StorageTek®

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3

STREAMLINE™ SL8500

MODULAR LIBRARY SYSTEM

USER'S GUIDE

PRODUCT TYPE
HARDWARE

StreamLine™ SL8500 Modular Library System

User's Guide

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First Edition (May 2004)

This edition contains 159 pages. See “Summary of Changes” on page iii for the revision history and summary of changes made to this publication.

Summary of Changes

EC	Date	Edition	Description
111906	May 2004	First	Initial Release
111920	July 2004	Second	Refer to this edition for the list of changes
111945	November 2004	Third	**Safety:** Added statement pertaining to products that require a ground connection at the wall outlet. See “EN60950-1:2001 Statement” on page xxii. **Chapter 1:** Updated the physical dimensions of the library. See “Library Specifications” on page 16. **Chapter 2**: Added additional information about the the dynamic World Wide Name (dWWN) feature. See “Dynamic World Wide Name” on page 23. **Chapter 3**: Updated the safety precautions for the Manaul Mode of Operations to ensure that the library is taken offline before entering. See “Precautions” on page 40.

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Figures

Tables

Preface

This guide, while intended primarily for users of the library, also contains information that can be used by system administrators. Most of the information pertains to the library hardware and related operations. For specific drive information or for client-generated software commands and console messages, refer to your drive or software documentation.

Organization

The organization of this guide is:

Chapter 1 "Introduction" provides an overview of the SL8500 modular library system.

Chapter 2 "Configuration Information" describes how to activate your site user account, verify the library and drive configuration entries, and upgrade firmware.

Chapter 3 "Library Operation" describes the tasks you can perform while the library is operating in automated and manual modes.

Chapter 4 "Cartridge Information" describes how to handle, inspect, and maintain cartridges.

Chapter 5 "Troubleshooting and Diagnostics" describes how to correct problems with the library and the attached devices (drives, CAP, robots, and elevators). It also describes some of the diagnostic utilities.

Chapter 6 "Obtaining Maintenance Support" describes how to contact Customer Support for assistance if problems occur with the tape library.

Appendix A "Cartridge Slot Locations" explains the locations and numbering schemes of the cartridge slots in the library.

Appendix B "Drive Bay Locations" explains the locations and numbering schemes of the drive bays in the library.

"Glossary" The "Glossary" defines new or special terms and abbreviations used in this manual.

Index The "Index" helps you find information in this manual.

Alert Messages

Alert messages call your attention to information that is especially important or that has a unique relationship to the main text or graphic.

Note: A note provides additional information that is of special interest. A note might point out exceptions to rules or procedures. A note usually, but not always, follows the information to which it pertains.

CAUTION: A caution informs the reader of conditions that might result in damage to hardware, corruption of data, corruption of application software, or long-term health problems in people. A caution always precedes the information to which it pertains.

WARNING: A warning alerts the reader to conditions that might result in injury or death. A warning always precedes the information to which it pertains.

Conventions

Typographical conventions highlight special words, phrases, and actions in this publication.

Item	Example	Description of Convention
Buttons	MENU	Font and capitalization follows label on product
Commands	Mode Select	Initial cap
Document titles	*System Assurance Guide*	Italic font
Emphasis	*not* or *must*	Italic font
File names	`fsc.txt`	Monospace font
Hypertext links	Figure 2-1 on page 2-5	Blue (prints black in hardcopy publications)
Indicators	Open	Font and capitalization follows label on product
Jumper names	TERMPWR	All uppercase
Keyboard keys	<Y> <Enter> or <Ctrl+Alt+Delete>	Font and capitalization follows label on product; enclosed within angle brackets
Menu names	Configuration Menu	Capitalization follows label on product
Parameters and variables	Device = *xx*	Italic font

Item	Example	Description of Convention
Path names	`c:/mydirectory`	Monospace font
Port or connector names	SER1	Font and capitalization follows label on product; otherwise, all uppercase
Positions for circuit breakers, jumpers, and switches	ON	Font and capitalization follows label on product; otherwise, all uppercase
Screen text (including screen captures, screen messages, and user input)	`downloading`	Monospace font
Switch names	Power	Font and capitalization follows label on product
URLs	http://www.storagetek.com	Blue (prints black in hardcopy publications)

Related Publications

The following publications relate to the SL8500 Tape Library are listed below.

Tape Drive Documentation	Part Number
Hewlett Packard Ultrium Tape Drive Manual	CD included with drive
IBM Ultrium Tape Drive Manual	CD included with drive
Seagate Ultrium Tape Drive Product Manual	CD included with drive
Super DLT600 Product Manual	CD included with drive
T9840 Tape Drive User's Reference Manual	95739
T9940 Tape Drive Operator's Guide	95989

Software Publications	Part Number
Automated Cartridge System Library Software (ACSLS)	
ACSLS System Administrator's Guide	3134648
ACSLS Messages	3134649
ACSLS Quick Reference	3134650

Host Software Component (HSC) MVS Publications	
HSC Operator's Guide	312531101
HSC Messages and Codes Guide	312531301

Other Publications	Part Number
American National Standard Dictionary for Information Processing Systems	ANSI X3/TR-1-82
Fibre Optics User's Guide	9433

Additional Information

StorageTek offers several methods for you to obtain additional information.

StorageTek's External Web Site

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Customer Resource Center

StorageTek's CRC is a Web site that enables members to resolve technical issues by searching code fixes and technical documentation. CRC membership entitles you to other proactive services, such as HIPER subscriptions, technical tips, answers to frequently asked questions, addenda to product documentation books, and online product support contact information. Customers who have a current warranty or a current maintenance service agreement may apply for membership by clicking on the Request Password button on the CRC home page.

The URL for the CRC is http://www.support.storagetek.com.

e-Partners Site

StorageTek's e-Partners site is a Web site that provides information about products, services, customer support, upcoming events, training programs, and sales tools to support StorageTek's e-Partners. Access to this site, beyond the e-Partners Login page, is restricted. On the e-Partners Login page, current partners who do not have access can request a login ID and password and prospective partners can apply to become StorageTek resellers.

The URL for the e-Partners site is http://members.storagetek.com.

Hardcopy Publications

Contact a StorageTek sales or marketing representative to order additional paper copies of this publication or to order other StorageTek customer publications in paper format.

Safety

The following pages describe common practices concerning electrostatic discharge, fiber optics, and library safety.

Electrostatic Discharge Damage Prevention

Before you touch any internal components in the library, including drives, you must take precautions against electrostatic discharge (ESD).

CAUTION: *Components are sensitive to static electricity:* Even a small electrostatic discharge can damage an electrical component that is inside the library. A damaged component might not fail immediately, but over time, it will become worse and might eventually cause an “intermittent” problem. Be sure that you touch an *unpainted* metal surface of the library before you reach inside the library or touch the drives or optional interface equipment.

Before you touch any internal components:

1. With your finger, touch an *unpainted* metal surface of the library. In some libraries, you can touch the library’s frame. In other libraries, you might have to touch a bolt on the wall or on the door frame.
2. Keep your body movement to a minimum as you touch the drives or the library components.

Antistatic wrist straps that have clip-on ends are commercially available.

Fiber-optic Safety

WARNING: *Eye hazard*. Never look directly into a fiber-optic cable, a fiber-optic connector, or a laser transceiver module. Hazardous conditions might exist from laser power levels that are capable of causing injury to the eye.

Be especially careful when using optical instruments with this equipment. Such instruments might increase the likelihood of eye injury.

The laser transceivers in fiber-optic equipment can pose dangers to personal safety. Ensure that anyone who works with this StorageTek equipment understands these dangers and follows safety procedures. Ensure that the

optical ports of every laser transceiver module are terminated with an optical connector, a dust plug, or a cover.

Each fiber-optic interface in this StorageTek Fibre Channel equipment contains a laser transceiver that is a Class 1 Laser Product. Each laser transceiver has an output of less than 70 µW. StorageTek's Class 1 Laser Products comply with EN60825-1:1994+A1+A2 and with sections 21 CFR 1040.10 and 1040.11 of the Food and Drug Administration (FDA) regulations.

CAUTION: Use of controls or adjustment or performance of procedures other than those specified herein might result in hazardous radiation exposure.

The following translations are for users in Finland and Sweden who wish to identify laser safety and classification:

CLASS 1 LASER
LUOKAN 1 LASERLAITE
KLASSE 1 LASER APPARAT

Laser Product Label

In accordance with safety regulations, a label on each StorageTek Fibre Channel product identifies the laser class of the product and the place and date of the manufacturer. The label appears on top of a Fibre Channel tape drive and near the Fibre Channel connectors on a Fibre Channel tape library. A copy of the label is shown here:

CLASS 1 LASER PRODUCT
LASER KLASSE 1
APPAREIL A LASER DE CLASSE 1
COMPLIES WITH 21 CFR 1040.10 AND 1040.11

EN60950-1:2001 Statement

The following statement pertains to products that require a ground connection at the wall outlet.

Norway:
Apparatet må tilkoples jordet stikkontakt

Finland:
Laite on liitettävä suojamaadoituskoskettimilla varustettuun pistorasiaan

Sweden:
Apparaten skall anslutas till jordat uttag

Denmark:
For tilsluting af de øvrige ledere, se medfølgende installationsvejledning

Library Safety

It is essential that safety procedures are followed. Be sure you are familiar with all the precautions in this section before you attempt to enter the library. Interlocks, robotics emergency robotics stop switches, and smoke detectors are provided to assure safety throughout the library.

Mechanical Access Door Mechanisms

On the rear of each door lock, a mechanism (painted yellow) is available to release the door lock from the inside of the library. This is a non-electrical safeguard against being locked inside the library.

Should an access door be shut and locked from the outside, someone inside the library need only push on the mechanism to unlock and open the door.

SL8500 Door Interlocks

Safety interlocks are on the:

- Door frames of the customer interface module has two switches behind each front access door
- Service safety door

These interlocks are monitored by the HBN card, which also removes power during an emergency robotics stop condition.

When two libraries are connected by a pas-thru port (PTP), entering the interior of either library will automatically suspends pass-thru operations. Operations within the library with the open door also stop, while the other library's operation continue.

Service Safety Door

The service safety door is a sliding door that is activated by a maintenance key. The maintenance key is controlled *only* by service representatives and is used only when a failing HandBot is to be replaced. Operation of the service safety door is controlled by the HBZ card on the elevator and turntable assembly.

The maintenance area is the space between the two front access doors and the service safety door. Within a library that contains redundant HandBots, a defective HandBot that is unable to move into the maintenance area is pushed into this maintenance area by the other, functional HandBot on the same rail.

The service safety door moves either to the left or right, depending upon which maintenance lock is opened. When the maintenance key is inserted into its lock and turned, the service safety door activates to separate the forward maintenance area from the library interior. This allows the service

representative to replace an HandBot while the remainder of the library is fully operational.

SL8500 Servo Power Interrupt

An additional safety feature is the servo power interrupt (SPI). If a library motor is determined to be out-of-range, the processor generates an SPI to turn off drive voltage to the faulty motor. This prevents a servo runaway condition until the cause of the problem can be determined.

Smoke Detection

A smoke detector is present within the library. If the detector senses smoke, the library performs an emergency power-off (EPO) procedure, removing all (AC and DC) power from the library.

The smoke detector is in the upper right section of the drive and electronics module, as seen from the rear of the machine.

The SL8500 does *not* ship with a Fire Suppression System but StorageTek's Professional Services can install one on site. Contact you service representative for more information.

Emergency Robotics Stop Switches

In case of a condition that requires an immediate power-off of the library, there are two Emergency Robotics Stop switches for the library:

- One interior, lighted switch on the left side of the drive area, as seen from the front of the machine
- One non-illuminated, covered switch on the front operator key panel

Actuating an emergency robotics stop switch immediately disconnects DC power to the power rails. After it is determined that it is safe to restore power, the switch is reset by pressing it again.

Front Access Door Switches

Four door switches monitor the state of the access doors; should a door open, the switches also initiate an emergency robotics stop to the HandBots within the library.

The HBN card shuts down power to the rails and front power buses in case an emergency robotics stop or unauthorized entry into the library occurs.

Interior Lighting

During normal operation, the interior of the library is illuminated by white LEDs. If either access door is opened, however, yellow LEDs are provided to assist maintenance personnel.

If either front access door is opened by an operator, the yellow LEDs flash on/off to indicate that one or both front access doors are opened. If a service representative initiates a maintenance activity, however, the LEDs remain on to aid the person entering the maintenance area of the library.

After exiting the library, the door is closed and locked. Following a door closure, the yellow LEDs flashes on/off for approximately 10 seconds, alerting anyone who may still be inside the library that library startup is about to begin.

Notices

Please read the following compliance and warning statements for this product.

CAUTION: *Potential equipment damage:* Cables that connect peripherals must be shielded and grounded; refer to descriptions in the cable instruction manuals. Operation of this equipment with cables that are not shielded and not correctly grounded might result in interference to radio and TV reception.

Changes or modifications to this equipment that are not expressly approved in advance by StorageTek will void the warranty. In addition, changes or modifications to this equipment might cause it to create harmful interference.

United States FCC Compliance Statement

The following compliance statement pertains to Federal Communications Commission Rules 47 CFR 15.105:

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

CISPR 22 and EN55022 Warning

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

Japanese Compliance Statement

The following compliance statement in Japanese pertains to VCCI EMI regulations:

この装置は、情報処理装置等電波障害自主規制協議会（ＶＣＣＩ）の基準に基づくクラスＡ情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

English translation: This is a Class A product based on the Technical Requirement of the Voluntary Control Council for Interference by Information Technology (VCCI). In a domestic environment, this product may cause radio interference, in which case the user may be required to take corrective actions.

Taiwan Warning Label Statement

The following warning label statement pertains to BSMI regulations in Taiwan, R.O.C.:

警告使用者: 這是甲類的資訊產品，在居住的環境中使用時，可能會造成射頻干擾，在這種情況下，使用者會被要求採取某些適當的對策。

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

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NOTICE

INTERNAL CODE LICENSE

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   c. “Maintenance Code” is defined as Microcode and other software, including data files, which may reside or execute in or be used by or in connection with Equipment, and which detects, records, displays, and/or analyzes malfunctions in the Equipment.

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Introduction

1

This chapter introduces the major hardware components and provides the library specifications for the StreamLine™ SL8500 modular library system, which is referred to as the SL8500 library or just the “library” throughout this manual. For software information and drive information, refer to the publications that pertain to these specific topics.

The library is a robotic system that mounts cartridges into storage slots or into drives for read/write operations. It also moves cartridges between the cartridge access port (CAP) to storage slots or between slots.

Library Overview

The SL8500 Library is a fully automated cartridge tape storage and retrieval system.

The base library stands 2.37 m (7.76 ft.) tall, 1.7 m (5.6 ft.) wide, and 2.76 m (9.1 ft.) deep. Depending on the model and features selected, *one* SL8500 library can store from 1,448 to 6,632 cartridge tapes and house from four to 64 tape drives.

A library complex, consists of two or more libraries that connect with pass-thru ports (PTPs) and contains *over* 200,000 customer usable cartridges and 1,984 tape drives.

The approximate speed of each robot (termed StreamLine HandBot™ high performance robotics) is from 2 m (75 in.) to 2.5 m (100 in.) per second.

Single Physical SL8500 Library—Base

The minimum SL8500 library configuration is composed of:

- A Drive and Electronics Module, containing from four to 64 tape drives and the controlling circuit cards for the library
- One Robotics Interface Module, containing up to 800 cartridge storage slots
- Multiple HandBots (four – eight) that service four rails. They move horizontally along rails and vertically along their individual Z axes. They retrieve cartridges from both inner and outer walls (and the elevator and turntable assembly or CAPs) by pivoting 180 degrees

- One Customer Interface Module that provides storage for 648 cartridges and contains an LED display
- A remote “operator panel” (StreamLine Library Console™ software that provides an operator panel display on the customer’s personal computer [PC])
- An elevator assembly located in the front (Customer Interface Module), that transfers cartridges vertically across rail boundaries (elevator) or from one side of the library to the other (by passing them to either HandBot using a turntable)
- A standard cartridge access port (CAP) that allows up to 39 cartridges to be entered/ejected at one time

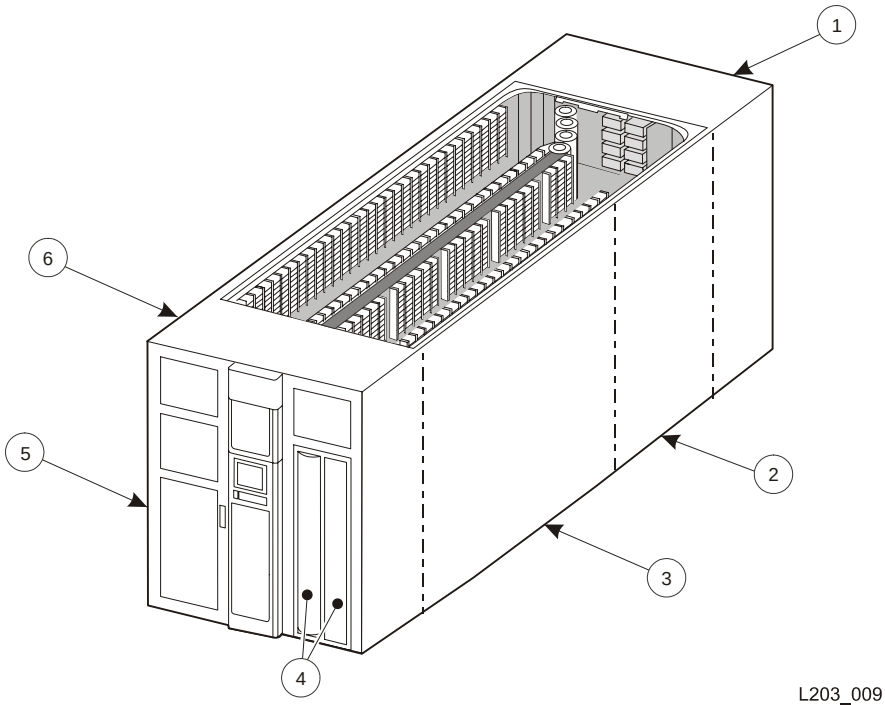
Single Physical SL8500 Library—Options

Options for each stand-alone SL8500 library are:

- A maximum of three additional storage expansion modules, providing 1,728 cartridge storage slots each, to a maximum cartridge storage number of 6,632 cartridges within one library
- A touch-panel operator control in the middle of the Customer Interface Module, between the two access doors
- An optional second CAP (CAP B) is also available
- Redundant HandBots (maximum of four) that provide redundancy should one robot encounter a failure.

An view of a library with one expansion frame is shown in Figure 2 on page 4.

Figure 1. Library Modules (L203_009)



1. Drive and electronics module
1. Robotics interface module
2. Storage expansion module
2. CAPs A and B (shown on front, right door)
3. Left front door
4. Customer Interface Module

Library Complex

A library complex is composed of two or more libraries connected by pass-thru ports (PTPs).

The maximum size library complex possible consists of either:

- 32 libraries for Host Software Component (HSC) systems, connected through PTPs, containing over 200,000 cartridge slots and 2,048 tape drives
- 31 libraries for Automated Cartridge System Library Software (ACSLS) connection, connected through PTPs, containing over 200,000 cartridge slots and 1,984 tape drives

Library Modules

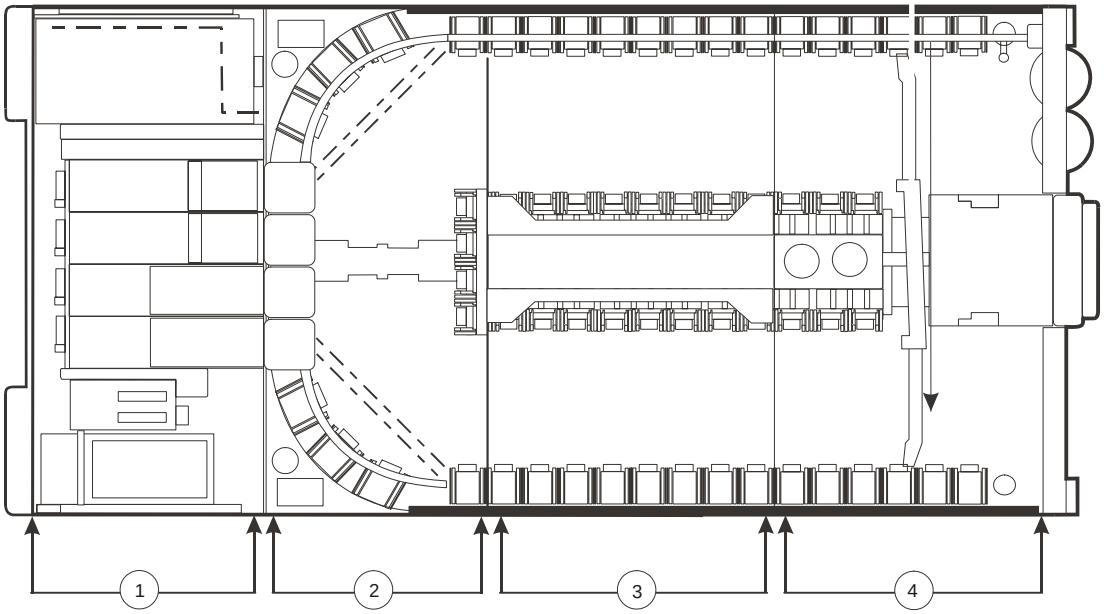
The base library consists of three modules:

1. **Drive and Electronics Module**
2. **Robotics Interface Module**
3. **Customer Interface Module**

Besides the three modules, *up to three* **Storage Expansion Modules** may be added per library to increase capacity. These expansion modules are installed between the Robotics Interface Module and the Customer Interface Module.

