another. If the problem persists, contact your IBM® service representative. Ensure that tape drive firmware is at the latest version. See Minimum firmware levels for common library features .	Warning Event
56	Unrecoverable unload failure	38h	The operation failed because the media cannot be unloaded.	Contact your IBM® service representative.	Warning Event
59	WORM Medium – integrity check failed	3Bh	Set when the drive determines that the data on tape is suspect from a WORM point of view.	1. Copy the data to another WORM tape cartridge. 2. Discard the faulty WORM tape.	Warning Event
60	WORM Medium – Overwrite attempted	3Ch	Set when the drive rejects a write operation because the rules for allowing WORM writes are not met. Data can be appended only to WORM media. Overwrites to WORM media are not allowed.	Write the data to a WORM tape cartridge or write the data to a non-WORM tape cartridge.	Warning Event

When a drive encounters an error, it provides sense data as a response to the host.

Refer to the *IBM TS4300 Tape Library SCSI Reference* for library sense data information. Refer to the *IBM LTO Ultrium Tape Drive SCSI Reference* for tape drive sense data information.

In addition, you can use the IBM Tape Diagnostic Tool (ITDT) to further examine data and determine errors. See [IBM Tape Diagnostic tool \(ITDT\)](#).

Drive Error Codes: Single-character display (SCD)

SCD drive error codes give descriptions of the errors and messages that pertain to the drive.

If you encounter problems while the tape drive is running, refer to [Troubleshooting](#).

The SCD display appears on the inside back of an installed library and can be seen through the front window of an expansion unit. It is seen on the lower center of a full-height drive. Each drive has a status light and single-character display, that when visible provides drive informational and error conditions. The single-character display shows either a single character, a dot (in the lower right of the display), or both.

Note: The SCD can be seen through the windows of expansion units, and for full-height drives only. If you have a base unit without expansion units, or if you have half-height drives, the SCD cannot be seen.

[Single-character display \(SCD\) codes](#) lists the codes for error conditions and informational messages. If multiple errors occur, the code with the highest priority (represented by the lowest number) displays first. When the error is corrected, the code with the next highest priority displays until no errors remain.

The SCD is blank during normal operation.

Single-character display (SCD) codes

[Table 1](#) gives descriptions of the errors and messages that pertain to the drive. For troubleshooting tips, see [Troubleshooting Guide](#).

- Make note of the SCD error code before a cartridge is removed or the SCD error code is cleared.
- If an error occurred with a cartridge in the drive, eject the cartridge from the drive with the library Management GUI (see [Locating Management functions](#)).

Attention: If the drive detects a permanent error and displays an error code other than SCD **0**, it automatically runs a drive dump. If you force a drive dump, the existing dump is overwritten and data can be lost. After you force a drive dump, do not turn OFF the power to the drive or you might lose the dump data.

Table 1. Error codes on the single-character display

Error code	Meaning
0	No error occurred and no action is required. This code displays when diagnostics finish running and no error occurred. Note: The single-character display is blank during normal operation of the tape drive.
1	Temperature problem. The tape drive detected that the recommended operating temperature was exceeded.
2	Power problem. The tape drive detected that the externally supplied power is outside the specified voltage limits (the tape drive is not operating).
3	Firmware problem. The tape drive determined that a firmware error occurred Note: Do not force a new dump; the tape drive already created one.
4	Firmware or hardware problem. The tape drive determined that a firmware or tape drive hardware failure occurred. Note: Do not force a new dump; the tape drive already created one.
5	Tape drive hardware problem. The drive determined that a tape path or read/write error occurred. Notes: • To prevent damage to the drive or tape, the tape drive does not allow a cartridge to be inserted if the current cartridge was successfully ejected. • Do not force a new dump; the tape drive already created one.
6	Tape drive or media error. The tape drive determined that an error occurred, but it cannot isolate the error to faulty hardware or to the tape cartridge. Ensure that the tape cartridge is the correct media type. See LTO media . Ensure tape drive is at the latest firmware version. See Minimum firmware levels for common library features .
7	Tape drive or media error. The tape drive determined that an error occurred, but it cannot isolate the error to faulty hardware or to the tape cartridge. Ensure that the tape cartridge is the correct media type. See LTO media .
8	Interface problem. The tape drive determined that a failure occurred in the tape drive hardware or in the host bus. Note: The error code clears 10 seconds after the drive detected the error.
9	Tape drive or library-drive communication error. The tape drive determined that a failure occurred in the tape drive's hardware or in the library-drive connection.
A	Degraded operation. The tape drive determined that a problem occurred which degraded the operation of the tape drive, but it did not restrict continued use. If the problem persists, determine whether the problem is with the drive or the media. Note: The drive is usable, though the single-character display continues to indicate an error and the status light flashes amber.
C	The tape drive needs to be cleaned. See Locating Management functions .
d	Fiber AL_PA conflict. Two drives on fiber loop have the same AL_PA.
e	Encryption error. Displayed when the drive detects an error that is associated with an encryption operation.
E	Fiber Port offline. Displayed when the drive fiber port received a port bypass command from another port on the Fibre Channel network.

Error code	Meaning
F	Fibre Channel error. No light is displayed if the drive fiber port does not detect light.
P	Write operation to a write protected cartridge was attempted. This action includes any attempt to overwrite a WORM protected tape. Ensure that the tape cartridge is the correct media type. See LTO media .
C	The drive is performing media optimization.

- [SCD dot](#)
- [Status light](#)

SCD dot

If a drive dump is present while the drive is in maintenance mode, a single red dot illuminates in the lower right corner of the SCD. To download the drive dump, see [Locating Management functions](#) or [IBM Tape Diagnostic tool \(ITDT\)](#).

The SCD dot turns OFF when you obtain a dump or update the drive firmware.

Note: If the drive dump is stored in ROM memory (SCD dot ON solid), the dump is lost when you turn OFF the power or reset the drive.

Status light

The Status light is a light-emitting diode (LED) that provides information about the state of the drive. The light can be green or amber, and (when lit) solid or flashing. [Table 1](#) lists the conditions of the Status light and single-character display (SCD) and provides an explanation of what each condition means.

Table 1. Meaning of Status light and single-character display (SCD)

If the Status light is...	And the SCD is...	Meaning
OFF	OFF	The drive has no power or is powered OFF.
Green	OFF	The drive is powered ON and in an idle state.
Flashing green	OFF	The drive is reading from the tape, writing to the tape, rewinding the tape, locating data on the tape, loading the tape, or unloading the tape.
Flashing green	OFF	The drive contains a cartridge during the power-ON cycle. In this case, the drive completes POST and slowly rewinds the tape (the process can take up to ten minutes). The light stops flashing and becomes solid when the drive completes the recovery and is ready for a read or write operation.
Flashing amber	Displaying error code	The drive is displaying error codes from the error code log on the SCD.
Amber	Red numbers, letters, or segments	During the power-on/initialization and POST (power-on self-test), the SCD briefly displays 8 , then becomes blank (not lit) when POST is complete and no POST errors occur. If a POST error is detected, an error code is displayed in the SCD and the Status light flashes amber.
Amber	Flashing 0	The drive is exiting from maintenance mode.
Amber	Flashing function	The drive is running the maintenance function.
Flashing amber once per second	Displaying error code	An error occurred and the drive or media might require service, or it might require cleaning.
Flashing amber once per second	Displaying C	The drive needs cleaning.
Flashing amber twice per second	OFF	The drive is updating firmware.
Flashing amber twice per second	OFF	The drive detected an error and is running a firmware recovery. It resets automatically.
Flashing amber twice per second	Flashing C	The drive is requesting a cartridge to be loaded.
Flashing amber twice per second	OFF	A drive dump is in flash memory.
Flashing green	Displaying C	The drive is performing media optimization.
Power must not be removed from the drive until the microcode update is complete. The drive indicates that the update is complete by resetting and running POST.		

Upgrading and servicing

In this section, you can follow the procedures to add, remove, and replace library components.

Also see the service videos in [IBM TS4300 Tape Library media center](#) for a demonstration of certain procedures.

Recommended tools

- #2 Phillips screwdriver
- Small Flat Head or Torx screwdriver

Identifying a failed component

Check which module contains the failed component. See [Locating faulty Components and Resolving Issues](#). If replacement parts are needed, go to [Replacement parts](#).

- [Internal view of library](#)
- [Adding, removing, or replacing a tape drive](#)
- [Adding or replacing a Base or Expansion Module](#)
- [Adding, removing, or replacing a power supply](#)
- [Replacing a Base or Expansion controller card](#)
- [Installing, removing, or replacing an accessor and spooling mechanism](#)
- [Removing or replacing a spooling mechanism](#)
- [Removing or replacing a magazine](#)
- [Moving the library modules](#)

Internal view of library

Figure 1. Internal view of the library

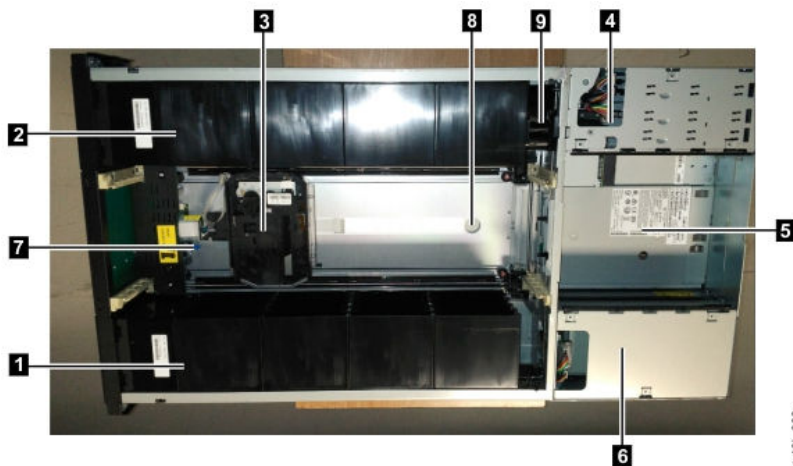


Table 1. Internal view description

Number	Item	Description
1	Right cartridge magazine	If the module is on the bottom, the right cartridge magazine holds 16 cartridges; if anywhere else in the library, it can hold 20 cartridges.
2	Left cartridge magazine	If the module is on the bottom, the left cartridge magazine holds 16 cartridges; if anywhere else in the library, it can hold 20 cartridges.
3	Accessor	This component contains the library accessor and bar code reader. The accessor moves cartridges to and from the • I/O station • Storage slots • Tape drive
4	Controller Card	This component is a customer replaceable unit (CRU) and stores the user configuration information or vital product data (VPD).
5	Tape drive	The module can contain a half-height or a full-height tape drive. The drive is a customer replaceable unit (CRU), and is designed for easy removal and replacement.
6	Power supply	The power supply is a customer replaceable unit (CRU) and the sole source of power for the module. The module is shipped with one power supply, but can contain an optional second power supply for redundancy.

Number	Item	Description
7	Robotic lock lever	This component is used to lock down the accessor so it cannot move. This action is done when the module is moved or when the robotic assembly is removed.
8	Finger hole	One of two finger holes that are used to lift out the accessor assembly. The other is under the accessor in the photograph.
9	Spooling mechanism	This component moves the accessor.

Adding, removing, or replacing a tape drive

	CAUTION: Static Sensitive Risk of damage to devices • A discharge of static electricity damages static-sensitive devices or micro circuitry. • Proper packaging and grounding techniques are necessary precautions to prevent damage.
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Table 1. Pinch hazard

  	CAUTION: Risk of pinching hands or fingers. Can trap hands, fingers, and cause serious injury. Keep hands clear during operation. (L012)
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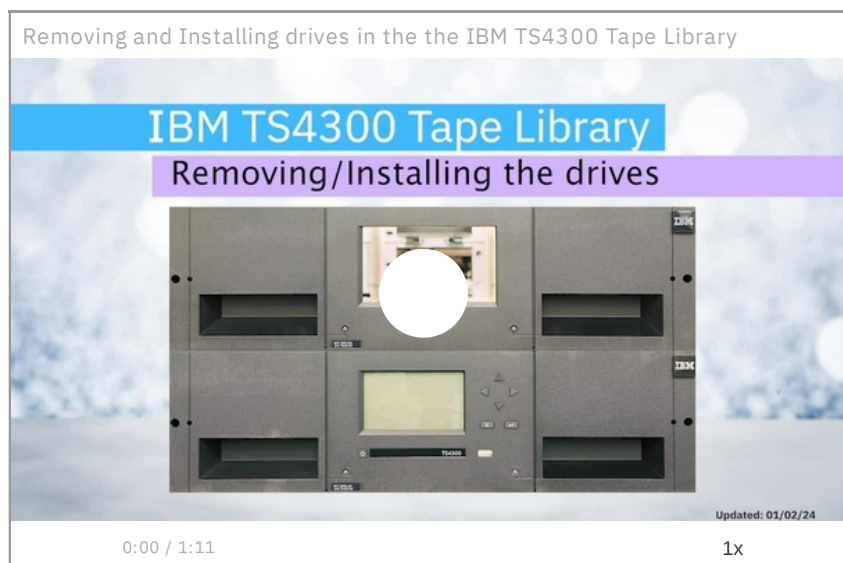
Warning: Only individuals who are informed about the procedures and risks can replace or upgrade this tape drive assembly. Read all troubleshooting documentation and procedures before you proceed with repair or upgrade procedures. Hazardous moving parts exist inside this product. Do not insert tools or any portion of your body into the drive bay openings.

Important: ESD events occurring during tape drive installation or removal may cause SAS link reset on tape drives installed in the library. If this occurs, restart any jobs that were running on affected SAS links.

Before you begin

Read [Numbering scheme overview](#).

Read the topic, [READ and FOLLOW before replacing drives](#), before doing any of the procedures on this page.

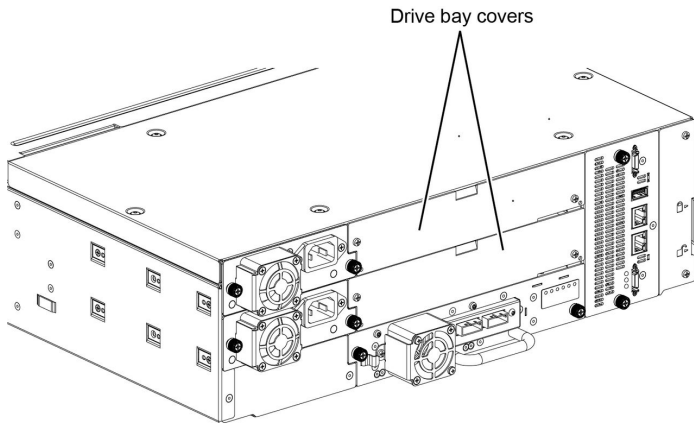


Adding a tape drive

Remember:

- Half-height tape drives can be installed in any drive bay in a module.
 - Full-height tape drives must be installed in the lowest two bays of a module. Installing a full-height drive in the top two bays of a module is not supported.
1. If you are adding a tape drive, remove a drive bay cover. With a Philips screwdriver, remove one half-height drive bay cover to install one half-height drive, or remove two drive bays covers to install a full-height tape drive.

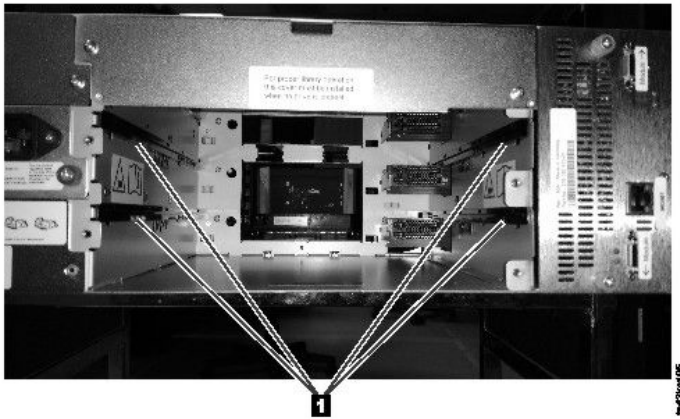
Figure 1. Drive bay covers



Note: A full-height tape drive must be installed in the lowest bay of the module.

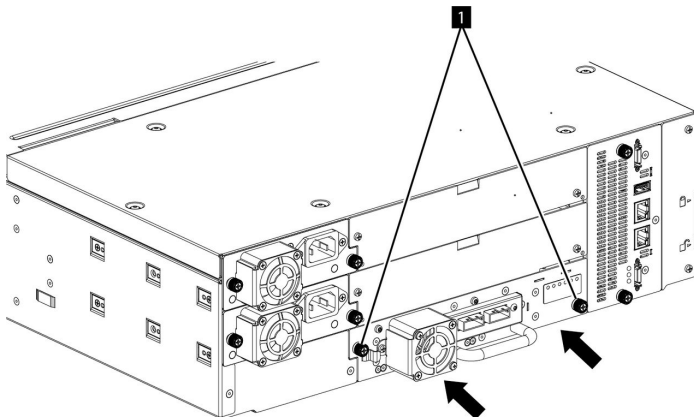
2. Align and slowly insert the new tape drive into the drive bay along the alignment rails (1 in [Figure 2](#)) while the drive assembly is supported. The tape drive must be flush with the back panel of the library.

Figure 2. Alignment rails



3. Tighten the captive thumbscrews (1 in [Figure 3](#)) with your fingers until the tape drive is secure.

Figure 3. Installing a tape drive

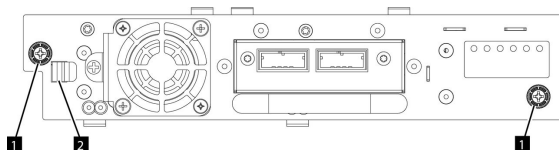


4. Verify the drive operation. Check Library communication LED (10101) on sled is blinking green. At this point drive should be ready on GUI.
5. Use one of the logical library wizards to add the drive to a logical library as needed.

Removing a tape drive

- Ensure that all host activity, including library operations are stopped to the drive that is being removed. Exercise extra caution in case of a control path drive. Removing a control path drive will have severe impact on the operation of logical library the drive was installed in.
- Ensure that the tape cartridge is removed from the tape drive. Use the Management GUI to move the cartridge to a storage slot or I/O station.
- Remove the FC or SAS cables from the tape drive.
- Loosen the blue captive thumbscrews (1 in [Figure 4](#)) on the tape drive. Press the lock lever (2 [Figure 4](#)) to the right and pull straight back on the tape drive handle while the bottom of the drive is supported to remove it from the unit.

Figure 4. Unlocking the drive



Attention: Support the bottom of the tape drive when it is removed to avoid damaging any of the internal connections.

- Execute **Reset the list of known drives and modules**. See [Locating Management functions](#).
- Confirm that the drive is logically removed by checking the Operator Panel or Management GUI.
- If replacement drive is not available, install the drive bay cover.
- If you are replacing the drive, see [Adding a tape drive](#).

Verifying Drive installation and operation

Using the Operator Panel or the Management GUI:

1. Confirm that the library recognizes the new tape drive by checking the Operator Panel or Management GUI. The new drive appears in the module status overview area on the left side of the screen.
2. Use the Management GUI or Operator Panel to verify that the tape drive has the current firmware. Update the firmware if necessary.
3. Use the Management GUI or Operator Panel to test the drive. See [Locating Management functions](#).

Adding or replacing a Base or Expansion Module

	Warning: Product Weight Caution: The weight of this part or unit is between 18.1 and 33.6 kg (40 and 74 lb). It takes two persons to safely lift this part or unit. (C009) Caution: The weight of this part or unit is between 33.6 and 46.3 kg (74 and 102 lb). It takes three persons to safely lift this part or unit. (C010) Risk of personal injury Before a module is moved or lifted • Observe local health and safety requirements and guidelines for manual material handling. • Remove all tapes to reduce the weight and to prevent cartridges from falling into the robotics path and damaging the library. • Remove all tape drives to reduce the weight. • Obtain adequate assistance to lift and stabilize the module during installation or removal. Risk of damage to devices When a module is placed into or removed from a rack • Extend the rack's leveling jacks to the floor. • Ensure that the full weight of the rack rests on the leveling jacks. • Install stabilizing feet on the rack. • Extend only one rack component at a time.
	CAUTION: Parts can be damaged by electrostatic discharge. Keep parts in electrostatic containers until needed. Ensure that you are properly grounded when static sensitive components are touched.

Adding a module: Overview

To add a module to an existing configuration, you will

1. Power down the library.
2. Remove the top or bottom plate of the module. See [Preparing top and bottom modules](#).
3. Install the module into the rack. See [Installing modules in a rack](#).

4. Align and connect the modules. See [Aligning and connecting modules](#).
5. Connect the components and cables. See [Replacing the Module components and cables](#).
6. Connect the power cords, power on the library, and complete [Verifying Library Module installation and configuration](#).
7. Add tape cartridges to the new module.

Replacing a module: Overview

To replace the module, you will

1. Update the library firmware to the minimum code level of 1.2.1.0-A00 or higher.
2. Save the library configuration. See [Saving the configuration](#).
3. Remove tape cartridges and power off the library. See [Removing the magazines and cartridges](#) and [Powering off the library](#).
4. Remove all the components from the module and disconnect the power cords and cables. See [Removing the Module cables](#).
5. Remove the module from the rack. See [Removing the Module from a rack](#).
6. Install the replacement module into the rack. See [Installing the Module into a rack](#).
7. Replace the components and cables. See [Replacing the Module components and cables](#).
8. Connect the power cords, power on the library, and complete [Verifying Library Module installation and configuration](#).
9. Replace the tape cartridges.

You need a T-10 Torx screwdriver to remove the drive bay covers and a small flat head screwdriver. Have several static safe bags available for the boards that are moved to the replacement chassis.

Before the replacement procedure is begun

- Ensure that the rack is level side to side and front to back.
- Verify that any applications that are using the library are idle.

Attention: If the temperature in the room where the replacement module is installed varies by 15 C (59 F) from the room where it was stored, allow it to acclimate to the surrounding environment for at least 12 hours before it is unpacked from the shipping container.

Saving the configuration

See [Locating Management functions](#) for instructions on saving configuration settings to a file or an FAT32 formatted USB flash drive with the Management GUI or with the Operator Panel. This action is needed only for the Base chassis module and only as an extra safety precaution for both chassis and controller card replacement.

Note: Do not do a Save Configuration on a library that is in a failed state. Save the configuration on a working library only.

Removing the magazines and cartridges

For detailed instructions, see [Locating Management functions](#) to open the magazines.

Note: As a best practice, complete this procedure while applications are idle. While the magazine is pulled or removed, the library robotic assembly cannot move media.

Powering off the library

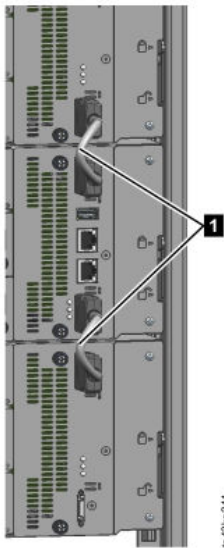
Power off the library from the front panel. Depress Power and hold it for 5 seconds. If the library does not complete a soft shutdown, depress and hold Power for 10 seconds.

Important: Under normal circumstances, when the library is powered off by using the front Power, the robot automatically parks and locks into the Base Module behind the Operator Panel. If you are given a choice during the power down procedure, choose the default park position. To protect the spooling cable or other sensitive parts, the accessor **must** be in the Base Module before any modules are removed from the library. If it is not, follow the procedure for returning the accessor to the base module. See [Returning the accessor to the Base Module](#). Verify that all host processes are idle.

Removing the Module cables

1. Remove the power cords from the module that is replaced.
2. Remove the expansion interconnect cables (1) from the module that is replaced and from the modules that are connected to it.

Figure 1. Interconnect cables



- Note: Completely removing the cables from both ends prevents damaging the expansion interconnect cables during module removal and replacement.
3. Remove any SAS, FC, or Ethernet cables from the module that is replaced.
 4. Remove the USB device, if present.

Removing the tape drives

Remove any tape drives from the module that is replaced. The library tracks the drive locations and issues events if the drives aren't in the expected locations. Note the drive locations so they can be replaced in the same order and drive bays.

1. Use your fingers to loosen the blue captive thumbscrews on the tape drive.
2. Pull straight back on the tape drive handle while the bottom of the drive is supported to remove it from the module.

Attention: Support the bottom of the tape drive when it is removed to avoid damaging any of the internal connections.

Removing the power supplies

While the power supplies are removed, be sure to support the bottom. For detailed instructions, see [Adding, removing, or replacing a power supply](#).

Removing the Base or Expansion controller card

For detailed instructions, see [Replacing a Base or Expansion controller card](#).

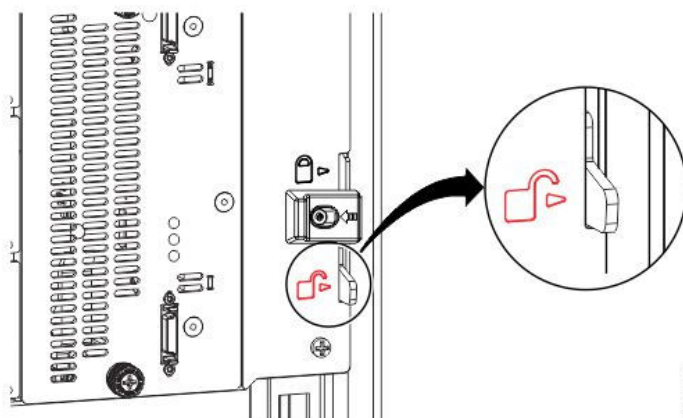
Removing the Module from a rack

Obtain assistance to lift and stabilize the module during removal and replacement.

- If you are removing a module that has a module immediately above or below it,
 1. From the front of the library, use a #2 Phillips screwdriver to loosen the screws two full turns on the module and its adjacent modules.
 2. From the back of the library, unlock the alignment mechanisms that connect the module with the adjacent modules.

Note: If a blue alignment lever lock is attached to the rear of the module, slide it to the left, then move the alignment lever. The lever lock has an internal spring, so hold it while the alignment lever is moved, and it automatically springs back into place after the lever is moved. See [Figure 2](#).

Figure 2. Unlocking or disengaging the alignment lever



From the front of the library, use a #2 Phillips screwdriver and your fingers to loosen the captive thumbscrews screws two full turns on the module to be removed (circled in [Figure 3](#)). Then, slide the module out of the rack.

Figure 3. Loosening the thumbscrews

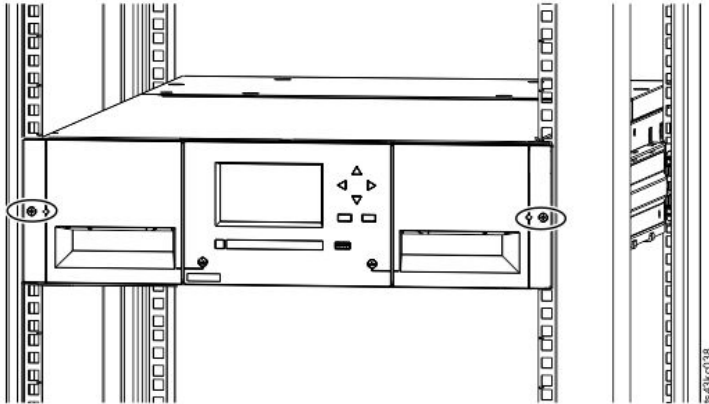
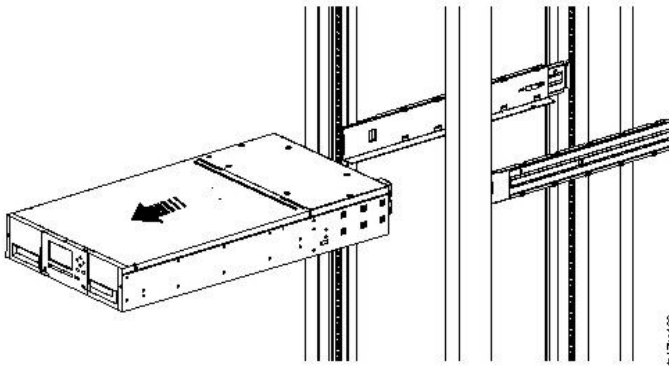


Figure 4. Sliding the module out of the rack



Moving the library cover plates

Unpack the replacement module and place it on a sturdy work surface. Save the packaging materials to return the empty module.

The Base Module has removable top and bottom cover plates. The two covers are identical and the process for removing and installing them is the same for the top and bottom of the module. See [Preparing top and bottom modules](#) for details. While this procedure refers to moving a cover from the Base Module, the information is the same for moving a cover from an Expansion Module. The covers must be removed only if the failed unit does not have the covers (the cover is on another module).

The replacement module is shipped with a bottom cover plate but not a top cover plate. Move the cover plates as necessary so the replacement module has the cover plates in the same location as the empty module and the empty module has a bottom cover plate.

Installing the Module into a rack

See [Installing modules in a rack](#) for details.

Replacing the Module components and cables

Replace the module components by reversing the removal procedures. Align the components carefully in the guide slots and tighten thumbscrews only with your fingers. If the thumbscrews cannot be tightened easily, verify that the component is aligned properly.

1. Replace the controller card. See [Replacing a Base or Expansion controller card](#).
2. Replace the tape drives in the same locations.
Tip: To help align the drive, remove the drive bay covers for one drive at a time.
See [Adding, removing, or replacing a tape drive](#).
3. Replace the magazines in the same locations.
4. Replace the power supplies. See [Adding, removing, or replacing a power supply](#).
5. Reattach any SAS, FC, expansion interconnect, and Ethernet cables that was removed earlier.
6. Reinsert the USB device if you removed it earlier.
7. Reattach the power cords.

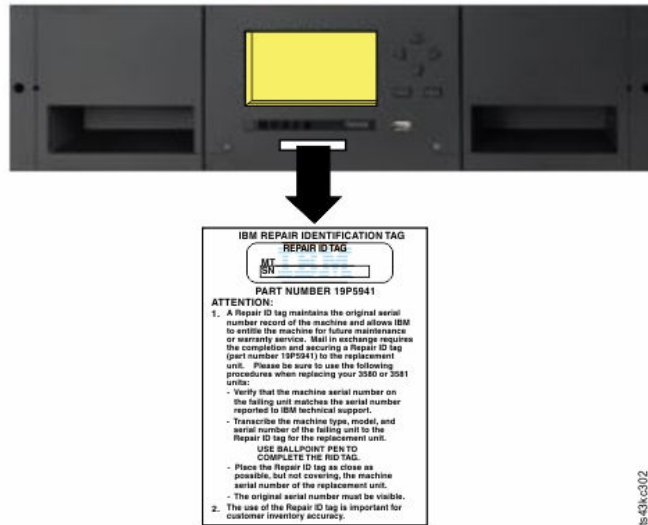
Verifying Library Module installation and configuration

- Power on the library.
- Verify that the library initializes correctly and that the status is Ready.
- Run Library Verify to verify that the replacement module is visible in the Operator Panel or Management GUI.
- If a module was replaced, validate the library configuration in the Management GUI at Library > Logical Libraries.
- Properly complete the Repair Identification (RID) tag that was included with the replacement module.

Note: A RID (Repair Identification) tag maintains the original serial number record of the module to ensure your warranty coverage, if applicable, is not interrupted. The tag is important for customer inventory accuracy. Follow the instructions on the RID tag precisely.

- Copy the serial number of the defective module onto the RID tag.
- Apply the tag to the front of the new replacement module.

Figure 5. Placement of the RID tag (Base Module shown)

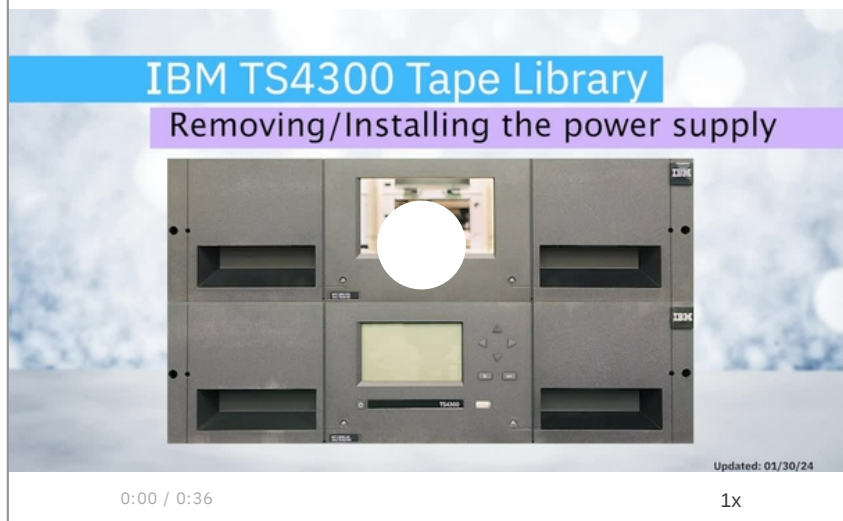


- If a module was added, you must reset your logical libraries by using the basic logical library wizard. See [Locating Management functions](#) to find and run the basic logical library wizard.

Adding, removing, or replacing a power supply

	CAUTION: Static Sensitive Risk of damage to devices • A discharge of static electricity damages static-sensitive devices or micro circuitry. • Proper packaging and grounding techniques are necessary precautions to prevent damage.
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Important: ESD events occurring during power supply installation or removal may cause SAS link reset on tape drives installed in the library. If this occurs, restart any jobs that were running on affected SAS links.



Removing the power supply

Figure 1. Power supplies

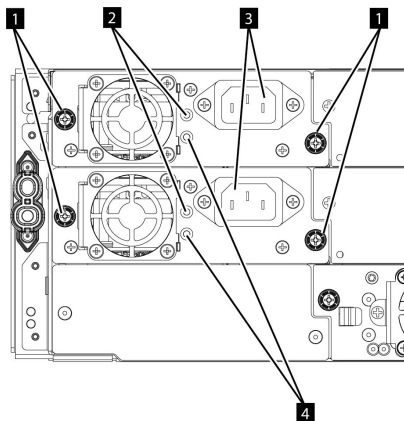


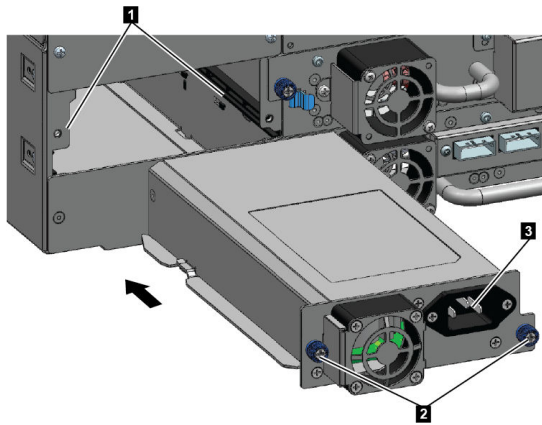
Table 1. Power supply components

1	Blue captive thumbscrews
2	White, lit if the AC power is connected.
3	AC power outlet
4	Green, lit if the Library in turned on.

1. Locate the failed power supply in the rear of the library. A power supply has failed if either the white or green LED is not lit. See the troubleshooting section for more detail.
2. Unplug the AC power cord (3) from the power supply you are replacing.
3. Loosen the two blue captive thumbscrews (1) with your fingers on the power supply.
4. Using the thumbscrews (one on each side), slowly pull the power supply approximately 10 cm (4 inches) from the back of the module.
5. Use one hand to completely remove the power supply from the module, while the other hand is used to support the bottom.

Installing the power supply

Figure 2. Sliding in the new power supply



1. Position the new power supply onto the alignment rails (1).
2. Slide the power supply into the module until it is flush with the back panel of the module.
3. Tighten the blue captive thumbscrews (2) with your fingers to secure it to the module.
4. Attach the AC power cord to the new power supply (3) and plug the power cord into an outlet.

Installing a secondary power supply

1. Remove the power supply face plate. Note that power supplies can only be installed in the top 2 bays.
2. Position the secondary power supply onto the alignment rails.
3. Slide the power supply into the module until it is flush with the back panel of the module.
4. Tighten the blue captive thumbscrews with your fingers to secure it to the module.
5. Attach the AC power cord to the new secondary power supply.

Verifying the power supply installation and operation

1. If AC power is plugged into the power supply and the library is turned on, both the white LED (2 in [Figure 1](#)) and the green LED (4 in [Figure 1](#)) will be lit.
2. Use the Operator Panel or Management GUI to confirm that the power supply is operating correctly. If there was a power supply event, it should now be cleared.

Replacing a Base or Expansion controller card



CAUTION:

- Parts can be damaged by electrostatic discharge. Keep parts in electrostatic containers until needed. Ensure that you are properly grounded when static sensitive components are touched.
- You must power off the library to install or replace this part or damage can occur.

Important: Do not replace both the base chassis and the Base Module controller card with repair components in the same procedure. The firmware does not allow the library to operate if both components are replaced at the same time. Critical library information is saved in the controller card and within the chassis. When one is replaced, the data from the original component is transferred to the repair component. If both the base chassis and Base Module controller are replaced, you must power cycle the library between component replacements.

Saving the configuration

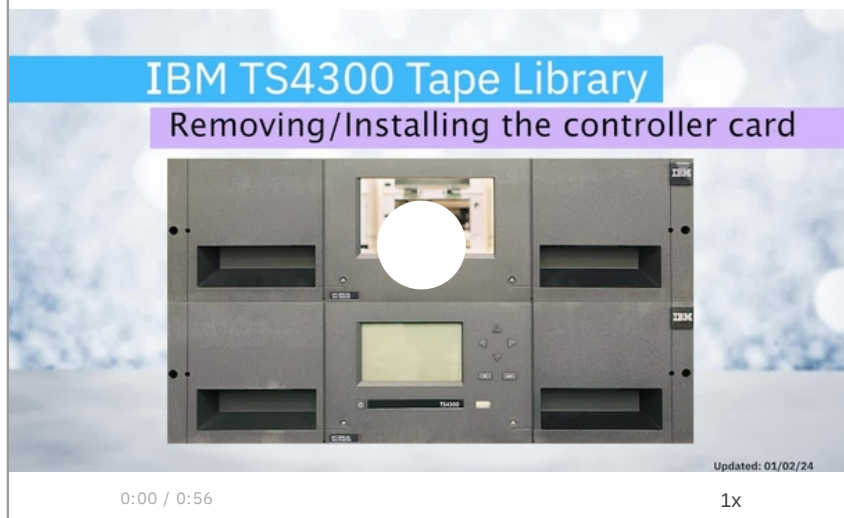
See [Locating Management functions](#) for instructions on saving configuration settings to a file with the Management GUI or with the Operator Panel. This procedure is done when a Base Module controller card is replaced, or as an extra precaution when both the controller card and the module are replaced.

Note: Do not do a Save Configuration on a library that is in a failed state. Save the configuration on a working library only.

Powering off the library

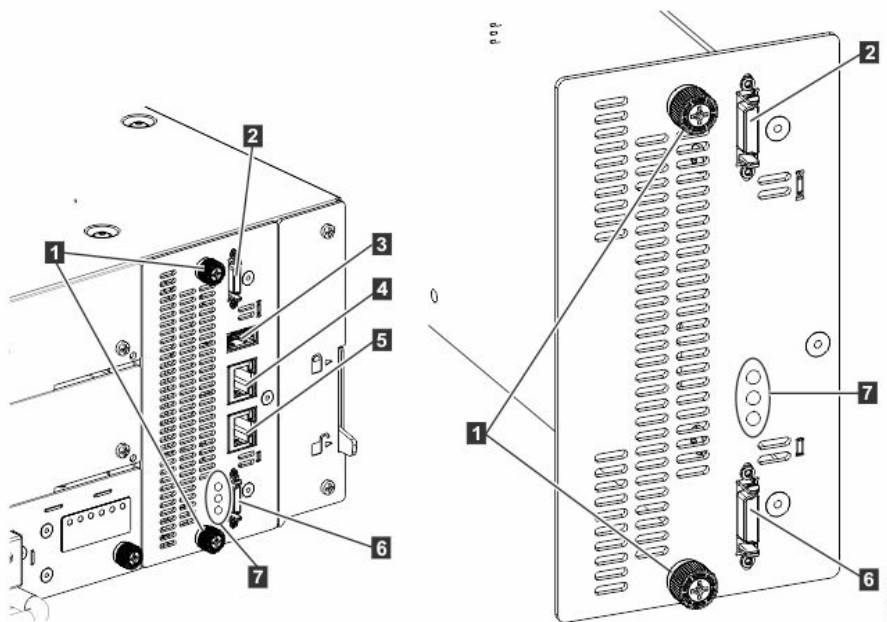
Verify that all host processes are idle, then power off the library from the front panel. Depress Power and hold it for 5 seconds. If the library does not complete a soft shutdown, depress and hold Power for 10 seconds.

Important: Under normal circumstances, when the library is powered off by using the front Power, the robot automatically parks and locks into the Base Module behind the Operator Panel. If you are given a choice during the power down procedure, choose the default park position. To protect the spooling cable or other sensitive parts, the accessor **must** be in the Base Module before any modules or drives are removed from the library. If it is not, follow the procedure for returning the accessor to the base module. See [Returning the accessor to the Base Module](#).



Removing the controller card

Figure 1. Controller card components



Note: The base controller card is on the left, and the expansion controller card is on the right.

Table 1. Controller card components

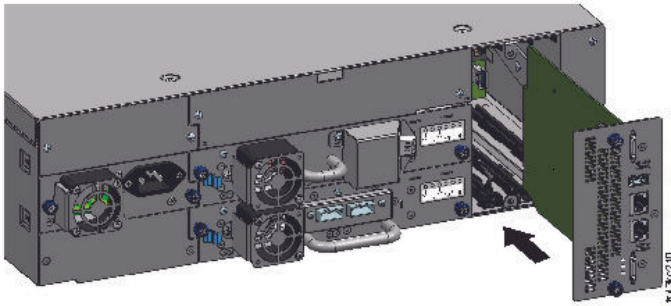
1	Blue captive thumbscrews
2	Upper Expansion Module connection port
3	USB Port
4	Ethernet Port A
5	Ethernet Port B
6	Lower Expansion Module connection port
7	Controller card LEDs, top to bottom - Green Controller Health Status. The flashing LED indicates that the controller is in good health status and properly working. - Yellow Controller Error. This LED turns on if the controller has a hardware issue. In this case, the green LED stops flashing. - Blue Unit Identifier. This LED is a beacon that can be turned on or off through the Management GUI. The LED gives the user an indication that the controller needs attention. See Locating faulty Components and Resolving Issues.

1. Unplug the AC power cables from the module that contains the failed controller card.
2. On the module that contains the failed controller card, remove the expansion interconnect cables (2 and 6) that connect to other modules, if present.
3. Remove the Ethernet cables (4 and 5) and the USB cable (3), if present. (An Expansion Module does not have Ethernet or USB ports. See [Figure 1](#)).
4. Loosen the two blue captive thumbscrews (1) on the controller.

5. Using the thumbscrews, slowly remove the controller from the module.

Installing the Base or Expansion controller card

Figure 2. Installing a Controller card



Important: Base and Expansion Module controller cards are keyed to fit in their respective modules only. A Base Module controller card **does not fit** into an Expansion Module, and vice versa. If you encounter resistance when the controller card is installed, make sure that you are installing the controller card into the appropriate module.

1. Position the new controller card on the alignment rails.
2. Slide the controller card slowly into the module until it is flush with the back panel of the module.
3. Tighten the blue captive thumbscrews (1) with your fingers to secure it to the module.
4. Replace the expansion interconnect cables (2 and 6), the Ethernet cable or cables (4 and 5), and the USB cable (3) that were removed previously. (An Expansion Module does not have Ethernet or USB ports. See [Figure 1](#)).
5. Plug in the AC power cables.

Powering on the library

Power on the library by pressing Power on the Base Module just below the Operator Panel. The green light illuminates. When the library is powered on, it inventories the tape cartridges in the magazines, checks the firmware version on all modules, and configures the tape drives. Then, the library confirms the presence of the existing modules, and searches for any new modules.

Verifying the Base or Expansion controller card

1. Verify that the library has the most up-to-date firmware revision. To find the version of firmware that is installed on the library, check the Library Properties page of the Management GUI or the Status... Library page of the Operator Panel.
2. If the Base Module controller is replaced, upgrade the firmware if necessary. Update the firmware from the Management GUI at Library... Actions... Update Library Firmware.
Important: If you are asked whether to retain the serial number, always select Yes.
3. Check the Attention light on the front panel and login to web interface and check the dashboard for any alerts.
4. With the Operator Panel or the Management GUI, check for any events. The event that indicated that the controller was faulty is cleared.
5. If the base module controller is replaced, the library configuration is automatically restored. Validate the library configuration, and complete a Restore if the library configuration was not restored.
6. If the UID LEDs are still illuminated, deactivate them by using the Operator Panel or Management GUI.
7. Resume the host applications.

Installing, removing, or replacing an accessor and spooling mechanism



CAUTION: Parts can be damaged by electrostatic discharge. Keep parts in electrostatic containers until needed. Ensure that you are properly grounded when static sensitive components are touched.

Powering off the library

Verify that all host processes are idle, then power off the library from the front panel. Depress Power and hold it for 5 seconds. If the library does not complete a soft shutdown, depress and hold Power for 10 seconds.

Important: Under normal circumstances, when the library is powered off by using the front Power, the robot automatically parks and locks into the Base Module behind the Operator Panel. If you are given a choice during the power down procedure, choose the default park position. To protect the spooling cable or other sensitive parts, the accessor **must** be in the Base Module before any components are removed from the library. If it is not, follow the procedure for returning the accessor to the base module. See [Returning the accessor to the Base Module](#).

Preparing to remove the accessor and spooling mechanism from the Base Module



Warning:

When a module is extended from the library - to reduce the risk of personal injury or damage to equipment

- Extend the rack-leveling jacks to the floor.
- Ensure that the full weight of the rack rests on the leveling jacks.
- Verify that the rack is level side to side and front to back.
- Install the rack stabilizer kit on the rack.
- Extend only one rack component at a time. Racks can become unstable if more than one component is extended.

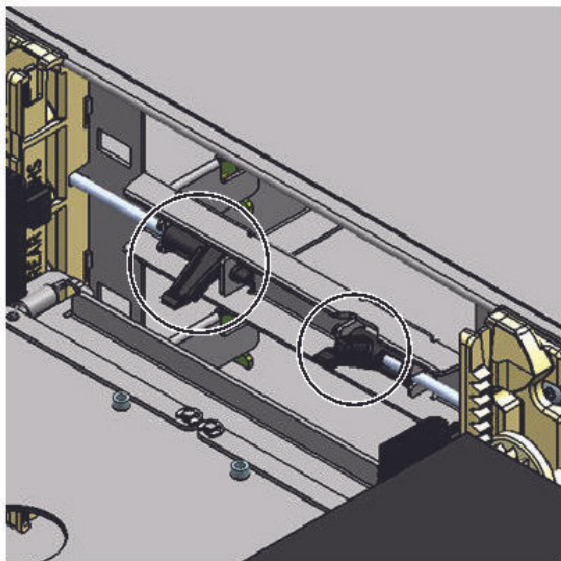
1. Loosen the front captive screws that connect the Base Module to the rack two full turns.
2. If adjacent Expansion Modules exist
 - a. Loosen the front captive screws two full turns on the adjacent expansion modules.
 - b. Unlock the alignment lever.
 - c. Disconnect and completely remove the expansion interconnect cables from the Base Module and from the adjacent modules. Removing the expansion interconnect cables completely prevents damaging the cables when the module is moved in and out of the rack.
3. Disconnect the power supply cables on the Base Module.
4. Disconnect the Ethernet, SAS, and Fibre Channel cables from the Base Module.
5. Completely loosen the front captive screws of the Base Module.
6. Slowly extend the Base Module from the front of the rack and remove it from the rack.
7. Place the Base Module on a flat, level surface, such as a table.
8. Remove the top library cover plate, if present.
 - a. Unlock the top cover with two small screwdrivers.
 - b. Remove the cover from the module.



Removing the accessor and spooling mechanism from the Base Module

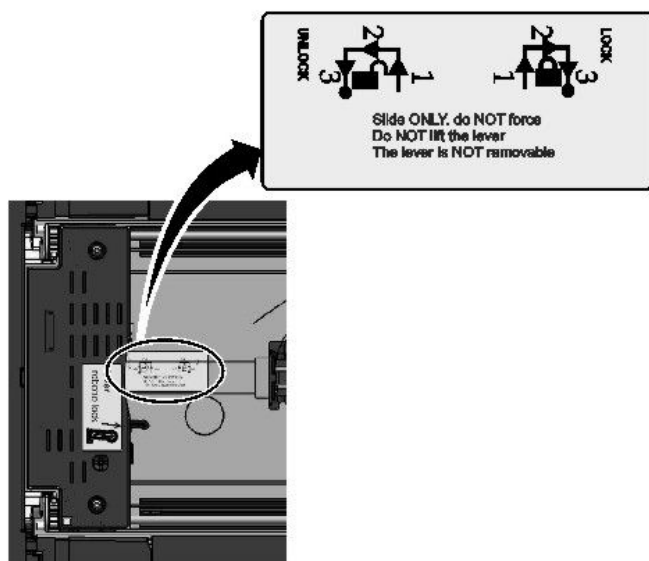
1. Remove the left and right magazines by using the magazine release levers (circled in [Figure 1](#)). Push up on the lever, then pull the magazine out.

Figure 1. Magazine release levers



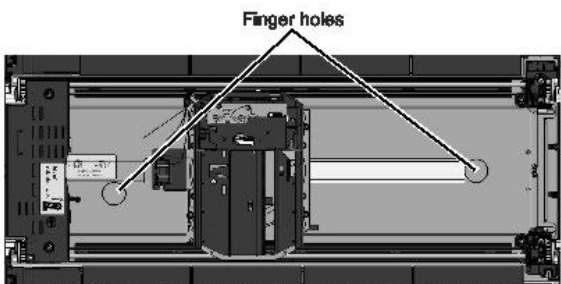
2. Slide the cartridge carrier toward the center of the accessor to access the robot-locking lever.
3. Standing at the front of the module, unlock the robot by moving the blue lever to the left, then toward you, then to the right.

Figure 2. Unlocking the robot



4. Place your fingers into the large holes on the accessor and pull up slowly.
Note: The accessor offers resistance. Lift the accessor no faster than 12 mm (0.5 inches) per second.

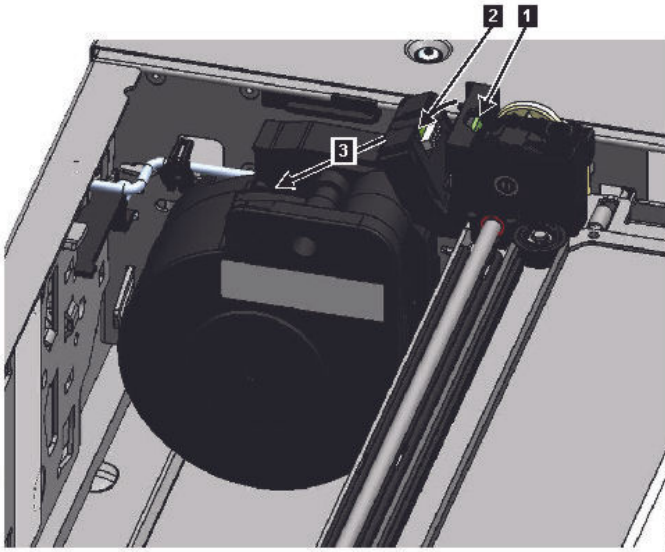
Figure 3. Finger holes



5. Lift the accessor gently from the module and place it on top of the gear mechanism. Take care not to damage the spooling cable.
6. Lock the robot to keep it from lowering
7. On the top of the accessor where the spooling cable is attached, press down on the latch (1 in [Figure 4](#)), then tilt out the piece that holds the spooling cable (2).

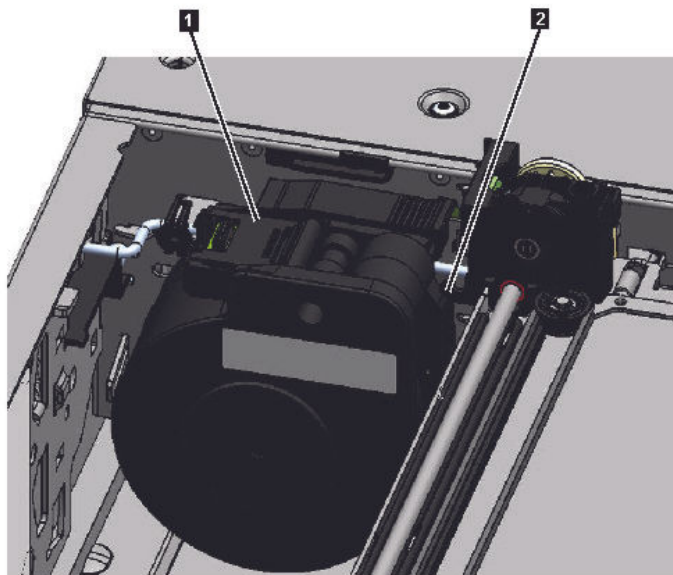
- Note: Note where the end of the spooling cable pivots in the accessor. It is important to know when you attach the new spooling cable to the accessor. See [2](#) in [Figure 5](#).
8. Lift the spooling cable from the accessor and place it in its cradle at the top of the spooling mechanism ([3](#) in [Figure 4](#)).

Figure 4. Unlocking the spooling cable and placing it in its cradle



9. Place the spooling connector ([1](#) in [Figure 5](#)) to the park position.

Figure 5. Spooling cable in park position



10. Unlock the lever and set aside the accessor. See [Figure 2](#).
Important: If a tape cartridge is still in the cartridge carrier, remove the cartridge by lifting it straight up. You might need to move the cartridge slightly from side to side.
11. Replace the spooling mechanism. Refer to [Removing or replacing a spooling mechanism](#).

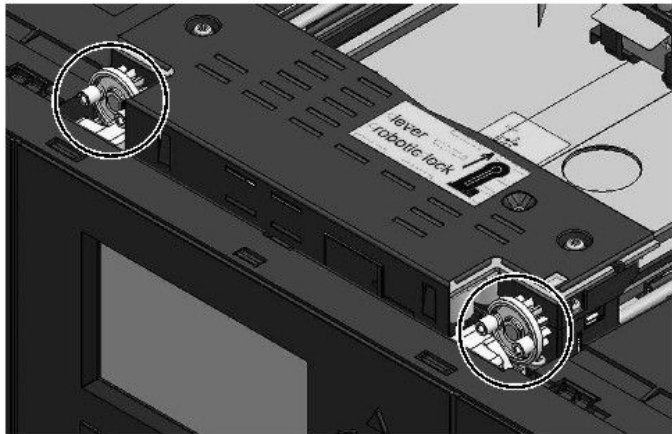
Installing the accessor into the Base Module

Important: If an accessor assembly is replaced, the minimum library firmware must be 1.2.1.0-A00. Go to Library > Actions > Update Library Firmware to update the library firmware.



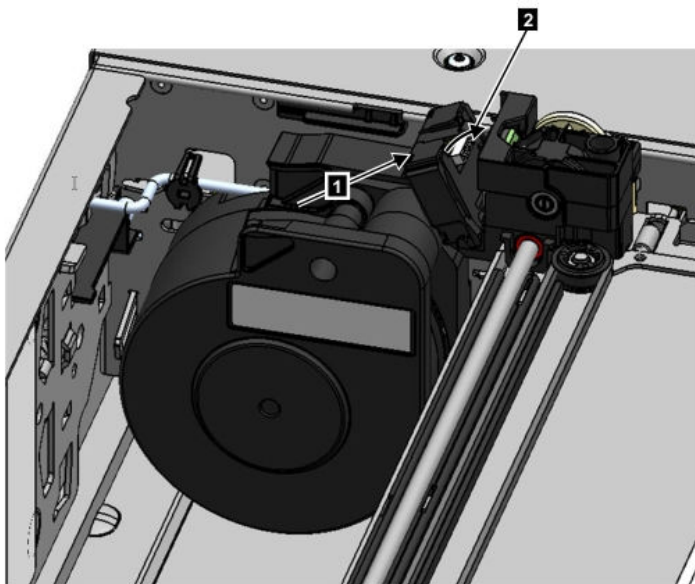
1. Each corner of the accessor has a gear with two protruding pins. Rotate one of the gears on the accessor so that the two pins are aligned horizontally. See [Figure 6](#)

Figure 6. Pins are aligned horizontally



2. The accessor is shipped with the robot in the unlocked position. Verify that the replacement unit is **locked**, then set it on top of the gears.
3. Place the gears of the accessor into the grooves on the inside corners of the module. **Confirm that all four of the pins are touching the outside of the grooves.**
4. Standing at the right side of the module, remove the end of the spooling cable from the park position.
5. Place the spooling cable into the grooves where it attaches to the accessor and rotate it until it snaps into place. See [Figure 7](#).

Figure 7. Installing the spooling cable



6. Unlock the accessor. The accessor drops smoothly. If it does not, check the alignment of the gears.
7. Before the accessor gets to the bottom, lock the robot. Standing at the front of the module, move the blue lever to the left, then away from you, then to the right.
 Tip: If the end of the spooling cable drops into the module, unlock the accessor, remove it from the module, return the end of the spooling cable to its cradle, return the accessor to its previous position in the module, relock the accessor, and repeat the procedure.

After the accessor and spooling mechanism installation

1. Push the magazines back into the module until they lock into place.
2. Replace the top cover on the Base Module if you removed one.
3. Slide the module into the rack.
4. If no adjacent modules exist, tighten the front screws.
5. If adjacent modules exist
 - a. Set the alignment mechanisms to the lock position. If you encounter resistance, adjust the upper module so the pin in the alignment mechanism moves into the hole in the lower module.
 - b. When the alignment mechanism is in the locked position, tighten the front screws on the module
 - c. Reconnect the expansion interconnect cables.
6. Reconnect the Ethernet, SAS, and Fibre Channel cables to the Base Module.
7. Reconnect the power supply cables to the Base Module.
8. Pack the failed accessor and spooling mechanism to return to your service.

Powering on the library

1. Power on the library by pressing Power on the Base Module just below the Operator Panel for 5 seconds.
2. The green light illuminates.
3. When the library is powered on, it inventories the tape cartridges in the magazines, checks the firmware version on all modules, configures the tape drives, confirms the presence of the existing modules, and searches for any new modules.

Verifying the installation

1. Verify that the library powers on and initializes correctly, and that the status is Ready.
2. If the UID LEDs are still illuminated, deactivate them by using the Operator Panel or Management GUI.
3. Run Library Verify to ensure that the library is working correctly.

- [Returning the accessor to the Base Module](#)

Returning the accessor to the Base Module

If you powered off the library and the accessor did not return to its park position in the Base Module behind the Operator Panel.

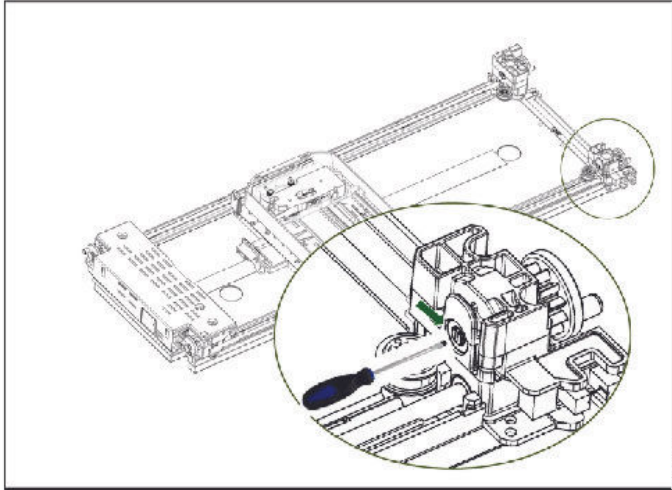
1. Power on the library by pressing Power on the Base Module just below the Operator Panel.
2. Return the accessor to its park position.
3. Power off the library by pressing Power on the Base Module and holding for 5 seconds.

If the accessor is still not in the Base Module, use one of the procedures in the following two sections.

If the accessor is stopped in an Expansion Module that is near the Base Module or is stopped directly between two modules.

1. Remove the front bezel from the Base Module, the Expansion Module containing the accessor, and modules in between as needed.
2. Insert a small flat head screwdriver into the screwdriver relief on the right rear bearing block of the accessor.

Figure 1. Inserting the screwdriver to manually operate the accessor

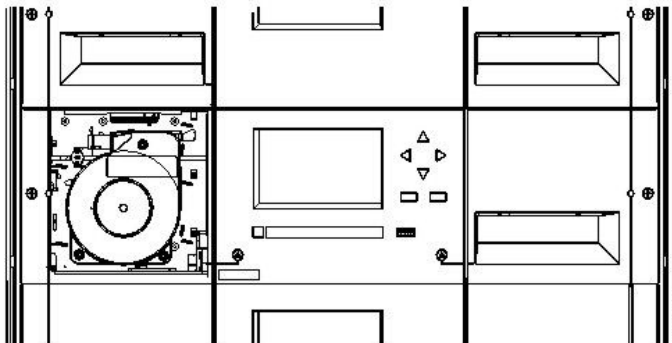


3. Turn the screwdriver to manually operate the accessor gear train and move the accessor into the Base Module.
4. Lock the accessor. Standing at the front of the module, move the blue lever to the left, then away from you, then to the right.
5. Reinstall the bezels that were previously removed.
6. Remove the accessor and spooling mechanism. See [Preparing to remove the accessor and spooling mechanism from the Base Module](#).
7. Install the new accessor and spooling mechanism. See [Installing the accessor into the Base Module](#).
8. Slide the Base Module back into the rack. See [After the accessor and spooling mechanism installation](#).

If the accessor is stopped in an Expansion Module that is not near the Base Module or it cannot move vertically.

1. Remove the left magazine of the Base Module. See [Removing or replacing a magazine](#). The library must already be powered off. Therefore, you must unlock the magazine by using the manual release.
2. Disconnect the power supply cables from all of the modules.
3. Using plastic-handled scissors, reach through the left magazine opening of the Base Module and carefully cut the spooling cable.