With a PTP installed between two or more libraries, all libraries can share their cartridges and effectively act as a single system.

Figure 2. Base Library with One Storage Expansion Module (L203_007)



L203_007

1. Drive and electronics module (rear)
2. Robotics Interface module
3. Optional Storage Expansion Module (up to three can be installed)
4. Customer interface module

Drive and Electronics Module

The major components of this module include:

- From one to 64 tape drives
- Primary and redundant Electronic Control Modules (ECMs)
- Load Sharing Power Supplies for the tape drives and robots
- Accessory racks (2 or 4)
- Power Distribution Units- main and N+1 (standard) or main plus 2N (optional)

Tape Drives

SL8500 library supports from 1 to 64 drives. The interface to these drives is fiber-optic based; meaning Fibre Channel, FICON[1], or ESCON[2] attachments.

The following table lists the supported vendors, drives types, and interfaces.

Table 1. Supported Drives

Vendor	Drive Type	Host Interface Type
StorageTek	T9840A	Fibre Channel, ESCON
	T9840B	Fibre Channel, FICON, ESCON
	T9840C	Fibre Channel, FICON, ESCON
	T9940B	Fibre Channel, VSM ESCON
HP (Gen2)	Linear Tape-Open (LTO)	Fibre Channel
IBM (Gen2)	Linear Tape-Open (LTO)	Fibre Channel
Quantum	Super DLT (SDLT600)	Fibre Channel

T9x40

StorageTek's T9x40 tape drives are high-performance drives designed for enterprise and client-server environments. There are two models available:

T9840 The access-centric T9840 Tape Drive is ideal for applications that demand high data throughput and fast recall. These drives give you access to data at an average of 8 seconds, store up to 40 GB, with transfer rates of up to 30 MB/s.

1. Short for *Fiber Connection*, or *Fiber Connectivity*—IBM's fiber optic channel technology that extends the capabilities ESCON. FICON supports full duplex data transfers over longer distances.
2. Short for *Enterprise Systems Connection*, or *Enterprise Systems Connectivity*—an IBM fiber optic channel technology that supports half duplex data transfers up to 200 Mb/s.

T9940 The T9940 Tape Drives are designed for high-capacity storage applications. They use a single reel cartridge tape for higher capacities of up to 200 GB with transfer rates of up to 30 MB/s.

LTO Ultrium

Linear Tape-Open (LTO) is a set of tape data format standards created to enable data interchange among different LTO Ultrium tape drive vendors. These LTO Ultrium standards allow data cartridges to be shared.

The LTO Ultrium Generation 2 tape drives store up to 200 gigabytes of native data on a single cartridge. These drives are a single reel, thread-and-load drive with a native transfer rate of 30-35 MB/s with capacities of up to 200 GB.

Super DLT

The Super DLT (SDLT) is a standard for mid-range UNIX and Windows platforms. The SDLT 600 incorporates an advanced tape recording technology for high capacity tapes, up to 300 GB, with transfer rates of up to 35 MB/s.

Electronics Control Module

Each library contains an electronics control module.

HBK Card

The HBK card contains flash memory and feature upgrade controls; it resides on a separate logic card within the control module. It contains the configuration, firmware versions, and features for the library.

Configuration

Library configuration is retained on the flash memory card. This saves significant time in cases where an HBC card must be replaced, because the new card fetches the configuration from flash memory instead of requiring manual re-configuration by a service representative.

Firmware Versions

Flash memory holds both the most recently activated firmware version and the previous firmware version. Therefore, if there is a requirement to return machine control to a previous version, a service representative merely re-activates the previous version and places the now-deactivated version into the “previous” state.

Features

When features are added to a library, they are tracked to the machine’s serial number[3]. Any upgrade must be matched to the serial number before

activation. The upgrade process is accomplished over the command line interface (CLI) by the service representative.

HBM Card

The HBM backplane provides CompactPCI Bus card slots and proprietary card slots for the tape drive interface card (HBT).

HBC Card

The HBC card is the library controller, responsible for coordinating all component operations within the library. It is the interface between the host and the library. One HBC card can control a library's operation, but a second HBC is available to assure redundancy. Operating voltage for HBC cards is +3.3 VDC.

In addition to the cards in the electronics control module, the HBC card interfaces with the following cards and components:

- Ethernet hubs (Library-to-library LANs, tape drive service LAN)
- TCP/IP/Web host interface
- HBS cards (robots)
- Power, smoke, and environmental monitoring circuits throughout the library
- Flash memory

HBT Card

The HBT card translates commands from the HBC controller card into unique drive commands, transferred across differential RS422 lines. The HBT card contain 66 Universal Asynchronous Receiver/Transmitters (UARTs); 64 are responsible for the parallel-to-serial conversion for the tape drives and the remaining two communicate with the tape environmental monitor card (HBD card).

3. Machine serial numbers are on the ceilings of each library.

Robotics Interface Module

The robots move cartridges between storage slots, between slots and tape drives, and between the CAP and slots.

There are four robotic rail assemblies in the library that provide both power and communications to the four or eight robots. Each robot can service up to 16 tape drives. Robots consists of:

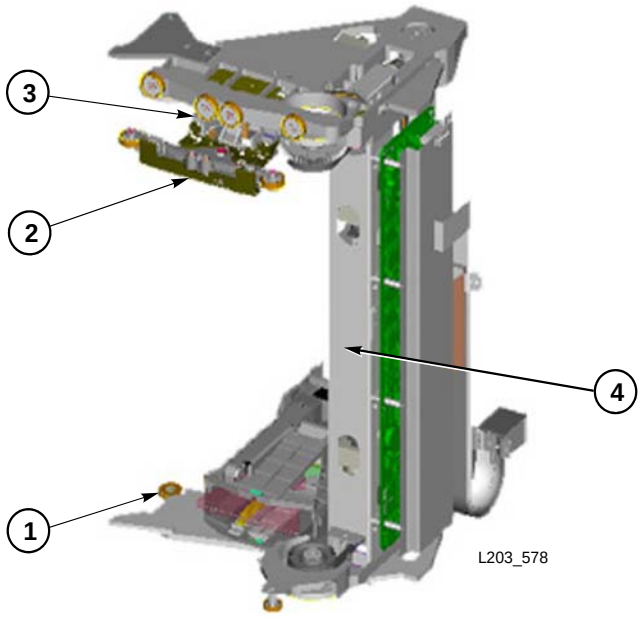
- Rail, brush, and HandBot assemblies
- A Z-mechanism for vertical motion of the hand
- A wrist-mechanism for lateral or horizontal motion
- A bar-code scanner for both targeting and reading cartridge labels
- A proximity sensor for detection of empty slots and unlabeled cartridges
- A belt-driven gripper mechanism for gripping the *sides* of the cartridges

Important:
Because of the four individual rails, each robotic assembly is considered a library storage module (LSM). So the architecture of the SL8500 provides four separate and unique LSMs within a single library.

To optimize system performance, the HandBots automatically implement the *Fast Load* capability. Once a HandBot successfully inserts a tape cartridge into a drive, it is immediately available for the next request and does not wait until the drive reports that the cartridge has been loaded. The SL8500 library control electronics waits to return the response to the mount request until it detects that the tape drive has successfully loaded the cartridge tape.

Two HandBots can service a single rail section within the library, providing redundancy. Each HandBot has two motors, if one fails, the other motor is powerful enough to move the defective HandBot into the forward service area. If both the motors fail for a HandBot, then the redundant HandBot moves the defective HandBot into the forward service area thus continuing HandBot operations.

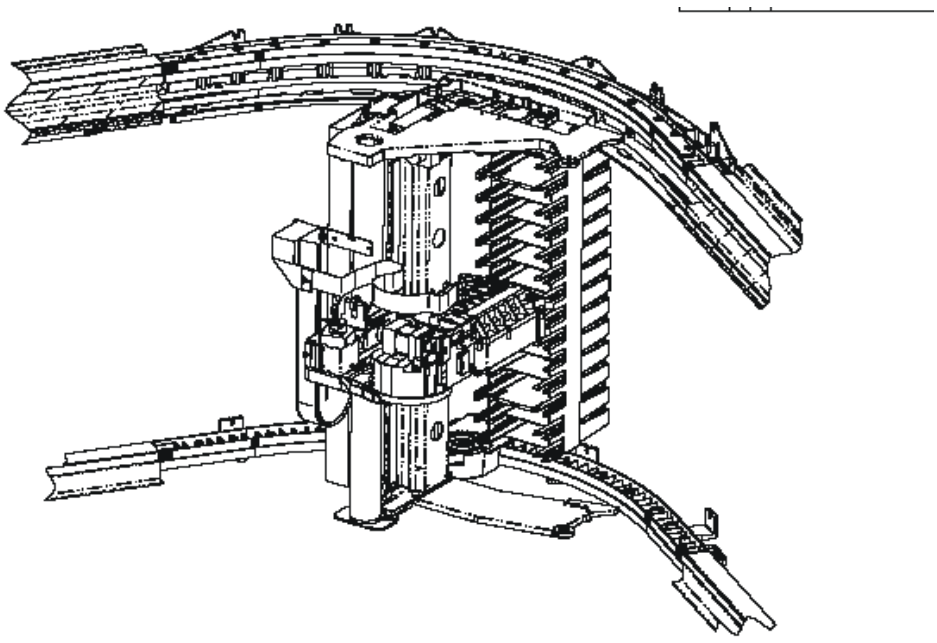
Figure 3. HandBot (Detail)



1. Lower pulley
2. Pre-load assembly
3. Gripper
4. HBB card

One robotics interface module contains up to 800 cartridge storage slots.

Figure 4. HandBot on the Power Rail (L203_010)



HandBot Numbering

Rails are numbered from 1 (top rail) to 4 (bottom rail). They are also designated as separate library storage modules (LSMs) within a library.

As examples:

- Rails 1 and 2 can be designated LSMs for HSC, while rails number 3 and 4 can be designated LSMs for ACSLS.
- If only one host exists, all rails become separate LSMs for that host.

See Appendix A, “Cartridge Slot Locations” for more details.

HandBot have the following numbering:

1. **Library number** (within a library complex)
2. **Rail number** – Rails are numbered 1 through 4, rail 1 is the top rail
3. **Column number** – Columns are “signed” numbers referenced from the customer interface module, where +1 is right of the center of the drive bays and -1 is to the left of the drive bays
4. **Side number** – Outer wall = 1, Inner walls = 2

   Note: Side numbers for HandBots are numbered according to their end stops: 1 (left HandBot stop) and 2 (right HandBot stop).

5. **Row number** – Numbered consecutively, from the top down

   Note: Because HandBot hands are not storage slots, their row numbering is 0.

As examples:

- Location 1, **1**, 0, **1**, 0 = the HandBot on rail 1 (top rail) that encounters the stop on the *left side* of the customer interface module
- Location 1, **1**, 0, **2,** 0 = the HandBot on rail 1 (top rail) that encounters the stop on the *right* side of the customer interface module
- Location 1, **2**, 0, **1**, 0 = the HandBot on rail 2 (next rail down) that encounters the stop on the *left side* of the customer interface module

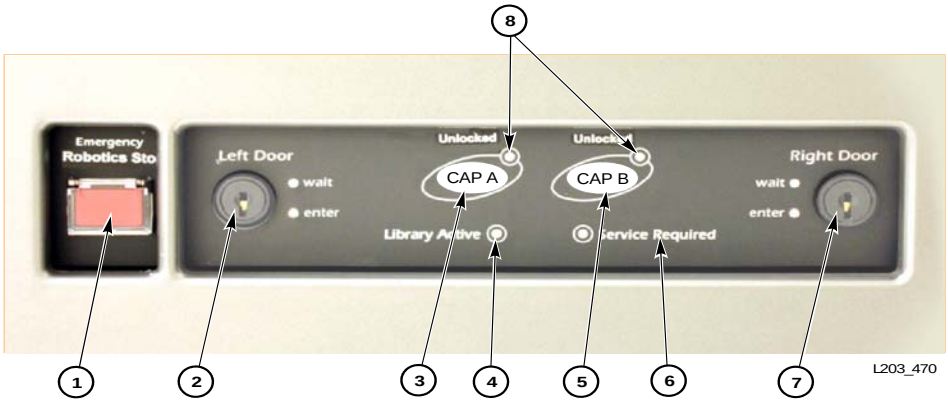
Customer Interface Module

The customer interface module consists of the following components:

- Keypad
- Touch screen operator control panel (optional)
- Cartridge storage slots
- Cartridge access port (CAP)
- Elevator assembly
- End stops
- Service safety door

Keypad

Figure 5. Keypad



1. Emergency robotics stop switch
2. Left service safety door key
3. CAP A button
4. Library active indicator
5. CAP B button
6. Service required indicator
7. Right service safety door key
8. CAP unlocked indicators

The keypad has the following buttons, switches, and indicators:

Table 2. Keypad Switches, Buttons, and Indicators

Emergency robotics stop switch	Actuate the emergency robotics stop switch to disconnect DC power to the power rails. When it is safe to restore power, press the switch to restore power to the rails.
CAP A button	Press to open and close CAP A.
CAP B button	Press to open and close CAP B.
Library active indicator	The green indicator flashes when the library is performing a task.
CAP unlocked indicators	The amber LED light is On when the CAP is unlocked, and Off when locked. When the light is On and blinking, manual intervention required. Open the CAP and make sure the cartridges in the CAP slots are properly seated.
Service required indicator	This red indicator is lit when operator intervention is required.
Service safety door keys (left and right doors)	Allows the service representatives to place the library in maintenance mode.

Operator Panel

In the SL8500, the StreamLine™ Library Console™ software is the operator panel software application capable of execution on both a touch-screen operator control panel (resident within the SL8500 frame), as well as a remote operator console (network PC).

The Library Console runs a JAVA application that provides the graphical user interface (GUI) for the library. The Library Console communicates to the library controller (HBC) through an Ethernet connection. In compliance with section 508 of the Americans with Disabilities Act, the touch-panel is accessible from a sitting or standing position.

The keypad interface of the software for the touch-panel enables alphanumeric data entry to the operator panel application from the local operator panel. The local operator panel does not contain either a keyboard or a mouse.

Use the Library Console to:

- View and modify status, statistics, and properties of the library and the associated devices (drives, CAP, robots, and elevators)
- Perform library audit and code load
- Display standard reports
- Display standard events
- Manage security

Touch-Screen Operator Control Panel

The touch screen operator control panel is an optional feature on the front of the library. This panel consists of a flat screen display with a touchable interface.

The local operator panel has the following features:

- 12.1 inch flat panel display
- Touch screen interface (no keyboard/mouse option)
- Resident within the library frame
- Ethernet interface
- JAVA application that provides the Graphical User Interface (GUI) for the library

Remote Operator Console

The remote operator console is a standard feature that displays the operator panel application on a personal computer (PC). A CD containing the Library Console software is supplied with each library that you can use to install the application.

Cartridge Storage Slots

A basic library can store up to 1448 data cartridges. This total does not include cartridges in the cartridge access port (CAP) or the reserved slots. A total of 192 slots are dedicated to diagnostic and cleaning cartridges that are not located in the data cartridge slots. See Chapter A, “Cartridge Slot Locations” for information on slot locations.

There are also eight drop-off slots in the library, two for each robot. These slots are used in the event of a robotic failure when there is still a cartridge in the hand.

Table 3 lists the capacity variations for the SL8500 library.

Table 3. SL8500 Capacity Variations

Module Type	Cartridge Capacity	Total in Storage expansion modules	Total Cartridges
Drive and Electronics[1]	0	0	
Robotic Interface	800	0	
Customer Interface[2]	648	0	
Basic library	1448	0	1448
First storage expansion module	1728	1728	3176
Second storage expansion module	1728	3456	4904
Third storage expansion module	1728	5184	6632

[1] There are no cartridge storage locations in the Drive and Electronics Module.
[2] The Customer Interface Module contains 192 storage slots for cleaning and diagnostic cartridges.

Cartridge Access Port (CAP)

CAPs allow operators to enter cartridges and eject cartridges from the library. A total of 39 cartridges can be imported or ejected at one time through each CAP. SL8500 library CAPs are installed on the right access door (Figure 1 on page 3). See Chapter 3, “Library Operation” for information on CAP operation.

Note: A CAP will not operate unless the library is in Automated mode.

Elevator Assemblies

Two standard elevator assemblies are used to transport up to four cartridges at a time across rail boundaries. The elevator assembly is located in the front portion of the customer interface module. The elevator assembly is powered by +48 VDC, routed from the drive and electronics module, and an HBV card at the rear of the assembly. Operation is controlled by the HBZ card.

Elevator assemblies in the SL8500 library are belt-driven and are therefore not counterweighted.

Standard HBZ Card

The standard elevator and turntable assembly controller (HBZ, on the left) is designated 1. It controls operation of:

- Both elevators
- Standard CAP A
- Service safety door

Storage Expansion Modules

Besides the basic configuration, up to three Storage Expansion Modules may be added per library to increase capacity. These expansion modules are installed between the Robotics Interface Module and the Customer Interface Module.

Each Storage Expansion Module increases the depth of the library by 1 m (3.125 ft.) *per module* and can contain up to 1,728 data cartridge slots.

Power

There are five (5) power grids that distribute power throughout the library. Two of the power grids carry 220 VAC; the other three carry 48 VDC.

- The two AC power grids distribute 220 VAC to the different Load Sharing Power Supplies, Electronics Control Module (ECM), and accessory racks.
- The three DC power grids supply 48 VDC to the tape drives, robots, and front frame components.
    - The Drive Power Grid supports up to 64 tape drives (with the proper number of Load Sharing Power Supplies). A single tape drive power supply provides power for up to 8 tape drives, so at least 8 power supplies are required for 64 tape drives (in an N+1 configuration).
    - The Robot and Pass-thru Port (PTP) Power Grid supplies power to the robots and the four pass-thru ports (PTP). A single power supply can

power up to four robots, so two power supplies are required for eight robots.

- The Front Frame Power Grid is powered by a *single* Load Sharing Power Supply that supplies 48 VDC power to the two Cartridge Access Ports if present, one Turntable, two Elevators, and the Safety Door.

Note: The power supply for the Front Frame Power Grid is in the Customer Interface Module. All the other Load Sharing Power Supplies are located in the Drive and Electronics Module.

Power Consumption

Power consumption for the library is as follows:

- Single phase configurations
  - 24 Amps per phase (minimum) – 13.0kW, 44,382 Btu/hr
  - 768 Amps per phase (maximum) – 416 kW, 1.4 M Btu/hr
- Three phase configurations
  - 40 Amps per phase (minimum) – 13.0 kW, 44,382 Btu/hr
  - 280 Amps per phase (maximum) – 416 kW, 1.4 M Btu/hr

Note: *Power cabling must be done by a licensed electrician.*

Power Configurations

Two power configurations are available for the SL8500 library:

1. N+1 base power configuration
2. 2N power configuration

N+1 Base Power Configuration

The base power configuration contains one system power distribution unit (PDU) and one N+1 PDU.

- The system PDU, connected directly to the branch circuit, provides AC power to three DC power grids and the electronics control module.
- The N+1 PDU supplies added +48 VDC load sharing power to each of the three DC power grids and an extra AC-to-DC power supply for the electronics control module.

The base power configuration provides power to the:

- Tape drive power supplies
- Robotic rail power supplies
- Customer Interface Module power supplies
- Electronics control module power supplies

Note: The base power configuration does not offer redundant AC power.

2N Power Configuration

The 2N power configuration contains the base power configuration (PDU 1) and a second PDU, PDU number 2.

This configuration provides power to the same components as N+1, plus power for:

- Optional, redundant load sharing power supplies
- Two additional accessory racks for customer components
- Redundant controller cards

Note: The 2N PDU is required for the 2N drive power, 2N robotic power, and also for the additional rack installed.

Library Specifications

Table 4. Library Specifications

Physical	
• Height • Width • Depth (Base Library) - With 1 expansion module - With 2 expansion modules - With 3 expansion modules	2.37 m (236.6 cm) or 7.76 ft (93.15 in.) 1.7 m (170.8 cm) or 5.6 ft (67.25 in.) 2.8 m (276.9 cm) or 9.1 ft (109 in.) 3.7 m (372.1 cm) or 12.2 ft (146.5 in.) 4.7 m (467.4 cm) or 15.3 ft (184 in.) 5.6 m (562.6 cm) or 18.5 ft (221.5 in.)
• Weights - Base Library - With 1 expansion module - With 2 expansion modules - With 3 expansion modules • Weight distribution per pad	*Library only:* 1954 kg (4,309 lb) 2392 kg (5,274 lb) 2830 kg (6,239 lb) 3396 kg (7,487 lb) 454 kg (1,000 lb)
• Service Clearances - Customer Interface Module - Drive & Electronics Module - Pass-thru port (between)	 66 cm (26 in.) 85 cm (33.5 in.) 15 cm (6 in.)
• Temperature - Operating - Shipping - Storing • Wet bulb (operating)	 +16 to +32°C (+60 to +90°F) -30.5 to +49°C (-23 to +120°F) +4.4 to +32°C (+40 to +90°F) +25.6°C (+78°F) maximum, non-condensing

Table 4. Library Specifications

Physical	
• Humidity - Operating - Shipping - Storing	 20% to 80% 5% to 90% 20% to 80%
• Operating Heat Output	44,380 Btu/hr (maximum loading**) Calculation for this is: 3.41214 **x** Watts = Btu/hr
• Power Consumption Single phase configuration and three phase configurations	13.0 kW (maximum loading**) 13.7 kVA kVA = kWatts ÷ Power factor The power factor for the SL8500 = 0.95
**Maximum loading includes 64 tape drives, 4 fully loaded racks, 8 HandBots, all the front frame components (CAPs, service door, and elevators), plus redundant control modules.	