Figure 2. Left magazine opening



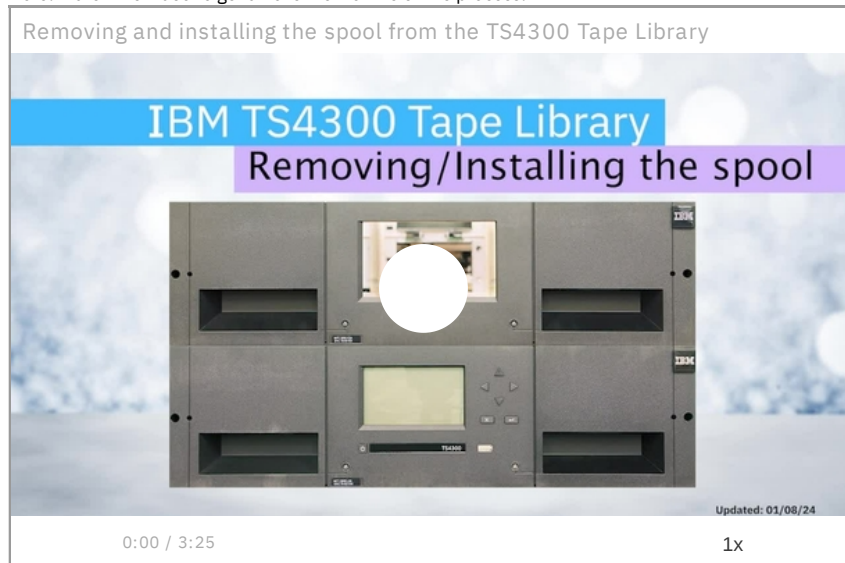
4. Extend the expansion module that contains the accessor while carefully guiding the free spooling cable. See [Preparing to remove the accessor and spooling mechanism from the Base Module](#). While minor differences might occur, these instructions for a Base Module also apply to an Expansion Module.
5. Remove the accessor from the Expansion Module by using Step 1 through Step 7 in [Removing the accessor and spooling mechanism from the Base Module](#).
6. Slide the Expansion Module back into the rack. See [After the accessor and spooling mechanism installation](#). While minor differences might occur, these instructions for a Base Module also apply to an Expansion Module.
7. Extend the Base Module. See [Preparing to remove the accessor and spooling mechanism from the Base Module](#).
8. Remove the spooling mechanism from the Base Module by using Step 8 through Step 10 in [Removing the accessor and spooling mechanism from the Base Module](#).
9. Install the new accessor and spooling mechanism. See [Installing the accessor into the Base Module](#).

10. Slide the Base Module back into the rack. See [After the accessor and spooling mechanism installation](#).

Removing or replacing a spooling mechanism

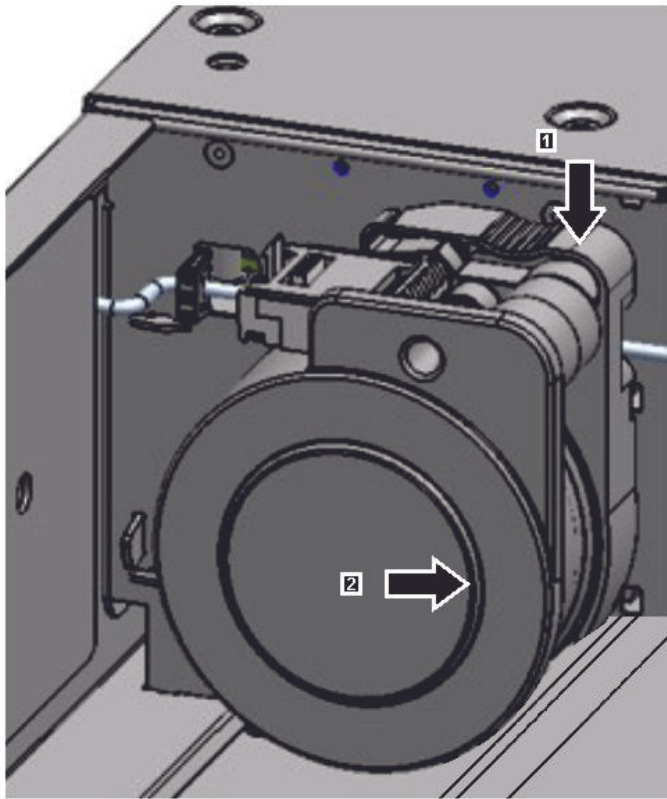
Occasionally, only the robotic spooling cable must be removed and replaced. See [Locating faulty Components and Resolving Issues](#).

Note: Watch the video to get an overview of the entire process:



1. Power down the library.
Important: Under normal circumstances, when the library is powered off by using the front Power, the robot automatically parks and locks into the Base Module behind the Operator Panel. If you are given a choice during the power down procedure, choose the default park position. To protect the spooling cable or other sensitive parts, the accessor **must** be in the Base Module before any components are removed from the library. If it is not, follow the procedure for returning the accessor to the base module. See [Returning the accessor to the Base Module](#).
2. Refer to [Preparing to remove the accessor and spooling mechanism from the Base Module](#) for the steps in preparing your library.
3. Remove the left magazine to provide clear access to the spooling mechanism.
4. Follow the steps in [Removing the accessor and spooling mechanism from the Base Module](#) to remove the accessor, disconnect the spooling cable, and place it in the park position.
5. Push down on the lever on the top of the spooling mechanism (1) and slide about 10 mm towards the center (2) to unlock the mechanism.

Figure 1. Unlocking the spooling mechanism



Note: Make sure that the spooling mechanism is unlocked before you try to pull it out. When the mechanism is unlocked, the cutout behind the mechanism is covered, and the mechanism cannot slide any further to the center.

Figure 2. Unlocked spooling mechanism - enlarged view

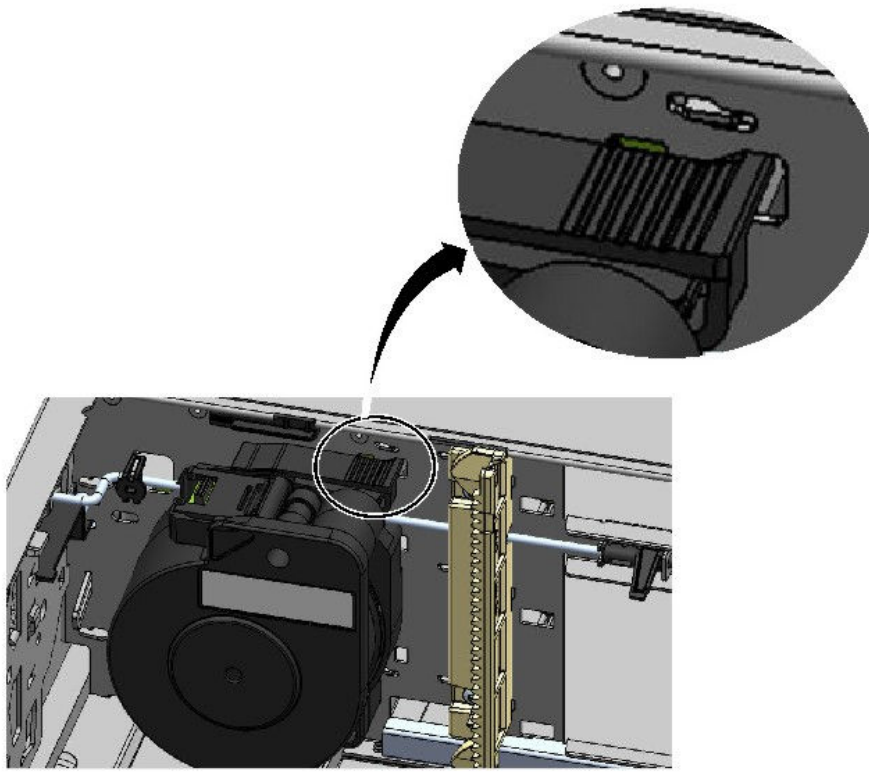
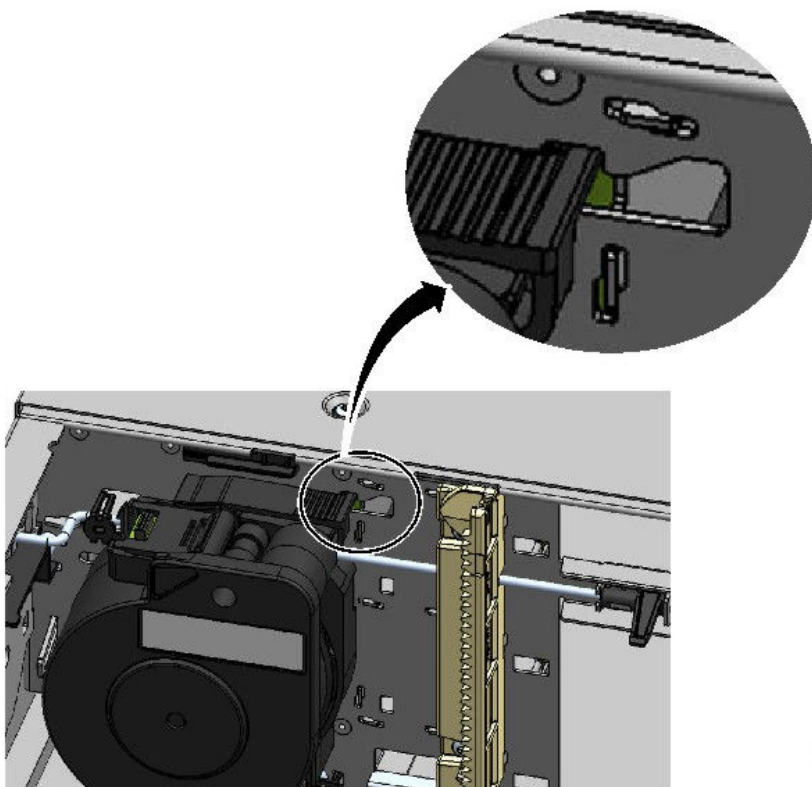


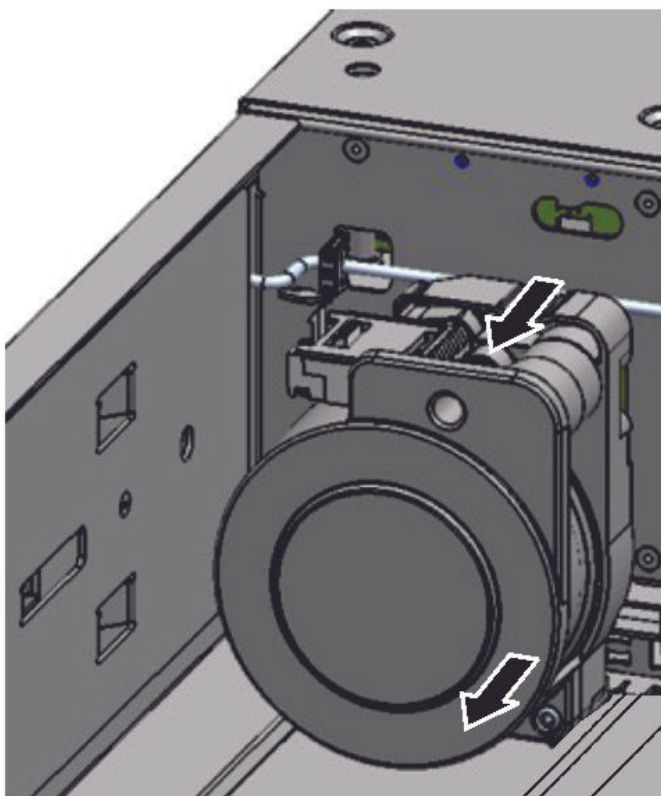
Figure 3. Locked spooling mechanism - enlarged view



4330209

6. Pull the spooling mechanism towards the front of the module to remove it.

Figure 4. Removing the spooling mechanism



4330211

7. Reverse the steps to replace the failed spooling mechanism with the new unit.
8. Follow the steps in [Installing the accessor into the Base Module](#) and [After the accessor and spooling mechanism installation](#) to put the library back into service.

Removing or replacing a magazine

It is recommended that you unlock the magazine with the Operator Panel, Management GUI, or the release button on the front panel. If these methods fail, or if a magazine needs to be removed when the power to the device is off, you can release the magazine manually. Only one magazine or I/O station can be open at a time.

Note: This procedure is completed more effectively while applications are idle. While the magazine is extended, the library robotic assembly cannot move media.

1. Log in as an administrator.
2. Go to Library > Modules and Magazines.
3. On the Actions menu, click Unlock Magazine.
4. Click Open in the left or right magazine column within the module that contains the magazine to be opened.
5. A message box indicates when the magazine is unlocked.
6. Unlock Magazine screen shows that the magazine is now unlocked.

Note: If not removed, the magazine and the I/O station reload after 30 seconds.

To manually eject the magazine, insert a paper clip or a small flat head screwdriver into the appropriate magazine release hole and gently push the tab in. See [Figure 1](#) and [Figure 2](#).

1. Open the magazine access door.
2. Insert a paper clip or a small flat head screwdriver into the appropriate magazine release hole and gently push the tab in.

Figure 1. Manually releasing the right magazine



Figure 2. Manually releasing the left magazine



3. Pull the magazines out of the module.

Moving the library modules

When a library module is moved within the rack, to a different rack, or in a rack to a different physical location, care must be taken to avoid personal injury and damage to the module.

 18.1-33.6 kg (40-74 lbs)	Warning: Product Weight Caution: The weight of this part or unit is between 18.1 and 33.6 kg (40 and 74 lb). It takes two persons to safely lift this part or unit. (C009) Caution: The weight of this part or unit is between 33.6 and 46.3 kg (74 and 102 lb). It takes three persons to safely lift this part or unit. (C010) Risk of personal injury Before a module is moved or lifted: • Observe local health and safety requirements and guidelines for manual material handling. • Remove all tapes to reduce the weight and to prevent cartridges from falling into the robotics path and damaging the library. • Remove all tape drives to reduce the weight. • Obtain adequate assistance to lift and stabilize the module during installation or removal.
 33.6-46.3 kg (74-102 lbs)	

Risk of damage to devices

When a module is placed into or removed from a rack:

- Extend the rack's leveling jacks to the floor.
- Ensure that the full weight of the rack rests on the leveling jacks.
- Install stabilizing feet on the rack.
- Extend only one rack component at a time.

Important: Under normal circumstances, when the library is powered off by using the front Power, the robot automatically parks and locks into the Base Module behind the Operator Panel. If you are given a choice during the power down procedure, choose the default park position. To protect the spooling cable or other sensitive parts, the accessor must be in the Base Module before any drives are removed from the library.

To move a module within a rack or into a different rack:

1. Save the library configuration.
2. Remove the tape cartridges from the tape drives and magazines, and power off the library.
3. Disconnect the power cords and cables, and unlock the alignment mechanisms.
Attention: Failure to disconnect all cables can result to damage to the cable or the mating electronic assembly in the library.
4. Remove the modules from the rack.
5. Remove the rack rails from the rack.
6. Verify that the destination rack is level side to side and front to back.
7. Install the rack rails in the destination rack.
8. Install the modules in the rack.
9. Replace the cables and lock the alignment mechanisms.
10. Connect the power cords, power on the library, and verify the operation.
11. Replace the tape cartridges.

For instructions for these steps, see [Adding or replacing a Base or Expansion Module](#) and [Installing](#).

Reference

This section provides information about the Help pages, REST API, LTO Media, and other reference documentation.

- [Minimum firmware levels for common library features](#)
- [Security](#)
More information for security and encryption protocols.
- [Differences between 21U and 48U libraries 3555](#)
- [Management GUI functions and roles](#)
- [REST API for scalable tape libraries](#)

The REST API is a simple application programming interface (API) to manage the 3U scalable tape libraries remotely over an HTTPS interface. This API is requested and needed for manufacturing and for automated test and monitoring systems.

- [Library Configuration Forms](#)
Make a copy of these forms, and fill them out as you are installing and configuring your library.

- [LTO media](#)
LTO™ media is available in various types. Ensure you choose a media type that your drive supports.

- [Replacement parts](#)
TS4300 tape library has Tier 1 and Tier 2 CRUs (customer replaceable units). These CRUs are parts of the library that must be added, removed, and replaced by the customer. Tier 1 CRUs do not require tools for installation while Tier 2 CRUs need tools for installation.

- [Manual cartridge removal procedure](#)
Follow this procedure if a cartridge must be manually removed and repaired.

- [Accessibility](#)
Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use the HTML version of the customer documentation successfully.

Minimum firmware levels for common library features

Table 1. Minimum firmware levels for common library features

Feature	Minimum Firmware Levels Required
LTO10 (FH) Tape Drives	Library Firmware must be at 1.7.1.1-A00 or greater to support the LTO10 tape drives. Ensure that any host applications and device drivers are at the minimum level that is required to support LTO10 tape drives.
LTO9 (HH/FH) Tape Drives	Library Firmware must be at 1.5.0.0-A00 or greater to support the LTO9 tape drives. Ensure that any host applications and device drivers are at the minimum level that is required to support LTO9 tape drives.
LTO8 (HH/FH) Tape Drives	Library Firmware must be at 1.1.1.0-A00 or greater to support the LTO8 tape drives. Ensure that any host applications and device drivers are at the minimum level that is required to support LTO8 tape drives.
LTO6 (HH/FH) and LTO7 (HH/FH) Tape Drives	Library Firmware must be at 1.1.0.1-A00 or greater to support the LTO6 and LTO7 tape drives. Ensure that any host applications and device drivers are at the minimum level that is required to support LTO6 and LTO7 tape drives.
Library-Managed Encryption	Library Firmware must be at 1.1.1.0-A00 or greater to support the Library-Managed Encryption feature. Ensure that any key manager applications are at the minimum level that is required to support the 3U library. SKLM/GKLM for z/OS encryption requires minimum library firmware 1.2.0.0-B00.

Feature	Minimum Firmware Levels Required
Path Failover (Control Path and Data Path)	Library Firmware must be at 1.1.1.0-A00 or greater to support the Path Failover feature. Ensure that any IBM® device drivers are at the minimum level that is required to support the 3U library.
Remote Logging (rsyslog)	Library Firmware must be at 1.1.1.0-A00 or greater to support the Remote Logging feature. Ensure that any IBM device drivers are at the minimum level that is required to support the 3U library.
LTO™ M8 media	Library Firmware must be at 1.1.1.1-B00 or greater to support the M8 media feature. Drive firmware must be at HB82 or greater to support the M8 media feature. Ensure that any IBM device drivers are at the minimum level that is required to support the 3U library.
Sequential Mode	Library Firmware must be at 1.1.1.2-A00 or greater to support Sequential Mode. Ensure that any host applications are at the minimum level that is required to support the 3U library in this mode.
Library Serial Number 7800K0K or greater	Library firmware must be at 1.2.1.0-A00 or greater to support newer library serial numbers.
Key Path Diagnostics (KPD)	Library Firmware must be at 1.3.0.0-A00 or greater to support KPD.

Security

More information for security and encryption protocols.

- [TLS Support](#)
TS4300 currently supports TLS 1.2 and TLS 1.3.

TLS Support

TS4300 currently supports TLS 1.2 and TLS 1.3.

TLS 1.3 speeds up encrypted connections with advancements such as TLS false start and Zero Round Trip Time (0-RTT).

Differences between 21U and 48U libraries 3555

This section references the differences between a library with the previous 21U height maximum and the current 48U height maximum.

The differences between these two types of libraries can be seen in their maximum configurations. Refer to [Structure and supported library configurations](#).

Library Differences

- The only hardware difference between the two configurations is the spooling cable. A new spooling cable assembly (also referred as spool) is designed to enable the library to extend up to 48U maximum height.
- New library firmware 1.6.1.0 is needed to support a 48U library. Firmware 1.6.1.0 cannot be down-leveled to a previous firmware level.
- The element numbering scheme is different for 21U and 48U libraries. Refer to [Numbering scheme details](#).
- A configuration saved on a 21U Library cannot be restored on a 48U Library. A configuration saved on a 48U Library cannot be restored on a 21U Library. Saved Configurations can only be restored on the same type of library.

How to Distinguish the Library Version

New part numbers are issued for 48U. The new 48U part numbers replace the existing 21U part numbers and the 21U part numbers will no longer be available.

- **From the base unit:**
To check on your base unit, refer to the image to find the part number label. See [Figure 1](#).

Figure 1. L3A 48U



- **From the spool:**
To identify if the Spool is for 21U or 48U, refer to [Figure 2](#).

Figure 2. 48U Label



- **From the GUI:**

Navigate to the 'Config/Spooling' field in GUI (Library > Dashboard > Actions > Properties). It will either display the library configuration, or the entire field will not be present. If the field is missing, it is a 21U Library with firmware older than 1.6.1.0. See [Figure 3](#)

Figure 3. GUI Library Information

Library Properties			
Library Information			
Vendor:	IBM	Product ID:	3573-TL
Serial Number:	3555L3A7800001	Service Tag:	
Base Firmware Revision:	1.6.1.0-C00	Expansion Firmware Revision:	0.41
Robotic Hardware Revision:	4	Robotic Firmware Revision:	0.13
Barcode Reader Hardware Revision:	SE-625	Barcode Reader Firmware Revision:	PAAAMC00-002-N09D0
Host Name:	TL-1C2AC2	IP Address:	IPv4: 9.11.44.138
WWide Node Name:	5000E111C2AC2000	Library Type:	32
Library Config/Spooling:	21U/21U		
Library Status			
Library Status:	Idle	Total Power On Time:	1195d 7h 26m
Cartridge in Transport:	None	Odometer:	2286
Robotic Location:	Module 2 (Base)	Shipping Lock:	Unlocked

Transitions between Configurations

A 21U Library can use 21U parts or 48U parts. A 48U Library can ONLY use 48U parts. DO NOT put 21U CRUs into a 48U Library, it can cause very complex issues.

Only the base unit (L3A) determines the maximum height of a library. To upgrade to a 48U library, only a base unit needs to be ordered and replaced. A 21U base unit cannot be upgraded into a 48U base unit.

An expansion unit is ambivalent to the base unit limitations and can be transferred from a 21U library to a 48U library.

Management GUI functions and roles

The administrator can access all functions of the library and can make changes. Other user roles have restrictions on what features can be accessed or changed. An administrator can give others access to the library but can restrict their full capability. See [Managing](#) for an overview of the four user roles.

Table 1. Management GUI functions and roles
Management GUI Functions and Roles

Management GUI Functions				Roles			
				Admin-istrator	Service	Super-user	Monitor
Library				✓	✓	✓	✓
	Dashboard			✓	✓	✓	✓
		Actions		✓	✓	✓	✓
			Inventory Library	✓	✓	✓	
			Update Library Firmware	✓	✓	✓	
			Export Library Logs	✓	✓	✓	
			Reset Library	✓	✓	✓	
			Turn Identifier (UID) Light On or Off	✓	✓	✓	
			Tests	✓	✓	✓	
			Library Verify	✓	✓	✓	
			Demo Mode	✓	✓	✓	
			Drive Test	✓	✓	✓	
			Slot to Slot Exerciser (0-10 cycles)	✓	✓	✓	✓
			Slot to Slot Exerciser (0-endless)		✓		
			Properties	✓	✓	✓	✓

Management GUI Functions				Roles			
				Admin-istrator	Service	Super-user	Monitor
	Modules and Magazines			✓	✓	✓	✓
		Actions		✓	✓	✓	
			Unlock I/O Station	✓	✓	✓	
			Unlock Magazine	✓	✓	✓	
			Enable or Disable I/O Station	✓	✓	✓	
		Modules		✓	✓	✓	✓
		Refresh		✓	✓	✓	✓
	Logical Libraries			✓	✓	✓	✓
		Actions		✓	✓	✓	✓
			Manage Logical Library (Expert Mode)	✓	✓	✓	
			Manage Logical Library (Basic Mode)	✓	✓	✓	
			Manage Driveless Logical Library	✓	✓	✓	
			Manage KMIP Encryption	✓	✓	✓	
			Manage SKLM for z/OS Encryption	✓	✓	✓	
			Graphical View	✓	✓	✓	✓
		Refresh		✓	✓	✓	✓
		Collapse All		✓	✓	✓	✓
	Events			✓	✓	✓	
		Error and Warning Events		✓	✓	✓	
			Actions	✓	✓	✓	
			Mark All Open Events Inactive	✓	✓	✓	
			Clear Log	✓	✓	✓	
			Include Inactive Events	✓	✓	✓	
		Service Events			✓		
			Actions		✓		
			Clear Log		✓		
		Informational Events		✓	✓	✓	
			Actions	✓	✓	✓	
			Clear Log	✓	✓	✓	
		Configuration Events		✓	✓	✓	
			Actions	✓	✓	✓	
			Clear Log	✓	✓	✓	
		Show All		✓	✓	✓	
Drive				✓	✓	✓	✓
	Drives and Ports			✓	✓	✓	✓
		Actions		✓	✓	✓	
			Modify Port Settings	✓	✓	✓	
			Clean Drive	✓	✓	✓	
			Reset Drive	✓	✓	✓	
			Eject Cartridge from Drive	✓	✓	✓	
			Drive Test	✓	✓	✓	
			Update Drive Firmware	✓	✓	✓	
			Export Service Logs	✓	✓	✓	
		Refresh		✓	✓	✓	✓
		Expand All		✓	✓	✓	✓
Cartridges				✓	✓	✓	✓
	Cartridges and Slots			✓	✓	✓	✓
		Actions		✓	✓	✓	✓
			Inventory Library	✓	✓	✓	
			Move Cartridges	✓	✓	✓	
			Graphical View	✓	✓	✓	
		Search Bar		✓	✓	✓	✓
		Clear		✓	✓	✓	✓
Access				✓	✓		
	Local User			✓			
		Add User		✓			
		Actions		✓	✓		
			Modify User Password (must click user)	✓			
			Modify Role Permissions	✓	✓		

Management GUI Functions					Roles			
					Admin-istrator	Service	Super-user	Monitor
			Modify Operator Panel PIN		✓			
			Remove User (must click user)		✓			
		Filter by name			✓	✓		
	Local Password Policies				✓	✓		
		Password Rules			✓	✓		
			Submit		✓	✓		
	LDAP Authentication				✓	✓		
		LDAP Servers			✓	✓		
			Add Server		✓			
			Actions		✓			
				Modify Server (click server)	✓			
				Remove Server (click server)	✓			
		LDAP Users			✓	✓		
			Add User		✓			
			Actions		✓			
				Modify User	✓			
				Remove User	✓			
		LDAP User Groups			✓	✓		
			Add User Group		✓			
			Actions		✓			
				Modify User Group (click group)	✓			
				Remove User Group (click group)	✓			
	Kerberos Authentication				✓	✓		
		Kerberos Servers			✓	✓		
			Add Server		✓			
			Actions		✓			
				Modify Server (click Server)	✓			
				Remove Server (click Server)	✓			
		Kerberos Users			✓	✓		
			Add User		✓			
			Actions		✓			
				Modify User	✓			
				Remove User	✓			
Settings					✓	✓	✓	✓
	Library				✓	✓	✓	
		Date and Time			✓	✓	✓	
			Time Zone		✓	✓	✓	
			Date Time Format		✓	✓	✓	
			Set Date Time		✓	✓	✓	
			SNTP		✓	✓	✓	
		Licensed Features			✓	✓	✓	
			Add License Key		✓	✓	✓	
			Licensed Key in Systems		✓	✓	✓	
		Firmware Update			✓	✓	✓	
			Firmware Level		✓	✓	✓	
		Advanced			✓	✓	✓	
			Save Configuration File		✓	✓	✓	
			Restore Configuration File		✓	✓	✓	
			Reset Configuration Only		✓	✓	✓	
			Full Factory Reset		✓	✓		
			Reset the list of known Drives and Modules		✓	✓	✓	
		Initial Configuration Wizard			✓	✓	✓	
			Configuration Wizard Application		✓	✓	✓	
		Auto Calibration			✓	✓		
			Start Auto Calibration Wizard		✓	✓		

Management GUI Functions					Roles			
					Admin-istrator	Service	Super-user	Monitor
	Network				✓	✓	✓	
		Ethernet			✓	✓	✓	
			General Network Settings		✓	✓	✓	
			Primary Network Port		✓	✓	✓	
			IPv4		✓	✓	✓	
			Secondary Network Port		✓	✓	✓	
			Reset Internal IP Range (in case of conflict)		✓	✓	✓	
	Notifications				✓	✓	✓	
		Email			✓	✓	✓	
			Email SMTP Settings		✓	✓	✓	
		SNMP			✓	✓	✓	
			SNMP Settings		✓	✓	✓	
		Remote Logging (rsyslog)			✓	✓	✓	
			Remote Logging		✓	✓	✓	
	Security				✓	✓	✓	✓
		Encryption			✓	✓	✓	✓
			Actions		✓	✓	✓	
				Manage KMIP Encryption	✓	✓	✓	
				Manage SKLM for z/OS Encryption	✓	✓	✓	
				Run Key Path Diagnostics	✓	✓	✓	
			Security Encryption Status		✓	✓	✓	✓
			Refresh		✓	✓	✓	✓
		GUI			✓	✓	✓	
			Secure Communications		✓	✓	✓	
			Certificate Settings		✓	✓	✓	
			Create Custom Certificate		✓	✓	✓	
			Backup Custom Certificate		✓	✓	✓	
			Restore Custom Certificate		✓	✓	✓	
			Session Timeout		✓	✓	✓	
			Operator Panel/RMI Session Locking		✓	✓	✓	

REST API for scalable tape libraries

The REST API is a simple application programming interface (API) to manage the 3U scalable tape libraries remotely over an HTTPS interface. This API is requested and needed for manufacturing and for automated test and monitoring systems.

The tape library supports [version 1.1.22](#).

Library Configuration Forms

Make a copy of these forms, and fill them out as you are installing and configuring your library.

Update the forms each time that changes are made to the library configuration and store these forms in a secure location. Having the information on these forms are helpful if a call to IBM® service is necessary.

You can also save library configuration data from the Management GUI. See [Locating Management functions](#).

- [Library information](#)
- [Module and drive information](#)
- [Logical Library information](#)

Library information

General Information	
Library type	TS4300 (MT 3555, 5544)

General Information	
Serial Number	
Host name	
SNTP server	
Encryption License Key	
Path Failover License Key	
Network Settings	
Domain Name	
Network Protocol	IPv4/IPv6
Max. Link Speed	
Method	
IP Address	
Gateway	
DNS1	
DNS2	
Security Settings	
Password Policy	
SSL	
Certificates	
LDAP Server (See also User Accounts)	
LDAP Domain	
Encryption Settings	
Encryption Key Manager Server 1/Port	
Encryption Key Manager Server 2/Port	
Notification Settings	
SMTP Notification Level	
SMTP Server/Port	
SMTP Security	
SMTP Email Address	
SNMP Community Name	
SNMP Notification Level	
SNMP Server/Port 1	
SNMP Server/Port 2	

Module and drive information

Make a copy of this page, for more than 2 modules.

Number	
Number of Power Supplies	
I/O Station Enabled	
Drive 1 (bottom slot) Type	
-- Serial Number	
-- Logical Library Number/Control Path	
-- Port Settings (FC only)	
Drive 2 (middle slot) Type	
-- Serial Number	
-- Logical Library Number/Control Path	
-- Port Settings (FC only)	
Drive 3 (top slot) Type	
-- Serial Number	
-- Logical Library Number/Control Path	
-- Port Settings (FC only)	
Number	
Number of Power Supplies	
I/O Station Enabled	
Drive 1 (bottom slot) Type	
-- Serial Number	
-- Logical Library Number/Control Path	
-- Port Settings (FC only)	
Drive 2 (middle slot) Type	
-- Serial Number	
-- Logical Library Number/Control Path	
-- Port Settings (FC only)	

Drive 3 (top slot) Type	
-- Serial Number	
-- Logical Library Number/Control Path	
-- Port Settings (FC only)	

Logical Library information

Make a copy of this page, for more than 2 logical libraries.

Number	
Name	
Number of Drives	
Number of Slots	
Number of I/O Slots	
Barcode Label Length Rep to Host	
Barcode Label Alignment Rep to Host	
Auto Clean	
Key Manager Type	
LTO7+ Multi-Initiator SCSI Conflict Detection	
Sequential Mode	

Number	
Name	
Number of Drives	
Number of Slots	
Number of I/O Slots	
Barcode Label Length Rep to Host	
Barcode Label Alignment Rep to Host	
Auto Clean	
Key Manager Type	
LTO7+ Multi-Initiator SCSI Conflict Detection	
Sequential Mode	

LTO media

LTO™ media is available in various types. Ensure you choose a media type that your drive supports.

IBM® Ultrium™ media is available in the following types:

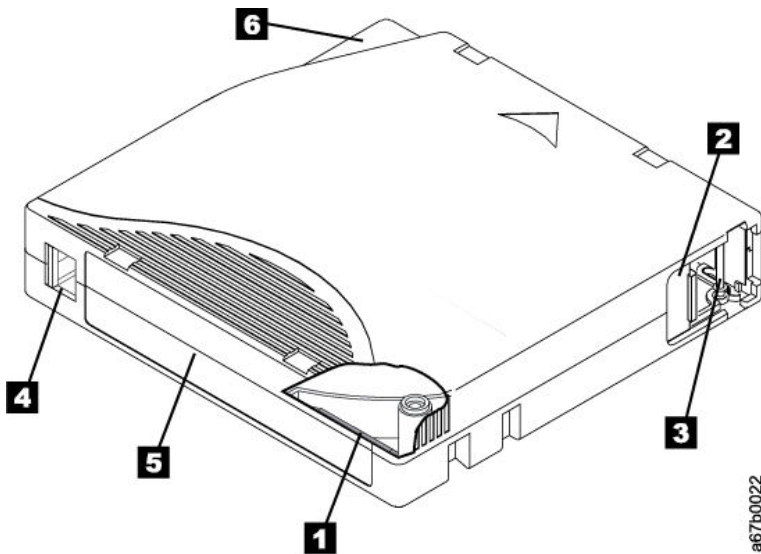
- Data cartridge
- WORM (Write Once, Read Many) cartridge
- Cleaning cartridge

To ensure that your IBM Ultrium tape drive conforms to IBM specifications for reliability, use only IBM LTO Ultrium tape cartridges. You can use other LTO-certified data cartridges, but they might not meet the standards of reliability that are established by IBM. The IBM LTO Ultrium data cartridge cannot be interchanged with the media used in other IBM non-LTO Ultrium tape products.

[Figure 1](#) shows the IBM LTO Ultrium data cartridge and its components.

1	LTO cartridge memory	4	Write-protect Switch
2	Cartridge door	5	Label area
3	Leader Pin	6	Insertion guide

Figure 1. The IBM LTO Ultrium data cartridge



- [Data cartridges](#)
The generations of IBM Ultrium data cartridges are identified by color.
- [WORM \(Write Once, Read Many\) cartridges](#)
Certain records retention and data security applications require a Write Once, Read Many (WORM) method for storing data on tape.
- [Cleaning cartridge](#)
A specially labeled IBM LTO Ultrium Cleaning Cartridge is used to clean the drive head.
- [Cartridge memory chip \(LTO-CM\)](#)
All generations of the IBM LTO Ultrium Data Cartridges include a Linear Tape-Open™ Cartridge Memory (LTO-CM) chip.
- [Bar code label](#)
Data cartridges can have bar code labels for identification..
- [Write-Protect switch](#)
The position of the write-protect switch on the tape cartridge determines whether you can write to the tape.
- [Handling the cartridges](#)
Incorrect handling or an incorrect environment can damage cartridges or their magnetic tape.
- [Inserting a tape cartridge](#)
Several steps for inserting a tape cartridge.
- [Repositioning or reattaching a leader pin](#)
Procedures involved with repositioning or reattaching a leader pin in your cartridge.
- [Disposing of tape cartridges](#)
Current rules about the appropriate disposal of tape cartridges.
- [Ordering media supplies](#)
Information about ordering several generations of media supplies for your tape drive.

Data cartridges

The generations of IBM® Ultrium™ data cartridges are identified by color.

Table 1. Cartridge types and colors

Type	Color
Ultrium 10	Black
Ultrium 10 WORM	Black
Ultrium 9	Teal
Ultrium 9 WORM	Teal and Silvery gray
Ultrium 8	Burgundy
Ultrium 8 WORM	Burgundy and Silvery gray
LTO M8	Purple
Ultrium 7	Purple
Ultrium 7 WORM	Purple and Silvery gray
Ultrium 6	Black
Ultrium 6 WORM	Black and Silvery gray

All generations contain 1/2-inch, dual-coat, magnetic tape.

You can order tape cartridges with the bar code labels included, or you can order custom labels.

When tape is processed in the cartridges, Ultrium tape drives use a linear, serpentine recording format. The native data capacity and recording format of Ultrium data cartridges is as follows:

Table 2. Cartridge data capacity and recording formats

Type	Native Data Capacity	Recording Format
------	----------------------	------------------

Type	Native Data Capacity	Recording Format
Ultrium 10	40 TB (100 TB at 2.5:1 compression)	Reads and writes data on 15104 tracks, 32 tracks at a time.
Ultrium 10	30 TB (75 TB at 2.5:1 compression)	Reads and writes data on 15104 tracks, 32 tracks at a time.
Ultrium 9	18 TB (45 TB at 2.5:1 compression)	Reads and writes data on 8960 tracks, 32 tracks at a time.
Ultrium 8	12 TB (30 TB at 2.5:1 compression)	Reads and writes data on 6656 tracks, 32 tracks at a time.
LTO M8	9 TB (22.5 TB at 2.5:1 compression)*	Reads and writes data on 3584 tracks, 32 tracks at a time.
Ultrium 7	6 TB (15 TB at 2.5:1 compression)	Reads and writes data on 3584 tracks, 32 tracks at a time.
Ultrium 6	2.5 TB (6.25 TB at 2.5:1 compression)	Reads and writes data on 2176 tracks, 16 tracks at a time.

*In any tape product with M8 cartridges, the minimum LTO8 tape drive firmware version is HB82.

The first set of tracks is written from near the beginning of the tape almost to the end of the tape. The head then repositions to the next set of tracks for the return pass. This process continues until all tracks are written and the cartridge is full, or until all data is written.

The cartridge door (2 in [Figure 1](#)) protects the tape from contamination when the cartridge is out of the drive. The tape is attached to a leader pin (3 in [Figure 1](#)) behind the door. 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 non-removable take-up reel. The head can then read or write data from or to the tape.

The write-protect switch (4 in [Figure 1](#)) prevents data from being written to the tape cartridge. For more information, see [Write-Protect switch](#).

The label area (5 in [Figure 1](#)) provides a location to place a label. For more information, see [Bar code label](#).

The insertion guide (6 in [Figure 1](#)) is a large, notched area that prevents the cartridge from being inserted incorrectly.

Table 3. Nominal cartridge life:
Load/unload cycles

Type	Load/Unload Cycles
Ultrium 10	20,000 (20k)
Ultrium 9	20,000 (20k)
Ultrium 8	20,000 (20k)
LTO M8	20,000 (20k)
Ultrium 7	20,000 (20k)
Ultrium 6	20,000 (20k)

- [LTO type M cartridge \(M8\)](#)

The LTO program introduced a new capability with LTO8 tape drives: the ability to write 9 TB (native) on a brand new LTO Ultrium 7 cartridge instead of 6 TB (native) as specified by the LTO7 format.

- [Capacity Scaling](#)

You can control the capacity of data cartridges to obtain faster seek times.

LTO type M cartridge (M8)

The LTO program introduced a new capability with LTO8 tape drives: the ability to write 9 TB (native) on a brand new LTO Ultrium 7 cartridge instead of 6 TB (native) as specified by the LTO7 format.

Such a cartridge is called an LTO7 initialized LTO Type M cartridge. These LTO Type M cartridges are identifiable by using an automation bar code label that ends with the last 2 characters "M8".

Table 1. LTO7 and later Cartridge Types

Cartridge/Density type	Bar code label	Cartridge Packaging/Silkscreen labeling	Native capacity	Tape Drive compatibility
L9	xxxxxxL9	LTO Ultrium 9	18 TB	LTO9
L8	xxxxxxL8	LTO Ultrium 8	12 TB	LTO8
M8	xxxxxxM8	LTO Ultrium 7	9 TB	LTO8
L7	xxxxxxL7	LTO Ultrium 7	6 TB	LTO7, LTO8

From now on, these cartridges are referred to as L9, L8, M8, and L7.

Only new, unused LTO Ultrium 7 cartridges can be initialized as M8 cartridges. When a cartridge is initialized as M8, it cannot be changed back to L7. Initialized M8 cartridges can be written and read only in an LTO8 tape drive. LTO7 tape drives cannot read initialized M8 cartridges.

M8 cartridges can be purchased as either pre-initialized (also referred to as "labeled and initialized") M8 data cartridges or uninitialized M8 data cartridges (M8 WORM cartridges are not supported). For either option, the bar code label is included. However, the uninitialized M8 data cartridge must first be initialized in tape libraries that support the automatic initialization of uninitialized M8 cartridges while under the control of ISV applications that recognize the "M8" bar code label.

A tape cartridge is initialized when it is first loaded into a compatible tape drive and data is written by the ISV application at the beginning of tape (sometimes referred to as "labeling a tape" or "writing from BOT"). The tape drive then establishes the density of the media.

If an uninitialized M8 cartridge is not initialized in a tape library that supports uninitialized M8 cartridges, then the cartridge might inadvertently and silently be initialized at the L7 density (that is, at a 6 TB native capacity) even if the bar code label states "M8". This action might occur with the usage of a non LTO8 tape drive, a stand-alone LTO7 tape drive, a stand-alone LTO8 tape drive, earlier LTO8 tape drive firmware, or earlier ISV software that does not recognize that M8 cartridges must be mounted only in LTO8 tape drives. M8 cartridges that are inadvertently initialized at the L7 density can continue to be read and written in LTO7 and LTO8 tape drives. However, they remain limited to the 6 TB native capacity.

In any tape product with M8 cartridges, the minimum LTO8 tape drive firmware version is HB82.

Capacity Scaling

You can control the capacity of data cartridges to obtain faster seek times.

To control the capacity of the cartridge (for example, to obtain a faster seek time) issue the SCSI command **SET CAPACITY**. For information about this command, refer to the *IBM® Ultrium Tape Drive SCSI Reference*.

WORM (Write Once, Read Many) cartridges

Certain records retention and data security applications require a Write Once, Read Many (WORM) method for storing data on tape.

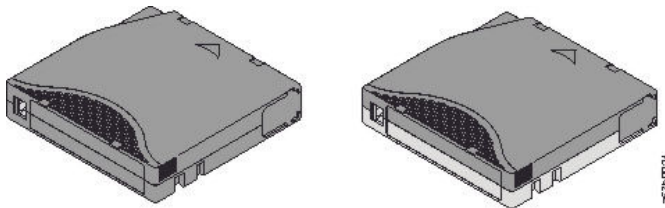
The LTO Ultrium 4 and later drives enable WORM support when a WORM tape cartridge is loaded into the drive.

- [WORM media](#)
- [Data security on WORM media](#)
Certain built-in security measures help ensure that the data that is written on a WORM cartridge does not become compromised.
- [WORM media errors](#)
Several conditions can cause WORM media errors to occur.
- [WORM requirements](#)
You can add WORM capability to your IBM® Ultrium™ tape drive.

WORM media

The standard read/write media are incompatible with the WORM feature so a specially formatted WORM tape cartridge is required, see [Figure 1](#). Each WORM cartridge has a unique, worldwide cartridge identifier (WWCID), which comprises the unique CM chip serial number and the unique tape media serial number. For more information about how to choose and purchase the appropriate WORM tape cartridges for your tape drive, see the section on ordering media supplies.

Figure 1. Ultrium Data and WORM Tape Cartridges



Data security on WORM media

Certain built-in security measures help ensure that the data that is written on a WORM cartridge does not become compromised.

For example:

- The format of an Ultrium WORM Tape Cartridge is not the same as the standard read/write media. This unique format prevents a drive that lacks WORM-capable firmware from writing on a WORM tape cartridge. For LTO 9, native data capacity is 18 TB and compressed data capacity is 45 TB.
- When the drive senses a WORM cartridge, the firmware prohibits the changing or altering of user data that is already written on the tape. The firmware notes the last point on the tape that can be appended.

WORM media errors

Several conditions can cause WORM media errors to occur.

- Information in the servo manufacturer's word (SMW) on the tape must match information from the cartridge memory (CM) module in the cartridge. If it does not match, a media Error Code [7](#) posts on the drive's single-character display (SCD).
- Inserting a WORM tape cartridge into a drive that is not compatible with WORM causes the cartridge to be treated as an unsupported medium. The drive reports a media Error Code [7](#). Upgrading the drive firmware to the correct code level resolves the problem.

WORM requirements

You can add WORM capability to your IBM® Ultrium™ tape drive.

To add WORM capability to your IBM LTO™ Ultrium 9 drives, you must use IBM Ultrium 9 WORM tape cartridges (18 TB), or IBM Ultrium 8 tape cartridges (12 TB).

To add WORM capability to your IBM LTO Ultrium 10 drives, you must use IBM Ultrium 10 WORM tape cartridges (30 TB)

Cleaning cartridge

A specially labeled IBM® LTO™ Ultrium™ Cleaning Cartridge is used to clean the drive head.

The drive itself determines when a head must be cleaned. It alerts you when the single-character display (SCD) flashes a . To clean the head manually, insert a cleaning cartridge into the tape load compartment. The drive completes the cleaning automatically. When the cleaning is finished, the drive ejects the cartridge, and the SCD is blank.

Note: The drive automatically ejects an expired cleaning cartridge without running the cleaning process. Replace the expired cleaning cartridge with a new cleaning cartridge and insert it into the drive.

The IBM cleaning cartridges are valid for 50 uses. The cartridge's LTO-CM chip tracks the number of times that the cartridge is used.

Important: After 50 uses, the cleaning cartridge expires. It is no longer usable, and must be replaced

Cartridge memory chip (LTO-CM)

All generations of the IBM® LTO™ Ultrium™ Data Cartridges include a Linear Tape-Open™ Cartridge Memory (LTO-CM) chip.

The Linear Tape-Open Cartridge Memory (LTO-CM) chip (1 in [Figure 1](#)) holds information about that specific cartridge, the media in the cartridge and the data on the media. The LTO-CM enhances the efficiency of the cartridge. For example, the LTO-CM stores the end-of-data location. When the cartridge is inserted and the **Write** command is entered, the drive can quickly locate the recording area and begin recording. The LTO-CM also aids in determining the reliability of the cartridge by storing data about its age, how many times it was loaded, and how many errors it accumulated. When you unload a tape cartridge, the tape drive writes any pertinent information to the cartridge memory.

The storage capacity of the Generation 9, and 10 LTO-CM is 32640 bytes. This capacity is double that of Generations 6, 7, and 8 LTO-CM (16320 bytes), and four times the capacity of Generations 5 and 4 LTO-CM, which is 8160 bytes. LTO Generations 1, 2, and 3 have an LTO-CM capacity of 4096 bytes.

Bar code label

Data cartridges can have bar code labels for identification..

A bar code label contains:

- A volume serial number (VOLSER) that is human-readable.
- A bar code that the library can read.

Note: The LTO Ultrium 9 tape drives do not require bar code labels, but you might choose to use labels for tape cartridge identification purposes. LTO tape drives do not require tape cartridges to have bar code labels. However, IBM libraries require tape cartridges to have bar code labeled on them for automation and human readability.

Table 1. Bar code label requirements for Ultrium tape drives and libraries

Ultrium Tape Drive/Library	Bar Code Label Requirements
5544	Required
3555	Required
3573	Required
3576	Required
3580	Not required
3581	Required with optional Bar Code Reader
3582	Required
3583	Required
3584	Required

When read by a library's bar code reader, the bar code identifies the cartridge's VOLSER to the library. The bar code also tells the library whether the cartridge is a data cartridge or cleaning cartridge. In addition, the bar code includes the two-character media-type identifier, see [Table 2](#).

[Figure 1](#) shows a sample bar code label for the LTO Ultrium Tape Cartridge.

Tape cartridges are ordered with the labels included or with custom labels. To order tape cartridges and bar code labels, see the section on ordering media supplies. The bar code for usage in IBM® tape libraries must meet predefined specifications. They include (but are not limited to):

- Eight uppercase alphanumeric characters, where the last 2 characters refer to the cartridge generation and WORM capability. See [Table 2](#).
- Label and printing to be non-glossy.
- Nominal narrow line or space width of 0.423 mm (0.017 in.)
- Wide to narrow ratio of 2.75:1.
- Minimum bar length of 11.1 mm (0.44 in.)

Table 2. Cartridges and VOLSERs compatible with the LTO tape drives

Cartridges	VOLSER
Ultrium 10 Data Cartridge	xxxxxxPA
Ultrium 10 Data Cartridge	xxxxxxLA
Ultrium 10 WORM Cartridge	xxxxxxLH
Ultrium 9 Data Cartridge	xxxxxxL9
Ultrium 9 WORM Cartridge	xxxxxxLZ
Ultrium 8 Data Cartridge	xxxxxxL8
Ultrium 8 WORM Cartridge	xxxxxxLY
LTO M8 Cartridge	xxxxxxM8
Ultrium 7 Data Cartridge	xxxxxxL7
Ultrium 7 WORM Cartridge	xxxxxxLX
Ultrium 6 Data Cartridge	xxxxxxL6
Ultrium 6 WORM Cartridge	xxxxxxLW
LTO Ultrium Cleaning Cartridge	CLNxxxLx

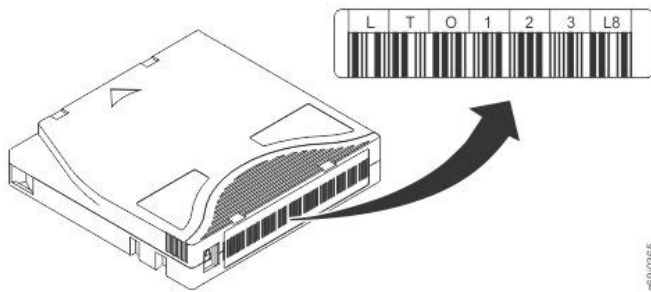
*An Ultrium 3 Tape Drive must have a minimum firmware level of 54xx for it to be compatible with the WORM cartridge.

To determine the complete specifications of the bar code and the bar code label, visit the web at <http://www.ibm.com/> and enter "IBM LTO Ultrium Cartridge Label Specification" in the search box. Or contact your IBM sales representative.

When a bar code label is attached to a tape cartridge, place the label only in the recessed label area (see **5** in [LTO media](#)). A label that extends outside of the recessed area can cause loading problems in the drive.

Attention: Do not place any type of mark on the white space at either end of the bar code. A mark in this area might prevent the library from reading the label.

Figure 1. Sample bar code label on the LTO Ultrium Tape Cartridge. The volume serial number (LTO123) and bar code are printed on the label.



- [Guidelines for bar code labels](#)
Apply some basic guidelines when you use bar code labels for your data cartridges.

Guidelines for bar code labels

Apply some basic guidelines when you use bar code labels for your data cartridges.

- Use only IBM-approved bar code labels on cartridges to be used in an IBM® tape library.
- Do not reuse a label or reapply a used label over an existing label.
- Before you apply a new label, remove the old label by slowly pulling it at a right angle to the cartridge case.
- Use peel-clean labels that do not leave a residue after it is removed. If there is glue residue on the cartridge, remove it by gently rubbing it with your finger. Do not use a sharp object, water, or a chemical to clean the label area.
- Examine the label before it is applied to the cartridge. Do not use the label if it has voids or smears in the printed characters or bar code. A library's inventory operation takes much longer if the bar code label is not readable.
- Remove the label from the label sheet carefully. Do not stretch the label or cause the edges to curl.
- Position the label within the recessed label area (see **5** in [Figure 1](#)).
- With light finger pressure, smooth the label so that no wrinkles or bubbles exist on its surface.
- Verify that the label is smooth and parallel, and has no roll-up or roll-over. The label must be flat to within 0.5 mm (0.02 in.) over the length of the label and have no folds, missing pieces, or smudges.
- Do not place other machine-readable labels on other surfaces of the cartridge. They might interfere with the ability of the drive to load the cartridge.

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 (**1**) is set to:

- The locked position  (solid red). Data cannot be written to the tape.
- The unlocked position (black void). Data can be written to the tape.

If possible, use your server's application software to write-protect your cartridges (rather than manually setting the write-protect switch). This setting allows the server's 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 tape drive is not able to write new data to them.

If you must manually set the write-protect switch, slide it left or right to the wanted position.

Figure 1. Setting the write-protect switch

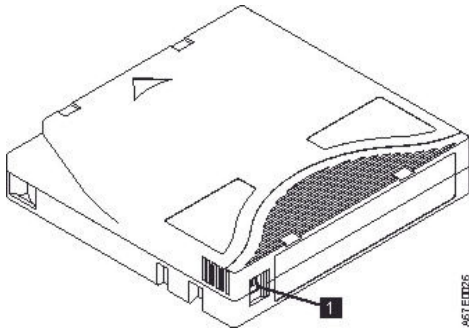


Table 1. Location of the write-protect switch

1	Write-protect switch
---	----------------------

Handling the cartridges

Incorrect handling or an incorrect environment can damage cartridges or their magnetic tape.

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

To avoid damage to your tape cartridges and to ensure the continued high reliability of your IBM® LTO Ultrium tape drives, use the following guidelines:

- **[Providing training](#)**
Providing training to the users of your tape drive can prolong the life of your tape cartridges.
- **[Ensuring proper packaging](#)**
When you ship or store data cartridges, ensure that they are packed securely.
- **[Proper acclimation and environmental conditions](#)**
Acclimate a tape cartridge to the operating environment before you use it.
- **[Completing a thorough inspection](#)**
Complete a thorough inspection of your tape cartridge before you use it.
- **[Handling the cartridge carefully](#)**
Handle tape cartridges carefully.
- **[Examples of cartridge problems](#)**
Several examples of cartridge problems.

Providing training

Providing training to the users of your tape drive can prolong the life of your tape cartridges.

- Post procedures that describe appropriate media handling in places where people gather.
- Ensure that anyone who handles tape is properly trained in handling and shipping procedures. This training includes operators, users, programmers, archival services, and shipping personnel.
- Ensure that any service or contract personnel who complete archiving procedures are properly trained in media-handling procedures.
- Include media-handling procedures as part of any services contract.
- Define and make personnel aware of data recovery procedures.

Ensuring proper packaging

When you ship or store data cartridges, ensure that they are packed securely.

About this task

- When a cartridge is shipped, use the original or better packaging.
- Always ship or store a cartridge in a jewel case.
- Use only a recommended shipping container that securely holds the cartridge in its jewel case during transportation. Ultrium Turtlecases (by Perm-A-Store) are tested and found to be satisfactory (see [Figure 1](#)). They are available at <http://www.turtlecase.com>.

Figure 1. Tape cartridges in a Turtlecase



- Never ship a cartridge in a commercial shipping envelope. Always place it in a box or package.
- If you ship the cartridge in a cardboard box or a box of a sturdy material, ensure that you
 - Place the cartridge in polyethylene plastic wrap or bags to protect it from dust, moisture, and other contaminants.
 - Pack the cartridge snugly; do not allow it to move around.
 - Double-box the cartridge (place it inside a box, then place that box inside the shipping box) and add padding between the two boxes (see [Figure 2](#)).

Figure 2. Double-boxing tape cartridges for shipping



Proper acclimation and environmental conditions

Acclimate a tape cartridge to the operating environment before you use it.

About this task

- Before you use a tape cartridge, acclimate it to the operating environment for 24 hours or the time necessary to prevent condensation in the drive. The time varies, depending on the environmental extremes to which the cartridge was exposed.
- Ensure that all surfaces of a cartridge are dry before it is inserted.
- Do not expose the cartridge to moisture or direct sunlight.
- Do not expose recorded or blank cartridges to stray magnetic fields of greater than 100 oersteds (for example, terminals, motors, video equipment, X-ray equipment, or fields that exist near high-current cables or power supplies). Such exposure causes the loss of recorded data or makes the blank cartridge unusable.
- Maintain the conditions that are described in [Environmental and shipping specifications for tape cartridges](#).

Completing a thorough inspection

Complete a thorough inspection of your tape cartridge before you use it.

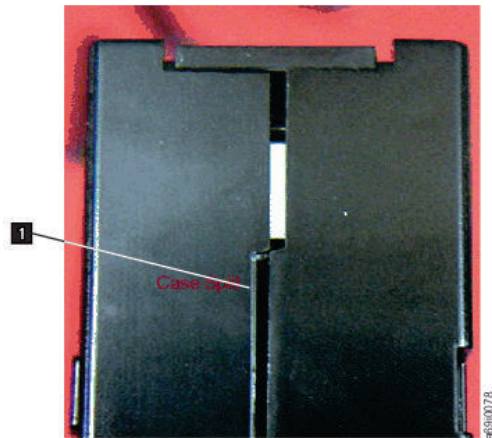
About this task

After a cartridge is purchased and before it is used, complete the following steps:

- Inspect the cartridge 's packaging to determine potential rough handling.
- When a cartridge is inspected, 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 it is used or stored.

- Inspect the rear of the cartridge (the part that loads first into the tape load compartment) and ensure that there are no gaps in the seam of the cartridge case (see **1** in [Figure 1](#) and **4** in [Figure 2](#)). If there are gaps in the seam (see [Figure 1](#)), the leader pin might be dislodged. Go to [Repositioning or reattaching a leader pin](#).

Figure 1. Checking for gaps in the seams of a cartridge



- Check that the leader pin is properly seated (see **2** in [Figure 1](#)).
- If you suspect that the cartridge was mishandled but it appears usable, copy any data onto a good cartridge immediately for possible data recovery. Discard the mishandled cartridge.
- Review handling and shipping procedures.

Handling the cartridge carefully

Handle tape cartridges carefully.

About this task

- Do not drop the cartridge. If the cartridge drops, slide the cartridge door back and ensure that the leader pin is properly seated in the pin-retaining spring clips. See **2** in [Figure 1](#). If the leader pin becomes dislodged, go to [Repositioning or reattaching a leader pin](#).
- Do not handle tape that is outside the cartridge. Handling the tape can damage the tape's surface or edges, 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.

Examples of cartridge problems

Several examples of cartridge problems.

About this task

Split cartridge case. See [Figure 1](#).

The cartridge's case is damaged. There is a high possibility of media damage and potential loss.

Procedure

1. Look for cartridge mishandling.
2. Use the IBM Leader Pin Reattachment Kit (part number 08L9129) to correctly seat the pin (see [Repositioning or reattaching a leader pin](#)). Then, immediately use data recovery procedures to minimize chances of data loss.
3. Review media-handling procedures.

Results

Improper placement of leader pin. See [Figure 1](#).

The leader pin is misaligned.

1. Look for cartridge damage.
2. Use the IBM® Leader Pin Reattachment Kit (part number 08L9129) to correctly seat the pin (see [Repositioning or reattaching a leader pin](#)). Then, immediately use data recovery procedures to minimize chances of data loss.

Inserting a tape cartridge

Several steps for inserting a tape cartridge.

About this task

To insert a tape cartridge:

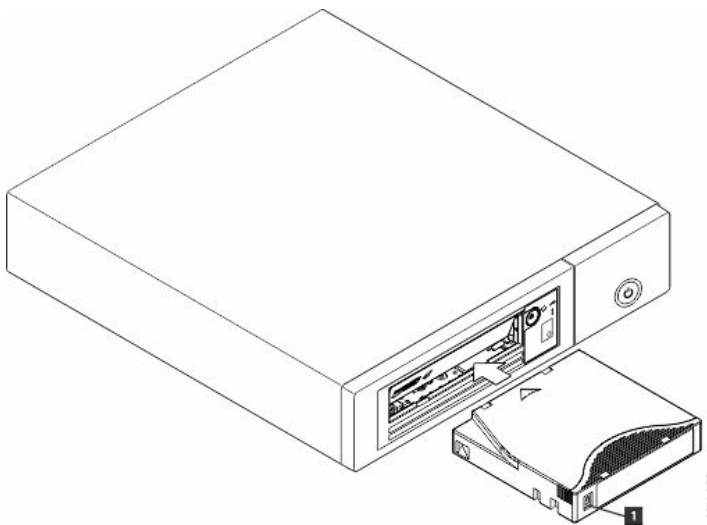
Procedure

1. Ensure that the drive is powered-on.
2. Ensure that the write-protect switch on the tape cartridge is properly set (see [Write-Protect switch](#)).
3. Grasp the cartridge so that the write-protect switch faces you (see **1** in [Figure 1](#)).
4. Slide the cartridge into the tape load compartment.

Notes:

- a. If the cartridge is already in an ejected position and you want to reinsert it, remove the cartridge, then insert it again.
- b. If the cartridge is already loaded and you cycle the power (turn it off, then on), the tape reloads.
- c. Do not attempt to load a cartridge when the drive is in Maintenance mode until the drive requests it.

Figure 1. Inserting a cartridge into the drive



Repositioning or reattaching a leader pin

Procedures involved with repositioning or reattaching a leader pin in your cartridge.

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

If the leader pin in your cartridge becomes dislodged from its pin-retaining spring clips or detaches from the tape, you must use the IBM® Leader Pin Reattachment Kit (part number 08L9129) to reposition or reattach it. (Do not reattach the pin if you must remove more than 7 meters (23 feet) of leader tape.) The sections that follow describe each procedure.

- [Repositioning a leader pin](#)
Procedure for repositioning a leader pin.
- [Reattaching a leader pin](#)
Procedure for reattaching a leader pin.

Repositioning a leader pin

Procedure for repositioning a leader pin.

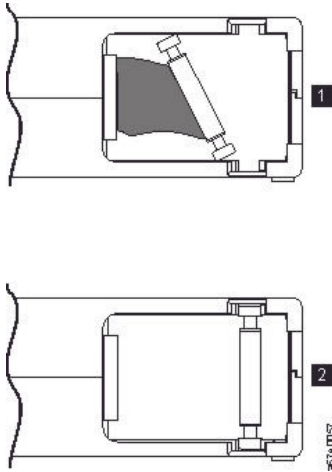
About this task

A leader pin that is improperly seated inside a cartridge interferes with the operation of the drive. [Figure 1](#) shows a leader pin in the incorrect **1** and correct **2** positions.