Tape Drive Weights *without* **Tray**	**Tape Drive Weights** *with* **Drive Tray**
• T9840 = 3.9 kg (8.5 lb) • T9940 = 6.8 kg (15.0 lb) • IBM LTO = 2.5 kg (5.5 lb) • HP LTO = 2.5 kg (5.5 lb) • **Drive Tray** = 4.3 kg (9.5 lb)	T9840 = 8.2 kg (18.0 lb) T9940 = 11 kg (24.3 lb) IBM LTO = 6.9 kg (15 lb) HP LTO = 6.9 kg (15 lb)
• **Cartridge Tape Weights** are approximately 227 g (8.0 oz) or 0.227 kg (0.5 lb)	

Embedded Firmware

Operating firmware is resident on the HBC card from the factory. The features of the firmware are explained in the following sections.

Security

Access to the Library Console is secured by a fixed set of user accounts at the site. The site user accounts include the customer administrator, StorageTek customer service engineer (CSE), and third party field service technician.

The Library Console security system requires activation of the site user accounts with an activation password. See “Dynamic World Wide Name” on page 23 for more information.

Operating Firmware

Some key features of the SL8500 firmware are:

1. Two firmware versions may be held on the HBC card. When firmware is upgraded, the earlier image of firmware remains in memory and may be restored if required.
2. Auto Discovery of additional tape drives
3. Auto Discovery of new cartridge slots and added libraries
4. Automatic handling of dynamic World Wide Name (dWWN) assignments

Host Library Interfaces

Although an SL8500 may be installed on a network, it is preferable that library activity be isolated from regular network traffic. Therefore, three distinct networks are present:

- Public network – handling all customer-attached networking for the public system controller ports, such as:
  - Web
  - Library-to-host commands
- Private network – handling all internal library networking for the private system controller ports, such as:
  - CAP
  - Elevator and turntable assembly
  - Drive TTI
  - PTP
  - Operator panel
- Multi-library network – handling all library-to-library networking between the dedicated system controller ports.

Two Ethernet ports are supplied on the HBC card for the multi-library and private networks; up to four more ports—two for public and two for private networks—are available.

Available host software are:

- ACSLS 7.1
- HSC 6.0.1

Drive interfaces can be Fibre Channel, ESCON, or FICON.

The host interface connection to the SL8500 library is through the TCP/IP protocol over an Ethernet 10/100-baseT. This connection scheme supports

enterprise-level system attachments and uses a Host Software Component (HSC) to manage and communicate with the library.

Library Management Software

The library management software controls the library hardware to mount and dismount cartridges on drives and move the robot. When the library is in automated mode, these operations occur without manual intervention. The software determines the location of the cartridge by accessing the audit data uploaded from the library. The software then allocates the drive to receive the cartridge.

These application maintain a database that tracks volume serial numbers (VOLID) of cartridges and their current locations in the library.

Host Software Component

When an SL8500 library is in a configuration with a Multiple Virtual Storage (MVS) host, the host must run a version of the StorageTek Host Software Component (HSC) along with the Storage Management Component (SMC).

StorageTek's HSC and SMC:

- Influence allocations
- Intercept mount and dismount messages
- Receive requests from the interface and translates them into commands

HSC resides *in* the MVS host, but is invisible to the actual operating system.

HSC 6.0 or higher is required for host control. However, for new drives, higher levels of HSC may be required.

ACSLS

ACSLS is a software package that manages library contents and controls library hardware for the mounting and dismounting of cartridges.

Note: ACSLS 7.1 or higher is required.

This application provides library management services such as cartridge tracking, pooling, reports, and library control.

Configuration Information

2

This chapter describes how to verify the library and drives configuration entries for operation.

Some configuration values, such as drive locations, capacity, and drive types are set through an automatic configuration process that occurs during an IPL. However, before the library is fully operational, some of the configuration values must be verified and entered manually.

Typically, your service representative will configure your library during installation, during firmware upgrade, or after drives are added. If you must change the library's configuration, you may enter the values through the Library Console. Library configuration also includes setting up cleaning options using the library management software.

Installing StreamLine Library Console

StreamLine Library Console is a software application that provides all of the functions to test, monitor, and operate the library. You should also obtain and activate this software before installing the library.

StreamLine Library Console is contained on a compact disk (PN 3139995xx). This software is loaded first to your personal computer, then customers must also load this on to their remote personal computer.

To install the software on your PC:

1. Run the Library Console installer from the CD.

   Note: Make sure to select the **remote** option as the **installation type**.

2. Follow the guided instructions to complete the installation.

Activating Password

If you are logging on to the Library Console for the first time you must activate your user account (admin) with an activation password.

The Library Console security system requires activation of your site user account with an activation password. This activation password is valid for one time use only. After the initial login with the activation password, the system prompts you to setup a new password for the user account. You can then

share the new password with other users requiring access to the Library Console using the same user account.

Your service representative will retrieve the Activation Password for the customer administrator account.

To Activate your User Account:

1. Logon to the Library Console by entering your site user ID (service, admin, or oem), activation password, and the library name.

   Note: The activation password is case sensitive. You must type this password exactly as it was issued by the Activation Password Request application. If you there is a mismatch, you have to obtain another password from the Activation Password Request application.

2. The system authenticates the user ID and the activation password for the library.

3. If the authentication is not successful, the system displays the following error message:.

   “account is not activated. Contact customer Support for an activation password.”

4. If the logon process is successful, the system directs you to the change password screen to do the following:

   a. Type a new password.

   b. Retype the new password to confirm.

   Note: It is mandatory to assign a new password to your user ID for future access to the Library Console.

■ Verifying Configuration Entries

To verify or enter configuration details using the Library Console, access the System Details module and then select the ? button for the online help.

Complete or verify the following fields to make the library and the drives operational:

Table 5. Library Configuration Entries

Fields	Valid Values	Description
Operational State	Offline Online	Offline indicates that the library is in the manual mode. Online indicates that the library is in the automatic mode.

Table 6. Drive Configuration Entries

Fields	Valid Values	Description
Port X Enabled	True False	Setting this value will turn on or off the physical port (A or B) on the drive. If you select False then the communication channel between the host software and the drive is disabled.
Operational State	Offline Online	Offline indicates that the drive is not available for host activity. Online indicates that the drive is available for host activity.

Dynamic World Wide Name

To correct re-configuration problems within a customer's Fibre Channel network, library firmware includes the dynamic Worldwide Name (dWWN) enhancement. Without the dWWN feature, if a device (for example, a defective tape drive) requires replacement, the new device is detected by the network as "unknown" and re-configuration of the network is required.

When enabled, dWWN assigns names to library drive *slots* rather than devices. When a drive is replaced, the new drive receives the same name as the one it replaced, thereby eliminating the need for system re-configuration There are three World wide Names reserved for each drive bay: Node, Port A, and Port B.

CAUTION: Changing the dWWN feature must be coordinated with the system administrator. The feature is usually enabled at installation time.
A record of the configuration should be kept; this is not only something that should always be done, but it absolutely essential with the dWWN feature to eliminate system issues in the case of an failure.
System problems: When enabling dWWN, all drives must be at the proper firmware level. If a drive has down level firmware, it will remain in the "configuring" state and is unavailable for host use.

Important:
Tape drives that are migrated from other libraries *will be assigned a different WWN* when installed in an SL8500 library. The existing storage area network will not associate this new WWN with the originally assigned name. A best practice is to configure all drive bay slots in the library and verify that the tape drive data path is bound correctly over the network.

Upgrading Firmware

The initial library code is factory-installed on all new libraries and resides within the flash memory on the HBC card.

Use the Library Console to download new firmware to the library.

There are two types of firmware packages (image files) for the library:

- SL8500 code for the library controllers and the associated devices
- Library Console application code for the local operator console

Notes: You can download code using only the remote operator console and not the local optional touch screen operator control panel. So, if the library has the optional touch screen panel, you can load updates to the Library Console application using the remote operator console.

The SL8500 code does not contain the code for the different drive types.

Before launching the code load utility, download the firmware upgrade package from the customer resource center (CRC) at http://www.support.storagetek.com to a folder on your PC.

Note: The firmware package is a .jar file. The firmware package for the SL8500 library firmware is SL8500.jar and for the touch screen operator control panel is SLConsoleLocalDist.jar.

Upgrading firmware is a three-step process:

1. Download the firmware package
2. Activate the downloaded firmware currently residing in the library complex
3. Reboot the library to make the firmware operational

Note: The library has two versions of the image file residing in the flash memory. After the library completes the reboot process, the latest image becomes active and the earlier version that serves as a backup may be restored if required.

For instructions on loading new code, refer to the online help documentation accessible through the application.

Upgrading the Remote Library Console

To upgrade the Remote Library Console application installed on your PC:

1. Download the appropriate Library Console code installer file from the customer resource center (CRC) at http://www.support.storagetek.com to a folder on your PC.

   Microsoft Windows installer file: SLConsoleWindowsSTK.exe
   Sun Solaris installer file: SLConsoleSolarisSTK.bin

   Note: You may want to uninstall the previous version of the application before launching the installer program.

2. Run the Library Console installer to install the application on your PC.

   Note: Make sure to select the **remote** option as the **installation type**.

3. Follow the guided instructions to complete the installation.

Library Operation

3

The library has three modes of operation, automated, manual, and maintenance. These modes are defined and explained in the following sections.

Automated Mode of Operation

The automated mode of operation is active when a library system or library complex is automatically mounting/dismounting cartridges without physical intervention by a person.

General automated library operations consist of the following activities:

- “Mounting and Dismounting of Cartridges”
- “Performing CAP Activities”
- “Monitoring Library Events”
- “Cleaning of Drives”

These activities are explained in the following sections.

Mounting and Dismounting of Cartridges

The central function of the library or library complex is the automated mounting and dismounting of cartridges. Host mount/dismount commands are accepted by the library’s central processor and translated into robotic commands that are performed by the robots.

Mount Sequence

A simplified mount sequence involves:

- A host requests that a specific volume serial number (VOLID) for a cartridge be mounted in a drive.
- The library transmits to the host that the VOLID is located within the library and a drive is available to satisfy the mount request.
- The library assumes responsibility for the mount.
- The host command is translated by the library controller into motion commands for the robot.
- The cartridge is taken from its slot and placed in the drive.
- The library returns status to the host that the mount operation is completed.
- The drive then performs the read/write activity directed by the host.

Dismount Sequence

A simplified dismount sequence involves the following:

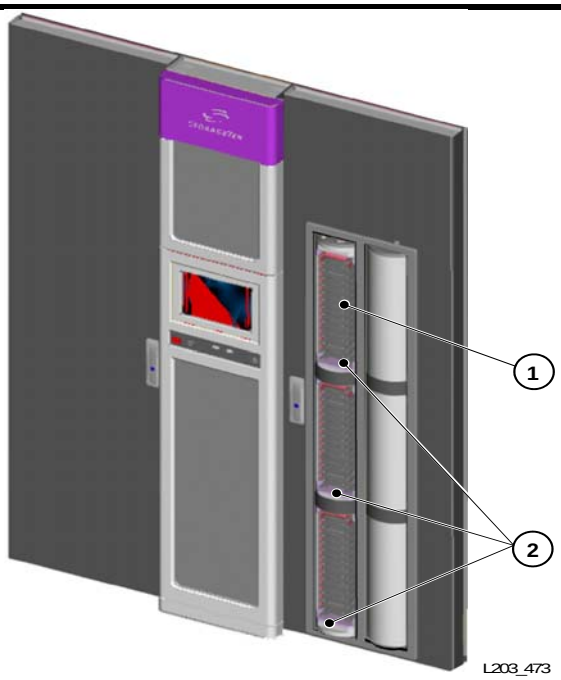
- A host requests that a specific VOLID be dismounted from a drive.
- The library transmits to the host that the VOLID is located in the drive and the library is available to satisfy the dismount request.
- The library assumes responsibility for the dismount.
- The host command is translated by the library controller into mechanical commands for the robot.
- The cartridge is taken from the drive and placed into its home slot.
- The library returns status to the host that the dismount operation is completed.

The library then awaits another activity directed by the host or continues those activities waiting in the library's queue of commands.

Performing CAP Activities

The CAP door contains a standard CAP A (on the left, as viewed from the front); an additional CAP (CAP B, on the right) is also available. CAPs allow you to import (enter) cartridges and export (eject) cartridges from the library.

Figure 1. CAP A Unlocked (L203-473)



1. CAP slot
2. Three magazines with 13 slots each

A single CAP contains three magazines; each magazine contains 13 cells, allowing import/export of up to 39 cartridges at a time. The magazines can be removed from the CAP to import cartridges in a batch mode. Rotation of the CAP is accomplished through a motor. CAP operations are controlled by the HBZ logic card.

The CAP magazines span the lower three rails and on the *right side* of the library only. If a cartridge is required to be imported to or exported from the top rail on the *right side*, an HandBot places the cartridge in an elevator slot to accomplish the move.

To open the CAP:

1. Logon to the Library Console and select **Tools > Utilities**.
2. Select the CAP and then change the **Locked** status to **False**, and then select **Apply**. See the online help documentation accessible through the Library Console application.

   Note: The LED light is on when you unlock the CAP and the CAP status changes to “unlocked” in the host library management software.
3. Press the appropriate CAP Unlocked button (CAP A or CAP B) on the operator keypad (Figure 5 on page 11).

   Note: This action causes the CAP to rotate outward and present the magazines to load or unload cartridges.

To close the CAP:

1. Press the appropriate CAP Unlocked button (CAP A or CAP B) on the operator keypad.

   Note: The above action causes the CAP to rotate inward for robotic access.

CAUTION: *Possible Equipment Damage*. DO NOT manually force the CAP to open or close.

2. From the Library Console, select **Tools > Utilities**.
3. Select the CAP and then change the **Locked** status to **False**, and then select **Apply**. See the online help documentation accessible through the Library Console application.

Cartridge Slot Locations

Slot locations within the CAPs have the following addressing:

1. **Library number** (within a library complex)
2. **Rail number** – Rails are numbered 1 through 4, rail 1 is the topmost rail.

Note: CAP slots begin numbering at rail 2.

3. **Column number** – Columns are “signed” numbers as seen from the front of the library, where +1 is right of the drive bays and -1 is to the left of the drive bays.

   Note: Both CAPs are column signed as 23.

4. **Side number** – Outer wall = 1, Inner wall = 2

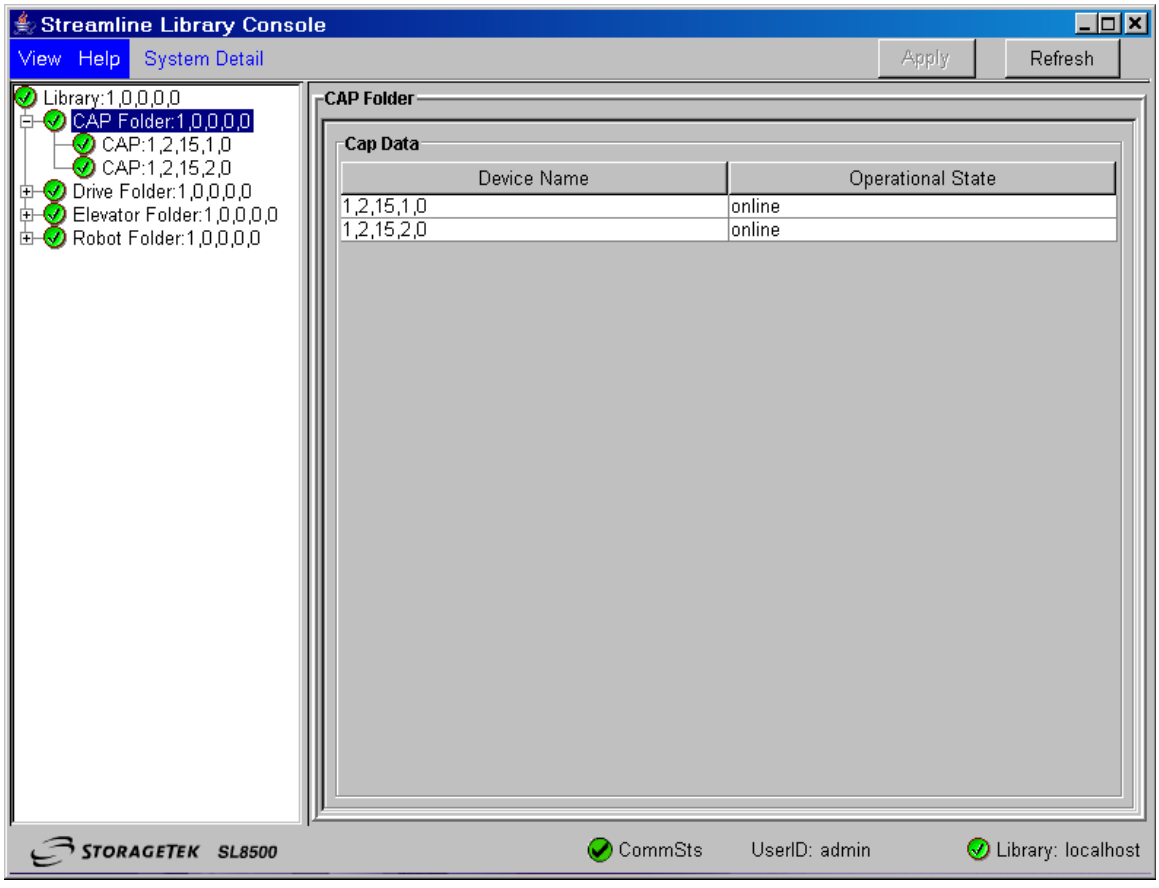
   Note: For CAPs, side number -1 = CAP A and side number +1 = CAP B.

5. **Row number** – Numbered consecutively, from the top down

   Note: CAP slots begin with row number 0, which is the magazine handle. CAP slots are not considered as storage slots.

An example of how this notation appears on the operator panel is shown in Figure 2.

Figure 2. StreamLine Library Console – CAP

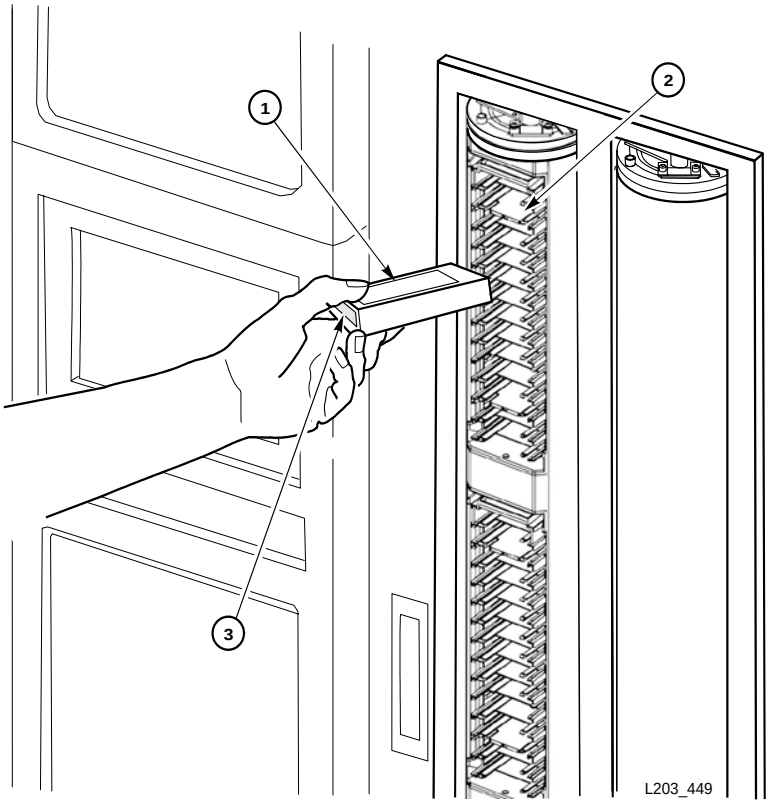


Importing Cartridges

When a cartridge is imported, the VOLID is read by the HandBot hand's bar-code line scanner and the cartridge is assigned a home slot by the library controller or mounted on a drive, depending upon the purpose for which it was imported. The location of a stored cartridge is recorded in library memory, designated in the form of library number, rail, column, side, and row numbers (see Appendix A, "Cartridge Slot Locations"). The location is also transmitted to the host and stored in its cartridge database.