To place the leader pin in its proper position, you need the following tools:

- Plastic or blunt-end tweezers
- Cartridge manual rewind tool (from Leader Pin Reattachment Kit, part number 08L9129)

Figure 1. Leader pin in the incorrect and correct positions. The cartridge door is open and the leader pin is visible inside the cartridge.

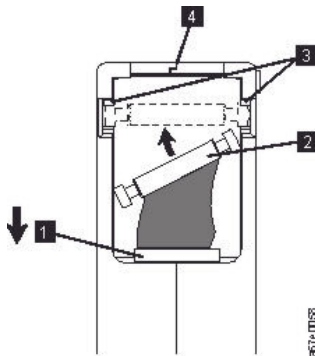


To reposition the leader pin:

Procedure

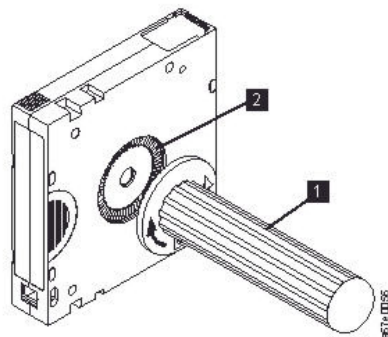
1. Slide open the cartridge door (1 in [Figure 2](#)) and locate the leader pin (2 (you might need to shake the cartridge gently to roll the pin toward the door).
2. With plastic or blunt-end tweezers, grasp the leader pin and position it in the pin-retaining spring clips (3).
3. Press the leader pin gently into the clips until it snaps into place and is firmly seated.
4. Close the cartridge door.

Figure 2. Placing the dislodged leader pin into the correct position. The cartridge door is open to show the leader pin.



5. To rewind the tape, insert the cartridge manual rewind tool (1 in [Figure 3](#)) into the cartridge's hub (2) and turn it clockwise until the tape becomes taut.

Figure 3. Rewinding the tape into the cartridge



6. Remove the rewind tool by pulling it away from the cartridge.
7. If you suspect that the cartridge was mishandled but it appears usable, copy any data onto a good cartridge immediately for possible data recovery. Discard the mishandled cartridge.

Reattaching a leader pin

Procedure for reattaching a leader pin.

About this task

The first meter of tape in a cartridge is leader tape. When the leader tape is removed there is a possibility of tape breakage. After the leader pin is reattached, transfer data from the defective tape cartridge. Do not reuse the defective tape cartridge.

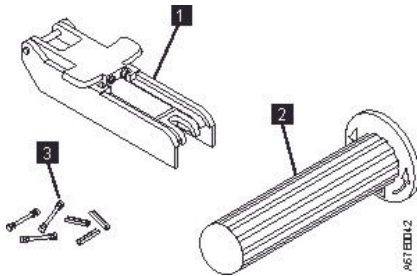
The Leader Pin Reattachment Kit contains three parts:

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

Attention:

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

Figure 1. Leader pin reattachment kit

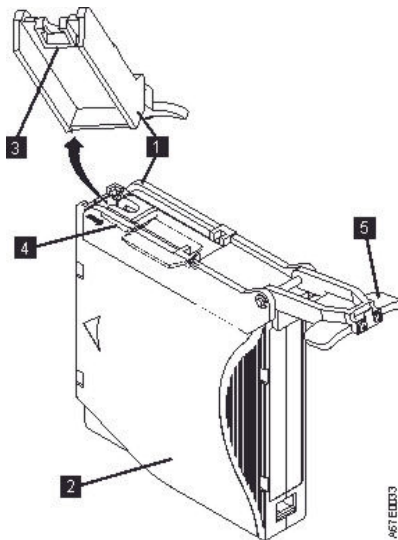


This procedure describes how to reattach a leader pin.

To reattach a leader pin with the IBM leader pin reattachment kit:

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

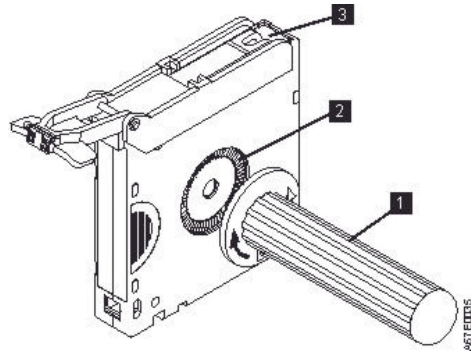
Figure 2. Attaching the leader pin attach tool to the cartridge. To hold the cartridge door open, hook the tool into the door and pull the tool back.



2. To find the end of the tape inside the cartridge, attach the cartridge manual rewind tool (**1** in [Figure 3](#)) to the cartridge's hub (**2**) by fitting the tool's teeth between the teeth of the hub. Turn the tool clockwise until you see the end of the tape inside the cartridge. Then, slowly turn the rewind tool counterclockwise to bring the tape edge toward the cartridge door (**3**).

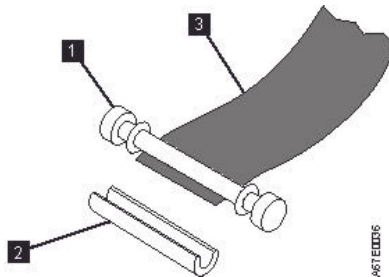
3. Continue to turn the rewind tool counterclockwise until approximately 13 cm (5 in.) of tape hangs from the cartridge door. If necessary, grasp the tape and pull gently to unwind it from the cartridge.
4. Remove the rewind tool by pulling it away from the cartridge. Set the tool and the cartridge aside.

Figure 3. Winding the tape out of the cartridge. Turn the cartridge manual rewind tool clockwise to see the end of the tape, then turn it counterclockwise to bring the tape to the cartridge door.



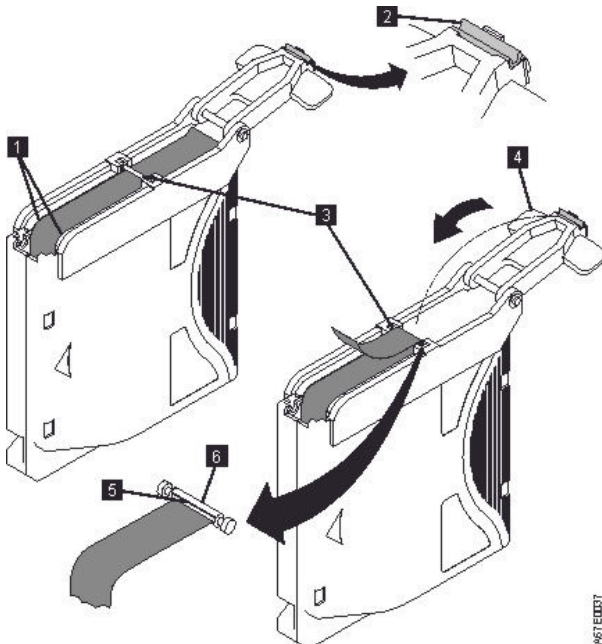
5. On the leader pin (1 in Figure 4), locate the open side of the C-clip 2. The C-clip is a small black part that secures the tape 3 to the pin.
6. Remove the C-clip from the leader pin by using your fingers to push the clip away from the pin. Set the pin aside and discard the clip.

Figure 4. Removing the C-clip from the leader pin. Use your fingers to push the C-clip from the leader pin.



7. Position the tape in the alignment groove of the leader pin attach tool (see 1 in Figure 5).
 8. Place a new C-clip into the retention groove 2 (Figure 5) on the leader pin attachment tool and make sure that the clip's open side faces up.
 9. Place the leader pin (from step 6) into the cavity 3 (Figure 5) of the leader pin attach tool.
- Attention: To prevent the leader pin from rolling into the cartridge, in the following step use care when the tape is folded over the pin.
10. Fold the tape over the leader pin and hold it with your fingers (see Figure 5).
- Note: Use care to ensure that the tape is centered over the leader pin. Failure to properly center the tape on the pin causes the repaired cartridge to fail. When the tape is properly centered, a 0.25 mm (0.01-in.) gap exists on both sides of the pin.

Figure 5. Attaching the leader pin to the tape



11. Close the pivot arm 4 of the leader pin attach tool by swinging it over the leader pin so that the C-clip snaps onto the pin and the tape.
12. Swing the pivot arm open and trim the excess tape 5 so that it is flush with the reattached leader pin 6.

13. Use your fingers to remove the leader pin from the cavity **3** in the leader pin attach tool.
14. Use the cartridge manual rewind tool to wind the tape back into the cartridge (wind the tape clockwise). Ensure that the leader pin is latched by the pin-retaining spring clips on each end of the leader pin.
15. Remove the rewind tool.
16. Remove the leader pin attach tool by lifting its end away from the cartridge.

Disposing of tape cartridges

Current rules about the appropriate disposal of tape cartridges.

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

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

If a tape cartridge must be disposed of in a secure manner, you can erase the data on the cartridge with a high-energy ac degausser (use a minimum of 4000 oersted peak field over the entire space that the cartridge occupies). The tape must make two passes through the field at 90 degree orientation change for each pass to achieve complete erasure. Some commercial degaussers have two magnetic field regions offset 90 degrees from each other to accomplish complete erasure in one pass for higher throughput. Degaussing makes the cartridge unusable.

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

Ordering media supplies

Information about ordering several generations of media supplies for your tape drive.

About this task

[Table 1](#) lists the cartridges and media supplies that you can order for the drive.

Table 1. Media supplies

Supply Item	Methods of Ordering Specify the VOLSER characters that you want.
20-PACK IBM LTO Ultrium 10 40 TB Data Cartridge (with attached labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 564. You can also order through an IBM-authorized distributor
20-PACK IBM LTO Ultrium 10 40 TB Data Cartridge (without labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 664. You can also order through an IBM-authorized distributor
20-PACK IBM LTO Ultrium 10 30 TB Data Cartridge (with attached labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 553. You can also order through an IBM-authorized distributor
20-PACK IBM LTO Ultrium 10 30 TB Data Cartridge (without labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 553. You can also order through an IBM-authorized distributor
20-PACK IBM LTO Ultrium 9 18 TB Data Cartridge (with attached labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 553. You can also order through an IBM-authorized distributor
20-PACK IBM LTO Ultrium 9 18 TB Data Cartridge (without labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 653. You can also order through an IBM-authorized distributor
5-PACK IBM LTO Ultrium 9 18 TB Data Cartridge (black and white labels unattached)	Order as part number xxxxxx through an IBM-authorized distributor.
20-PACK IBM Ultrium 9 18 TB WORM Tape Cartridge (with attached labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 573. You can also order through an IBM-authorized distributor
20-PACK IBM Ultrium 9 18 TB WORM Tape Cartridge (without labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 673. You can also order through an IBM-authorized distributor

Supply Item	Methods of Ordering Specify the VOLSER characters that you want.
20-PACK IBM LTO Ultrium 8 12 TB Data Cartridge (with attached labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 552. You can also order through an IBM-authorized distributor
20-PACK IBM LTO Ultrium 8 12 TB Data Cartridge (without labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 652. You can also order through an IBM-authorized distributor
5-PACK IBM LTO Ultrium 8 12 TB Data Cartridge (black and white labels unattached)	Order as part number 01PL340 through an IBM-authorized distributor.
20-PACK IBM Ultrium 8 12 TB WORM Tape Cartridge (with attached labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 572. You can also order through an IBM-authorized distributor
20-PACK IBM Ultrium 8 12 TB WORM Tape Cartridge (without labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 672. You can also order through an IBM-authorized distributor
20-PACK IBM Type M (M8) 9 TB Data Cartridge	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 452. Specify the VOLSER characters that you want. You can also order through an IBM-authorized distributor
20-PACK IBM LTO Ultrium 7 6 TB Data Cartridge (with attached labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 551. You can also order through an IBM-authorized distributor
20-PACK IBM LTO Ultrium 7 6 TB Data Cartridge (without labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 651. You can also order through an IBM-authorized distributor
5-PACK IBM LTO Ultrium 7 6 TB Data Cartridge (black and white labels unattached)	Order as part number 38L7189 through an IBM-authorized distributor.
20-PACK IBM Ultrium 7 6 TB WORM Tape Cartridge (with attached labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 571. You can also order through an IBM-authorized distributor
20-PACK IBM Ultrium 7 6 TB WORM Tape Cartridge (without labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 671. You can also order through an IBM-authorized distributor
20-PACK IBM LTO Ultrium 6 2.5 TB Data Cartridge (with attached labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 550. You can also order through an IBM-authorized distributor
20-PACK IBM LTO Ultrium 6 2.5 TB Data Cartridge (without labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 650. You can also order through an IBM-authorized distributor
5-PACK IBM LTO Ultrium 6 2.5 TB Data Cartridge (black and white labels unattached)	Order as part number 35P1902 through an IBM-authorized distributor.
20-PACK IBM Ultrium 6 2.5 TB WORM Tape Cartridge (with attached labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 570. You can also order through an IBM-authorized distributor
20-PACK IBM Ultrium 6 2.5 TB WORM Tape Cartridge (without labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 670. You can also order through an IBM-authorized distributor
20-PACK IBM LTO Ultrium 5 1.5 TB Data Cartridge (with attached labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 014. You can also order through an IBM-authorized distributor
20-PACK IBM LTO Ultrium 5 1.5 TB Data Cartridge (without labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 015. You can also order through an IBM-authorized distributor
5-PACK IBM LTO Ultrium 5 1.5 TB Data Cartridge (black and white labels unattached)	Order as part number 46C2084 through an IBM-authorized distributor.
20-PACK IBM Ultrium 5 1.5 TB WORM Tape Cartridge (with attached labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 034. You can also order through an IBM-authorized distributor

Supply Item	Methods of Ordering Specify the VOLSER characters that you want.
20-PACK IBM Ultrium 5 1.5 TB WORM Tape Cartridge (without labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 035. You can also order through an IBM-authorized distributor
20-PACK IBM LTO Ultrium 4 800 GB Data Cartridge (with attached labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 010. You can also order through an IBM-authorized distributor
20-PACK IBM LTO Ultrium 4 800 GB Data Cartridge (without labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 011. You can also order through an IBM-authorized distributor
5-PACK IBM LTO Ultrium 4 800 GB Data Cartridge (black and white labels unattached)	Order as part number 95P4278 through an IBM-authorized distributor.
20-PACK IBM Ultrium 4 800 GB WORM Tape Cartridge (with attached labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 032. You can also order through an IBM-authorized distributor
20-PACK IBM Ultrium 4 800 GB WORM Tape Cartridge (without labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 033. You can also order through an IBM-authorized distributor
IBM LTO Ultrium 3 400 GB Data Cartridge Order VOLSER labels separately (see Ordering bar code labels).	Order as part number 24R1922 through an IBM-authorized distributor.
IBM LTO Ultrium 3 400 GB WORM Tape Cartridge Order VOLSER labels separately (see Ordering bar code labels).	Order as part number 96P1203 through an IBM-authorized distributor.
IBM LTO Ultrium 2 200 GB Data Cartridge Order VOLSER labels separately (see Ordering bar code labels).	Order as part number 08L9870 through an IBM-authorized distributor.
IBM LTO Ultrium 1 100 GB Data Cartridge Order VOLSER labels separately (see Ordering bar code labels).	Order as part number 08L9120 through an IBM-authorized distributor.
IBM LTO Ultrium Cleaning Cartridge (universal cleaning cartridge for use with Ultrium drives) VOLSER labels are included.	Order as part number 35L2086 through an IBM-authorized distributor.
Leader Pin Reattachment Kit	Order as part number 08L9129 through an IBM-authorized distributor.
Manual Rewind Tool	Order as part number 08L9130 through an IBM-authorized distributor.

To find the closest IBM-authorized distributor call 1-888-IBM-MEDIA.

- [Ordering bar code labels](#)

If you want to order bar code labels for your tape cartridges, you can order them from several authorized suppliers.

Ordering bar code labels

If you want to order bar code labels for your tape cartridges, you can order them from several authorized suppliers.

About this task

The LTO™ Ultrium™ tape drives do not require cartridge bar code labels. However, if you use your data cartridges or cleaning cartridges in an IBM® tape library product, you might need cartridge bar code labels if your tape library product requires them. See [Table 1](#). You can order these labels separately from the IBM data cartridges and cleaning cartridges.

You can order bar code labels directly from the authorized label suppliers in [Table 1](#).

Table 1. Authorized suppliers of custom bar code labels

In America	In Europe and Asia
EDP/Colorflex Broomfield, CO U. S. A. Telephone: 800-438-8362 http://www.tri-optic.com	EDP Europe, Ltd. U. K. Telephone: 44 (0) 1245-322380 http://www.edpeurope.com/media-label
Dataware Houston, TX 77274 U. S. A. Telephone: 800-426-4844 http://www.datawarelabels.com/	Dataware Labels Europe Australia Telephone: (029) 496-1111 http://www.datawarelabels.com/

In America	In Europe and Asia
NetC Trumbell, CT U. S. A. Telephone: 203-372-6382 http://www.netcllc.com/	NetC Europe Ltd U. K. Telephone: 44 (0) 1823 49 1439 http://www.netclabels.co.uk NetC Asia Pacific Pty Ltd Australia Telephone: 61 (0) 7 5442 6263 http://www.netclabels.com.au

Replacement parts

TS4300 tape library has Tier 1 and Tier 2 CRUs (customer replaceable units). These CRUs are parts of the library that must be added, removed, and replaced by the customer. Tier 1 CRUs do not require tools for installation while Tier 2 CRUs need tools for installation.

There are hardware differences between some CRUs for 21U capable libraries and 48U capable libraries. All 48U CRUs will work in 21U libraries; however, 21U CRUs may not work and may cause issues if installed in a 48U library. Refer to [Differences between 21U and 48U libraries](#) to determine the library type for CRU ordering.

To order parts, contact * Service. See [Contacting IBM technical support](#).

Table 1. Replacement parts

Part Number	Description
03WK017	5544 Base Chassis - Includes operator panel, accessor, spooling mechanism
03WK021	5544 Expansion Chassis
02XY033	3555 Base Chassis, 48U - Includes operator panel, accessor, spooling mechanism
02XV566	3555 Expansion Chassis
02XY977	Accessor, 48U - Includes Spooling Mechanism
02XY978	Spooling Mechanism, 48U
02XY976	Base Controller, 48U
00VJ962	Expansion Controller
00GH772	Expansion Cable
00GH763	LTO6 FH FC Drive Assembly
00GH761	LTO6 HH FC Drive Assembly
00GH759	LTO6 HH SAS Drive Assembly
00GH768	LTO7 FH FC Drive Assembly
00GH766	LTO7 HH FC Drive Assembly
00GH764	LTO7 HH SAS Drive Assembly
00GH814	LTO8 FH FC Drive Assembly
00GH812	LTO8 HH FC Drive Assembly
00GH810	LTO8 HH SAS Drive Assembly
02XX411	LTO9 HH SAS Drive Assembly
02XX413	LTO9 HH FC Drive Assembly
02XX415	LTO9 FH SAS Drive Assembly
02XX417	LTO9 FH FC Drive Assembly
03UW740	LTO10 FH FC Drive Assembly
00GH724	Left Magazine Asm
00GH726	Right Magazine Asm
00VJ940	Power supply
12R9314	Fibre Channel Wrap Tool
95P6566	SAS Wrap Tool
00VJ139	2 M Mini-SAS/Mini-SAS 1x Cable
15R8848	Fiber Cable HBW LC/LC 25 M
41V2120	Fiber Cable HBW LC/LC 10 M
46C2900	4 M AE1 MINI-SAS TO MINI-SAS
46C2902	3 M Y MINI-SAS HD TO MINI-SAS
46X9904	SAS 1X to 4X INTERPOSER
39M5068	Power Cable 10 AMP / 250 VAC - 2.8M
39M5081	Power Cable 10 AMP / 125 VAC - 2.8M
39M5095	Power Cable 10 AMP / 250 VAC - 2.8M
39M5102	Power Cable 10 AMP / 250 VAC - 2.8M
39M5123	Power Cable 10 AMP / 250 VAC - 2.8M
39M5130	Power Cable 10 AMP / 250 VAC - 2.8M
39M5144	Power Cable 10 AMP / 250 VAC - 2.8M
39M5151	Power Cable 10 AMP / 250 VAC - 2.8M
39M5158	Power Cable 10 AMP / 250 VAC - 2.8M

Part Number	Description
39M5165	Power Cable 10 AMP / 250 VAC - 2.8M
39M5172	Power Cable 10 AMP / 250 VAC - 2.8M
39M5199	Power Cable 10 AMP / 250 VAC - 2.8M
39M5206	Power Cable 10 AMP / 250 VAC - 2.8M
39M5219	Power Cable 10 AMP / 250 VAC - 2.8M
39M5226	Power Cable 10 AMP / 250 VAC - 2.8M
39M5240	Power Cable 10 AMP / 250 VAC - 2.8M
39M5247	Power Cable 10 AMP / 250 VAC - 2.8M
39M5254	Power Cable 10 AMP / 250 VAC - 2.8M
39M5378	Power Cable 10 AMP / 250 VAC - 4.3M

Table 2. MTM 3555 21U only replacement parts

Part Number	Description
00VJ943	3555 Base Chassis, 32 slot - Includes operator panel, accessor, spooling mechanism
02JE720 ¹	3555 Base Chassis, 40 slot - Includes operator panel, accessor, spooling mechanism
00VJ955	3555 Accessor, 32 slot - Includes Spooling Mechanism
02JE722 ²	3555 Accessor, 40 slot - Includes Spooling Mechanism
00VJ956	3555 Spooling Mechanism
02XV763 ³	3555 Base Controller, 32 slot

^{1, 2} These parts can only be used in libraries having serial number 7800K0K or greater. Ensure that library firmware is at 1.2.1.0-A00 or later to support newer library serial numbers.

³ This part should only be used in libraries with 32 slot capacity. For 40 slot 21U libraries, use the '3555 Base Controller, 48U'

Manual cartridge removal procedure

Follow this procedure if a cartridge must be manually removed and repaired.

Attention:

- It is recommended that the drive and tape be returned to IBM for removal and recovery.
- If the cartridge in the drive is an INPUT tape that contains ACTIVE or 'ONLY COPY' data (no backup), eject commands that are issued at the host fail to unload the tape, and power-cycling the drive fails to eject the cartridge, make no further attempts to unload this tape. Call Technical Support and open a PMR if one is not already open, to initiate the process of sending the drive with the loaded cartridge in for recovery.
- These procedures must be completed only by a trained IBM® service provider. SSRs claim their time against service code 33 ECA 013 when they complete this procedure.
- Inform the customer that the following procedure has high risk of damaging the drive and high risk of not being able to recover the data.
- A drive brick transfer to another drive sled is NOT POSSIBLE with this library.
- [Recommended tools](#)
- [Before you begin](#)
- [Beginning procedure](#)
- [Full height drive: Tape spooled off supply reel](#)
- [Half height drive: Tape spooled off supply reel](#)
- [Full height drive: Tape pulled from or broken near leader pin](#)
- [Half height drive: Tape pulled from or broken near leader pin](#)
- [Full height drive: Tape broken in mid-tape](#)
- [Half height drive: Tape broken in mid-tape](#)
- [Full height drive: Tape tangled along tape path](#)
- [Half height drive: Tape tangled along tape path](#)
- [Full height drive: No apparent failure or damage to tape](#)
- [Half height drive: No apparent failure or damage to tape](#)
- [Ending procedure](#)

Recommended tools

Procedure

- #1 Phillips screwdriver
- ESD Kit
- Flashlight (optional)
- #1 Flathead screwdriver (optional)

Before you begin

About this task

When a tape drive error is reported by the library, the drive produces a memory dump and saves it in Random Access Memory (RAM). If the library or drive is powered OFF, this information is lost. To preserve this information for analysis by IBM Technical Support, the drive memory dump must be copied to the drive's flash memory. Complete the following steps to write a drive memory dump to flash memory.

Procedure

1. Log in to the Management GUI.
2. Attempt to remove the cartridge with the device power ON and with library manager, a host application, or the Unload button. Press and hold Unload for 12 seconds. This action causes the drive to eject the cartridge when it completes the midtape recovery
3. Ensure that the operator issued the appropriate application commands to complete a rewind and unload of the cartridge. This procedure is to ensure that the stuck cartridge is not because of a hang condition in the application
4. Attempt to remove the cartridge by power-cycling the drive. Look for the drive to attempt a midtape recovery.
Note: It can take 5 minutes to 1 hour (depending on cartridge type (LTO 5, and so on) and how much of the tape is spooled out of the cartridge) for the cartridge to rewind and unload.
5. If the cartridge unloads, inform the operator that the cartridge is unloaded. If the cartridge does not unload, repeat steps 2 and 3 before this procedure is continued.
Note: If the cartridge in the drive is an INPUT tape that contains ACTIVE or 'ONLY COPY' data (there is no backup), eject commands that are issued at the host fail to unload the tape, and power-cycling the drive fails to eject the cartridge, make no further attempts to unload this tape. Call Technical Support and open a PMR if one is not already open, to initiate the process of sending the drive with the loaded cartridge in for recovery.

Beginning procedure

About this task

Note: If the cartridge in the drive is an INPUT tape that contains ACTIVE or 'ONLY COPY' data (there is no backup), eject commands that are issued at the host fail to unload the tape, and power-cycling the drive fails to eject the cartridge, make **no further attempts** to unload this tape. Call Technical Support and open a PMR if one is not already open, to initiate the process of sending the drive with the loaded cartridge in for recovery.

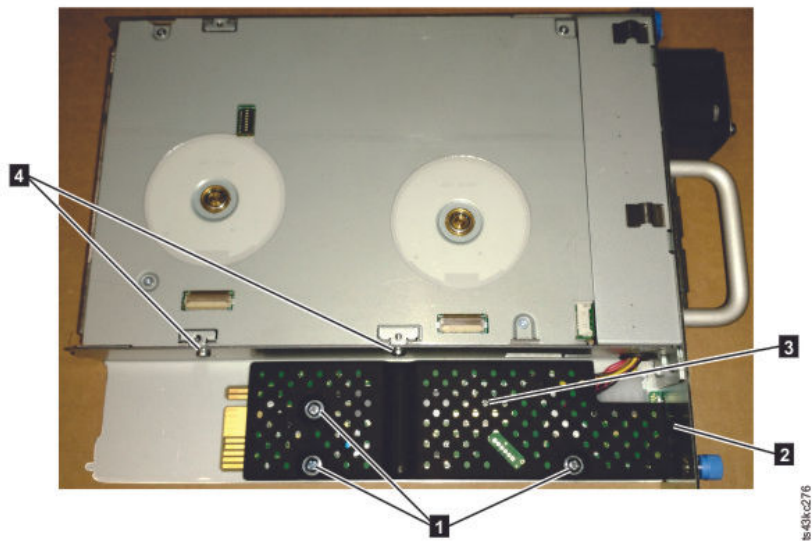
- [Removing the drive brick from the sled](#)
- [Removing the drive cover](#)

Removing the drive brick from the sled

Procedure

1. Remove the tape drive sled from the library.
 2. Place the sled on a clean, sturdy work surface.
- It is not necessary to remove the plastic cover or connection card.

Figure 1. Connection screws and plastic cover

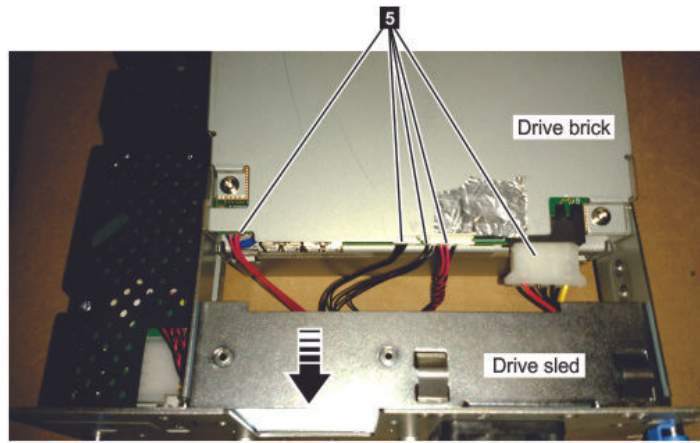


1	Connection card screws
2	Plastic cover

3	Connection card (under the plastic cover)
4	Screws that hold the drive brick to the sled (2 on each side).

3. Remove the drive brick from the sled by completing these steps:
 - a. Remove the four screws (two on each side of the sled **4**) that secure the sled to the drive brick.
 - b. Pull the drive brick out of the front of the sled far enough to unplug the cables (**5**). Some of the cables and connectors are small and can be delicate, so be careful when you are unplugging them.

Figure 2. The drive brick, showing the cables to be unplugged.



Note: Make sure to note where each cable is connected, so they can be connected correctly later.

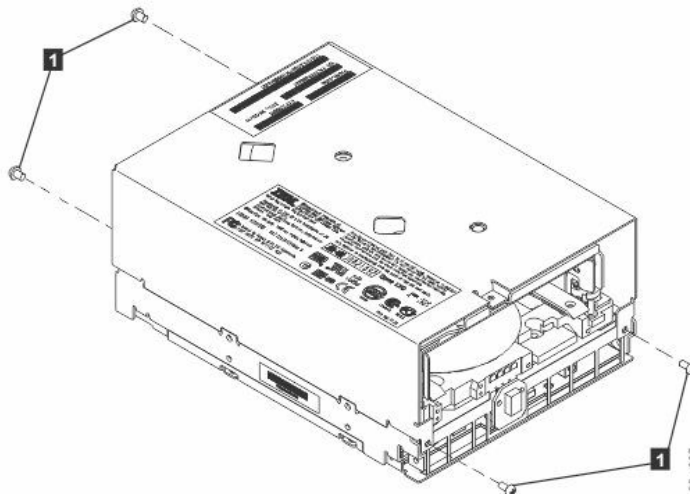
- c. Remove the drive brick from the sled.

Removing the drive cover

Procedure

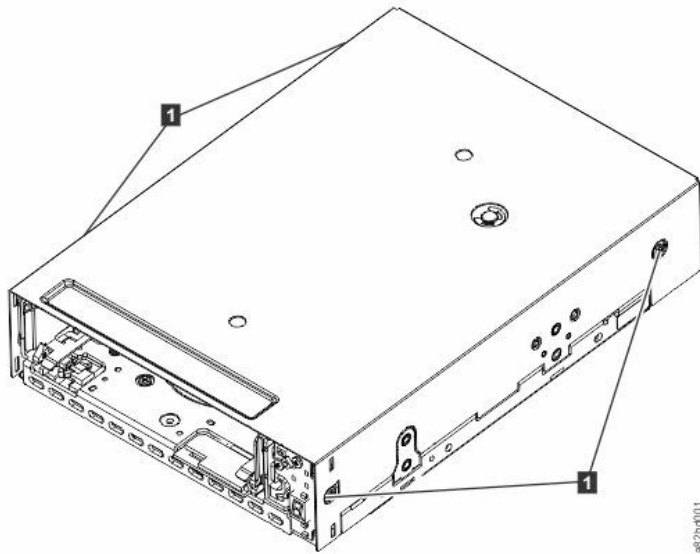
1. Ground yourself to the drive by using an ESD Kit.
2. Remove the cover of the full height drive by completing these steps:
 - a. Remove the four cover-mounting screws and washers **1**.
 - b. Remove the cover by lifting it up.

Figure 1. Removing the cover from the full height drive



3. Remove the cover of the half height drive by completing these steps:
 - a. Remove the four cover-mounting screws (**1**). Two screws are on each side of the drive.
 - b. Remove the cover by lifting it up.

Figure 2. Removing the cover from the half height drive



4. Inspect the drive to decide which of the following conditions most closely matches the symptom on the drive:
 - Tape spooled off the supply reel - All the tape appears to be on the take up reel and no tape is on the supply reel (inside the cartridge). Test the drive after the procedure is completed.
 - Tape pulled from leader pin (or broken at the front end) - All the tape appears to be on the supply reel (inside the cartridge) and little or no tape appears to be on the take up reel. The leader block is positioned in the take up reel. Return the drive after the procedure is completed.
 - Tape broken in mid-tape - Tape appears to be on both the supply reel (inside the cartridge) and take up reel. Test the drive after the procedure is completed.
 - Tape tangled along tape path - Tape appears to be tangled and damaged but intact. Return the drive after the procedure is completed.
 - OR --
 - No damage to tape (or no apparent failure) - There appears to be no damage or slack to the tape. Return the drive after the procedure is completed.

Full height drive: Tape spooled off supply reel

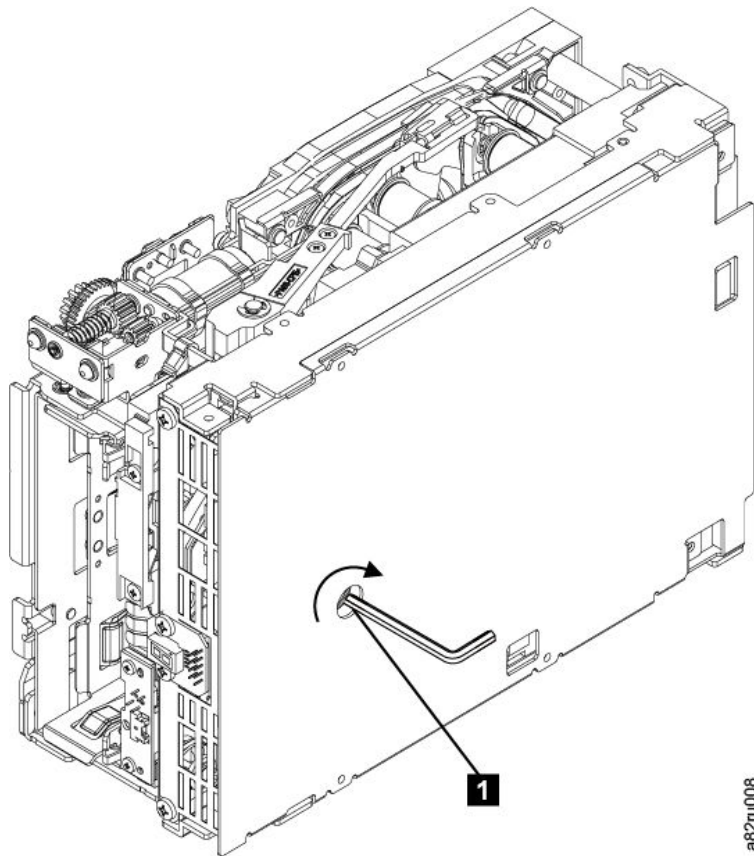
About this task

Note: If the cartridge in the drive is an INPUT tape that contains ACTIVE or 'ONLY COPY' data (there is no backup), eject commands that are issued at the host fail to unload the tape, and power-cycling the drive fails to eject the cartridge, make no further attempts to unload this tape. Call Technical Support and open a PMR if one is not already open, to initiate the process of sending the drive with the loaded cartridge in for recovery.

Procedure

1. With the front of the drive facing you, pull an arm's length of tape out of the take up reel from the left side of the drive.
2. From the take up reel, thread tape around the rear of the tape path and over the head and rollers on the left side of the drive.
3. Set the drive on its left side with the head and tape path facing up.
4. Moisten a cotton swab with water and wet approximately 13 mm (0.5 in.) of the tape end and feed it onto the supply reel (inside the cartridge).
5. From the bottom of the drive, insert a 2.5 mm offset hex wrench through the bottom cover access hole and into the reel motor axle.

Figure 1. The hex wrench rewinds tape into cartridge



6. Turn the supply reel clockwise, allowing the moistened tape to adhere to the hub as it winds around the supply reel (inside the cartridge).
7. Continue spooling into the cartridge until the tape is taut and remains within the flanges of the tape guiding rollers. Ensure that you do not stretch the tape.
8. Go to [Ending procedure](#).

Half height drive: Tape spooled off supply reel

Before you begin

Attention: **DO NOT TOUCH THE OUTER GUIDE RAIL (2). THIS RAIL IS DELICATE AND EASILY DAMAGED.**

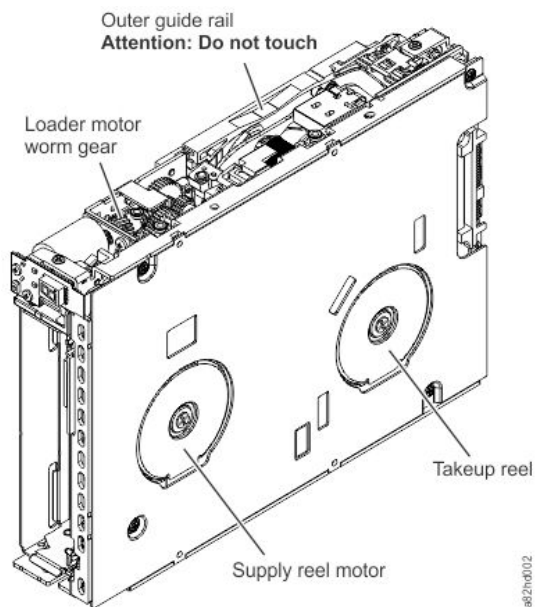
About this task

Note: If the cartridge in the drive is an INPUT tape that contains ACTIVE or 'ONLY COPY' data (there is no backup), eject commands that are issued at the host fail to unload the tape, and power-cycling the drive fails to eject the cartridge, make **no further attempts** to unload this tape. Call Technical Support and open a PMR if one is not already open, to initiate the process of sending the drive with the loaded cartridge in for recovery.

Procedure

1. From the takeup reel, pull an arm's length of tape around the rear of the tape path and over the head and rollers on the left side of the drive.
2. Set the drive on its left side with the head and tape path facing up.
3. Ensure that the tape is not twisted. Untwist the tape if required.
4. Moisten a cotton swab with water and wet approximately 13 mm (0.5 in.) of the tape end and feed it onto the supply reel (inside the cartridge).
5. Turn the supply reel (4) clockwise, allowing the moistened tape to adhere to the hub as it winds around the supply reel (inside the cartridge).

Figure 1. Rewinding tape into cartridge



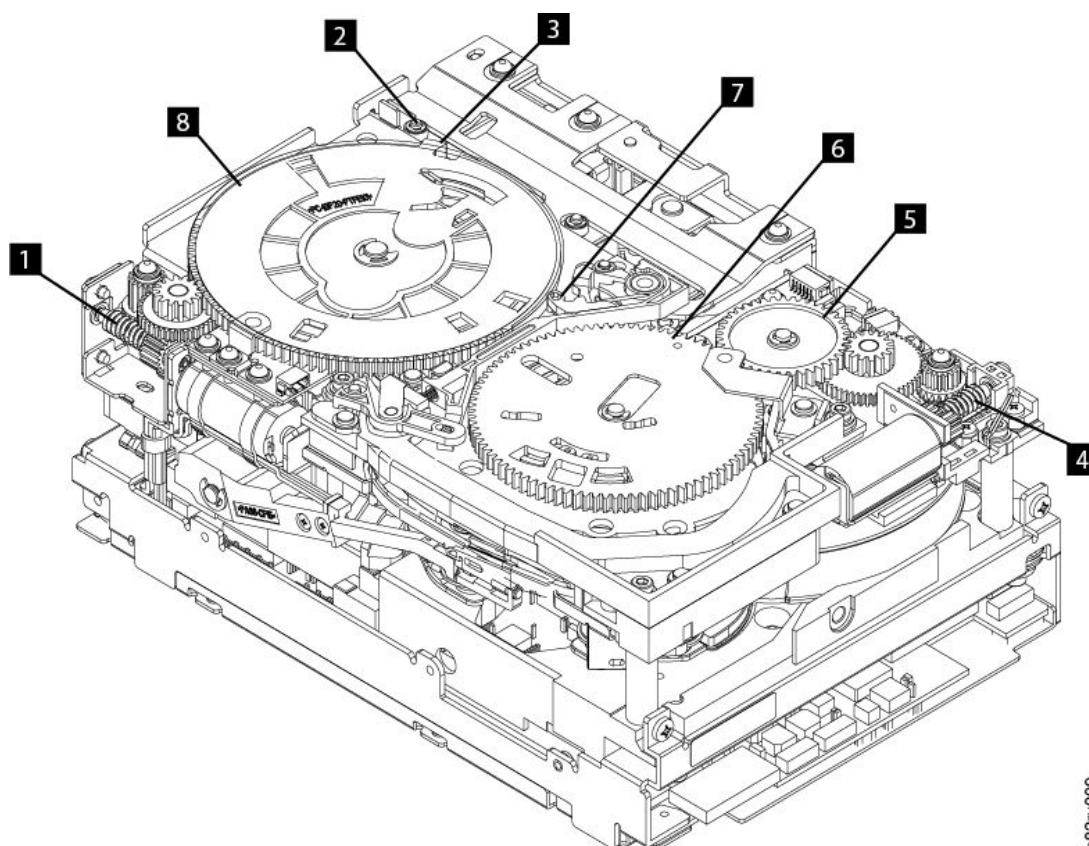
1	Loader motor worm gear	3	Takeup reel motor
2	Outer guide rail (WARNING: Do Not Touch)	4	Supply reel motor

- Continue spooling into the cartridge until the tape is taut and remains within the flanges of the tape guiding rollers. Turn the supply reel (4) 10 more turns. Ensure that you do not stretch the tape.
- Go to [Ending procedure](#).

Full height drive: Tape pulled from or broken near leader pin

About this task

Figure 1. Drive with cover removed to reveal gear train.

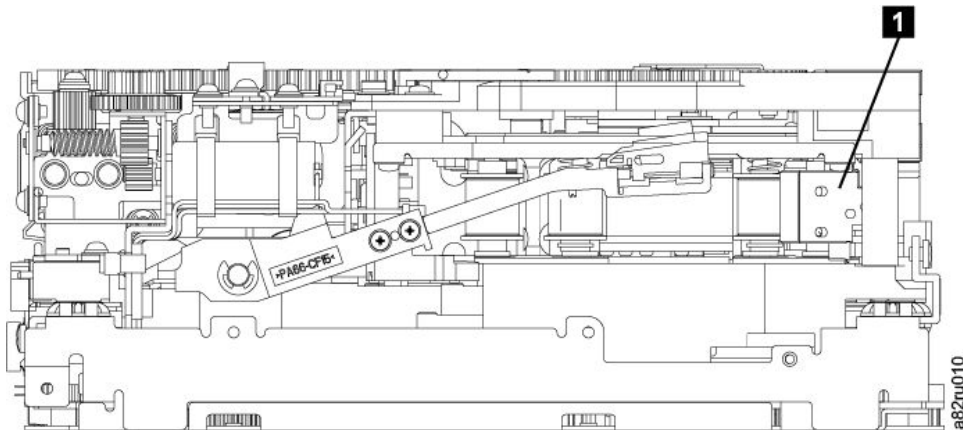


1	Loader motor worm gear	6	Threader mechanism gear
2	Cartridge loader tray guide bearing	7	Lever
3	Rotator stub	8	Loader mechanism gear
4	Threader motor worm gear		
5	Threader intermediate gear		

Procedure

- From the left side of the drive, pull out tape from the take up reel.
Note: If there is more than approximately 0.6 m (2 ft.) of tape on the take up reel, go to [Full height drive: Tape broken in mid-tape](#).
- If there is less than approximately 0.6 m (2 ft.) of tape on the take up reel, cut off the excess tape as close to the leader pin, as possible.
- Locate the threader motor worm gear (**4**) the rear of the drive. Use your finger to rotate the threader motor worm gear and slowly rotate the threader mechanism gear (**6**) clockwise. This action rotates the threader motor worm gear (**4**) clockwise, drawing the tape leader block assembly (LBA) into the cartridge.
- As the LBA is secured in the cartridge, you hear the LBA retention spring clips click into place. If you do not hear the click, continue rolling until the threader motor worm gear (**4**) stops. The LBA is in the correct position.
Note: Be sure to keep tension on the tape as the LBA is drawn into the cartridge by using a hex wrench as shown in [Figure 1](#).
- Notice the following mechanisms:
 - Loader mechanism gear (**8**) nearest the front of the drive that actuates the cartridge loader mechanism
 - Position of the rotator stub (**3**).
 - Front loader motor worm gear (**1**). Rotating this gear allows the loader mechanism gear (**8**) to turn.
- Rotate the loader motor worm gear (**1**) to turn the loader mechanism gear (**6**) counterclockwise. Continue turning until the rotator stub (**3**) loses contact with the lever (**7**). This action releases the LBA leader pin.
- Rotate the threader motor worm gear (**4**) to turn the threader mechanism gear (**6**) counterclockwise. This action moves the LBA out of the cartridge and past the read/write head. Stop this rotation when the LBA is near the tape guide roller nearest the rear of the drive (**1**).

Figure 2. Leader Block Assembly (LBA)

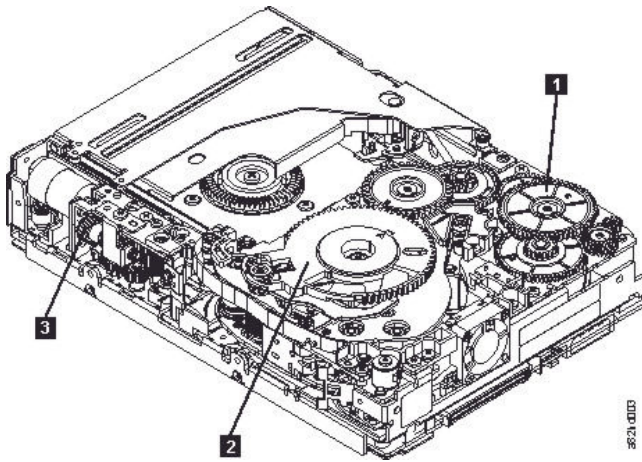


- Continue rotating the loader motor worm gear (**1**) until the rotate stub (**3**) is positioned as shown. Notice that the rotator stub (**3**) is nearly aligned with the cartridge loader tray guide bearing (**2**).
- Remove the cartridge from the cartridge loader tray.
- Go to [Ending procedure](#).

Half height drive: Tape pulled from or broken near leader pin

Before you begin

Figure 1. Drive with cover removed to reveal gear train.

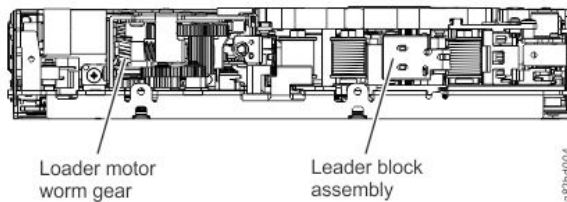


1	Threader intermediate gear	2	Threader mechanism gear	3	Loader motor worm gear
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Procedure

1. Pull out tape from the takeup reel.
Note: If there is more than approximately 0.6 m (2 ft.) of tape on the takeup reel, go to [Half height drive: Tape broken in mid-tape](#)
2. If there is less than approximately 0.6 m (2 ft.) of tape on the takeup reel, cut off the excess tape as close to the leader pin, as possible.
3. Reattach the leader pin to the remaining tape.
4. Locate the threader intermediate gear (1) near the rear of the drive. You can use your finger to rotate the threader intermediate gear (1) and slowly rotate the threader mechanism gear (2) clockwise. This action draws the tape leader block assembly (LBA) into the cartridge.
5. As the leader pin is secured in the cartridge, you hear the leader pin retention spring clips click into place. If you do not hear the click, continue rolling until the threader intermediate gear (1) stops. The LBA is in the correct position.
6. Rotate the loader motor worm gear (3) clockwise as viewed from the front of the drive until it stops. This action releases the LBA leader pin.
7. Rotate the threader intermediate gear (1) counterclockwise until the leader block is in front of the read/write head. This action moves the LBA out of the cartridge.

Figure 2. Leader Block Assembly (LBA)



1	Loader motor worm gear	2	Leader block assembly (LBA)
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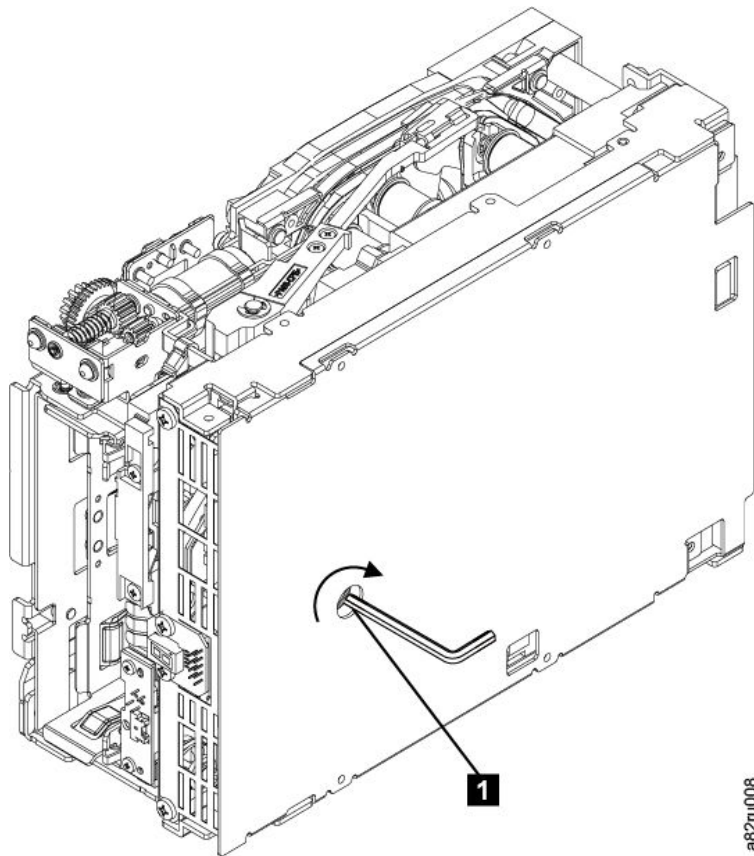
8. Rotate the loader motor worm gear (3) counterclockwise as viewed from the front of the drive until it stops.
9. Remove the cartridge from the cartridge loader tray.
10. Go to [Ending procedure](#).

Full height drive: Tape broken in mid-tape

Procedure

1. With the front of the drive facing you, pull an arm's length of tape out of the take up reel from the left side of the drive.
Note: If there is less than approximately 5 cm (2 in.) of tape on the take up reel, go to [Full height drive: Tape pulled from or broken near leader pin](#).
2. From the supply reel inside the cartridge, pull approximately 0.3 m (1 ft.) of tape.
3. From the take up reel, thread tape around the rear of the tape path and over the head rollers on the left side of the drive.
4. Moisten a cotton swab with water, and wet approximately 13 mm (0.5 in.) of the tape end. Overlap the tape ends, loosely mending them together.
5. Set the drive on its left side with the head and tape path facing up.
6. From the bottom of the drive, locate the access hole (1 in [Figure 1](#)) in the bottom cover. Insert a 2.5 mm offset hex wrench through the bottom cover access hole and into the reel motor axle. Begin spooling tape back into the cartridge by turning the hex wrench clockwise.

Figure 1. The hex wrench rewinds tape into cartridge



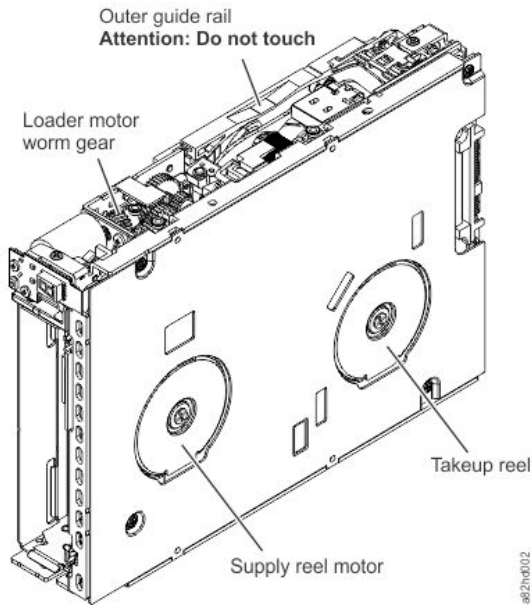
7. Turn the supply reel clockwise, carefully guiding the mended portion of the tape to wind around the hub of the supply reel that is located inside the cartridge. Continue spooling into the cartridge until the tape is taut. The tape must remain within the flanges of the tape guiding rollers. Ensure that you do not stretch the tape.
8. Go to [Ending procedure](#).

Half height drive: Tape broken in mid-tape

Procedure

1. With the front of the drive facing you, pull an arm's length of tape out of the takeup reel. From the takeup reel, thread tape around the rear of the tape path and over the head rollers on the left side of the drive.
Note: If there is less than approximately 5 cm (2 in.) of tape on the takeup reel, go to [Half height drive: Tape pulled from or broken near leader pin](#).
2. From the supply reel inside the cartridge, pull approximately 0.3 m (1 ft.) of tape.
3. Ensure that the tape is not twisted. Untwist the tape if required.
4. Moisten a cotton swab with water, and wet approximately 13 mm (0.5 in.) of the tape end. Overlap the tape ends, loosely mending them together.
5. Set the drive on its left side with the head and tape path facing up.
6. Turn the supply reel (4) clockwise, carefully guiding the mended portion of the tape to wind around the hub of the supply reel that is located inside the cartridge. Continue spooling into the cartridge until the tape is taut. The tape must remain within the flanges of the tape guiding rollers. Turn the supply reel (4) 10 more turns. Ensure that you do not stretch the tape.

Figure 1. Rewinding tape into cartridge



1	Loader motor worm gear	3	Takeup reel motor
2	Outer guide rail (WARNING: Do Not Touch)	4	Supply reel motor

7. Go to [Ending procedure](#).

Full height drive: Tape tangled along tape path

About this task

Note: If the cartridge in the drive is an INPUT tape that contains ACTIVE or 'ONLY COPY' data (there is no backup), eject commands that are issued at the host fail to unload the tape, and power-cycling the drive fails to eject the cartridge, make **no further attempts** to unload this tape. Call Technical Support and open a PMR if one is not already open, to initiate the process of sending the drive with the loaded cartridge in for recovery.

Procedure

1. Carefully pull out excess tape and untangle.

Note: If you find the tape to be broken, go to one of the following appropriate procedures:

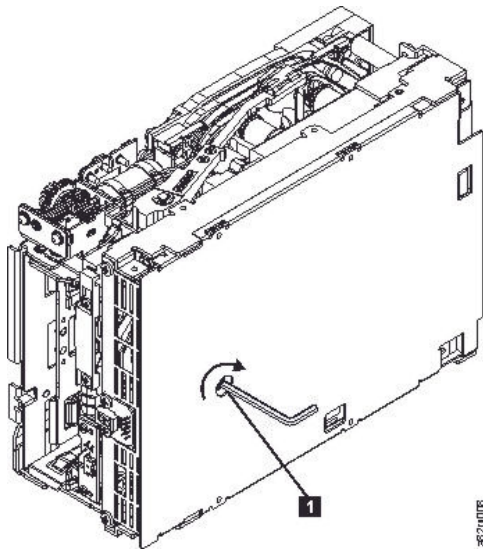
- [Full height drive: Tape spooled off supply reel](#)
- [Full height drive: Tape pulled from or broken near leader pin](#)

--OR--

[Full height drive: Tape broken in mid-tape](#)

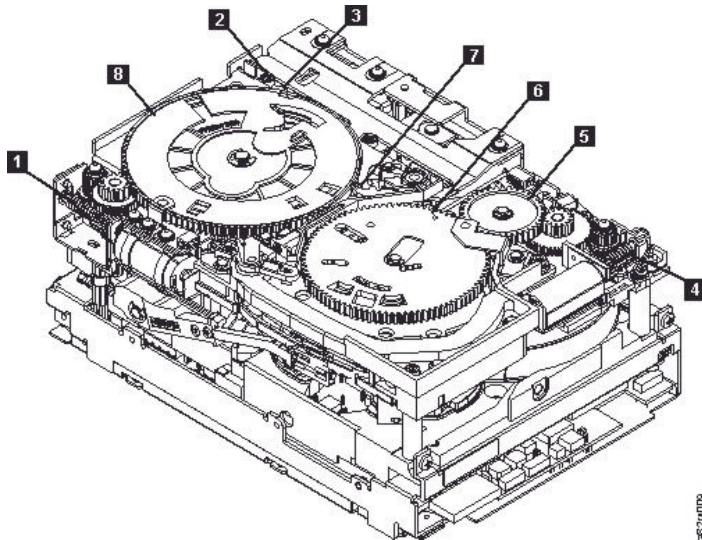
2. Set the drive on its left side with the head and tape path facing up.

Figure 1. The hex wrench rewinds tape into cartridge



3. From the bottom of the drive, locate the access hole (1 in [Figure 1](#)).
 4. Insert a 2.5 mm offset hex wrench through the bottom cover access hole and into the reel motor axle. Begin spooling the tape back into the cartridge by turning the hex wrench clockwise.
 5. Continue spooling into the cartridge until the tape is taut and remains within the flanges of the tape guiding rollers. Ensure that you do not stretch the tape.
 6. Locate the threader motor worm gear (4 in [Figure 2](#)) on the rear of the drive. Use your finger to rotate the threader motor worm gear and slowly rotate the threader mechanism gear (6 in [Figure 2](#)) clockwise.
- This action rotates the threader motor worm gear (4 in [Figure 2](#)) clockwise, drawing the LBA into the cartridge.

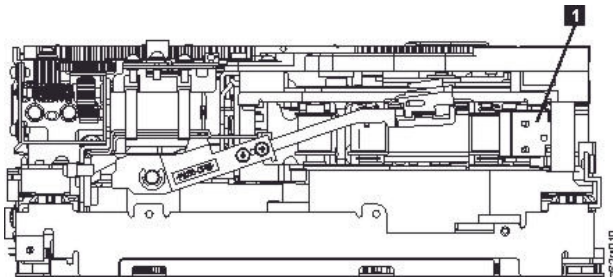
Figure 2. Drive with cover removed to reveal gear train.



1	Loader motor worm gear	6	Threader mechanism gear
2	Cartridge loader tray guide bearing	7	Lever
3	Rotator stub	8	Loader mechanism gear
4	Threader motor worm gear		
5	Threader intermediate gear		

7. As the tape leader block assembly (LBA) is secured in the cartridge, you hear the LBA retention spring clips click into place. If you do not hear the click, continue rolling until the threader motor worm gear (4 in [Figure 2](#)) stops. The LBA is in the correct position.
Note: Be sure to keep tension on the tape as the LBA is drawn into the cartridge by using a hex wrench as shown in [Figure 1](#).
8. Notice these mechanisms:
 - a. Loader mechanism gear (6 in [Figure 2](#)) nearest the front of the drive that actuates the cartridge loader mechanism.
 - b. Position of the rotate stub (3 in [Figure 2](#)).
 - c. Front loader motor worm gear (1 in [Figure 2](#)). Rotating this gear allows the loader mechanism gear (8 in [Figure 2](#)) to turn.
9. Rotate the loader motor worm gear (1 in [Figure 2](#)) to turn the threader mechanism gear (6 in [Figure 2](#)) counterclockwise. Continue turning until the rotator stub (3 in [Figure 2](#)) loses contact with the lever (7 in [Figure 2](#)). This action releases the LBA leader pin.
10. Rotate the threader motor worm gear (4 in [Figure 2](#)) to turn the threader mechanism gear (6 in [Figure 2](#)) counterclockwise. This action moves the LBA out of the cartridge and past the read/write head. Stop this rotation when the LBA is near the tape guide roller nearest the rear of the drive that is shown as 1 [Figure 3](#).

Figure 3. Leader Block Assembly (LBA)



11. Continue rotating the loader motor worm gear (1 in [Figure 2](#)) until the rotator stub (3 in [Figure 2](#)) is positioned as shown. Notice that the rotator stub (3 in [Figure 2](#)) is nearly aligned with the cartridge loader tray guide bearing (2 in [Figure 2](#)).
12. Remove the cartridge from the cartridge loader tray.
13. Go to [Ending procedure](#).

Half height drive: Tape tangled along tape path

About this task

Note: If the cartridge in the drive is an INPUT tape that contains ACTIVE or 'ONLY COPY' data (there is no backup), eject commands that are issued at the host fail to unload the tape, and power-cycling the drive fails to eject the cartridge, make **no further attempts** to unload this tape. Call Technical Support and open a PMR if one is not already open, to initiate the process of sending the drive with the loaded cartridge in for recovery.

Procedure

1. Carefully pull out excess tape and untangle.

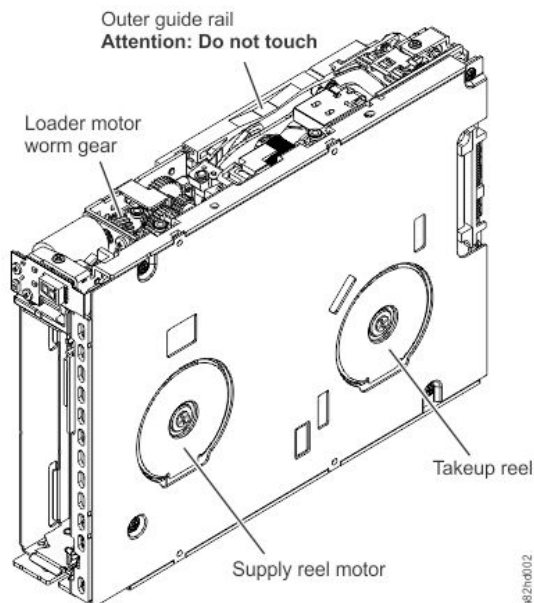
Note: If you find the tape to be broken, go to one of the following appropriate procedures:

 - [Half height drive: Tape spooled off supply reel](#)
 - [Half height drive: Tape pulled from or broken near leader pin](#)

–OR–

 - [Half height drive: Tape broken in mid-tape](#)
2. Set the drive on its left side with the head and tape path facing up.

Figure 1. Rewinding tape into cartridge



1	Loader motor worm gear	3	Takeup reel motor
2	Outer guide rail (WARNING: Do Not Touch)	4	Supply reel motor

3. Turn the supply reel (4) clockwise.
4. Continue spooling into the cartridge until the tape is taut and remains within the flanges of the tape guiding rollers. Turn the supply reel (4) 10 turns. Ensure that you do not stretch the tape.
5. Go to [Ending procedure](#).