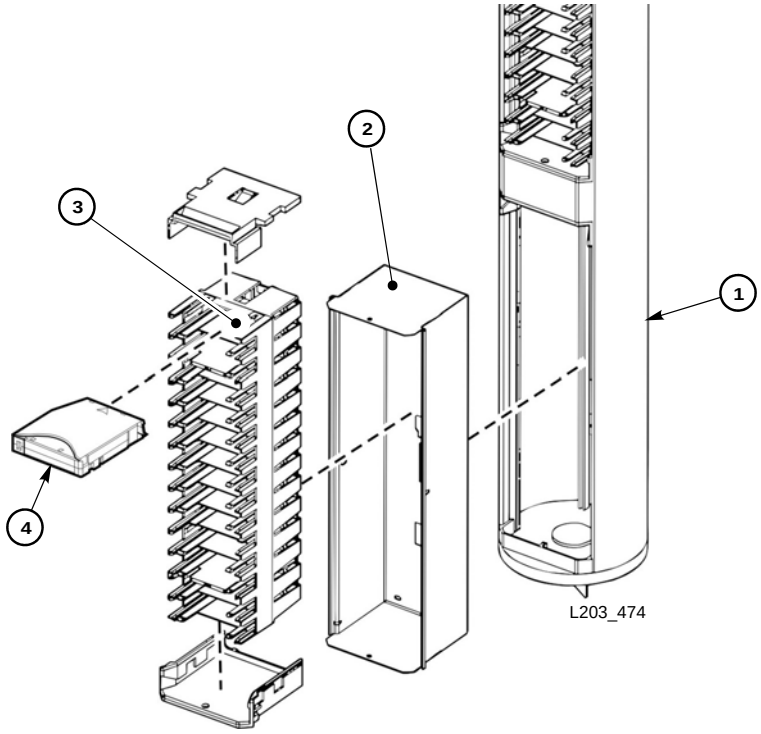
Cartridges must be properly labeled (see "LTO Ultrium Generation 2 (Gen2) Fibre Channel Drives" on page 53) and correctly placed in the CAP slots. Insert the cartridges so that the customer label (if present) is facing up, the hub gear is facing down, and the VOLID label is facing you. Cartridges may be placed in any CAP slot, in any order; the HandBot audits all CAP slots upon closure of the CAP door. See "Cartridge Labels" on page 46 for proper labeling and placement information.

Figure 3. Placement of Cartridges with the Magazine Inside the CAP L203_449)



1. Customer label (9x40 only)
2. Magazine slots
3. Volume serial number label

Figure 4. Placement of Cartridges with the Magazine Outside the CAP L203_474)



1. CAP
2. CAP magazine removed
3. Magazine slots
4. Inserting cartridge with hub down

When a CAP is in automated mode, it is unlocked unless it is currently being used to import cartridges.

To import cartridges using the CAP:

1. Make sure that the CAP is unlocked (see Table 2 on page 11 for a description of CAP indicators).
2. Press the appropriate CAP Unlocked button (CAP A or CAP B) on the operator key pad.

   Note: This action causes the CAP to rotate outward and present the magazines to load cartridges.

3. With the CAP open, you may enter the cartridges into the magazines while the magazines are in the CAP; or you may remove the magazines from the CAP, insert cartridges into the magazines, and then replace the cartridge-filled magazines into the CAP.

   Note: Cartridges may be placed in any CAP slot, in any order; the library audits all CAP slots when the CAP door closes.

CAUTION: *Possible Media Damage*. While cartridges that do not contain external labels or are placed upside-down can be entered, this is not advisable. It presents problems when an audit is performed. Likewise, cartridges that contain unreadable or damaged labels should not be entered.

4. Press the appropriate CAP Unlocked button (CAP A or CAP B) on the operator key pad.

   Note: This above action causes the CAP to rotate inward for robotic access.

5. Make sure that the CAP is locked (see Table 2 on page 11 for a description of CAP indicators).

CAUTION: *Possible Equipment Damage*. DO NOT manually force the CAP to open or close.

Exporting Cartridges

When a cartridge is exported, you must specify the VOLIDs of the cartridge you wish to remove from the library. The VOLID location is then retrieved from the librarys' memory, the HandBot moves to the cartridge, removes it from its slot, and the cartridge is placed into the CAP slot. A total of 39 cartridges may be exported at one time through each CAP.

After the CAP is opened, the location of the cartridge is erased from the librarys' memory and the host database. This is especially important when exporting *cleaning* cartridges from a library; if the cleaning cartridge is not removed from the CAP and the CAP is closed, the library treats the cartridge as "new" and the expired cleaning cartridge is used again.

To export cartridges using the CAP:

1. Type the eject command at the console. Refer to your library management software publication for the command syntax.
2. The robot places cartridges into the CAP slots until all the specified cartridges are in the CAP. Refer to your library management software publication for the console messages.
3. Press the appropriate CAP Unlocked button (CAP A or CAP B) on the operator key pad.

   Note: This action causes the CAP to rotate outward and present the magazines with the exported cartridges.

4. With the CAP open, remove the exported cartridge either by removing the cartridges from the magazine inside the CAP, or by removing the magazine from the CAP and then taking the cartridges from the magazine outside the CAP.

If you remove the magazine, replace the empty magazine inside the appropriate CAP (CAP A or B).

5. Press the appropriate CAP Unlocked button (CAP A or CAP B) on the operator key pad.

   CAUTION: *Possible Equipment Damage*. DO NOT manually force the CAP to open or close.

6. If more cartridges need to be exported, the robot continues filling the CAP. Wait until the CAP door is unlocked and repeat steps 3 through 5.

Note: The export operation ends automatically when all specified cartridges have been exported.

Monitoring Library Events

Library operations are continually monitored by the HBC controller. All events associated with these operations are logged by the HBC card and can be retrieved by operators and service representative for examination.

Library events are accessible from the Library Console (see “Event Monitors” on page 62). Events are represented by the following codes:

- Action codes (what command was issued, such as “load drive”)
- Result codes (what was the result of the action requested)
- Known service plan (KSP) diagnosis (what mechanism or component is responsible for the task or fault)

See “Working with the Search Utility” on page 64 to lookup on a result code.

Events are stored under three headings:

- Communication events (host-to-library, library-to-library, and library-to-drive). Data for these events include:
  - Date/time stamp
  - Library identifier
  - Drive identifier
  - Requestor
  - Interface protocol
  - Communication type
- Error events, which include:
  - Date/time stamp
  - Drive identifier
  - Operation type
  - Four-digit (hexadecimal) Action Code
  - Interrupt level (generated by the hardware or software)
  - VOLID for media-related events

- Warning events, which indicate a loss of performance or events that may be indicative of future, fatal errors. The data for these are the same as in error events.

Cleaning of Drives

The automatic mounting of cleaning cartridges can be enabled in one of two ways:

- By installing cleaning cartridges in the reserved slots (see Appendix A, “Cartridge Slot Locations”). You can schedule a clean using your library management software. Refer to your library management software publication for command syntax.
- By importing a cleaning cartridge through a CAP during normal operations. See “Performing CAP Activities” on page 32.

Manual Mode of Operation

Manual mode of operation is used when the library (or library complex) is unavailable for system use or human intervention is required. An example of this situation would be when a library experiences an unrecoverable error, making automated mounts/dismounts impossible.

In the case of a failure of a non-redundant component (for example, a single HBC controller card for the entire library), the library is said to be “unavailable” to the system. In this case, the entire library must be placed offline until the repair is accomplished.

A library’s inability to automatically perform cartridge mounts/dismounts does not, however, stop cartridge tape activity—mount and dismount requests by the host continue to be generated.

To perform the cartridge activities, someone might be required to physically enter the library and manually perform the mount/dismount activities previously done by the robot. The location of the cartridge to be mounted is supplied by the software and the slot location must be determined by the coordinates shown in Appendix A, “Cartridge Slot Locations”.

Manual operations include:

- “Placing the Library Offline”
- “Determining the Library is Not in Automatic Mode”
- “Entering the Library”
- “Locating a Cartridge and Drive”
- “Moving the Robot”
- “Mounting a Cartridge”
- “Dismounting a Cartridge”
- “Placing the Library Online”
- “Placing the Drives to Online”

Precautions

When you enter a library to manually mount and dismount cartridges, you must strictly observe safety precautions and pay attention to the physical space restrictions.

Safety Precautions

In manual mode, you must observe the following safety precautions. Be sure to *always*:

- Ensure the library is offline.
- Leave both the front access doors open whenever you work inside the library. There are switches on each door frame that disconnect DC power and signal lines to the library’s robotic motors when either access door is opened.

Physical Restrictions

The library design is optimized for high density, so there is not much free room for movement. Be careful not to:

- Snag your clothing on the arrays that house the cartridges (only 0.4 m [18 in.] of aisle clearance).
- Bump your head or body against the arrays

You might also have to move a robot to gain access to a cartridge, in which case, you must avoid damaging the robot’s mechanical or electronic components. See “Moving the Robot” on page 43).

If you are manually loading or unloading a cartridge, your hands must remain clear of the drive’s mechanical and electronic load components.

Placing the Library Offline

Place the library offline using your library management software. Refer to you library management software publication for the command syntax and console messages.

Notes:

1. Wait for the message confirming the library is offline. If the library does not come offline, enter the command to display the status of the library.
2. Wait for the outstanding processes to complete or type the command to force the library offline to all hosts.

The library remains offline until you issue a command to place the library online.

Determining the Library is Not in Automatic Mode

The following conditions indicate that the library is not functioning in automatic mode:

- One or both the library access doors are open.
- The robot does not automatically mount and dismount cartridges.
- The device tree in the StreamLine Library Console indicates that there is a problem with the library.

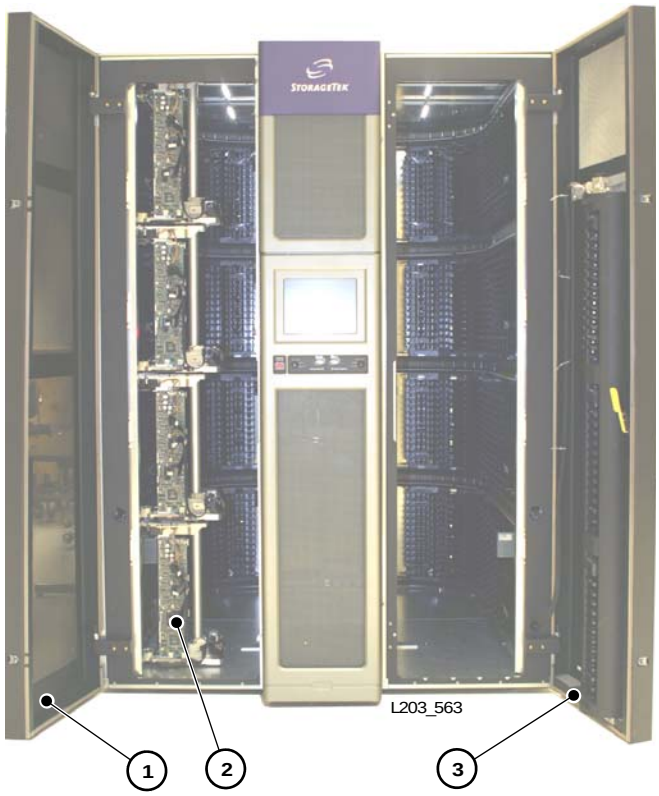
Entering the Library

WARNING: *Physical Injury*. You can be injured if you do not follow the correct procedure to enter the library.

To prevent personal injury, follow these precautions:

1. Make sure that the library is offline (see “Placing the Library Offline” on page 41).
2. Do not attempt to override any of the electrical or mechanical safety devices in the library.
3. Do not enter the library without informing someone in the immediate area.
4. Make sure both the front access doors are open.

Figure 5. Library Front View (Access Doors Open) (L203_563)



1. Left access door
2. Robots
3. Right access door

To open the door:

1. Insert the key and unlock the access door.
2. Pull the paddle handle to activate the opening mechanism and open the access door. Opening the access door activates a switch, which automatically causes a software interrupt and stops the robot. Take the key with you so that no one can close the door while you are inside, and then enter the library.

Locating a Cartridge and Drive

The library management software provides the location and the VOLID of the cartridge and also the drive bay address available for the manual mount. Before you enter the library, write down the VOLID, cartridge location, and the drive bay location.

To locate a cartridge:

1. Logon to the Library Console.
2. Select **Tools > Utilities** and then select the **Search** tab.
3. From the pull-down menu select **Cartridge Location** as the **Search Type**.
4. Enter the VOLID of the cartridge you are trying to locate.
5. Select the **Requester** as default from the pull-down menu.

   Note: The *default* requester displays the physical slot location address (see “SL8500 Address” on page 68) of the cartridge. If you select a library management software as a requester, the system displays the HLI-PRC address (see “HLI-PRC Address” on page 80).
6. Select the **Cartridge Type** (data, clean, unreadable label, duplicate label).
7. Select Search button from the top right corner.

The Library Console application displays the physical slot location address of the cartridge. See Figure 11 through Figure 18 on page 76 for pictorial maps.

To locate a drive:

See “Manually Locating a Drive Bay” on page 87.

Moving the Robot

You might have to move the robot to:

- Locate the cartridge from the slots.
- Access the drive panel and identify the drive to perform a manual mount/dismount.

WARNING: To prevent physical injury and damage to components, follow the instructions carefully.

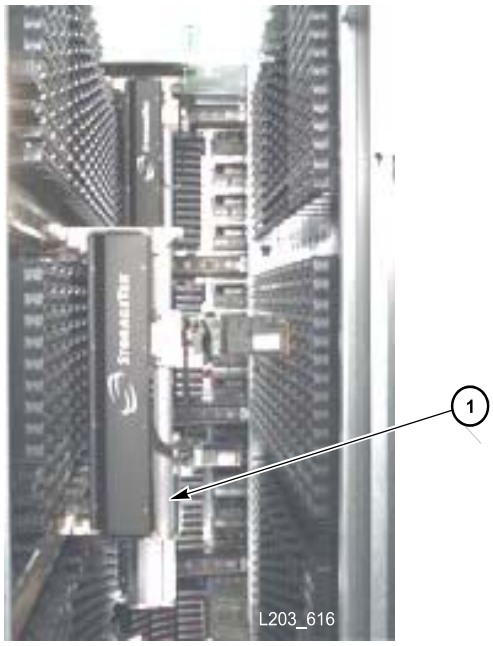
To move the robot, follow these precautions:

1. Do not enter the library or move any of the HandBot mechanisms if you have any reason to suspect they are enabled.
2. Do not touch any shiny polished surfaces. Body oils can destroy the lubrication on these surfaces.

WARNING: If all four HandBots are parked near each other, before you enter the library, move the HandBots out of your way one at a time starting at the lowest rail. You could trip over the HandBots on the lower rails or injure your head with the HandBots on the upper rails.

3. Do not touch any lubricated parts.
4. Hold the HandBot carriage handle to push or pull as shown in Figure 6.
5. The HandBot should move freely. Do not force the HandBot if movement is restricted. Before you close the library access doors, look inside the library and ask in a loud voice if anyone is inside the library.

Figure 6. Moving the HandBot (L203_565)



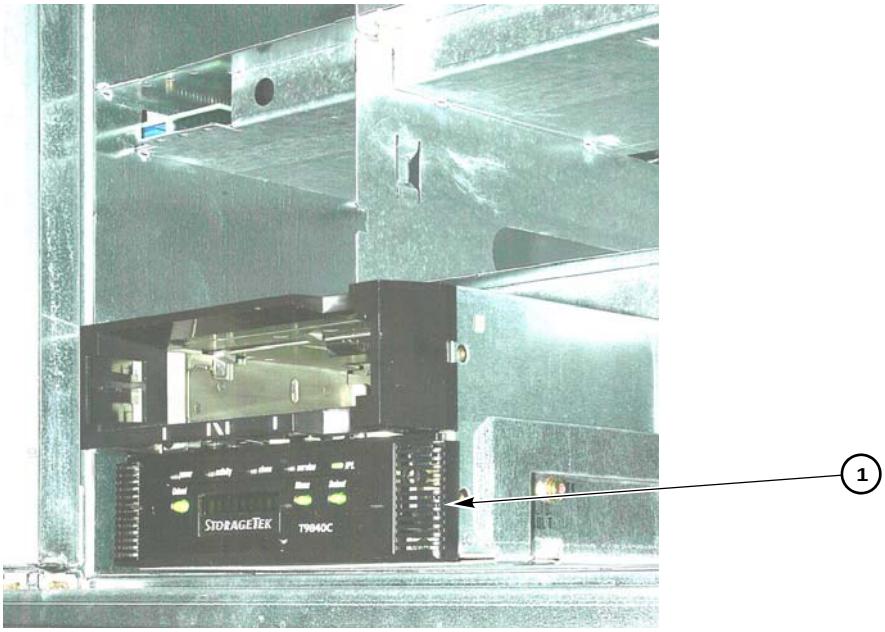
1. HandBot handle (hold the handle to move the HandBot)

6. Leave the library only when you are certain that the HandBots can move freely in all directions.

CAUTION: *Damage to Robot*. Make sure no extra material (manuals, eyeglasses, tools) are left inside. These objects would cause the robot to stop and could damage it.

Mounting a Cartridge

Figure 7. Drive Panel (L202_015)



1. Drive bay

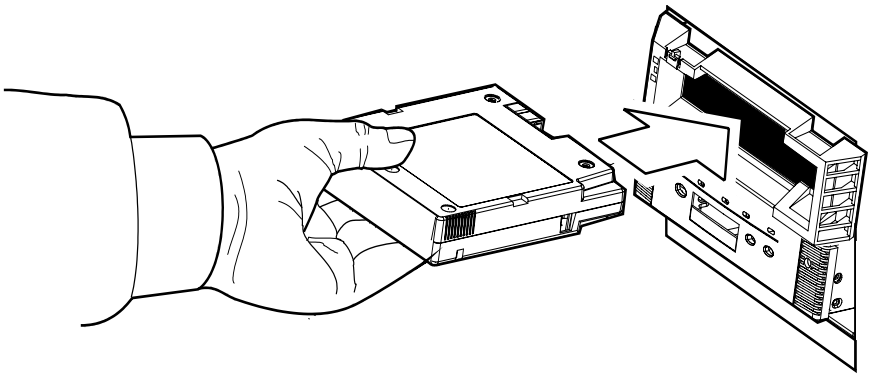
To manually mount a cartridge, follow these instructions:

1. Whether you manually insert a T9x40 cartridge or an LTO Ultrium cartridge, the VOLID label must be facing you, with the numeric characters *above* the bar code.
2. Do not force the cartridge into the tape drive. If you feel some resistance as you insert the cartridge, make sure you are installing the cartridge into the appropriate tape drive.
3. T9840 and T9940 tape drives look very similar, but you cannot put 9840 cartridges in a T9940 tape drive, nor put 9940 cartridges in T9840 tape drive.

   Never attempt to insert an LTO Ultrium cartridge in a T9x40 tape drive. However, you can insert an LTO Ultrium cartridges in either an IBM or HP Ultrium tape drive.

Figure 8 shows manual insertion of a T9840 cartridge.

Figure 8. Manually Inserting a Tape Cartridge (L202_039)



L203_472

For more information on manually mounting a cartridge into a drive, refer to the relevant tape drive publication.

Dismounting a Cartridge

All T9x40 and LTO Ultrium tape drives have a unload button on the operator panel.

1. Make sure that the tape drive is not in use by the system.
2. Press the UNLOAD switch. One of the following conditions occurs:
   - After the tape rewinds, the cartridge is ejected from the drive. Remove the cartridge from the drive.
   - The cartridge is not ejected after the tape rewinds. Refer to your drive documentation for more information.

For more information on manually dismounting a cartridge from a drive, refer to the relevant tape drive publication.

Exiting the Library

Before you leave the library, make sure that no tools or foreign objects are left, and no cartridges are outside the cartridge slots. Then:

1. Return the cartridges that your removed to do a manual mount/dismount to their slots.
2. Step outside the library.

   WARNING: Before you close the library access door, look inside the library and ask in a loud voice if anyone is inside the library.

3. Close the front access door.

CAUTION: *Equipment/Media Damage*. Do not slam the door. You could damage the door or cause cartridges to fall onto the floor. The robot cannot recover cartridges that fall onto the floor.

4. Insert the key and lock the access door. Keep the key in a safe place.

In the unlikely event that someone becomes locked inside and the system begins to start up, lights flash for 30 seconds before the robot starts to move. This provides enough time to push the emergency robotic stop switch on the CAP door (Figure 9 on page 47). This actions stops any further robotic movement.

Figure 9. Emergency Robotic Stop Switch (L203_471)

1. Emergency robotics stop switch

Placing the Drives to Online

The following pages describe how to varying the drives online:

T9840/T9940 Drive Display

To verify that the T9840/T9940 drives are ready and online, press the MENU switch—the display should now read Online.

If the drive displays Offline, press the SELECT switch once to place it online.

- If the drive message indicates Online, the transition to online completed.
- If the Onl Pend message appears, the online state is pending due to completion of diagnostic tests.
- If other messages appear, refer to either the T*9840/T9840 Tape Drive User's Reference Manual*, PN 95739, or *T9940 Tape Drive Operator's Guide*, PN 95989.

LTO Ultrium Drives

LTO Ultrium drives are automatically placed online when you place the library online.

Placing the Library Online

You can vary the library online using your library management software. Refer to library management software publication for the command syntax and console messages.

Maintenance Mode of Operation

Maintenance mode is active when a service representative enters the access door to perform maintenance or to replace a component.

An example of this would be the replacement of a defective HandBot when a redundant or operational HandBot is available. Each HandBot has two motors, if one fails, the other motor is powerful enough to move the defective HandBot into the forward service area. If both the motors fail for a HandBot, then the redundant HandBot moves the defective HandBot into the forward service area thus continuing HandBot operations. The service representative then requests that the library be made available for maintenance entry on the side where the HandBot is positioned. The maintenance key (available only to a service person) is inserted, a service safety door moves to the side selected (partitioning the service area from operational library activity) and the HandBot is replaced.

During the replacement, the library continues to function. Because there are cartridge arrays in the forward portion of the Customer Interface Module, these slots are reserved for diagnostic and cleaning cartridges only. A mount request for a cartridge in the slot closer to the side (left or right) where the service safety door is engaged may be inhibited until the maintenance activity is completed. The reserved slots on the other side of the service area may still be accessed if the service safety door is not engaged on that side as well.

After the maintenance activity is completed, the access door is closed and locked and the service safety door moves to the center, clearing the area for HandBot operations. The HandBots then resume their full service.

Cartridge Information

4

This chapter describes how to handle, inspect, and maintain cartridges.

Cartridge Requirements

Cartridges must meet specifications defined in *American National Standard Magnetic Tape and Cartridge for Information Interchange*.

Refer to your drive vendor's publication and Web site for specific cartridge requirements and specifications.

Colored cartridges are approved only if the measured reflection density is greater than 0.1 as measured by an X-rite 404G color reflection densitometer. For more information about colored cartridges, contact your StorageTek marketing representative.

Colored measurements are:

Bandwidth	ANSI Status T Wide band (380 to 780 nm)
Measuring range	Density (0.00 to 2.50) D
Accuracy	±0.02 D
Repeatability	±0.01 D
Aperture diameter	3.4 mm (0.13in.)

For more information about colored cartridges, contact your StorageTek marketing representative.

Cartridge Labels

The SL8500 library supports three types of barcode labels:

- For T9x40 drives, 1/2-inch labels supplied by Trioptic (Engineered Data Products/Colorflex) or Tricode (American Eagle/Writeline). Both versions require a separate Media ID Type, which is one character.
- For LTO drives, labels with eight characters, the last two of which are the required Media ID Domain and the Media ID Type characters.
- For SDLT drives, labels with seven characters, the last of which is the required Media ID character.

Notes:

3. Pre-labeled cartridges are available from StorageTek. For information on ordering these cartridges, see “Ordering Cartridges/Labels” on page 47.
4. StorageTek does *not* supply cartridge labels. For a supplier of labels only, see “Ordering Cartridges/Labels” on page 47.
5. Cleaning and diagnostic kits have one labeled cleaning cartridge and one labeled diagnostic cartridge with a volume serial number of 0 (zero) for each. Extra cleaning and diagnostic labels are sent with each library.

Non-labeled Cartridges

Non-labeled cartridges are *not* supported in the SL8500 library. If non-labeled cartridges are left inside the library and a software audit (such as HSC) is initiated, the cartridges will be ejected through the CAP.

Upside Down Cartridges

Inserting a cartridge upside down can cause damage to the HandBot and to the cartridge.

The behavior for upside down cartridges is explained in the following sections.

LTO Cartridges

For upside down LTO cartridges, the label can be recognized and may be placed into a cartridge slot.

When the library tries to load the cartridge into a drive:

- the drive will not allow the upside down cartridge to be inserted,
- the cartridge is returned to its original slot, and
- the drive posts a load error message on the host console.

The operator should verify if there is an upside down condition by ejecting the cartridge through the CAP.

T9x40 Drives

Caution: *Equipment and cartridge damage:* An upside down 9x40 cartridge can cause damage to both the HandBot and the cartridge. Make sure the customer is aware of the problems this can cause.

CAP Entry:
If you insert a 9x40 cartridge upside down into a CAP slot, the cartridge will not seat correctly within the slot and the CAP can not close.

Manual Array Slot Entry:
If you insert a 9x40 cartridge upside down into a storage slot, the cartridge will extend from the slot and damage can occur to both the HandBot and the cartridge.

Ordering Cartridges/Labels

Contact your authorized StorageTek Selling Agent for *labeled cartridges*.

For cartridge *labels*, contact EDP/Colorflex at:

- Phone: 1.888.438.8362 (domestic and international)
- Web site: http://www.colorflex.com

For technical questions, contact StorageTek Sales Support at:

- Phone: 1.800.275.4785
- E-mail: sales_support@storagetek.co

The following tables list StorageTek part numbers for labeled tapes.

T9840 Cartridges

Table 7. T9840 Cartridge Part Numbers and Feature Codes

Description	Part Number	Quantity / Feature Code
Labeled, EDP	310323201	01 PK / EBLA
Black cartridge, EBCDIC, EDP	310323301	01 PK / IEBC, EBLA
Black cartridge, ASCII, EDP	310323401	01 PK / IASC, EBLA
Black cartridge, UNISYS, EDP	310323501	01 PK / IUNI, EBLA
Black cartridge, Cray, EDP	310323701	01 PK / ICRA, EBLA
Black cartridge, AS/400, EDP	310323801	01 PK / IAS4, EBLA
Vanilla cartridge	310671501	01 PK / UN01

T9940 Cartridges

Table 8. T9940 Cartridge Part Numbers and Feature Codes

Description	Part Number	Quantity / Feature Code
Vanilla cartridge	312868001	01PK, UN01
Cartridge, labeled, EDP	312868201	01PK,EBLA
Cartridge, EBCDIC, EDP	312868301	01PK,EBLA,IEBC
Cartridge, ASCII, EDP	312868401	01PK,EBLA,IASC
Cartridge, UNISYS, EDP	312868501	01PK,EBLA,IUNI
Cartridge, Cray, EDP	312868701	01PK,EBLA,ICRA
Cartridge, AS/400, EDP	312868801	01PK,EBLA,IAS4

VolSafe Cartridges

Table 9. 9940 VolSafe Cartridge Part Numbers and Feature Codes

Description	Part Number	Quantity / Feature Code
VolSafe EBCDIC, EDPC	313497601	VLSF, IEBC, EVLA
VolSafe ASCII, EDP	313497701	VLSF, IASC, EVLA
VolSafe EDP	313497801	VLSF, EVLA
20 GB Raven Black, VolSafe	313498001	VLSF,

Table 10. 9840 VolSafe Cartridge Part Numbers and Feature Codes

Description	Part Number	Quantity / Feature Code
VolSafe EBCDIC, EDPC (A/B)	313335501	VLSF, IEBC, EVLA
VolSafe ASCII, EDP (A/B)	313335601	VLSF, IASC, EVLA
VolSafe EDP (A/B)	313488701	VLSF, EVLA
20 GB Raven Black, VolSafe (A/B)	313336901	VLSF, UN01
VolSafe, EBCD1C, EDP, C	312565401	VLSC, IEBC, EVLA
VolSafe, ASCII, EDP, C	312565501	VLSC, IASC, EVLA
VolSafe, EDP, C	312565601	VLSC, EVLA
20 GB Raven Black, VolSafe (C)	312565301	VLSC, UN01

LTO2 Cartridges

Table 11. LTO Gen 2 Cartridge Part Numbers and Feature Codes

Description	Part Number	Feature Code
10 Count, 200 GB, LTO2, Vertical label	312528401	2C10, EVLA, VLBL
20 Count, 200 GB, LTO2, Vertical label	312528501	2C20,EVLA,VLBL
10 Count, 200 GB, LTO2, Horizontal label	312528601	2C10, EVLA, HLBL
20 Count, 200 GB, LTO2, Horizontal label	312528701	2C20, EVLA, HLBL
200 GB diagnostic, LTO2, Vertical label	312528801	L2DG, VLBL, EVLA
20 Count, 200 GB, LTO2, Unlabeled	311627001	20NL
20 Count, 200 GB, LTO2, Horizontal label	311627101	20LB, HLBL
20 Count, 200 GB, LTO2, Vertical label	311627201	20LB, VLBL
10 Count, 200 GB, LTO2, Horizontal label	311628501	10LB, HLBL
10 Count, 200 GB, LTO2, Vertical label	311628601	10LB, VLBL

Cleaning Cartridges

Table 12. Cleaning Cartridge Part Numbers and Feature Codes

Description	Part Number	Feature Code
9840 Cleaning Cartridge, Black	310324601	98CL
9940 Cleaning Cartridge	312869601	99CL
SDLT Cleaning Cartridge, Labeled	313745701	SDLC
LTO Universal Cleaning Cartridge, Labeled	313793301	UNCL

■ Preparing Cartridges

The following pages describe how to prepare a cartridge for use in the tape library.

Handling a Cartridge

Improper handling of cartridges can result in a loss of data or damage to a library component.

Improper handling of cartridges can result in a loss of data or damage to a machine component.

To handle a cartridge correctly:

- Do not carry several cartridges loosely in a container. The leader blocks can snag on other cartridges and become unlatched.

Note: T9940 and LTO Ultrium cartridges have leader blocks. T9840 cartridges do not.

- Make sure that the leader block is latched every time you pick up a cartridge.
- Keep cartridges *clean*.
- Inspect a cartridge before each use and *never* put a damaged cartridge into a drive or library.
- Never release a leader block and pull tape from a cartridge.
- Never open a cartridge.
- Do not handle tape that is outside the cartridge; the tape edge might be damaged.
- Do not expose the tape or cartridge to direct sunlight or moisture.
- Do not expose a recorded cartridge to magnetic fields; this might destroy data on the tape.

Inspecting and Identifying a Cartridge

A defective or dirty cartridge can damage a drive. Always inspect a cartridge before you insert it into a drive or into a tape library. See Figure 15 on page 51 through Figure 17 on page 53. Look for:

- Cracked or broken cartridge
- Broken leader
- Broken tape access door
- Damaged file-protect selector or write-protect switch
- Liquid in the cartridge
- Labels not firmly attached or extending over the cartridge edge
- Any other obvious damage

All the cartridges you use in a SL8500 library are similar, but they have significant differences.

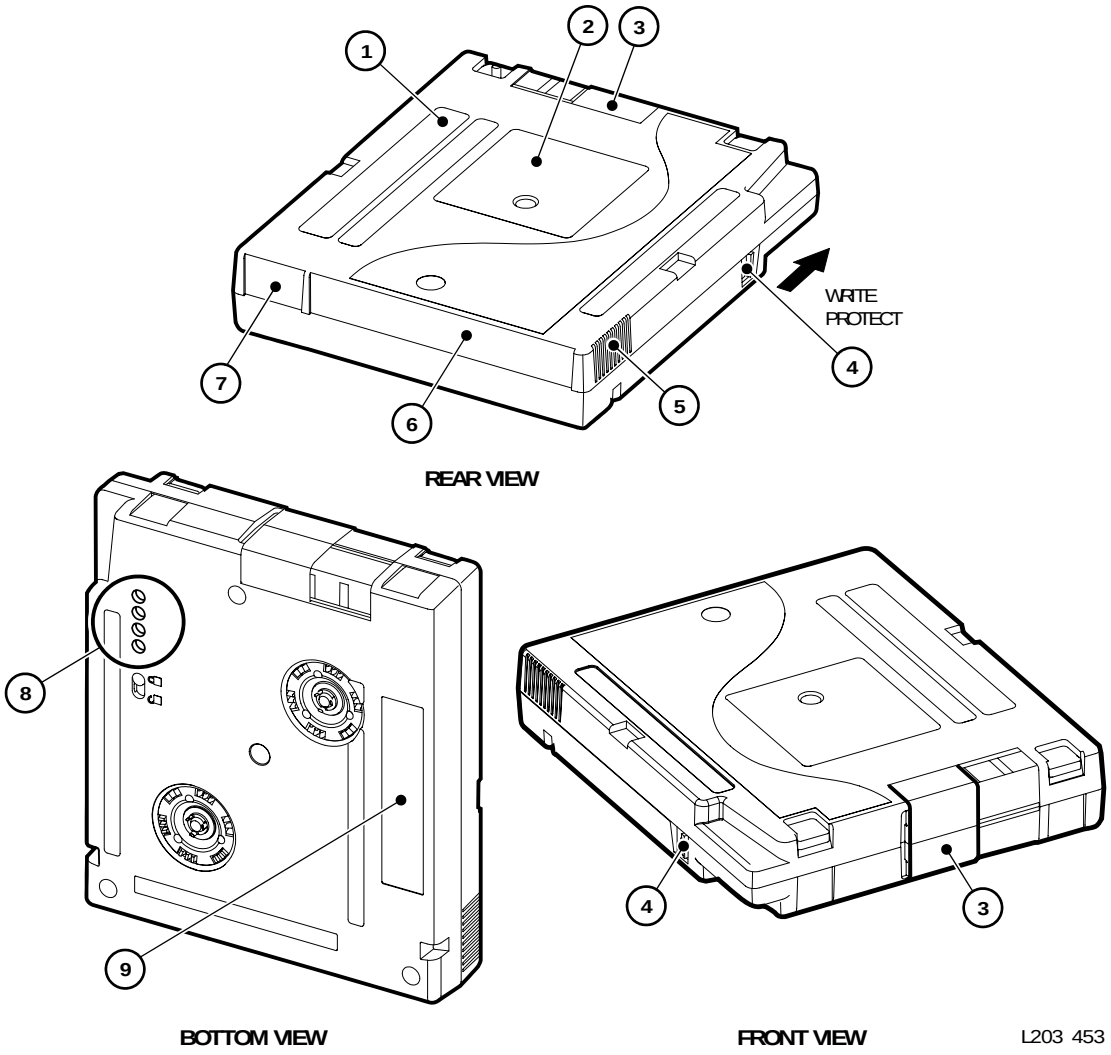
StorageTek Cartridges

The T9840 and T9940 Tape Drives use a cartridge tape that is the same physical size; however, they are *not* interchangeable.

T9840 Cartridge

The T9840 tape cartridge has two reels between which the tape travels (Figure 15). It does not have a leader block. It cannot be used in a T9940 or LTO Ultrium tape drive.

Figure 15. A T9840 Cartridge (L203_453)



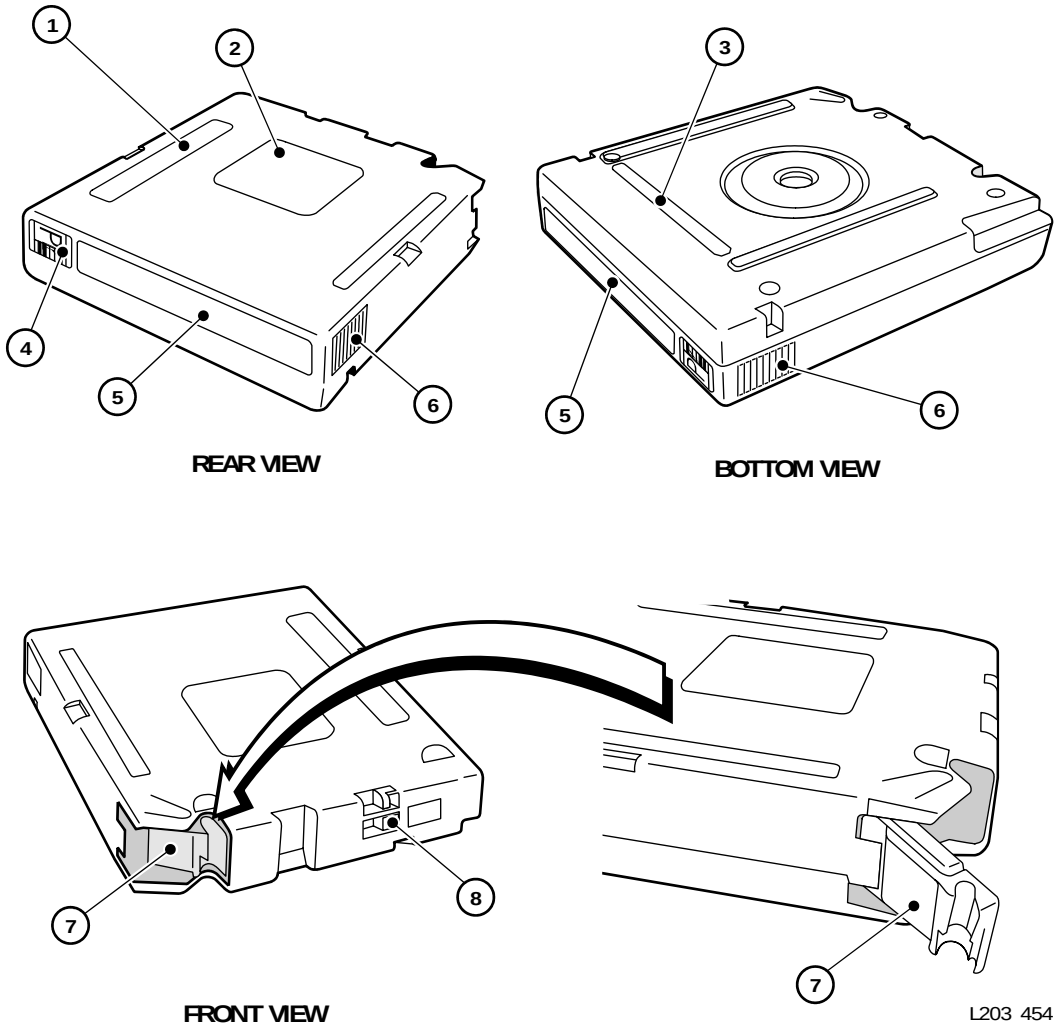
1. Manufacturer's label
2. Customer's label
3. Tape access door
4. Write-protect switch
5. Finger grips
6. VOLID label
7. Media ID label (R=data, U=cleaning, yellow for VolSafe)
8. Media ID (machine identifiable)
9. Manufacturer Part ID

Note: The manufacturer and media identification labels are yellow (9840A/B), green (9840C). The write-protect switch is yellow (9840A/B), green (9840C).

T9940 Cartridge

The T9940 cartridge has a single reel and a leader block that the T9940 tape drive uses to move the tape across the tape drive head (Figure 16). A T9940 cartridge cannot be used in a T9840 or LTO Ultrium tape drive.

Figure 16. A T9940 Cartridge (L203_454)



1. Manufacturer's label (yellow for VolSafe)
2. Customer's label
3. Manufacturer's part ID
4. Media ID label (P=data, W=cleaning)
5. VOLID label
6. Finger grips
7. Tape leader block
8. Write-protect switch (yellow for VolSafe)

VolSafe Cartridges

VolSafe (volume safe) is a special StorageTek feature that provides write once, read many (WORM) technology to VolSafe designated tape cartridges. VolSafe permits new data to only append the tape media, while it prevents erasure or overwrite of previously written data.

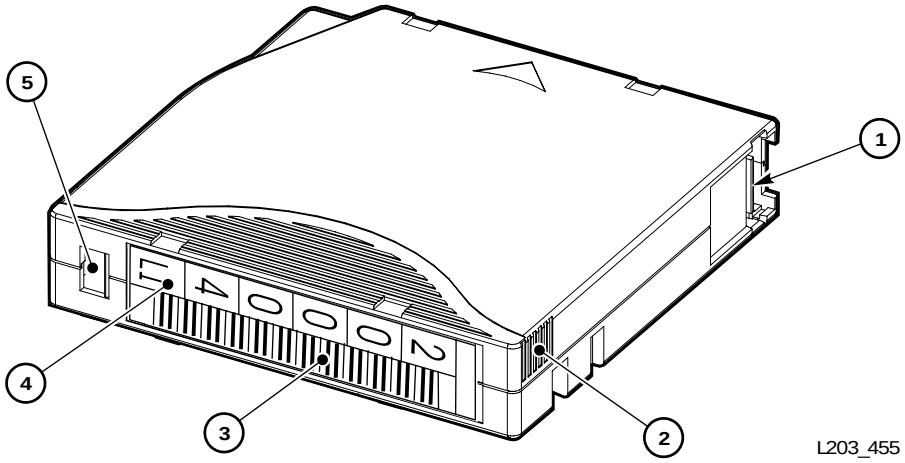
The T9840 and T9940 Tape Drives each use a unique cartridge and you can identify the VolSafe cartridge by colored areas on the cartridge.

The manufacturer and media identification labels are yellow (9840A/B and 9940), green (9840C). The write-protect switch is yellow (9840A/B and 9940), green (9840C). See Figure 15 on page 51and Figure 16 on page 52.

LTO Ultrium Cartridge

An LTO Ultrium cartridge has a single reel and a leader block (Figure 17), which makes it similar to a T9940 cartridge, but it cannot be used in place of a T9940 cartridge. Ultrium cartridges follow the linear tape open (LTO) format that allows them to be used in Ultrium tape drives made by any manufacturer, such as Hewlett-Packard, IBM, or Certance. In the past, cartridges could be used only in tape drives from the same manufacturer as the tape.