Full height drive: No apparent failure or damage to tape

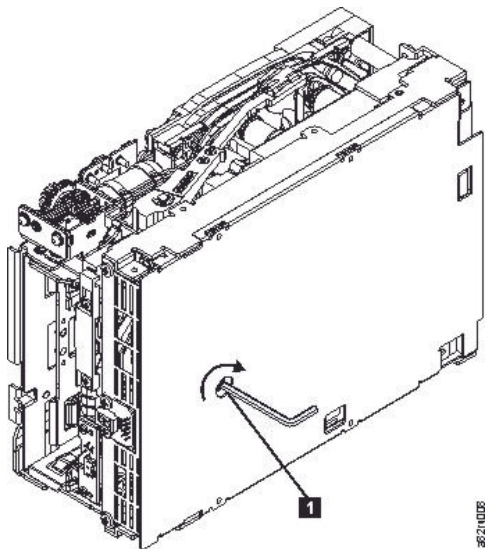
About this task

Note: If the cartridge in the drive is an INPUT tape that contains ACTIVE or 'ONLY COPY' data (there is no backup), eject commands that are issued at the host fail to unload the tape, and power-cycling the drive fails to eject the cartridge, make **no further attempts** to unload this tape. Call Technical Support and open a PMR if one is not already open, to initiate the process of sending the drive with the loaded cartridge in for recovery.

Procedure

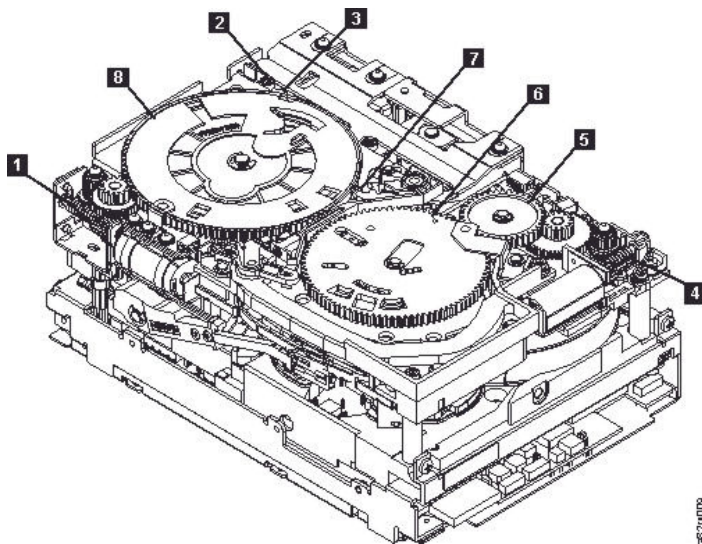
1. Set the drive on its left side with the head and tape path facing up.

Figure 1. The hex wrench rewinds tape into cartridge



2. From the bottom of the drive, locate the access hole (1 in Figure 1).
 3. Insert a 2.5 mm offset hex wrench through the bottom cover access hole and into the reel motor axle. Begin spooling the tape back into the cartridge by turning the hex wrench clockwise.
 4. Continue spooling into the cartridge until the tape is taut and remains within the flanges of the tape guiding rollers. Ensure that you do not stretch the tape.
 5. Locate the threader motor worm gear (4 in Figure 2) on the rear of the drive. Use your finger to rotate the threader motor worm gear and slowly rotate the threader mechanism gear (6 in Figure 2) clockwise.
- This action rotates the threader motor worm gear (4 in Figure 2) clockwise, drawing the LBA into the cartridge.

Figure 2. Drive with cover removed to reveal gear train.

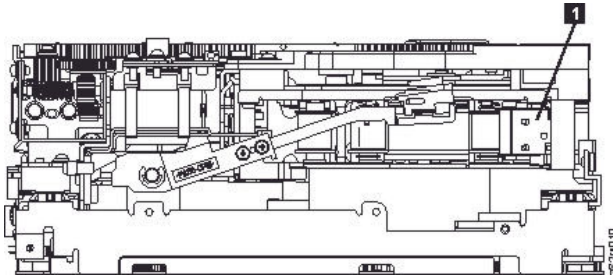


1	Loader motor worm gear	6	Threader mechanism gear
2	Cartridge loader tray guide bearing	7	Lever

3	Rotator stub	8	Loader mechanism gear
4	Threader motor worm gear		
5	Threader intermediate gear		

6. As the tape leader block assembly (LBA) is secured in the cartridge, you hear the LBA retention spring clips click into place. If you do not hear the click, continue rolling until the threader motor worm gear (4 in [Figure 2](#)) stops. The LBA is in the correct position.
Note: Be sure to keep tension on the tape as the LBA is drawn into the cartridge by using a hex wrench as shown in [Figure 1](#).
7. Notice these mechanisms:
 - a. Loader mechanism gear (6 in [Figure 2](#)) nearest the front of the drive that actuates the cartridge loader mechanism.
 - b. Position of the rotate stub (3 in [Figure 2](#)).
 - c. Front loader motor worm gear (1 in [Figure 2](#)). Rotating this gear allows the loader mechanism gear (8 in [Figure 2](#)) to turn.
8. Rotate the loader motor worm gear (1 in [Figure 2](#)) to turn the loader mechanism gear (6 in [Figure 2](#)) counterclockwise. Continue turning until the rotator stub (3 in [Figure 2](#)) loses contact with the lever (7 in [Figure 2](#)). This action releases the LBA leader pin.
9. Rotate the threader motor worm gear (4 in [Figure 2](#)) to turn the threader mechanism gear (6 in [Figure 2](#)) counterclockwise. This action moves the LBA out of the cartridge and past the read/write head. Stop this rotation when the LBA is near the tape guide roller nearest the rear of the drive that is shown as 1 [Figure 3](#).

Figure 3. Leader Block Assembly (LBA)



10. Continue rotating the loader motor worm gear (1 in [Figure 2](#)) until the rotator stub (3 in [Figure 2](#)) is positioned as shown. Notice that the rotator stub (3 in [Figure 2](#)) is nearly aligned with the cartridge loader tray guide bearing (2 in [Figure 2](#)).
11. Remove the cartridge from the cartridge loader tray.
12. Go to [Ending procedure](#).

Half height drive: No apparent failure or damage to tape

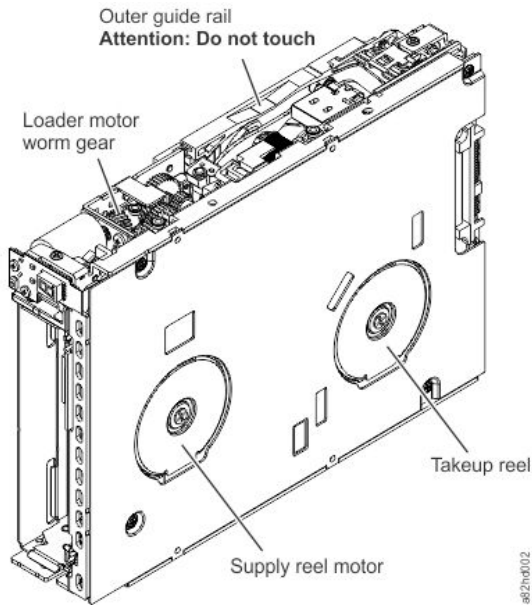
About this task

Note: If the cartridge in the drive is an INPUT tape that contains ACTIVE or 'ONLY COPY' data (there is no backup), eject commands that are issued at the host fail to unload the tape, and power-cycling the drive fails to eject the cartridge, make **no further attempts** to unload this tape. Call Technical Support and open a PMR if one is not already open, to initiate the process of sending the drive with the loaded cartridge in for recovery.

Procedure

1. Set the drive on its left side with the head and tape path facing up.

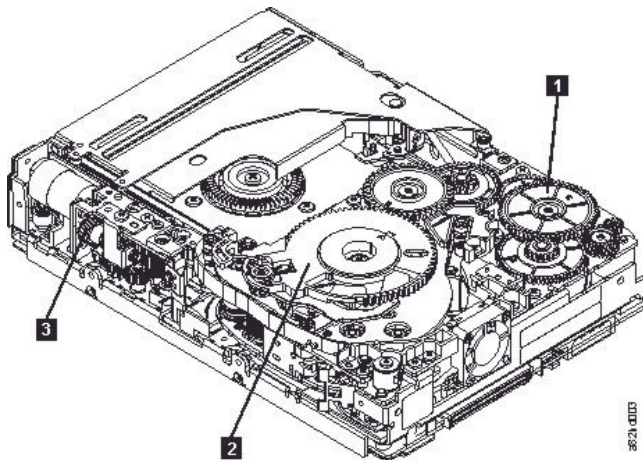
Figure 1. Rewinding tape into cartridge



1	Loader motor worm gear	3	Takeup reel motor
2	Outer guide rail (WARNING: Do Not Touch)	4	Supply reel motor

2. Begin spooling the tape back into the cartridge by turning the supply reel motor (**4**) clockwise.
3. Continue spooling into the cartridge until the tape is taut and remains within the flanges of the tape guiding rollers. Ensure that you do not stretch the tape. Continue spooling until all tape is removed from the takeup reel (**3**).
4. Locate the threader intermediate gear (**1**) near the rear of the drive. You can use your finger to rotate the threader intermediate gear (**1**) and slowly rotate the threader mechanism gear (**2**) clockwise. This action draws the tape leader block assembly (LBA) into the cartridge.

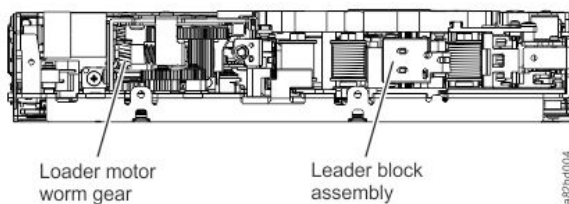
Figure 2. Drive with cover removed to reveal gear train.



1	Threader intermediate gear	2	Threader mechanism gear	3	Loader motor worm gear
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5. As the leader pin is secured in the cartridge, you hear the leader pin retention spring clips click into place. If you do not hear the click, continue rolling until the threader intermediate gear (**1**) stops. The LBA is in the correct position.
Note: Be sure to keep tension on the tape as the LBA is drawn into the cartridge.
6. Rotate the loader intermediate gear (**1**) clockwise as viewed from the front of the drive until it stops. This action releases the LBA leader pin.
7. Rotate the threader motor worm gear (**3**) counterclockwise until the leader block is in front of the read/write head. This action moves the LBA out of the cartridge.

Figure 3. Leader Block Assembly (LBA)



1	Loader motor worm gear	2	Leader block assembly (LBA)
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8. Rotate the loader motor worm gear **(3)** counterclockwise as viewed from the front of the drive until it stops.
9. Remove the cartridge from the cartridge loader tray.
10. Go to [Ending procedure](#).

Ending procedure

Procedure

1. Reassemble the drive brick by reversing the steps in [Removing the drive cover](#).
2. Reassemble the drive sled and reinstall the drive brick by completing these steps:
 - Plug in the RS-422 cable, the power cable (if applicable), and the signal cable.
 - Push the drive brick fully into the sled.
 - Align the two screws holes on each side of the sled with the screw holes on each side of the drive brick. DO NOT TIGHTEN THE SCREWS COMPLETELY.
 - When the drive and sled are properly aligned, fully tighten the screws.
3. Install the tape drive sled in the library.
4. Power ON the library and wait for the library to finish POST (power on self test), inventory, and mid-tape recovery. This step can take up to 1 hour.
5. If the cartridge does not eject from the drive, move the cartridge from the drive to the I/O station, then discard the cartridge.
 - Operator Panel: Operation > Move Cartridge from Drive to Home Slot
 - Management GUI: Drives > Actions > Eject Cartridge from Drive
6. Run Library Verify before normal library operations resume.
7. If necessary, return the failed drive sled to IBM.

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Features

The major accessibility features for the HTML version of this document are:

- You can use screen-reader software and a digital speech synthesizer to hear what is displayed on the screen. The following screen readers are tested: WebKing and Window-Eyes.
- You can operate all features with the keyboard instead of the mouse.

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You can use keys or key combinations to complete operations and initiate many menu actions that are also done through mouse actions. You can navigate the HTML version of the *IBM® TS4300 Tape Library User's Guide* help system from the keyboard with the following key combinations:

- To traverse to the next link, button, or topic, press Tab inside a frame (page).
- To move to the previous topic, press ^ or Shift+Tab.
- To scroll all the way up or down, press Home or End.
- To print the current page or active frame, press Ctrl+P.
- To select, press Enter.

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Refer to the [Electronic emission notices](#) for Class A and Class B notices.

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

Safety and environmental notices

When this product is used, observe the danger, caution, and attention notices that are contained in this guide. The notices are accompanied by symbols that represent the severity of the safety condition.

Most danger or caution notices contain a reference number (Dxxxx or Cxxxx). Use the reference number to check the translation in the [IBM Environmental and safety notices](#) publication online.

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

- [Danger and Caution notices](#)
- [Possible safety hazards](#)
- [Class I laser product](#)
- [Acclimation](#)

Server and storage equipment (racks and frames) must be gradually acclimated to the surrounding environment to prevent condensation.

- [Performing the safety inspection procedure](#)
- [Rack safety](#)
- [Power Cords](#)

For your safety, IBM provides a power cord with a grounded attachment plug to use with this IBM product. To avoid electrical shock, always use the power cord and plug with a properly grounded outlet.

Danger and Caution notices

Danger notices

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

 	To prevent a possible shock from touching two surfaces with different protective ground(earth), use one hand, when possible, to connect or disconnect signal cables. (D001) Overloading a branch circuit is potentially a fire hazard and a shock hazard under certain conditions. To avoid these hazards, ensure that your system electrical requirements do not exceed branch circuit protection requirements. Refer to the information that is provided with your device or the power rating label for electrical specifications. (D002) If the receptacle has a metal shell, do not touch the shell until you have completed the voltage and grounding checks. Improper wiring or grounding could place dangerous voltage on the metal shell. If any of the conditions are not as described, STOP. Ensure the improper voltage or impedance conditions are corrected before proceeding.(D003) An electrical outlet that is not correctly wired could place hazardous voltage on the metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock.(D004) When working on or around the system, observe the following precautions: Electrical voltage and current from power, telephone, and communication cables are hazardous. To avoid a shock hazard: • If IBM supplied a power cord(s), connect power to this unit only with the IBM provided power cord. Do not use the IBM provided power cord for any other product. • Do not open or service any power supply assembly. • Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm. • The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords. ◦ For AC power, disconnect all power cords from their AC power source. ◦ For racks with a DC power distribution panel (PDP), disconnect the customer's DC power source to the PDP. • When connecting power to the product ensure all power cables are properly connected. ◦ For racks with AC power, connect all power cords to a properly wired and grounded electrical outlet. Ensure that the outlet supplies proper voltage and phase rotation according to the system rating plate. ◦ For racks with a DC power distribution panel (PDP), connect the customer's DC power source to the PDP. Ensure that the proper polarity is used when attaching the DC power and DC power return wiring. • Connect any equipment that will be attached to this product to properly wired outlets.
 	• 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. • Do not attempt to switch on power to the machine until all possible unsafe conditions are corrected. • Assume that an electrical safety hazard is present. Perform all continuity, grounding, and power checks specified during the subsystem installation procedures to ensure that the machine meets safety requirements. • Do not continue with the inspection if any unsafe conditions are present. • Before you open the device covers, unless instructed otherwise in the installation and configuration procedures: Disconnect the attached AC power cords, turn off the applicable circuit breakers located in the rack power distribution panel (PDP), and disconnect any telecommunications systems, networks, and modems. • Connect and disconnect cables as described in the following procedures when installing, moving, or opening covers on this product or attached devices. To disconnect: 1. Turn off everything (unless instructed otherwise). 2. For AC power, remove the power cords from the outlets. 3. For racks with a DC power distribution panel (PDP), turn off the circuit breakers located in the PDP and remove the power from the Customer's DC power source. 4. Remove the signal cables from the connectors. 5. Remove all cables from the devices. To connect: 1. Turn off everything (unless instructed otherwise). 2. Attach all cables to the devices. 3. Attach the signal cables to the connectors. 4. For AC power, attach the power cords to the outlets. 5. For racks with a DC power distribution panel (PDP), restore the power from the Customer's DC power source and turn on the circuit breakers located in the PDP. 6. Turn on the devices. • Sharp edges, corners and joints may be present in and around the system. Use care when handling equipment to avoid cuts, scrapes and pinching. (D005)
	Heavy equipment - personal injury or equipment damage might result if mishandled. (D006) Uninterruptible power supply (UPS) units contain specific hazardous materials. Observe the following precautions if your product contains a UPS: • The UPS contains lethal voltages. All repairs and service must be performed only by an authorized service support representative. There are no user serviceable parts inside the UPS. • The UPS contains its own energy source (batteries). The output receptacles might carry live voltage even when the UPS is not connected to an AC supply.

	- Do not remove or unplug the input cord when the UPS is turned on. This removes the safety ground from the UPS and the equipment connected to the UPS. - The UPS is heavy because of the electronics and batteries that are required. To avoid injury, observe the following precautions: - Do not attempt to lift the UPS by yourself. Ask another service representative for assistance. - Remove the battery, electronics assembly, or both from the UPS before removing the UPS from the shipping carton or installing or removing the UPS in the rack.
	(D007)
	Professional movers are to be used for all relocation activities. Serious injury or death might occur if systems are handled and moved incorrectly. (D008)
	Ensure that your DC mains supply is earthed at the point of generation per IEC 60950-1 and ITU-T Recommendation K.27. (D009)
 	Serious injury or death can occur if loaded lift tool falls over or if a heavy load falls off the lift tool. Always completely lower the lift tool load plate and properly secure the load on the lift tool before moving or using the lift tool to lift or move an object. (D010)
	DANGER: Multiple power cords. The product might be equipped with multiple AC power cords or multiple DC power cables. To remove all hazardous voltages, disconnect all power cords and power cables. (L003)

Caution notices

A caution notice calls attention to a situation that is potentially hazardous to people because of some existing condition, or to a potentially dangerous situation that might develop because of some unsafe practice.

	The doors and covers to the product are to be closed at all times except for service by trained service personnel. All covers must be replaced and doors closed at the conclusion of the service operation. (C013)
	This product is equipped with a 3-wire (two conductors and ground) power cable and plug. Use this power cable with a properly grounded electrical outlet to avoid electrical shock. (C018)
	This assembly contains mechanical moving parts. Use care when servicing this assembly. (C025)

A caution notice can be accompanied by one of several symbols:

If the symbol is...	It means...
	A generally hazardous condition not represented by other safety symbols.
	A hazardous condition due to the use of a laser in the product. Laser symbols are always accompanied by the classification of the laser as defined by the U. S. Department of Health and Human Services (for example, Class I, Class II, and so forth).
 	Risk of hand pinching, can trap hands, fingers and cause serious injury. Keep hands clear during operation (L012).
	Caution: moving parts. (L037)
 18.1-33.6 kg (40-74 lbs)	The weight of this part or unit is between 18 and 32 kg (39.7 and 70.5 lb). It takes two persons to safely lift this part or unit. (C009)
 33.6-46.3 kg (74-102 lbs)	The weight of this part or unit is between 32 and 55 kg (70.5 and 121.2 lb). It takes three persons to safely lift this part or unit. (C010)
	A hazardous condition due to the unit's susceptibility to electrostatic discharge.

Possible safety hazards

Possible safety hazards to the operation of this product are:

Electrical

An electrically charged frame can cause serious electrical shock.

Mechanical

Hazards (for example, a safety cover missing) are potentially harmful to people.

Chemical

Do not use solvents, cleaners, or other chemicals that are not approved for use on this product.

Before the library is used, repair any of the preceding problems.

Class I laser product

Before the library is used, review the following laser safety information.

The product might contain a laser assembly that complies with the performance standards set by the US Food and Drug Administration for a Class I laser product. Class I laser products do not emit hazardous laser radiation. The product has the necessary protective housing and scanning safeguards to ensure that laser radiation is inaccessible during operation or is within Class I limits. External safety agencies reviewed the product and obtained approvals to the latest standards as they apply.

Acclimation

Server and storage equipment (racks and frames) must be gradually acclimated to the surrounding environment to prevent condensation.

When server and storage equipment (racks and frames) is shipped in a climate where the outside temperature is below the dew point of the destination (indoor location), there is a possibility that water condensation can form on the cooler inside and outside surfaces of the equipment when the equipment is brought indoors.

Sufficient time must be allowed for the shipped equipment to gradually reach thermal equilibrium with the indoor environment before you remove the shipping bag and energize the equipment. Follow these guidelines to properly acclimate your equipment:

- Leave the system in the shipping bag. If the installation or staging environment allows it, leave the product in the full package to minimize condensation on or within the equipment.
- Allow the packaged product to acclimate for 24 hours.¹ If there are visible signs of condensation (either external or internal to the product) after 24 hours, acclimate the system without the shipping bag for an additional 12 - 24 hours or until no visible condensation remains.
- Acclimate the product away from perforated tiles or other direct sources of forced air convection to minimize excessive condensation on or within the equipment.

¹ Unless otherwise stated by product-specific installation instructions.

Note: Condensation is a normal occurrence, especially when you ship equipment in cold-weather climates. All IBM® products are tested and verified to withstand condensation that is produced under these circumstances. When sufficient time is provided to allow the hardware to gradually acclimate to the indoor environment, there should be no issues with long-term reliability of the product.

Performing the safety inspection procedure

Before you service the unit, complete the following safety inspection procedure.

1. Stop all activities between the host and the library's tape drives.
2. Turn off the power to the library by pushing in the Power button on the front of the tape library for 4 seconds.
3. Unplug the library's power cord from the electrical outlet and the library's power supply unit.
4. Check the library's power cords for damage, such as a pinched, cut, or frayed cord.
5. If drives are FC/SAS attached, check the tape drive's FC/SAS cable for damage.
6. Check the top and bottom covers of the library for sharp edges, damage, or alterations that expose its internal parts.
7. Check the top and bottom covers of the library for proper fit. They must be in place and secure.
8. Check the product label at the rear of the library to make sure that it matches the voltage at your outlet.

Rack safety

The following general safety information must be used for all rack-mounted devices.

DANGER



Observe the following precautions when working on or around your IT rack system.

- Heavy equipment - personal injury or equipment damage might result if mishandled.
- Always lower the leveling pads on the rack cabinet.
- Always install stabilizer brackets on the rack cabinet.
- To avoid hazardous conditions due to uneven mechanical loading, always install the heaviest devices in the bottom of the rack cabinet. Always install servers and optional devices starting from the bottom of the rack cabinet.
- Rack-mounted devices are not to be used as shelves or work spaces. Do not place objects on top of rack-mounted devices. In addition, do not lean on rack mounted devices and do not use them to stabilize your body position (for example, when working from a ladder).



- Each rack cabinet might have more than one power cord.
 - For AC powered racks, be sure to disconnect all power cords in the rack cabinet when directed to disconnect power during servicing.
 - For racks with a DC power distribution panel (PDP), turn off the circuit breaker that controls the power to the system unit(s), or disconnect the customer's DC power source, when directed to disconnect power during servicing.
- Connect all devices installed in a rack cabinet to power devices installed in the same rack cabinet. Do not plug a power cord from a device installed in one rack cabinet into a power device installed in a different rack cabinet.
- An electrical outlet that is not correctly wired could place hazardous voltage on the metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock. (R001 part 1 of 2)

Caution



- Do not install a unit in a rack where the internal rack ambient temperatures might exceed the manufacturer's recommended ambient temperature for all your rack-mounted devices.
- Do not install a unit in a rack where the air flow is compromised. Ensure that air flow is not blocked or reduced on any side, front, or back of a unit that is used for air flow through the unit.
- Consideration must be given to the connection of the equipment to the supply circuit so that overloading of the circuits does not compromise the supply wiring or overcurrent protection. To provide the correct power connection to a rack, refer to the rating labels on the equipment in the rack to determine the total power requirement of the supply circuit.
- (For sliding drawers) Do not pull out or install any drawer or feature if the rack stabilizer brackets are not attached to the rack. Do not pull out more than one drawer at a time. The rack might become unstable if you pull out more than one drawer at a time.



- (For fixed drawers) This drawer is a fixed drawer and must not be moved for servicing unless specified by the manufacturer. Attempting to move the drawer partially or out of the rack might cause the rack to become unstable or cause the drawer to fall out of the rack. (R001 part 2 of 2)

Caution



Removing components from the upper positions in the rack cabinet improves rack stability during relocation. Follow these general guidelines whenever you relocate a populated rack cabinet within a room or building:

- Reduce the weight of the rack cabinet by removing equipment, starting at the top of the rack cabinet. When possible, restore the rack cabinet to the configuration of the rack cabinet as you received it. If this configuration is not known, you must do the following:

- Remove all devices in the 32U position (compliance ID RACK-001) or 22U (compliance ID RR001) and above.
 - Ensure that the heaviest devices are installed in the bottom of the rack cabinet.
 - Ensure that there are little-to-no empty U-levels between devices installed in the rack-cabinet below the 32U (compliance ID RACK-001) or 22U (compliance ID RR001) level, unless the received configuration specifically allowed it.
- If the rack cabinet you are relocating is part of a suite of rack cabinets, detach the rack cabinet from the suite.
- If the rack cabinet you are relocating was supplied with removable outriggers, they must be reinstalled before the cabinet is relocated.
- Inspect the route that you plan to take to eliminate potential hazards.
- Verify that the route that you choose can support the weight of the loaded rack cabinet. Refer to the documentation that comes with your rack cabinet for the weight of a loaded rack cabinet.
- Verify that all door openings are at least 760 x 2032 mm (30 x 80 in.).
- Ensure that all devices, shelves, drawers, doors, and cables are secure.
- Ensure that the four leveling pads are raised to their highest position.
- Ensure that no stabilizer bracket is installed on the rack cabinet during movement.
- Do not use a ramp that is inclined at more than 10 degrees.
- When the rack cabinet is in the new location, complete these steps.
 - Lower the four leveling pads.
 - Install stabilizer brackets on the rack cabinet or in an earthquake environment bolt the rack to the floor.
 - If you removed any devices from the rack cabinet, repopulate the rack cabinet from the lowest position to the highest position.
- If a long-distance relocation is required, restore the rack cabinet to the configuration of the rack cabinet as you received it. Pack the rack cabinet in the original packaging material, or equivalent. Also, lower the leveling pads to raise the casters off the pallet and bolt the rack cabinet to the pallet. (R002)
- DANGER:** Racks with a total weight of > 227 kg (500 lb.), Use Only Professional Movers! (R003)

Caution



- Rack is not intended to serve as an enclosure and does not provide any degrees of protection required of enclosures.
- It is intended that equipment installed within this rack will have its own enclosure. (R005)
- Tighten the stabilizer brackets until they are flush against the rack. (R006)
- Use safe practices when lifting. (R007)
- Do not place any object on top of a rack-mounted device unless that rack-mounted device is intended for use as a shelf. (R008)
- If the rack is designed to be coupled to another rack only the same model rack should be coupled together with another same model rack. (R009)

Danger



Main Protective Earth (Ground): This symbol is marked on the frame of the rack. The PROTECTIVE EARTHING CONDUCTORS must be terminated at that point. A recognized or certified closed loop connector (ring terminal) must be used and secured to the frame with a lock washer using a bolt or stud. The connector must be properly sized to be suitable for the bolt or stud, the locking washer, the rating for the conducting wire used, and the considered rating of the breaker. The intent is to ensure the frame is electrically bonded to the PROTECTIVE EARTHING CONDUCTORS. The hole that the bolt or stud goes into where the terminal connector and the lock washer contact must be free of any non-conductive material to allow for metal to metal contact. All PROTECTIVE BONDING CONDUCTORS must terminate



at this main protective earthing terminal or at points marked with . (R010)



Always ensure that a load of 95 kg (210 lb) is inside the bottom of the rack (compliance ID RR001), especially before relocating or servicing units with their Center of Gravity (CoG) higher than 22U. (R011)

Power Cords

For your safety, IBM provides a power cord with a grounded attachment plug to use with this IBM product. To avoid electrical shock, always use the power cord and plug with a properly grounded outlet.

IBM power cords used in the United States and Canada are listed by Underwriter's Laboratories (UL) and certified by the Canadian Standards Association (CSA).

For units intended to be operated at 115 volts: Use a UL-listed and CSA-certified cord set consisting of a minimum 18 AWG, Type SVT or SJT, three-conductor cord, a maximum of 15 feet in length and a parallel blade, grounding-type attachment plug rated 15 amperes, 125 volts.

For units intended to be operated at 230 volts (U.S. use): Use a UL-listed and CSA-certified cord set consisting of a minimum 18 AWG, Type SVT or SJT, three-conductor cord, a maximum of 15 feet in length and a tandem blade, grounding-type attachment plug rated 15 amperes, 250 volts.

For units intended to be operated at 230 volts (outside the U.S.): Use a cord set with a grounding-type attachment plug. The cord set should have the appropriate safety approvals for the country in which the equipment will be installed.

IBM power cords for a specific country or region are usually available only in that country or region.

EU Data Act (Regulation 2023/2854)

Overview

This Data Information Page provides information regarding data generated by this product. To the extent that access to and use of this data is governed by Regulation (EU) 2023/2854 ("Data Act") the EU Data Act Terms available at [this link](#) apply.

Vital Product Data (VPD) / Machine Readable Product Data (MRPD)

Description

Human readable information on product data including Serial Number, Machine Type and Model, Date of manufacture, and similar identifying information.

Data characteristics

- Format: Text files, CSV files, HTTP/HTTPS, JSON or XML files, and other human readable file types
- Volume: Varies by product, but VPD/MRPD size does not typically change; as of 2025, this data could be up to 4GB
- Generation: Real-time when the product is powered on; most VPD/MRPD data remains static

Storage and retention

- Storage products can send product data to IBM, sometimes via a service or management console
- Products and consoles can store product data sent to IBM temporarily, deleting data based on space management requirements and/or time
- IBM servers can store product data for at least 180 days

User access and control

- Product data can be obtained by customers through GUIs, CLIs, SNMP, REST interfaces, host commands, and other mechanisms
- Users cannot erase VPD/MRPD data
- Access available through:
 - Service console GUI, CLI and/or REST interface
 - Product-specific interfaces (GUIs, CLIs, REST interface, SNMP, host commands)

Configuration Data

Description

Human readable information describing the configuration of the product, identifying parts such as FRUs (Field Replaceable Units) and Feature Codes.

Data characteristics

- Format: Text files, CSV files, HTTP/HTTPS, JSON or XML files, and other human readable file types
- Volume: Varies by product and is expected to change with future code product updates and as new features are added; as of 2025, this data could be up to 4GB
- Generation: Real-time when the product is powered on; most configuration/inventory data is stable until the customer upgrades the product

Storage and retention

- Storage products can send product data to IBM, sometimes via a service or management console
- Products and consoles can store product data sent to IBM temporarily, deleting data based on space management requirements and/or time
- IBM servers can store product data for at least 180 days

User access and control

- Product data can be obtained by customers through GUIs, CLIs, SNMP, REST interfaces, host commands, and other mechanisms
- Access available through:
 - Service console GUI, CLI and/or REST interface
 - Product-specific interfaces (GUIs, CLIs, REST interface, SNMP, host commands)

Logging Data

Description

Files containing data generated by system use and available to customers, including:

- High level error logs tracking error information
- Command logs showing information such as read or write commands sent to the storage device

- Access logs tracking users logging into the system and running admin commands

Data characteristics

- Format: Text files, CSV files, HTTP/HTTPS, JSON or XML files, and other human readable file types
- Volume: Varies by product and is expected to change with future code product updates and as new features are added; as of 2025, this data could be up to 4GB
- Generation: Real-time when the product is powered on; logging runs continuously and is finite in length, with older data removed as newer data is generated

Storage and retention

- Storage products can send product data to IBM, sometimes via a service or management console
- Products and consoles can store product data sent to IBM temporarily, deleting data based on space management requirements and/or time
- IBM servers can store product data for at least 180 days

User access and control

- Product data can be obtained by customers through GUIs, CLIs, SNMP, REST interfaces, host commands, and other mechanisms
- Access available through:
 - Service console GUI, CLI and/or REST interface
 - Product-specific interfaces (GUIs, CLIs, REST interface, SNMP, host commands)

Glossary

This glossary defines the special terms, abbreviations, and acronyms that are used in this publication. If you do not find the term that you are looking for, refer to the index or to the *Dictionary of Computing*, 1994.