Figure 17. An LTO Ultrium Cartridge (L203_455)



1. Tape access door
2. Finger grips
3. VOLID label
4. Media ID label
5. Write protect switch

LTO Ultrium Generation 2 (Gen2) Fibre Channel Drives

The Gen2 cartridge specifics include:

1. Use of standard Ultrium cartridges
2. Ability to read/write to Gen1 tape media
3. A new model code for Gen2 drives—LTO2001 and new feature code—IBFC
4. Cartridge Media ID for Gen2 drives is “L2” (200 GB)

The major improvements seen with the Gen2 drives are:

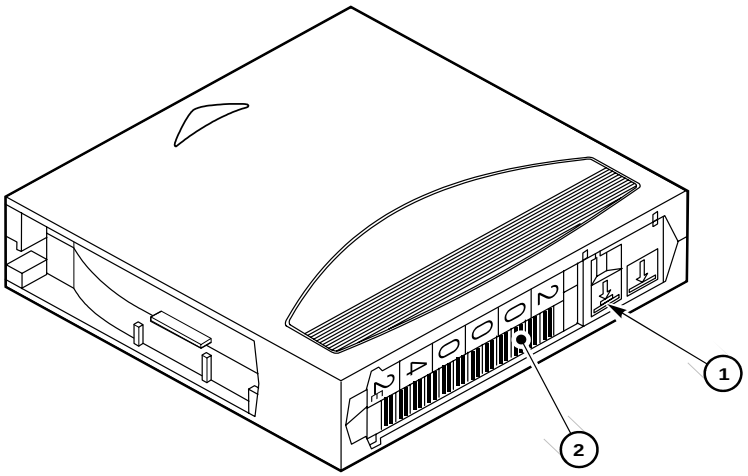
- Increased native capacity of 200 GB or up to 400 GB compressed
- Data transfer rate of 40–80 MB/sec

Super DLTtape II

The Super DLTtape II cartridge like other high capacity cartridges has only the supply reel inside the cartridge. The take-up reel is inside the tape drive.

The Super DLTtape I and DLTtape VS1 are both readable on the SDLT 600 Tape Drive.

Figure 18. SDLTtape II Cartridge Tape



L203_450

1. Write-protect switch
2. VOLID label

Applying Labels to Cartridges

Cartridge labels reflect the cartridge media and usage. Cleaning cartridges have CLN in the VOLID; diagnostic cartridges have DG in the VOLID. The media ID label correlates to the tape drive or transport capable of using the cartridge:

Table 13. Cartridge Codes

Drive Type	Media ID	Usage
T9840	R	Data
	U	Cleaning
T9940	P	Data
	W	Cleaning
HP GEN2 LTO Ultrium	C_1 plus CLN	Cleaning
IBM GEN2 LTO Ultrium	C_2 plus CLN	Cleaning
HP and IBM GEN2 LTO Ultrium	C_u	Universal cleaning cartridge
HP and IBM GEN2 LTO Ultrium	L_2	Data
SDLT 600		

Table 14. Ultrium Cartridge Models

Description	Model Number
Ultrium media cartridge	MEDLTOM
Universal cleaning cartridge	MEDCLNT
Required feature code:	
20-count 100 GB data cartridges	1C20
Universal cleaning cartridge	UNCL
EDP Vivid Color Labels	EVLA
Horizontal labels	HLBL
Vertical labels	VLBL

To apply the label on a cartridge:

1. Make sure that the cartridge has been at room temperature for at least 24 hours.
2. Clean the surface where the label will be placed using a cleaning solution made for this purpose. See “Cleaning the Cartridge Exterior” on page 61.
3. Peel the backing from the VOLID label.
4. Lay the cartridge flat, in the position you would use to insert the cartridge in a tape drive.
5. Position the VOLID label with the bar-code characters *below* the alphanumeric characters. Press it into place.

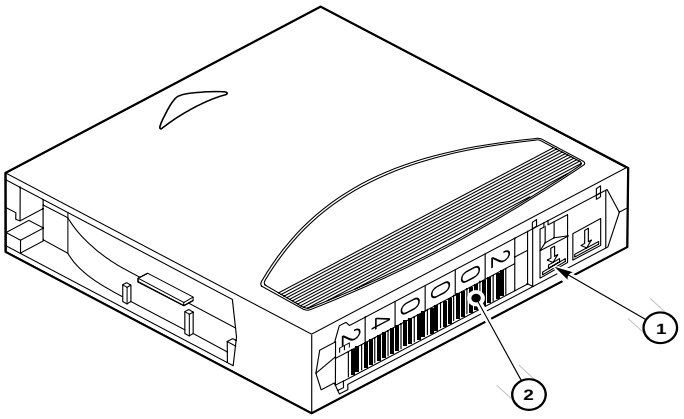
   Note: On LTO Ultrium VOLID labels, the alphanumeric characters can be either vertical or horizontal.
6. If the cartridge has a customer label, place the label in the area and press it into place.
7. Repeat Steps 2 through 5 for the media ID label.

The label must be within the indented area of the cartridge so that the edges of the label are parallel to the edges of the cartridge. The label should be close to the inside edge of the indented area but must *never* overlap the edge of this area. Figure 19 through Figure 21 illustrates labeling and the locations of the SDLT, the T9840 and T9940 cartridges. See Figure 17 for the LTO Ultrium cartridge and label.

Notes:

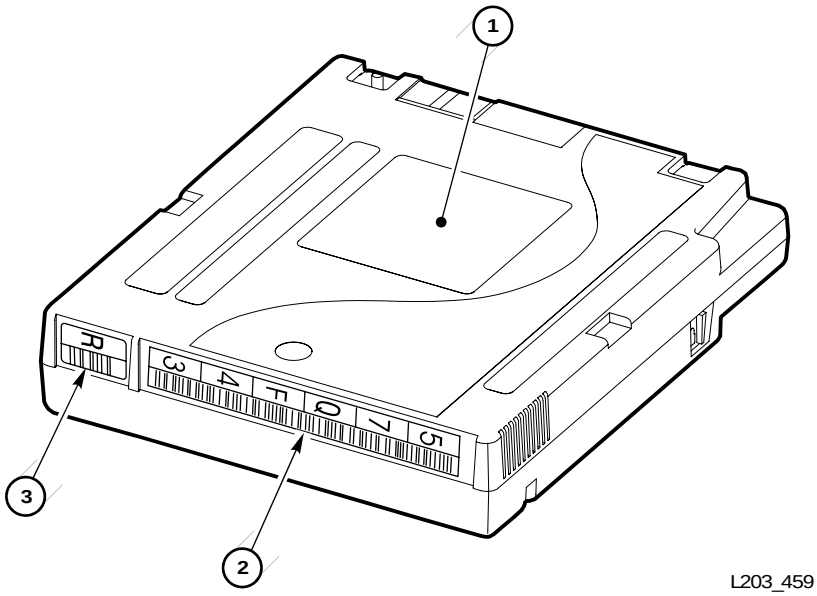
1. Make sure that the label is not placed elsewhere on the cartridge surface.
2. Make sure that the edges of the label do not curl up; curling causes the cartridge to stick in the drive loader.
3. Use labels that do not leave a residue when they are removed.
4. Make sure that the label contains a VOLID.

Figure 19. Applying Cartridge Label to SDLT Cartridge (L203_450)



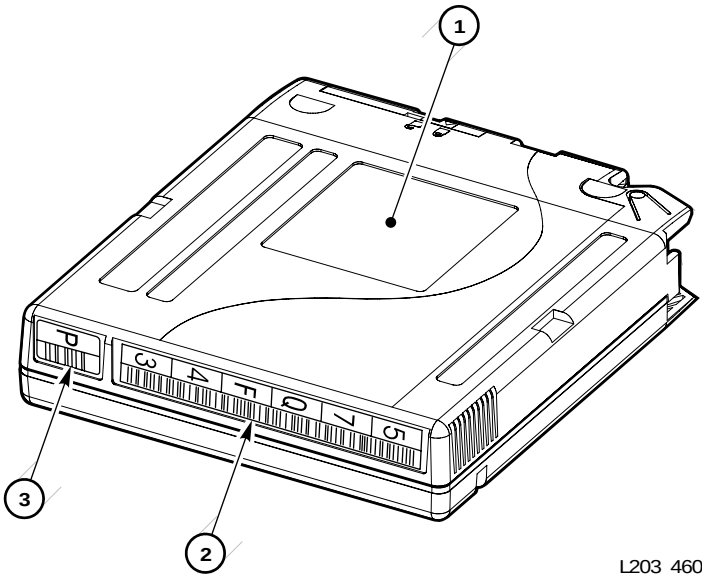
1. SDLT cartridge
2. VOLID label

Figure 20. Applying Cartridge Label to T9840 Cartridge (L203_459)



1. Customer Label
2. VOLID label
3. Media ID label (“R” = data, “U” = cleaning)

Figure 21. Applying Cartridge Label to T9940 Cartridge (L203_460)



1. Customer label
2. VOLID label
3. Media ID label (“R” = data, “U” = cleaning)

Setting the Write Protect Switch

The following sections provide information about setting the write protect switch on the tape cartridges. The switch location and design varies slightly between cartridge types.

Setting the T9840 Write Protect Switch to Read-Only

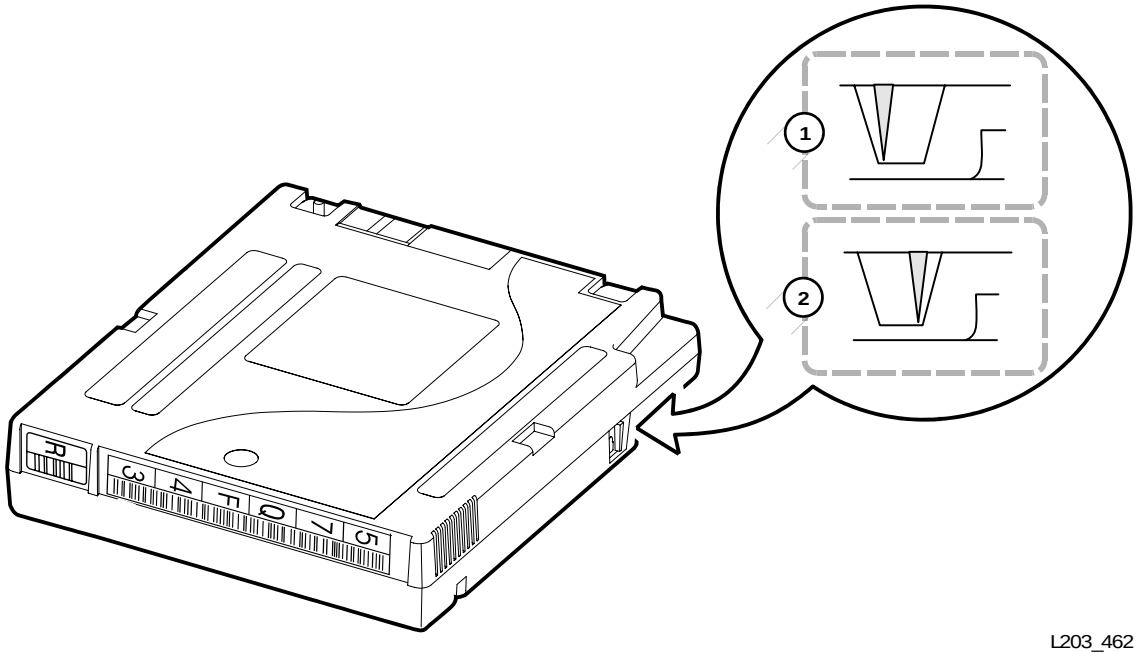
You can set the T9840 write protect switch so that the cartridge is read-only (nothing can be written on the tape). Slide the switch (Figure 22) to the front of the cartridge. In this position, the drive can only read data from the tape and cannot write data.

Setting the T9840 Write Protect Switch to Read/Write

You can set the T9840 write protect switch so that the cartridge is write-enabled. Slide the switch (Figure 22) to the rear of the cartridge. In this position, the drive can write as well as read data. This setting is recommended when you enter cartridges into the library.

Note: Some software has a feature called virtual thumb wheel, allowing read-only access to a cartridge that is not physically write-protected.

Figure 22. Setting the T9840 Cartridge Write Protect Switch (L203_462)



1. Write enable position
2. Write protect position

Setting the T9940 Write Protect Switch to Read-Only

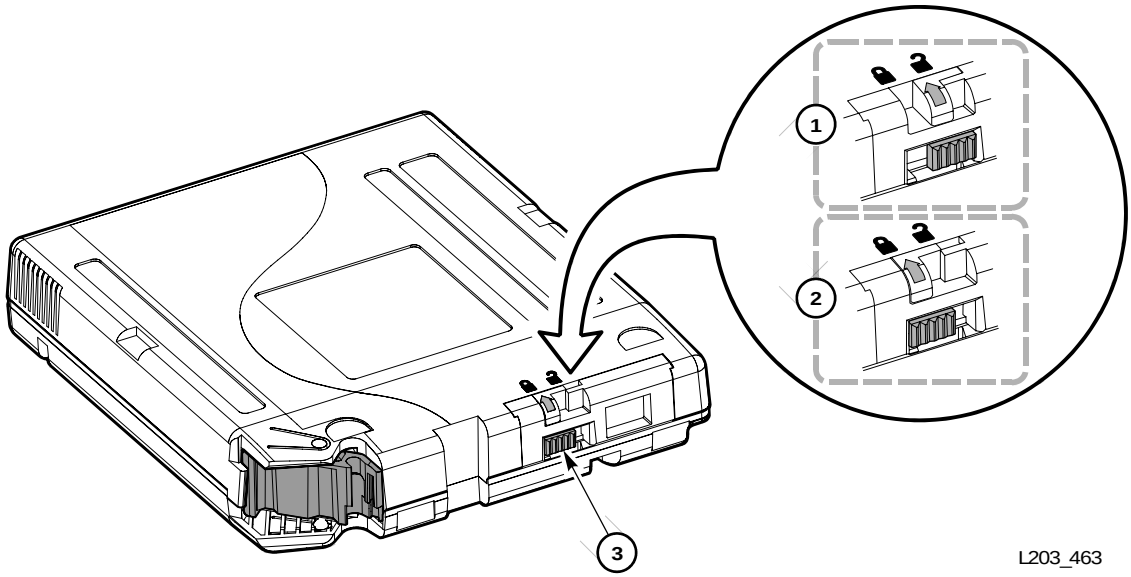
You can set the T9940 write protect switch so that the cartridge is read-only (nothing can be written on the tape). Slide the switch (Figure 23 on page 60) to the write protect position. In this position, the drive can only read data from the tape and can not write data.

Setting the T9940 Write Protect Switch to Read/Write

You can set the T9940 write protect switch so that the cartridge is write-enabled. Slide the switch (Figure 23) to the write enabled position. In this position, the drive can write as well as read data. This setting is recommended when you enter cartridges into the library.

Note: Some software has a feature called virtual thumb wheel, allowing read-only access to a cartridge that is not physically write-protected.

Figure 23. Setting the T9940 Cartridge Write Protect Switch (L203_463)



1. Write enable position
2. Write protect position
3. Write protect switch

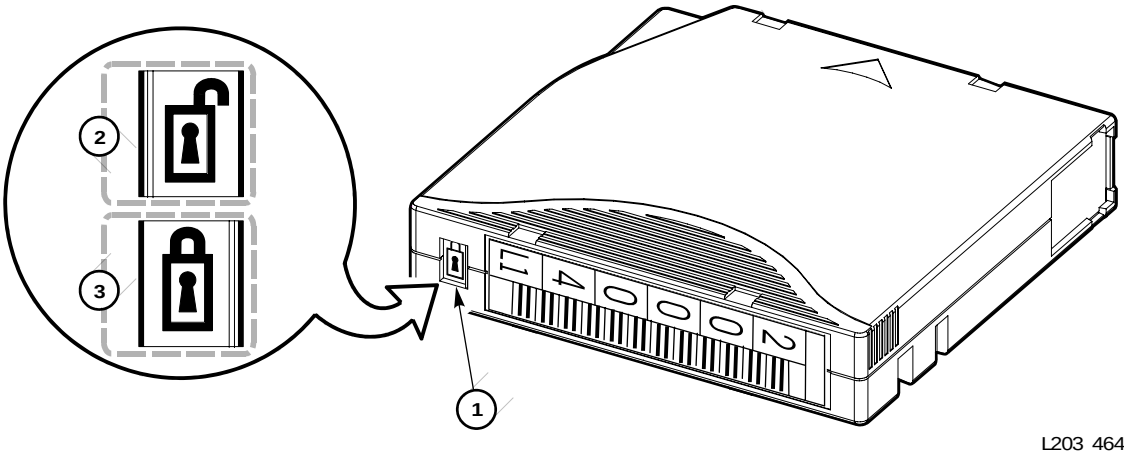
Setting the LTO Ultrium Write Protect Switch to Read-Only

You can set the LTO Ultrium write protect switch so that the cartridge is read-only (nothing can be written on the tape). Slide the switch (Figure 24) so that the “closed lock” is revealed. In this position, the drive can only read data from the tape and can not write data to it.

Setting the LTO Ultrium Write Protect Switch to Read/Write

You can set the LTO Ultrium write protect switch so that the cartridge is write-enabled. Slide the switch (Figure 24) so that the “open lock” is revealed. In this position, the drive can write as well as read data. This setting is recommended when you enter cartridges into the library.

Figure 24. Setting the LTO Ultrium Cartridge Write-Protect Switch (L203_464)



1. Write protect switch (data=red, cleaning=gray)

Cleaning the Cartridge Exterior

CAUTION: CARTRIDGE DAMAGE: Certain solvents can damage the cartridges. DO NOT USE ACETONE, TRICHLOROETHANE, TOLUENE, XYLENE, BENZENE, KETONE, METHYL ETHYL KETONE, METHYLENE CHLORIDE, ETHYLDICHLORIDE, ESTERS, ETHYL ACETATE, OR SIMILAR CHEMICALS TO REMOVE LABELS OR TO CLEAN CARTRIDGES.

Wipe all dust, dirt, and moisture from the cartridge with a lint-free cloth.

Use StorageTek Tape Cleaner Wipes, PN 4046289-01 to clean the cartridges. These wipes are saturated with isopropyl alcohol. Do not let any solution touch the tape or get inside the cartridge.

Using Cleaning Cartridges

Cleaning cartridges have a media ID label that identifies the type of tape drive in which it can be used (see Table 13 on page 55).

These cartridges can not be used as scratch cartridges or initialized by software utilities.

CAUTION: PROCEDURE ERROR: When you enter a cleaning cartridge, the software considers it to be new, and sets the usage counter to zero. DO NOT RE-ENTER A CLEANING CARTRIDGE THAT LIBRARY HAS EJECTED.

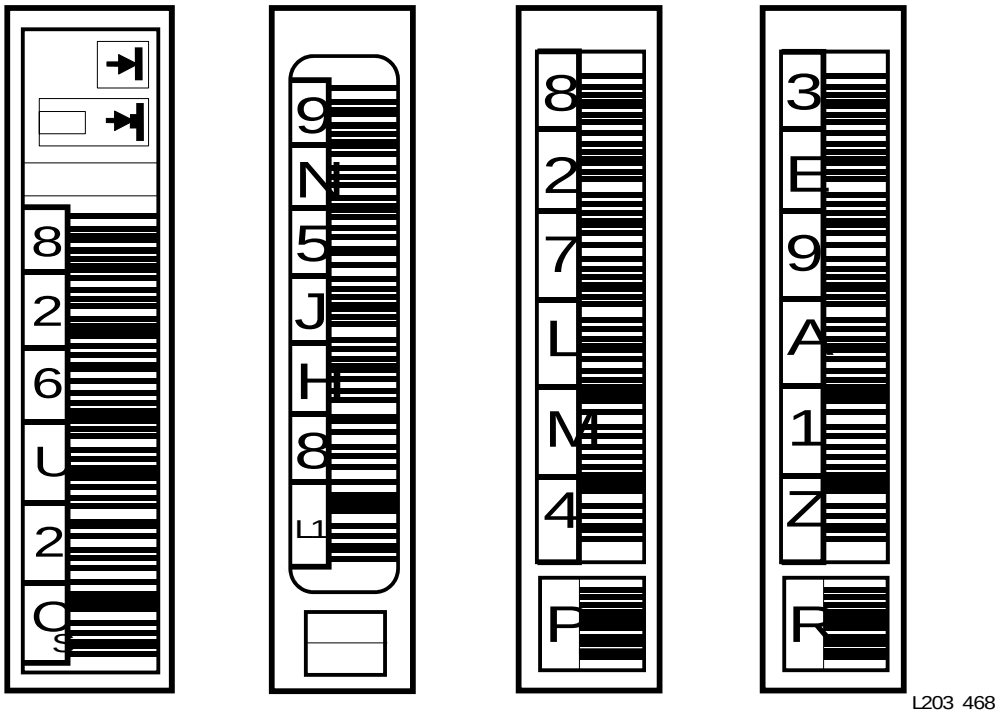
Repairing a Detached Leader Block

When a T9940 or LTO Ultrium cartridge tape is damaged, use a backup tape if possible. If a cartridge leader block is detached, there is no backup tape, and the cartridge or tape has no obvious damage, you may repair the leader block using a repair kit provided by the tape supplier. You can use the tape one time to copy the data onto another tape.

Cartridge Label Examples

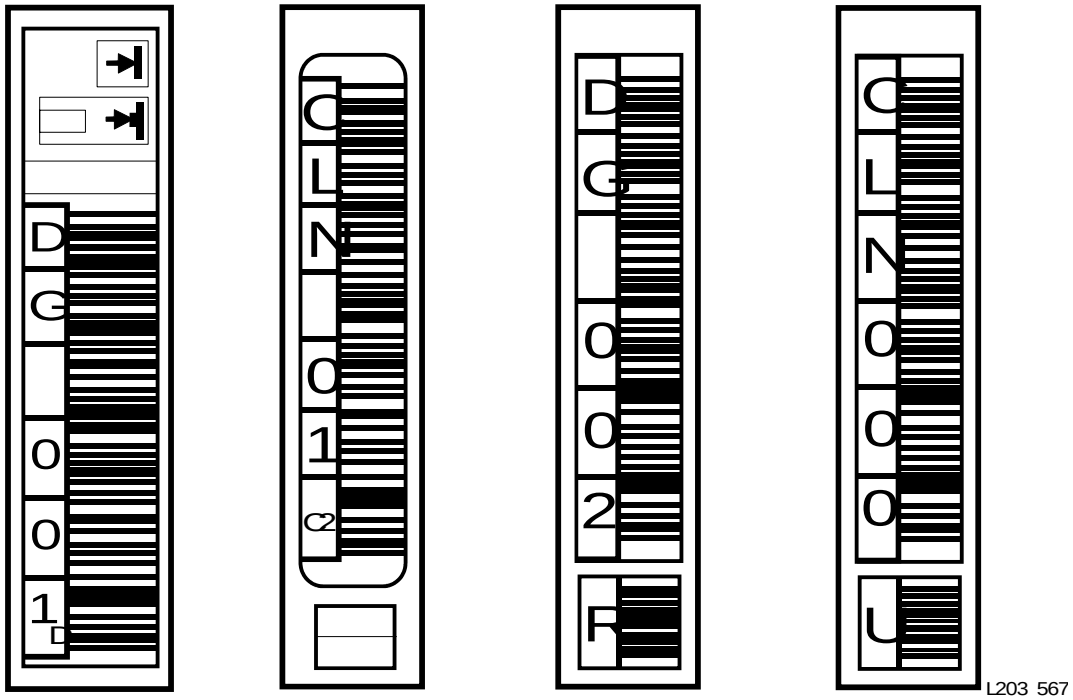
Table 15 and Table 16 on page 63 show examples of the various cartridge labels used by the drives in the library. Be sure to use the proper labels for each drive type.

Table 15. Label Examples—Data Cartridges

SDLT	LTO Ultrium	T9940	T9840
			
Media ID Labels			

SDLT	LTO Ultrium	T9940	T9840
The SDLT Media ID is incorporated into the tape label, and includes: **S** = Super DLT	The LTO Media ID is incorporated at the end of the tape label, and includes: **C1** = HP cleaning **C2** = IBM cleaning **CU** = Universal **L*x*** = Data cartridge: L2 = 200GB L1 = 100 GB LA = 50 GB LB = 30 GB LC = 10 GB	The Media ID label for the T9940 is at the end of the tape label, and includes: **P** = Data **W** = Cleaning	The Media ID label for the T9840 is at the end of the tape label, and includes: **R** = Data **U** = Cleaning

Table 16. Label Examples—Cleaning and Diagnostic Cartridges

SDLT Diagnostic	LTO Cleaning	T9940 Diagnostic	T9840 Cleaning
			
Diagnostic and Cleaning Cartridge Label Identifiers			
DG = Diagnostic Plus the Media ID label to identify the type of cartridge. **CLN** = Cleaning	The cleaning Media ID labels include: **C1** = HP **C2** = IBM **CU** = Universal	**DG** = Diagnostic Plus the Media ID label: **P** = Data **CLN** = Cleaning plus **W** = Cleaning	**CLN** = Cleaning plus **U** = Cleaning **DG** = Diagnostic Plus the Media ID label: **R** = Data

Maintaining Cartridges

The following pages list cartridge specifications, describe how to store and clean cartridges, use cleaning cartridges, and repair a detached leader block.

T9840 Cartridge Specifications

The StorageTek 9840 cartridge tape was designed to provide fast access to data and storage of up to 20 gigabytes of uncompressed data with an average access time of just 12 seconds. Table 17 lists the specifications of the 9840 cartridge with the T9840x Tape Drives.

Table 17. T9840 Cartridge Tape Specifications

Performance	**T9840A**	**T9840B**	**T9840C**
Capacity, native (uncompressed)	20 GB	20 GB	40 GB
Read/Write speed	2.0 m/s (79 ips)	4.0 m/s (158 ips)	3.4 m/s (134 ips)
Search/Rewind speed	11.0 m/s (440 ips)		
Formulation	Advanced metal particle (AMP)		
Coercivity	1625+/-75 Oersteds (130+/16.0 KA/m)		
Substrate	Polyethylene naphthalate (PEN)		
Archival life	15–30 years		
Uncorrected bit error rate	1x10(-18)		
Permanent errors	0		
Compatibility	T9840A, T9840B, T9840C		
Number of tracks	288	288	
Form factor	Half inch, 3480/3490E		
Height	25.4 mm (1.0 in.)		
Width	109.0 mm (4.29 in.)		
Weight	262.0 g (9.17 oz)		
Drop strength	1.0 m (38.4 in.)		
Humidity			
Operating	20%–80%		
Storage (archive)	30%–40%		
Shipping	5%–80%		
Temperature (non-condensing)			
Operating	+15° to +32°C (+60° to +90°F)		

Table 17. T9840 Cartridge Tape Specifications

Storage (archive)	+15° to +25°C (+59° to +77°F)
Shipping	-23° to +49°C (-10° to +120°F)
Wet bulb maximum	26°C (78°F)

T9940 Cartridge Specifications

The StorageTek 9940 tape cartridge was designed to store up to 200 gigabytes of uncompressed data, or up to 400 gigabytes with 2:1 data compression, on a single cartridge. Table 18 lists the specifications of the 9940 cartridge with the T9940x Tape Drives.

Table 18. T9940 Cartridge Tape Specifications

Performance	**T9940A**	**T9940B**
Capacity, native (uncompressed)	60 GB	200 GB
Read/Write speed	2.0 m/s (79 ips)	2.4 m/s (95 ips)
Search/Rewind speed	11.0 m/s (440 ips)	
Formulation	Advanced metal particle (AMP)	
Coercivity	1625+/-75 Oersteds (130+/16.0 KA/m)	
Substrate	Polyethylene naphthalate (PEN)	
Archival life	15–30 years	
Uncorrected bit error rate	$1x10^{(-18)}$	
Permanent errors	0	
Compatibility	T9940A, T9940B	
Number of tracks	288	576
Form factor	Half inch, 3480/3490E	
Width	109.0 mm (4.29 in.)	
Length	125.0 mm (4.92 in.)	
Height	25.4 mm (1.0 in.)	
Weight:	262.0 g (9.17 oz)	
Drop strength	1.0 m (39.3 in.)	
Humidity		
Operating	20%–80%	
Storage (archive)	30%–40%	
Shipping	5%–80%	

Table 18. T9940 Cartridge Tape Specifications

Temperature (non-condensing)	
Operating	+15° to +32°C +60° to +90°F
Storage (archive)	+15° to +25°C +59° to +77°F
Shipping	-23° to +49°C -10° to +120°F
Wet bulb maximum	26°C (78°F)

LTO Ultrium Cartridge Specifications

LTO Generation 2 technology stores up to 200 gigabytes of uncompressed data on a single cartridge, or up to 400 gigabytes with 2:1 data compression.

StorageTek offers Ultrium tape cartridges manufactured by Maxell Corporation.

Table 19. LTO Cartridge Tape Specifications

Performance	**LTO Generation 2**
Capacity, native (uncompressed)	200 GB; 400 GB (with 2:1 compression)
Read and write tape speed	5.9 m/s
Search and rewind speed	7.0 m/s
Formulation	Metal particle (MP)
Coercivity	1850+/-75 Oersteds (147,218 A/m)
Substrate	Polyethylene naphthalate (PEN)
Archival life	15-30 years
Uncorrected bit error rate	$1x10^{(-17)}$
Permanent errors	0
Tape drive compatibility	LTO Generation 1, LTO Generation 2
Number of tracks	512
Form factor	Half inch
Width	105.4 mm (4.15 in.)
Length	102.0 mm (4.02 in.)
Depth	21.5 mm (0.85 in.)
Weight	210.0 g (0.463 lb)
Humidity	
Operating	20%-80%

Table 19. LTO Cartridge Tape Specifications

Performance	LTO Generation 2
Storage (archive)	20%-80%
Shipping	20%-80%
Temperature (non-condensing)	
Operating	10 to 40°C (50 to 104°F)
Shipping	-23 to 49°C (-10 to 120°F)
Wet bulb maximum	26°C (78°F)

SDLT Cartridge Tape Specifications

SDLT tape cartridges store up to 300 gigabytes which makes SDLT cartridges ideal for storing, archiving and backing up large volumes of information. StorageTek offers SDLT tape cartridges in a partnership with Quantum Corporation.

Table 20. SDLT Cartridge Tape Specifications

Performance	DLTtape II
Capacity, native (uncompressed)	300 GB
Read and write tape speed	
Search and rewind speed	
Formulation	eMP60
Coercivity	
Substrate	Super PET
Archival life	30 years
Uncorrected bit error rate	
Permanent errors	0
Tape drive compatibility	SDLT600
Number of tracks	
Form factor	Half inch
Width	105.6 mm (4.16 in.)
Length	105.3 mm (4.15 in.)
Depth	25.4 mm (1.0 in.)
Weight	222.5 g (7.85 oz)
Humidity	20%-80%

Table 20. SDLT Cartridge Tape Specifications

Performance	DLTtape II
Operating	
Storage (archive)	
Shipping	
Temperature (non-condensing)	10° to 40°C (50° to 104°F)
Operating	
Shipping	
Wet bulb maximum	26°C (78°F)

Storing of Cartridges

When you store a cartridge:

- Do not take a cartridge out of its protective wrapping until you are ready to use it. Use the tear string, not a sharp instrument, to remove the wrapping.
- Store cartridges in a clean environment that duplicates the conditions of the room in which they are used.
- Before using a cartridge, make sure that it has been in its operating environment for at least 24 hours.
- Archival storage is 1 to 10 years for 9x40 cartridge tapes and 15 to 30 years for LTO Ultrium cartridge tapes.

Troubleshooting and Diagnostics

5

This chapter describes how to correct problems with the library and the attached devices (drives, CAP, robots, and elevators). It also includes some of the diagnostic procedures you can perform using the StreamLine Library Console.

If you encounter any problems with the library, you should take several steps before you contact the Technical Excellence Center (TEC).

If you must contact the TEC, see Chapter 6 for more information.

Troubleshooting the Library

The following table describes a few of the troubleshooting tips:

Table 1. Troubleshooting Table

Problem	What to do
Service Required (red) LED is constantly lit.	**Perform the following procedure:** Use the Library Console to check the health of the library and the attached devices (drives, CAP, robots, and elevators). To perform a health check: 1. Launch the StreamLine Library Console application. 2. Access the System Detail module (Tools > System Detail). 3. Check the device tree for the following indicators:  Device Health  Device Error **Note:** The device tree is on the left panel that provides a list of devices attached to the library (drives, CAP, robots, elevator). The Status (for example, online/offline) and Statistics (for example, uptime, downtime, errors and warnings) options tabs provide more information on the health of the library and devices. For more information, see the online help documentation accessible through the Library Console application. **Other checks:** • Make sure that all cartridges are fully seated and properly oriented in their slots. • Inspect the library floor for any foreign objects or debris; remove any objects you find.
CAP unlocked LED is lit and blinking.	Open the CAP and make sure the cartridges in the CAP slots are properly seated. See “To open the CAP:” on page 33.

Table 1. Troubleshooting Table (Continued)

Problem	What to do
The client computer cannot communicate with the library or drives.	Make sure that all cables are securely attached to their connectors on the rear of the library, the drives, and the client computer.
The StreamLine Library Console does not display modified data or information remains static.	• Select the **Refresh** button to update the screen. • Check the heartbeat monitor icon of the Library Console.  The heartbeat monitor icon is on the status line of the Library Console screens that flashes periodically indicating that the library and server are communicating:  If the heartbeat monitor stops blinking heartbeat monitor icon on status line changes to the warning icon. The warning icon indicates that the Library Console has lost communication with the library.  When the library looses communication with the server, after about 30 to 60 seconds, the warning icon is replaced by an error icon and the system displays the following error message: "Heartbeat message not received from the server." Select Problem Details to obtain possible causes and suggested actions about the error message. **Note:** When there is a communication failure, you MUST log off from the Library Console and then log on again to restore communication between the library and server. For more information, see the online help documentation accessible through the StreamLine Library Console application.
The StreamLine Console cannot communicate with the library.	The version of the Library Console is not compatible with the library controller code. 1. Download a different version of the application. See "Upgrading Firmware" and "Upgrading the Remote Library Console" on page 25. 2. Restart the Library Console. 3. Logon again to the Library Console.

Table 1. Troubleshooting Table (Continued)

Problem	What to do
Drive is unable to eject a cartridge.	See “Dismounting a Cartridge” in the “Manual Mode of Operation” on page 39.
Unable to find a cartridge VOLID.	Perform a library audit using the Library Console. The Library Console offers two types of audits: Entire library audit: to verify the cartridge database (stored in the HBC car) for the VOLID and location of all the cartridges in the library. Physical audit: to verify the VOLID from the slot locations of the cartridge in the library. The system then updates the cartridge database with the results of the physical audit. This audit will help resolve any discrepancies between the library and the cartridge database. For more information, see the online help documentation accessible through the StreamLine Library Console application.

Drive Tray LEDs

The LED on the back of each tray indicates that a drive, power supply or environmental fault exists. This indicator is used to locate a defective tape drive.

Note: The information in the HP tables was taken from the Hewlett-Packard documentation.

Table 2. HP Single-LED Patterns

LED	Status and Cause	Action Required
Ready (green)	• Lit steadily when tape drive is receiving power and ready but no activity is occurring	None
	• Flashing when tape drive is engaged in activity such as Read, Write, or Space; being cleaned; or performing a self-test	None
	• Flashing quickly when downloading software	None
	• Off when tape drive is powered-off or self-test failed	Check power switch and cable connection
Drive Error (orange)	• Lit when tape drive has a problem • Flashing when unrecoverable hardware failure occurs.	Power cycle or successful tape load turns off LED, but LED starts flashing again if same operation is performed and fault is present.
Tape Error (orange)	Flashing when tape drive thinks it contains a faulty tape	Remove and make sure that you have the correct type of cartridge. Reload the cartridge. If flashing occurs again, get rid of cartridge. Place a known, good cartridge into tape drive.
Clean (orange)	• Lit steadily when supported cleaning cartridge is cleaning tape drive	None
	• Flashing when tape drive needs to be cleaned with supported cleaning tape.	If still flashing **after** tape drive is cleaned and a new or known data is loaded, call for service

Table 3. HP Multi-LED Patterns

Sequence	Cause	Action Required
All LEDs off	Tape drive not have power Tape drive faulty Occurs just after tape drive has been switched on or reset	Make sure that power switch is in ON position Check power cable connection and replace if necessary Power cycle the tape drives Call for service
Ready and Clean off Drive Error and Tape Error are flashing	Tape drive has failed to execute power-on self-test (POST)	Power cycle or reset tape drive Call for service
Ready is off, all others are lit.	Firmware is being reprogrammed.	None. Do not reset or power cycle tape drive.
Ready flashes and other LEDS are steadily lit	Firmware is being downloaded	None. If a problem occurs, Ready is steadily lit and Tape Error flashes until tape load is started.
Ready is flashing and Clean is lit	Tape drive is being cleaned	None. Cleaning cartridge will eject when cleaning is completed. Cleaning cycle can take up to 5 minutes.
Tape is ejected immediately and Tape Error is flashing or Drive Error flashes on unloading tape	Cartridge memory might be faulty.	Slide the red switch on the cartridge to the write-protect position. Load the cartridge for a Read operation. Recover the data, then destroy the cartridge.
Drive Error, Tape Error, Ready flashing	Firmware download problem	Insert cartridge to clear LED sequence. Tape Drive uses old firmware.
Ready and Drive Error lit and Tape Error and Clean off, alternating with. Tape Error and Clean lit and Ready and Drive Error off	Firmware error	Power cycle or reset tape drive. If continues, upgrade firmware.

Note: The information in the IBM tables was taken from the IBM documentation.

Table 4. IBM LTO Drive Buttons and Indicators

Buttons/Indicator	Description
Red display	For code numbers and their meanings see Table 5.
Blue button	Used to unload the tape cartridge
LED	**Indicator** • Yellow when initializing • Green when ready • Red when problem occurs

Table 5. IBM LTO Drive Codes and Meaning

Code	Status and Cause	Action Required
0	No error occurred. This code displays • When power is cycled (turned off, then on) to the tape drive. • When diagnostics have finished running and no error occurred. **Note:** The single-character display is blank during normal operation of the tape drive.	No action is required.

Table 5. IBM LTO Drive Codes and Meaning (Continued)

Code	Status and Cause	Action Required
1	The tape drive detected that the recommended operating temperature was exceeded. The error code clears when you power-off the tape drive or place it in maintenance mode.	1. If a fan is present in the enclosure, ensure that it is rotating. If not, replace the fan. 2. Remove any blockage that prevents air from flowing freely through the tape drive. 3. Ensure that the operating temperature and airflow is within the specified range. 4. If the operating temperature is within the specified range and the problem persists, replace the tape drive. 5. The error code clears when you power-off the tape drive or place it in maintenance mode.
2	The tape drive detected that the externally supplied power is either approaching the specified voltage limits (the drive is still operating) or is outside the specified voltage limits (the drive is not operating). The error code clears when you power-off the tape drive or place it in maintenance mode.	1. Ensure that the power connector is properly seated. 2. Ensure that the proper DC voltages are being applied within the tolerances allowed (refer to specifications in your Ultrium LTO manual). 3. Replace tape drive. 4. The error code clears when you power-off the tape drive or place it in maintenance mode.

Table 5. IBM LTO Drive Codes and Meaning (Continued)

Code	Status and Cause	Action Required
3	The tape drive determined that a firmware error occurred.	1. Collect a drive dump. Refer to your LTO Ultrium manual for information about drive dumps. **Note:** Do not force a drive dump; the tape drive has already created one. 2. Power the tape drive off and on, then retry the operation that produced the error. 3. If the problem continues, download new firmware and retry the operation. 4. The error code clears when you power-off the tape drive or place it in maintenance mode.
4	The tape drive determined that a firmware or tape drive hardware failure occurred.	1. Collect a drive dump. Refer to your LTO Ultrium manual for information about drive dumps. 2. Power the tape drive off and on, then retry the operation that produced the error. The error code clears when you power-off the tape drive or place it in maintenance mode. 3. Download new firmware and retry the operation. 4. Replace the tape drive.
5	The tape drive determined that a tape path or read/write error occurred. **Note:** The tape drive will not allow you to insert a cartridge if the current cartridge was successfully ejected.	1. Cycle power to the tape drive off or place it in maintenance mode. 2. Replace the tape drive.

Table 5. IBM LTO Drive Codes and Meaning (Continued)

Code	Status and Cause	Action Required
6	Problem occurred while the tape drive was writing data to the tape.	Retry the operation with a different cartridge: • If the operation succeeds, the original cartridge was defective. Copy data from the defective cartridge and discard it. • If the operation fails and another tape drive is available, insert the cartridge into the other tape drive and retry the operation. • If operation fails, discard the defective cartridge. • If the operation succeeds, insert a scratch cartridge into the first drive and run the tape drive diagnostics (refer to your LTO Ultrium manual). If the diagnostics fail, replace the drive.
	If the problem occurs with multiple tape cartridges.	1. if you do not know the tape cartridge's volume serial number, run the tape drive diagnostics (refer to your LTO Ultrium manual). • If the diagnostics fail, replace the tape drive. • If the diagnostics succeed, run the Test Head diagnostic (refer to your LTO Ultrium manual). If the Test Head diagnostic fails, replace the tape drive. If the Test Head diagnostic succeeds, replace the cartridges that cause the problem. The error code clears when you remove the tape cartridge or place the tape drive in maintenance mode.

Table 5. IBM LTO Drive Codes and Meaning (Continued)

Code	Status and Cause	Action Required
	The problem occurred while the tape drive was reading data from the tape.	1. If you know the volume serial number of the tape cartridge. Insert the cartridge into an available drive and retry the operation. • If the operation fails, discard the defective cartridge. • If the operation succeeds, insert a scratch cartridge into the first drive and run the tape drive diagnostics (refer to your LTO Ultrium manual). • If the diagnostic fails replace the drive. • If the diagnostics succeed, discard the cartridge. 2. If another drive is not available, insert a scratch cartridge into the drive and run the tape drive diagnostics (refer to your LTO Ultrium manual). • If the diagnostics fail, replace the drive. • If the diagnostics succeed, discard the cartridge.
	If the problem occurs with multiple tape cartridges or if you do not know the tape cartridges volume serial number.	Run the tape drive diagnostics (refer to your LTO Ultrium manual). • If the diagnostics fail, replace the tape drive. • If the diagnostics succeed, run the Test Head diagnostics. (refer to your LTO Ultrium manual) • If the Test Head diagnostic fails, replace the tape drive. • If the Test Head diagnostic succeeds, replace the cartridges that caused the problem.