Numbers

2:1 compression

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

2.5:1 compression

The relationship between the quantity of data that can be stored with compression as compared to the quantity of data that can be stored without compression. In 2.5:1 compression, two-and-a-half times as much data can be stored with compression as can be stored without compression.

3U

This library requires 3 units (3U) of rack space.

A

A

Ampere.

AC

Alternating current.

Access method

A technique for moving data between main storage and input or output devices.

Accessor

This component contains the library robot and bar code reader. The accessor moves cartridges to and from the I/O Station, storage slots, and tape drives.

Adapter card

A circuit board that adds function to a computer.

Adj

Adjustment.

Administrator (Admin)

The Admin role has access to all menus. The default password is `adm001`, and the default PIN is `0000`.

AH

Authentication Header. An Internet Protocol intended to guarantee connectionless integrity and data origin authentication of IP datagrams. Further, it can optionally protect against replay attacks by using the sliding window technique and discarding old packets.

AIX®

Advanced Interactive Executive. IBM®'s implementation of the UNIX® operating system. The System p system, among others, uses AIX as its operating system.

Alphanumeric

Pertaining to a character set that contains letters, numerals, and other characters, such as punctuation marks.

Alter

To change.

Ambient temperature

The temperature of air or other media in a designated area, particularly the area that is surrounding equipment.

AME

Application Managed Encryption.

ampere (A)

A unit of measure for electric current that is equivalent to a flow of 1 coulomb per second, or to the current produced by 1 volt applied across a resistance of 1 ohm.

ANSI
American National Standards Institute.

API
Application planning interface. A set of clearly defined methods of communication between various software components.

Application-managed encryption
Tape encryption that is controlled by an application.

Archive
To collect and store files in a designated place.

ASCII
American National Standard Code for Information Interchange. A 7 bit coded character set (8 bits including parity check) that consists of control characters and graphic characters.

Assigning a device
The establishing of the relationship of a device to a running task, process, job, or program.

Assignment
The naming of a specific device to complete a function.

Asynchronous
Pertaining to two or more processes that do not depend upon the occurrence of specific events such as common timing signals.

Attention (notice)
A word for calling attention to the possibility of danger to a program, device, or system, or to data. Contrast with *caution* and *danger*.

ATTN
Attention.

Authentication Header (AH)
A member of the IPSec protocol suite. AH guarantees connectionless integrity and data origin authentication of IP packets.

B

Backup
To make extra copies of documents or software for safekeeping.

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

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

Bar code reader
A laser device that is specialized for scanning and reading bar codes and converting them into either the ASCII or EBCDIC digital character code.

Bezel
Decorative and safety cover.

Bicolored
Having two colors.

bit
Either of the digits 0 or 1 when used in the binary numbering system.

BOM or bill of materials
A list of specific types and amounts of direct materials that are expected to be used to produce a specific job or quantity of output.

Border Gateway Protocol (BGP)
BGP is the core routing protocol of the Internet. It works by maintaining a table of IP networks or 'prefixes' that designate network reachability among autonomous systems (AS).

BRMS
Backup Recovery and Media Services.

Browser
A client program that initiates requests to a web server and displays the information that the server returns.

Buffer
A routine or storage that is used to compensate for a difference in rate of flow of data or time of occurrence of events, when data is transferred from one device to another.

Bus
A facility for transferring data between several devices that are located between two end points, only one device able to transmit at a specified moment.

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

C

CA
Certificate Authority.

CA certification
In cryptography, a certificate from a certificate authority (CA).

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

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

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

Cartridge storage slot
Individual slot that is located within a magazine that is used to house tape cartridges.

Caution (notice)
A word to call attention to possible personal harm to people. Contrast with *attention* and *danger*.

CD

Compact Disc. A disc, usually 4.75 inches in diameter, from which data is read optically by using a laser.

CE
Customer engineer, field engineer, service representative.

Centimeter (cm)
One one-hundredth of a meter (0.01 m). Approximately 0.39 inches.

Channel command
An instruction that directs a data channel, control unit, or device to run an operation or set of operations.

Char
Character.

CHK
Check.

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

CM
Cartridge Memory. Within each data cartridge, an embedded electronics and interface module that can store and retrieve a cartridge's historical usage and other information.

CoD
Capacity on-demand.

Command
A control signal that initiates an action or the start of a sequence of actions.

Compact disc (CD)
A disk, usually 4.75 inches in diameter, from which data is read optically by using a laser.

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

Concurrent
Refers to diagnostic procedures that can be run on one control unit while the rest of the subsystem remains available for customer applications.

Contingent connection
A connection between a channel path and a drive that is caused when a unit check occurs during an I/O operation.

Controller
A device that provides the interface between a system and one or more tape drives.

Control path drive
*Controller*A device that provides the interface between a system and one or more tape drives.*Control path drive* A drive that communicates messages from the host computer to the library in which the drive is installed.

Cookie
A packet of data that is exchanged between the library and a web browser to track configuration.

CP
Circuit protector.

CPF
Control Path Failover.

CRU
Customer Replaceable Unit.

CSA
Canadian Standards Association.

Ctrl
Control.

CU
Control unit.

D

Danger (notice)
A word to call attention to possible lethal harm to people. Contrast with *attention* and *caution*.

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

Data buffer
The storage buffer in the control unit. This buffer is used to increase the data transfer rate between the control unit and the channel.

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

Data check
A synchronous or asynchronous indication of a condition that is caused by invalid data or incorrect positioning of data.

DC
Direct current.

DCS
Designated Cleaning Slot.

Degauss
Makes a magnetic tape nonmagnetic by using electrical coils that carry currents that neutralize the magnetism of the tape.

Degausser
A device that makes magnetic tape nonmagnetic.

Degradation
A decrease in quality of output or throughput or an increase in machine error rate.

Degraded
Decreased in quality of output or throughput or increased machine error rate.

Deserialize
To change from serial-by-bit to parallel-by-byte.

Detented
A part that is held in position with a catch or lever.

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

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

DHCPv6
The Dynamic Host Configuration Protocol for IPv6. Although IPv6's stateless address autoconfiguration removes the primary motivation for DHCP in IPv4, DHCPv6 can still be used to statefully assign addresses if the network administrator wants more control over addressing.

DH group
Diffie-Hellman group.

DIAG
Diagnostic section of maintenance information manual.

Differential
See *High Voltage Differential (HVD)*.

Direct-access storage
A storage device in which the access time is independent of the location of the data.

Display contrast
The brightness of the display on the Operator Panel.

DLL
Dynamic Link Library. The Microsoft™ implementation of the shared library concept. These libraries usually have the file extension dll, ocs (for libraries that contain activeX controls, or drv (for legacy system drivers).

DNS
Directory Name System. This system allows the library to recognize text-based addresses instead of numeric IP addresses.

Download
To transfer programs or data from a computer to a connected device, typically a personal computer.
To transfer data from a computer to a connected device, such as a workstation or personal computer.

DPF
Data Path Failover.

DRAM
Dynamic random-access memory.

Drive, magnetic tape
A mechanism for moving magnetic tape and controlling its movement.

Drive Not Configured
This message occurs during the first boot after a factory settings restore is run. This message is not a real issue since it takes time for the library to configure.

DRV
Drive.

DSA key
Encryption key type.

DSE
Data security erase.

DSP
Digital signal processor.

E

EBCDIC
Extended binary-coded decimal interchange code.

EC
Edge connector. Engineering change.

ECC
Error correction code.

EEB
Ethernet Expansion Blade.

EEPROM
Electrically erasable programmable read-only memory.

EIA
Electronics Industries Association.

EIA unit
A unit of measure, which is established by the Electronic Industries Association, equal to 44.45 millimeters (1.75 inches).

Eject
To remove or force out from within.

EKM
Encryption Key Manager.

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

Email
See *electronic mail*.

Encryption
A method of storing data in a format that helps protect data from inadvertent or deliberate compromise. An encryption-enabled drive contains the necessary hardware and firmware to encrypt and decrypt host tape application data. Encryption policy and encryption keys are provided by the host application or host server.

Encryption key manager (EKM)
A software program that assists IBM-encrypting tape drives in generating, protecting, storing, and maintaining encryption keys that encrypt information that is written to and decrypt information that is read from tape media.

Entitlement
IBM Entitlement is the official right to receive service and support for your tape library.

EPO

	Emergency power off.
EPROM	Erasable programmable read only memory.
EQC	Equipment check.
Equipment check	An asynchronous indication of a malfunction.
Error log	A data set or file in a product or system where error information is stored for later access.
ESD	Electrostatic discharge.
ESP	Encapsulating Security Payload. An Internet Protocol that provides origin authenticity, integrity, and confidentiality protection of a packet. ESP also supports encryption-only and authentication-only configurations, but encryption without authentication is discouraged because it is insecure.

F

FAT32	FAT stands for File Allocation Table. FAT32 is an extension which means that data is stored in chunks of 32 bits. Any USB flash drive that is used for updating firmware or exporting logs for the TS4300 library must be in this format.
Fault symptom code (FSC)	A hexadecimal code that is generated by the drive or the control unit microcode in response to a detected subsystem error.
FC	Fibre Channel, Feature code.
FCC	Federal communications commission.
FE	Field engineer, customer engineer, or service representative.
FH	Full Height.
Fibre Channel	A high-speed method to connect data storage to a server. The British spelling of "Fibre" is used because the technology can be used with either fiber optic or copper cables. Thus, the name does not imply that it can be used only with a fiber optic cable.
Fiducial	A target that is used for teaching a physical location to a robot.
Field replaceable unit (FRU)	An assembly that is replaced in its entirety when any one of its components fails.
File	A named set of records that are stored or processed as a unit. Also referred to as a data set.
File protection	The processes and procedures that are established in an information system that are designed to inhibit unauthorized access to, contamination of, or deletion of a file.
File transfer protocol (FTP)	In the Internet suite of protocols, an application layer protocol that uses TCP and Telnet services to transfer bulk-data files between machines or hosts.
Firmware	Proprietary code that is delivered as microcode as part of an operating system. Firmware is more efficient than software loaded from an alterable medium and more adaptable to change than pure hardware circuitry. An example of firmware is the Basic input/output system (BIOS) in read-only memory (ROM) on a PC system board.
FLASH EEPROM	An electrically erasable programmable read-only memory (EEPROM) that can be updated.
FMR	Field microcode replacement.
Format	The arrangement or layout of data on a data medium.
Formatter	Part of a magnetic tape subsystem that runs data conversion, speed matching, encoding, first-level error recovery, and interfaces to one or more tape drives.
FP	File protect.
Frayed	Damaged as if by an abrasive substance.
FRU	Field replaceable unit.
FSC	Fault symptom code.
FSI	Fault symptom index.
FTSS	Field Technical Sales Support.
Functional microcode	Microcode that is resident in the machine during normal customer operation.

G

g	Gram.
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GB	gigabyte.
GBIC	Gigabit Interface Converter.
Gb/s	gigabits/second
Gbit	gigabit
gigabit (Gbit)	1 000 000 000 bits.
gigabyte (GB)	1 000 000 000 bytes.
Gigabit Interface Converter (GBIC)	Converts copper interface to optic interface.
Gnd	Ground.
GUI	Graphical User Interface

H

HBA	Host Bus Adapter.
HD Slot Technology	High-density (HD) slot technology. Allows multiple cartridges to be stored in a tiered architecture.
hertz (Hz)	Unit of frequency. 1 hertz equals one cycle per second.
hex	Hexadecimal.
HH	Half Height.
High Voltage Differential (HVD)	A logic-signaling system that enables data communication between a supported host and the library. HVD signaling uses a paired plus and minus signal level to reduce the effects of noise on the SCSI bus. Any noise that is injected into the signal is present in both a plus and minus state, and is canceled. Synonymous with <i>differential</i> .
HVD	SCSI Bus High-Voltage Differential.
Hz	Hertz (cycles per second).

I

IBM Security Key Lifecycle Manager (SKLM)	IBM's EKM application that assists encrypting tape drives in generating, protecting, storing, and maintaining encryption keys that encrypt information that is written to and decrypt information that is read from tape media.
IBM Spectrum Archive™	Formerly known as Linear Tape File System™ (LTFS). A file system that works with LTO™ Generation tape technology to access data stored on an IBM tape cartridge.
IBM Ultrium™ Tape Drive	Located within the library, a data-storage device that controls the movement of the magnetic tape in an IBM LTO Ultrium Tape Cartridge. The drive houses the mechanism (drive head) that reads and writes data to the tape.
ID	Identifier.
Identifier (ID)	(1) In programming languages, a lexical unit that names a language object. For example, the names of variables, arrays, records, labels, or procedures. An identifier usually consists of a letter optionally followed by letters, digits, or other characters. (2) One or more characters that are used to identify or name data element and possibly to indicate certain properties of that data element. (3) A sequence of bits or characters that identifies a program, device, or system to another program, device, or system.
IEC	International Electrotechnical Commission.
IKE	Internet Key Exchange that is used in the IPsec protocol.
IML	Initial microprogram load.
Incompatible magazine	This message might display on the Operator Panel during library initialization. It occurs during factory restore or VPD. This message is not a real issue since it takes time for the library to configure.
Initial microprogram load (IML)	The action of loading a microprogram from external storage to writable control storage.
Initiator	The component that runs a command. The initiator can be the host system or the tape control unit.
INST	Installation.
Interface	

	A shared boundary. An interface might be a hardware component to link two devices or it might be a portion of storage or registers accessed by two or more computer programs.
Internet Key Exchange (IKE)	The protocol that is used to set up a security association (SA) in the IPSec protocol suite. See also <i>Security Association (SA)</i> .
Internet Protocol Version 4 (IPv4)	See <i>IPv4</i> .
Internet Protocol Version 6 (IPv6)	See <i>IPv6</i> .
Interposer	The part that is used to convert a 68-pin connector to a 50-pin D-shell connector.
Intervention required	Manual action is needed.
INTRO	Introduction.
I/O	Input/output.
I/O Station	Cartridge location that is dedicated for the insertion of cartridges into and the removal of cartridges from the library.
IOP	Input/output processor.
IP	Internet Protocol.
IP address	An identifier for a computer or device on an Internet Protocol (TCP/IP) network. Networks that use the TCP/IP protocol route messages that are based on the IP address of the destination. See <i>IPv4</i> and <i>IPv6</i> .
IPL	Initial program load.
IPSec (IP Security)	A set of protocols for securing IPv6 network communications by authentication and encryption.
IP Stack	A TCP/IP protocol stack that manages static IP addresses.
IPv4	A network layer protocol for packet-switched networks. IPv4 supports 2^{32} (about 4.3 billion) addresses.
IPv6	A network layer protocol for packet-switched networks. It is the designated successor of IPv4 for general use on the Internet. The main improvement of IPv6 is the increase in the number of addresses available for networked devices, allowing, for example, each mobile phone and mobile electronic device to have its own unique address.
ISV	Independent software vendor.
ITDT	IBM Tape Diagnostic tool.
ITST	Idle-time self-test.

K

Kerberos	Kerberos Authentication is a standard (RFC 1510) third-party authentication protocol that provides end-to-end security for distributed computing environments.
Key Path Diagnostics (KPD)	Key Path Diagnostics is a test tool that provides details to troubleshoot Encryption communication issues.
kilogram (kg)	1000 grams (approximately 2.2 pounds).
km	kilometer. 1000 Meters, Approximately 5/8 mile.
KMIP	Key Management Interoperability Protocol.

L

LAN	Local area network. A computer network within a limited area.
LCB	Library Control Blade.
LCD	See <i>liquid crystal display</i> .
LDAP	Lightweight Directory Access Protocol. This protocol allows the library to use login and password information that is stored on a server to grant access to the library functions.
LDAPS	Secure LDAP over SSL.
LDI	Library Drive Interface.
LED	Light-emitting diode.

Library certification	In cryptography, a certificate that is provided by the library.
Library-managed encryption	Tape encryption that is controlled by the tape library.
Linear Tape-Open™ (LTO)	A type of tape storage technology that is developed by the IBM Corporation, Hewlett-Packard, and Quantum. LTO technology is an "open format" technology, which means that its users have multiple sources of product and media. The "open" nature of LTO technology enables compatibility between different vendors' offerings by ensuring that vendors comply with verification standards. The LTO technology is implemented in two formats: the Accellis format focuses on fast access; the Ultrium format focuses on high capacity. The Ultrium format is the preferred format when capacity (rather than fast access) is the key storage consideration. An Ultrium cartridge has a compressed data capacity of up to 30 TB (2.5:1 compression) and a native data capacity of up to 12 TB.
Liquid crystal display (LCD)	A low-power display technology that is used in computers and other I/O devices.
Loadable	The ability to be loaded.
LME	Library Managed Encryption.
LTO	See <i>Linear Tape-Open</i> .
LTO cartridge memory (LTO-CM)	Within each LTO Ultrium data cartridge, an embedded electronics and interface module that can store and retrieve a cartridge's historical usage and other information.
LUN	Logical Unit Number.
LVD	SCSI Bus Low Voltage Differential.

M

M8	LTO 8 Type M Cartridge.
MAC address	The Media Access Control address of a computer networking device.
Magnetic tape	A tape with a magnetic surface layer on which data can be stored by magnetic recording.
Management GUI	Web User Interface, Web UI, Web GUI.
MAP	Maintenance analysis procedure.
Mask	A pattern of characters that controls the retention or elimination of portions of another pattern of characters. To use a pattern of characters to control the retention or elimination of portions of another pattern of characters.
Master file	A file that is used as an authority in a job and that is relatively permanent, even though its contents might change. Synonymous with main file.
Maximum Transmission Unit (MTU)	The size of the largest packet that a network protocol can transmit.
MB	Megabyte (expressed as data rate in MB/s or MB/second).
Media capacity	The amount of data that can be contained on a storage medium, expressed in bytes of data.
Media-type identifier	Pertaining to the bar code on the bar code label of the IBM Ultrium tape cartridge, a two-character code, L1, that represents information about the cartridge. L identifies the cartridge as one that can be read by devices that incorporate LTO technology; 1 indicates that it is the first generation of its type.
Mega	One million of.
meter	In the Metric System, the basic unit of length equal to approximately 39.37 inches.
MIB	Management Information Base. Information repository that is used by SNMP.
Micro	One millionth of.
Microcode	(1) One or more micro instructions. (2) A code, representing the instructions of an instruction set, which is implemented in a part of storage that is not program-addressable. (3) To design, write, and test one or more micro instructions. (4) See also <i>microprogram</i> .
Microdiagnostic routine	A program that runs under the control of a supervisor, usually to identify field replaceable units.
Microdiagnostic utility	A program that is run by the customer engineer to test the machine.
Microinstruction	A basic or elementary machine instruction.
Microprogram	A group of micro instructions that when run completes a planned function. The term microprogram represents a dynamic arrangement or selection of one or more groups of micro instructions for execution to complete a particular function. The term microcode represents microinstructions that are used in a product as an alternative to hard-wired circuitry to implement certain functions of a processor or other system component.

MIM	Media information message.
mm	Millimeter.
Modifier	That which changes the meaning.
Monitor	The Monitor role is an interchangeable term corresponding to the User role. The Monitor role has viewing privileges to the unit, but is not able to make configuration changes.
Mount a device	To assign an I/O device with a request to the operator.
MP	Microprocessor.
ms	Millisecond.
MSG	Message.
Multipath	Pertaining to using more than one path.

N

N/A	Not applicable.
Network Address Translation (NAT)	NAT involves rewriting the source or destination addresses of IP packets as they pass through a router or firewall. Most systems that use NAT do so to enable multiple hosts on a private network to access the Internet over a single public IP address.
NEMA	National Electrical Manufacturers Association.
Node	In a network, a point at which one or more functional units connect channels or data circuits.
NTFS	New Technology File System. The primary file system that is used in Windows™.
NTP	Network Time Protocol. This protocol allows the library to set its internal date and time that is based on the date and time of a server.
NVS	Nonvolatile storage. A storage device whose contents are not lost when power is cut off.

O

OCP	Operator Panel (Operator Control Panel).
Oersted	The unit of magnetic field strength in the unrationalized centimeter-gram-second (cgs) electromagnetic system. The oersted is the magnetic field strength in the interior of an elongated, uniformly wound solenoid that is excited with a linear current density in its winding of ` 1 ampere per 4 π centimeters of axial length.
Offline	Pertaining to the operation of a functional unit without the continual control of a computer. Contrast with <i>online</i> .
Online	Pertaining to the operation of a functional unit that is under the continual control of a computer. Contrast with <i>offline</i> .
OPER	Operation.
OV	Over voltage.
Overrun	Loss of data because a receiving device is unable to accept data at the rate it is transmitted.
Overtightening	To tighten too much.

P

Parameter	A variable that is given a constant value for a specified application and that might denote the application.
p bit	Parity bit.
PC	Parity check.
PCC	Power® control compartment.
PDF	Portable Document Format.
PE	Parity error. Product engineer.
PFS	

	Perfect forward secrecy.
Pick	Pertaining to the library to remove, by using a robotic device, a tape cartridge from a storage slot or drive.
Picker	A robotic mechanism that is located inside the library that moves cartridges between the cartridge storage slots and the drive.
PM	Preventive maintenance.
POR	Power-on reset.
Port	A physical connection for communication between the 3590 and the host processor. The 3590 has 2 SCSI ports.
Portable Document Format (PDF)	A standard that is specified by Adobe™ Systems, Incorporated, for the electronic distribution of documents. PDF files are compact, can be distributed globally (by way of email, the web, intranets, or CD-ROM), and can be viewed with the Acrobat Reader. Acrobat Reader is software from Adobe Systems that can be downloaded at no cost from the Adobe Systems home page.
Private key	A cryptographic key that is used to decrypt a message.
PROM	Programmable read only memory.
PS	Power supply.
PTF	Program temporary fix. A single bugfix or group of bugfixes that are distributed in a form ready to install for customers.
PWR	Power.

R

Rack	A unit that houses the components of a storage subsystem, such as the library.
Rackmount kit	A packaged collection of articles that are used to install the rack-mounted version of the library.
RAM	Random access memory.
Random access memory	A storage device into which data is entered and from which data is retrieved in a nonsequential manner.
Random Mode	In Random mode, the library allows the server's (host's) application software to select any data cartridge in any order.
RAS	Reliability, availability, and serviceability.
Record	A collection of related data or words, which are treated as a unit.
Recording density	The number of bits in a single linear track measured per unit of length of the recording medium.
Recoverable error	An error condition that allows continued execution of a program.
Ref	Reference.
Reg	Register.
Reinventory	To inventory again.
REST	Representational state transfer. Part of an API. REST systems aim for fast performance, reliability, and the ability to grow, by reusing components that can be managed and updated without affecting the system as a whole, even while it is running.
Retension	The process or function of tightening the tape onto the cartridge, if it is sensed that the tape has a loose wrap on the cartridge.
RFC (Request for Comments)	Request for Comments (RFC) documents are a series of memoranda, which encompasses new research, innovations, and methodologies applicable to Internet technologies.
RH	Relative humidity.
RID tag	Repair identification tag.
RML	Rack Mount Line.
Robot	Picker.
Robotic Assembly	The picker, picker assembly.
Robotics	Picker assembly.
Root CA certification	In cryptography, a root certificate from a certificate authority (CA).
RPQ	Request for price quotation.

RSA key
Encryption key type.
R/W
read/write.

S

s
Seconds of time.

SAC
Service Action Code. Code that is developed to indicate possible FRU or FRUs to replace to repair the hardware.

SAN
Storage area network.

SAS
Serial Attached SCSI. A computer bus technology and serial communication protocol for direct attached storage devices. SAS is a replacement for parallel SCSI with higher speeds, but still uses SCSI commands.

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

SCD
Single Character Display.

SCSI
Small computer system interface.

SE
Single-ended.

Sequential Mode
Sequential Mode is intended to be used by host applications that aren't supporting SCSI media changer devices but need to get another cartridge loaded if the current cartridge is full.

Segment
A part.

Sel
Select.

Serial Attached SCSI (SAS)
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. It supports full-duplex signal transmission up to 3 Gb/s. In addition, SAS drives can be hot-plugged.

Serialize
To change from parallel-by-byte to serial-by-bit.

Serializer
A device that converts a space distribution of simultaneous states, which represents data into a corresponding time sequence of states.

Service
Access to this level is for Service personnel only - Service personnel have access to all menus.

Servo, servos
An adjective for use in qualifying some part or aspect of a servomechanism.

Servomechanism
A feedback control system in which at least one of the system signals represents mechanical motion.

Signature
A digital signature that is used in cryptography to identify one party to ensure authenticity.

SKLM (IBM Security Key Lifecycle Manager)
IBM EKM application that assists encrypting tape drives in generating, protecting, storing, and maintaining encryption keys that encrypt information that is written to and decrypt information that is read from tape media.

SKLM for z/OS®
Security Key Lifecycle Manager for IBM System z® mainframes.

Slot blocker
A slot blocker is used to restrict/close off a data cell so a data cartridge cannot be inserted.

Small Computer Systems Interface (SCSI)
A standard that is used by computer manufacturers for attaching peripheral devices (such as tape drives, hard disks, CD-ROM players, printers, and scanners) to computers (servers). Pronounced "scuzzy". Variations of the SCSI interface provide for faster data transmission rates than standard serial and parallel ports (up to 320 megabytes per second). The variations include

- Fast/Wide SCSI - Uses a 16-bit bus, and supports data rates of up to 20 MBps.
- SCSI-1 - Uses an 8-bit bus, and supports data rates of 4 MBps.
- SCSI-2 - Same as SCSI-1, but uses a 50-pin connector instead of a 25-pin connector, and supports multiple devices.
- Ultra-SCSI - Uses an 8- or 16-bit bus, and supports data rates of 20 or 40 MBps.
- Ultra2 SCSI - Uses an 8- or 16-bit bus and supports data rates of 40 or 80 MBps.
- Ultra3 SCSI - Uses a 16-bit bus and supports data rates of 80 or 160 MBps.
- Ultra160 SCSI - Uses a 16-bit bus and supports data rates of 80 or 160 MBps.
- Ultra320 SCSI - Uses a 16-bit bus and supports data rates of 320 MBps.

SMI-S
See *Storage Management Initiative Specification (SMI-S)*.

SMTP
Simple Mail Transfer Protocol. SMTP is a standard for email transmissions across the internet.

SNMP
Simple Network Management Protocol. SNMP is used by network management systems to monitor network-attached devices for conditions that warrant administrative attention.

SNTP

	Simple Network Time Protocol. Used to synchronize the clocks of network-attached devices.
SMW	Servo Manufacturer's Word.
SNS	Sense.
Special feature	A feature that can be ordered to enhance the capability, storage capacity, or performance of a product, but is not essential for its basic work.
SPI	Security Parameters Index.
SR	Service representative, see also <i>CE</i> .
SRAM	Static random access memory.
SS	Status store.
SSH	Secure Shell.
SSL (Secure Sockets Layer)	A set of cryptographic protocols for secure communications on the Internet for such things as web browsing, email, Internet faxing, instant messaging, and other data transfer. SSL allows applications to communicate across a network in a way that is designed to prevent eavesdropping, tampering, and message forgery.
SSP	Serial SCSI Protocol.
ST	Store.
Standard feature	The significant design elements of a product that are included as part of the fundamental product.
START	Start maintenance.
StartTLS	Secure LDAP communication that uses TLS.
Storage Management Initiative Specification (SMI-S)	A storage standard that is developed and maintained by the Storage Networking Industry Association (SNIA). It is also ratified as an ISO standard. The main objective of SMI-S is to enable broad interoperable management of heterogeneous storage vendor systems.
Subsystem	A secondary or subordinate system, capable of operating independently of, or asynchronously with, a controlling system.
Superuser	The Superuser role has access to most sections of the library menus.
SUPP	Support.
Sync	Synchronous, synchronize. Occurring with a regular or predictable time relationship.

T

Tachometer, tach	A device that emits pulses that are used to measure/check speed or distance.
Tape cartridge	A container that holds magnetic tape that can be processed without separating it from the container.
Tape void	An area in the tape in which no signal can be detected.
TB	Terabyte.
TCP/IP	Transmission Control Protocol/Internet Protocol.
TCU	Tape control unit.
Terabyte	One terabyte = 1,000,000,000,000 bytes, or 1000 gigabytes (GBs).
TH	Thermal.
TKLM (IBM Tivoli® Key Lifecycle Manager)	IBM's EKM application that assists encrypting tape drives in generating, protecting, storing, and maintaining encryption keys that encrypt information that is written to and decrypt information that is read from tape media.
thread/load operation	A procedure that places tape along the tape path.
TLS	Transport :Layer Security.
TM	Tapemark, Trademark.
Transport mode	End-to-end communications security in which the end-point computers do the security processing.
Trusted certification	In cryptography, a trustworthy certificate that is not registered with a certificate authority.
Tunnel mode	Port-to-port communications security in which security is provided to several machines by a single node.

U

UART	Universal asynchronous receiver/transmitter.
UID	Unit Identification.
UL	Underwriter's Laboratories.
Universal rack connector	A rackmount kit has four universal rack connectors as part of the kit. Each connector has two sides - one side is for round-hole racks, and the other side is for square-hole racks. The square-hole side might be painted. The connectors are installed from the inside of the rack out, and the rails are hooked onto them. See Figure 1 .
Unload	Prepare the tape cartridge for removal from the drive.
User	The User role is an interchangeable term corresponding to the Monitor role. The User role has viewing privileges to the unit, but is not able to make configuration changes.
Utilities	Utility programs.
Utility programs	A computer program in general support of the processes of a computer. For instance, a diagnostic program.
UV	Under voltage.

V

VOLSER	Volume serial number.
Volume	A certain portion of data, together with its data carrier, that can be handled conveniently as a unit.
VPD	Vital product data. The information that is contained within the tape drive that requires nonvolatile storage that is used by functional areas of the drive, and information that is required for manufacturing, RAS, and engineering.

W

Web UI, Web GUI, Web User Interface	Management GUI
Word	A character string that is convenient for some purpose to consider as an entity.
Worldwide Node Name (WWNN)	A unique character string that identifies Fibre Channel Host Bus adapters (HBA).
WORM	Write Once, Read Many.
Write	Write command.
WT	World trade.
WWCID	Worldwide Cartridge Identifier.
WWN	Worldwide Name.
WWNN	Worldwide Node Name.
WWPN	Worldwide port name.

X

XR	External register.
XRA	External register address register.