Table 5. IBM LTO Drive Codes and Meaning (Continued)

Code	Status and Cause	Action Required
7	The tape drive determined that an error occurred because of a faulty tape cartridge.	1. Insert another tape cartridge. If the problem occurs with multiple tape cartridges see resolving Media-Related problems in your Ultrium LTO manual. 2. The error code clears when you remove the tape cartridge or place the drive in maintenance mode.
8	Tape drive or SCSI Bus failed.	1. Refer to fixing SCSI Bus Errors in your LTO Ultrium manual.
	Fibre Channel detects light through the fiber cable but cannot perform data communication properly.	1. Refer to fixing Fibre Channel Errors in your Ultrium LTO manual.
9	The tape drive determined that a failure occurred in the tape drive hardware or in the LDI (RS-422) connection.	1. Run the LDI or RS-422 wrap test. Refer to function codes in your Ultrium LTO manual. 2. If diagnostics fails replace the tape drive. 3. If the diagnostics runs successfully, the problem is with the enclosure or the cable to the enclosure. 4. The error clears when you place the tape drive in maintenance mode.
o,c,b or h	No error or message assigned. There may be a problem with the single-character display.	1. Turn the power off, then on and determine weather all segments on the single-character display are lit. 2. Refer to the latest version of code and documentation.
A	The tape drive determined that a problem occurred which degraded the operation of the tape drive, but it did not restrict continued use.	1. Replace the tape drive. 2. The error code may clear when you clean the tape drive or place it in maintenance mode.
B	No error or message is assigned.	1. Refer to the error code chart in your Ultrium LTO manual.

Table 5. IBM LTO Drive Codes and Meaning (Continued)

Code	Status and Cause	Action Required
C	The tape drive needs to be cleaned.	1. Clean the tape drive. Refer to Cleaning the Drive Head in your Ultrium LTO manual.
d	Fibre Channel AL_PA conflict. More than one device has the same address.	1. Set each tape drive to have its own unique AL_PA address. Refer to Setting the Arbitrated Loop Physical Address in your Ultrium LTO manual.
D	No error or message assigned.	1. See Error Code 0 in this table.
E	The tape drive's Fibre Channel port has been placed offline by another device or by an operator.	1. This code is set when the Offline command is received from another device on the Fibre Channel interface. Determine why the device at the other end of the Fibre Channel (the server, switch or other device) placed the tape drive offline. 2. Reset the tape drive. 3. The tape drive is placed offline when it receives the Online command from the Fibre Channel interface.
F	No light is being received over the Fibre Channel.	Refer to Fixing Fibre Channel Errors in your Ultrium LTO manual. Place the tape drive in Maintenance mode.

Diagnostic Utilities

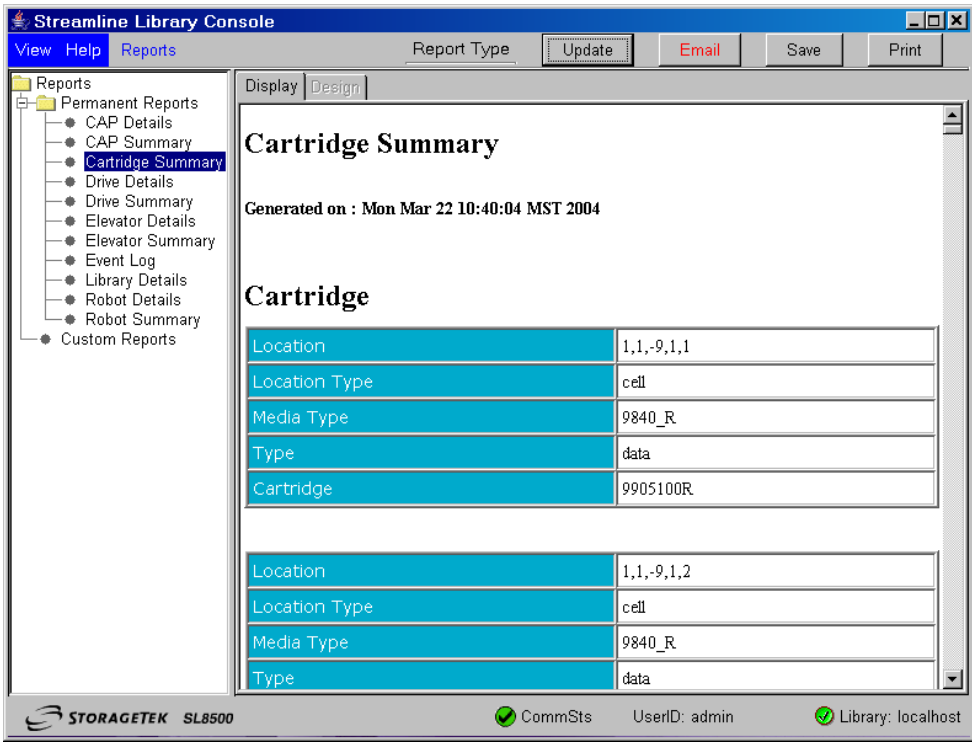
The StreamLine Library Console provides utilities, reports, and monitors to help diagnose a problem with the library and the attached devices (drives, CAPs, robots, and elevators).

Reports

The reports from the StreamLine Library Console provide static information on the library and the associated devices (for example, drives, robots, elevators, and CAPs), events, and tape cartridges.

Permanent reports are predefined and built into the Library Console application. These reports are useful when you need to access the report utility and quickly select an existing report template to generate relevant data to view, e-mail, print, or save to a file. This can help the service representative diagnose a problem remotely. For example, the service representative might want a summary report of all the cartridges after an audit. You can quickly access the Reports module and select the Cartridge Summary report from the Permanent reports folder and display it on screen. Figure 10 is a sample report providing a summary of all the cartridges in the library.

Figure 10. Sample Permanent Report



Event Monitors

Event monitors are setup to collect information about the library and the associated devices when specific events occur. For example, mounting a cartridge on a drive can be an event that causes an event monitor to track the number of reads on the drive.

Event monitors help service representatives to easily identify and resolve problems to minimize unscheduled machine downtime.

Permanent monitors are predefined and built into the Library Console application. These monitors are useful to quickly select an existing event

monitor template to capture the data associated with the event. For example, a service representative has to resolve a problem with the tape drive in physical location (1,2,1,1,1) that has been logging read errors. Diagnosis of this problem requires monitoring the different events associated with the drive starting with the drive mount. The service representative selects the permanent monitor designed to collect this information as soon as the event occurs. The system starts displaying the different activities related to the event monitor.

Utilities

The Library Console provides the following utilities to:

- Load code
- Perform audits
- Perform a library self test
- Search for a cartridge, result code, or operation code
- Modify the CAP locked status

Loading Code

See “Upgrading Firmware” on page 24 for information on code load.

Performing Audits

The audit process performs the inventory synchronization with the physical library.

During initialization, the library audits the location and VOLID of all cartridges in the storage and reserve slots. The library also performs an audit when you:

- Open and close the library access doors
- Make a request at the host console to audit the tape library
- Make a request from the Library Console

The SL8500 maintains a cartridge database in the HBC card. The cartridge database contains the following information for all the cartridges in the library:

- VOLID
- SL8500 slot location

You can perform a virtual or physical audit. See the online help documentation accessible through the Library Console application.

Performing Library Self Test

Use the self-test utility to verify proper operation of the library after a new installation, service activity, or to just validate the operational state of the library and the associated devices (drives, CAPs, elevators, and robots.

You can perform a partial or full self test:

The *partial self test* is non-disruptive and does not require the library to be taken offline. The routine does not affect the library operations currently active. The test verifies the network connectivity of the library and the associated devices (drives, CAPs, elevators, and robots).

The *full self test* performs a partial self test and also audits the library. See the online help documentation accessible through the Library Console application.

WARNING: The library has to be takes offline to perform a full self-test. So, make sure to end all the library operations that are currently active before performing a full self test.

Working with the Search Utility

The search utility provides a convenient way to look up information on the following:

- Cartridge locations
- Result codes (the result of the action requested)
- Operation codes.

Note: You can lookup a cartridge location either in the hardware format (physical location) or HLI-PRC format based on the library management software. See “SL8500 Address” and “HLI-PRC Address” in Appendix A.

See the online help documentation accessible through the Library Console application.

Modifying the CAP Locked Status

Before attempting to enter or eject cartridges using a CAP, you must unlock the CAP and then open it. See “Performing CAP Activities” on page 32. The Library Console provides the functionality to lock and unlock the CAPs.

See the online help documentation accessible through the Library Console application.

Obtaining Maintenance Support 6

This chapter describes what to do if problems occur with the tape library. In some cases, you might be able to correct the problem. In other cases, you must contact your service representative, as described in this chapter.

When the problem is caused by cartridge tapes, see Chapter 4, “Cartridge Information.” When the problem is caused by cartridge tape drives, refer to your tape drive operator’s guide.

Customer Initiated Maintenance

Customer initiated maintenance begins with a telephone call from you to the StorageTek Technical Excellence Center (TEC). You receive immediate attention from qualified StorageTek personnel, who record problem information and respond with the appropriate level of support.

To contact the TEC about a problem:

1. Use the telephone to call the StorageTek customer service at:

   800.525.0369 (within the United States)

   303.673.4056 (outside the United States)

2. Describe the problem to the call taker. The call taker will ask several questions and will either route your call to or dispatch a service representative.

If you have the following information when you place a service call, the process will be much easier:

Account name _____

Site location number _____

Contact name _____

Telephone number _____

Equipment model number _____

Device address _____

Device serial number (if known) _____

Urgency of problem _____

Problem description _____

StorageTek’s Worldwide Offices

You may contact any of StorageTek’s worldwide offices to discuss complete storage, service, and support solutions for your organization. You can find address and telephone number information on StorageTek’s external Web site at:

http://www.storagetek.com/global

Cartridge Slot Locations

A

Library Walls

The SL8500 library has two walls:

The *Inner walls* has 14 slot arrays.

The *Outer walls* use various sizes of arrays consisting of:

- 13 cartridge slots (allowing space for the robotic rails)
- 8-slot arrays placed within the future PTP areas and underneath the stop brackets for the service safety door
- 4-slot arrays used on sections that are cutout for each future PTP
- 3-slot arrays at the ends of all rails; these slots are reserved for robotic end stop labels (top slot), proximity calibration (middle slot), and drop-off slot (bottom slot)

There are also 4-slot arrays for each elevator and turntable assembly.

Service areas are located on each, front side of the customer interface module; these areas are reserved for non-functioning HandBots and do not interfere with cartridge GET or PUT operations by the functioning HandBots. Currently, arrays installed within the service areas (198 slots) are reserved for diagnostic and cleaning cartridges only.

Cartridges placed in arrays lie flat, hub down, and parallel to the floor. To prevent slippage, cartridges are held in their slot by internal retainer clips. Each array has *two targets* centered vertically to accommodate the different sizes and depths of cartridges.

Aisle space between arrays is limited to 0.5 m (18 in.). Due to the built-in redundancy of components, entry into the library beyond the maintenance area should be infrequent.

Reserved Slots

There are a total of 230 slots within the library that are reserved (that is, not to be used for data cartridge storage); these are listed in Table 6.

Table 6. Reserved Slots

Slots	Use	Location
198	Diagnostic or Cleaning Cartridges	Front section of Customer Interface Module (separated from data cartridge cells by the Service Safety Door area)
24	3-cell arrays: • endstop label (top) • proximity sensing (middle) • drop-off slot for single HandBot (bottom)	Front section of Customer Interface Module
8	Drop-off slot for second HandBot	Top cell under the PTP area
Total = 230		

Cartridge Address

You have to understand two types of addressing scheme to manually locate a cartridge:

- SL8500 address
- HLI-PRC (Host LMU Interface - Panel, Row, Column) address

There are significant difference between the two addressing schemes.

SL8500 Address

The SL8500 library firmware designates cartridge locations with a five-digit number as viewed from the front of the library, Library, Rail, Column, Side, and Row represented as L,R,C,S,W.

Library number: The number within a library or library complex

Rail number: Rails are numbered 1 through 4; Rail 1 is the top rail

Column number: Columns are “signed” numbers referenced from the customer interface module, where +1 is right of the center of the drive bays and -1 is to the left of the drive bays

Side number: Outer walls = 1, inner walls = 2

Row number: Numbered consecutively, from the top (1) down

See “Locating a Cartridge and Drive” on page 43 to locate a cartridge using the Library Console.

Figure 11. Cartridge and Drive Locations – Internal Firmware (1 of 8) (L203_590)

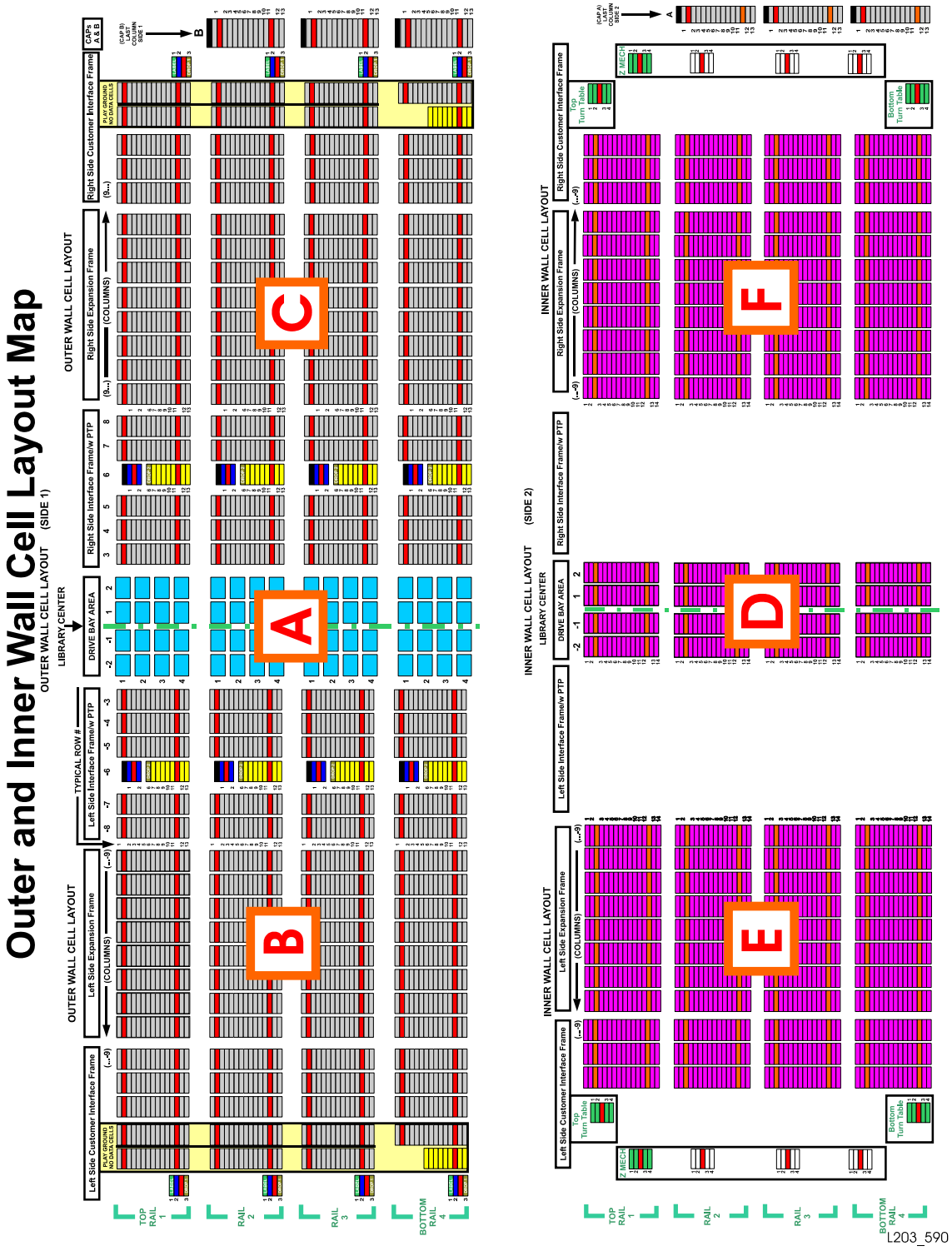


Figure 12. Cartridge and Drive Locations – Internal Firmware (2 of 8)(L203_591)

LIBRARY ADDRESSES

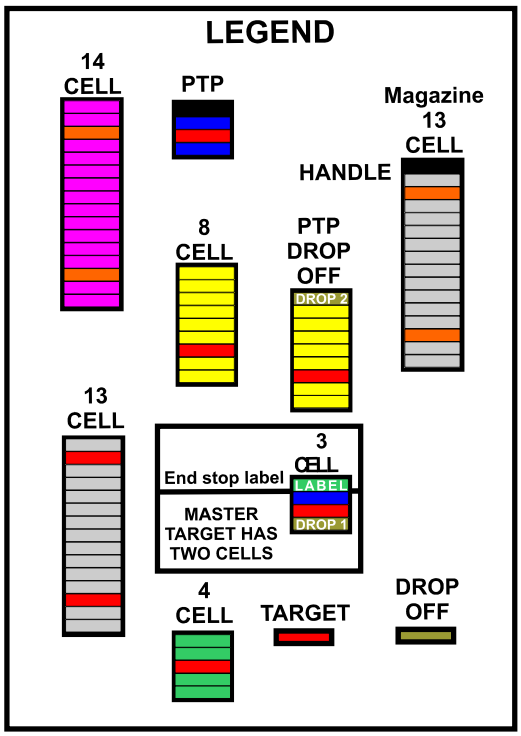
Addresses are written as 5 integer digits separated by 4 comma characters. The integers represent: <LSM within a library comlplex>,<rail within a LSM>, <column>, <side>, <row>.

The rails in this library frame are numbered 1,2,3, and 4 with 1 being the top and 4 being the bottom.

The column in this library is represented by a signed number where -1 is just to the left of center, +1 is just to the right of center (middle of drive bay is center and there is no #0).

The sides is this library are 1= outside, 2 inside, where inside refers to the storage cells on the inner or central panels.

Rows begin numbering with 1, the Top row.
Drop 1 cells are drop-off cells for single HandBots.
Drop 2 cells are drop-off cells for dual HandBots.



L203_591

Figure 13. Cartridge and Drive Locations – Internal Firmware (3 of 8)(L203_592)

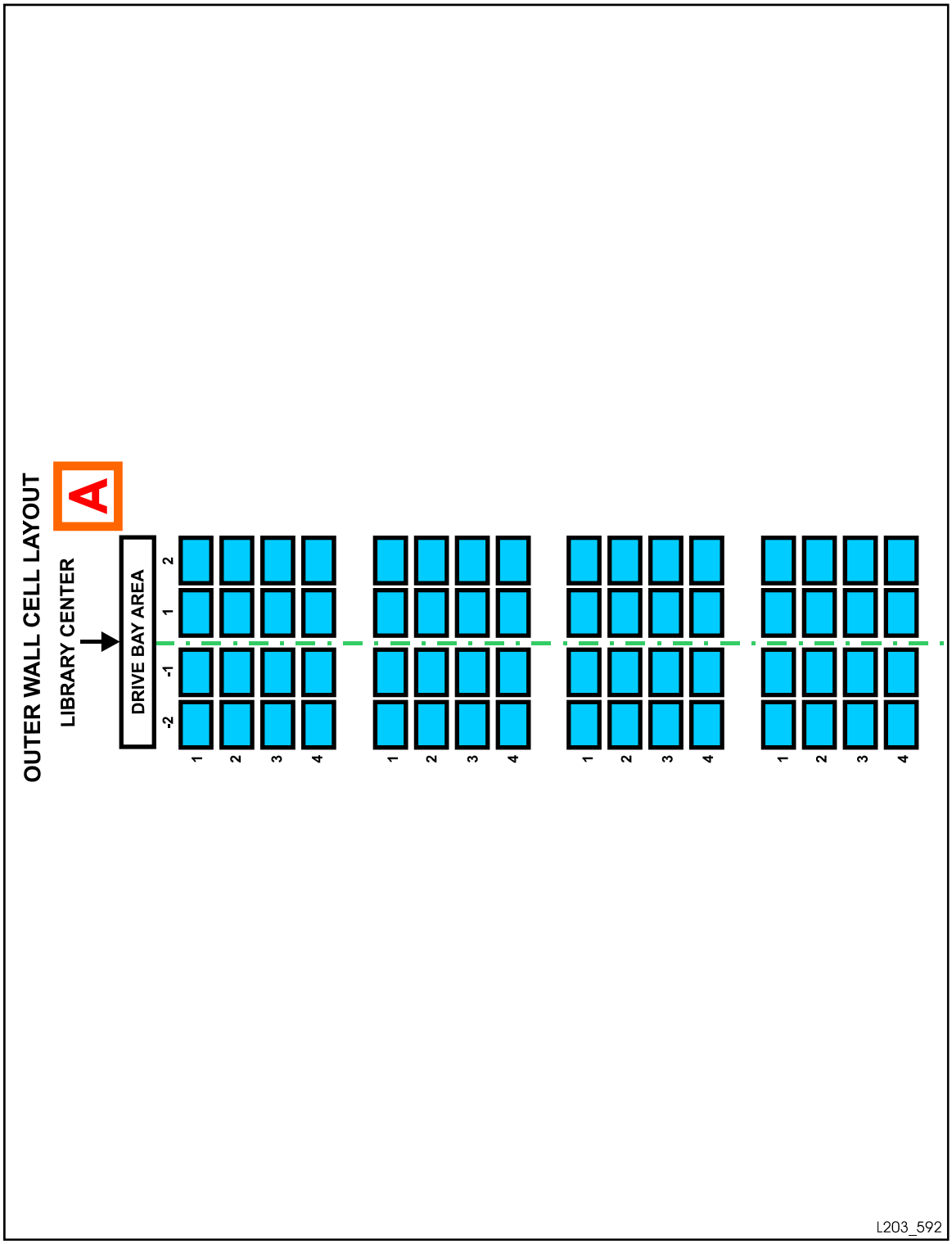


Figure 14. Cartridge and Drive Locations – Internal Firmware (4 of 8)(L203_593)

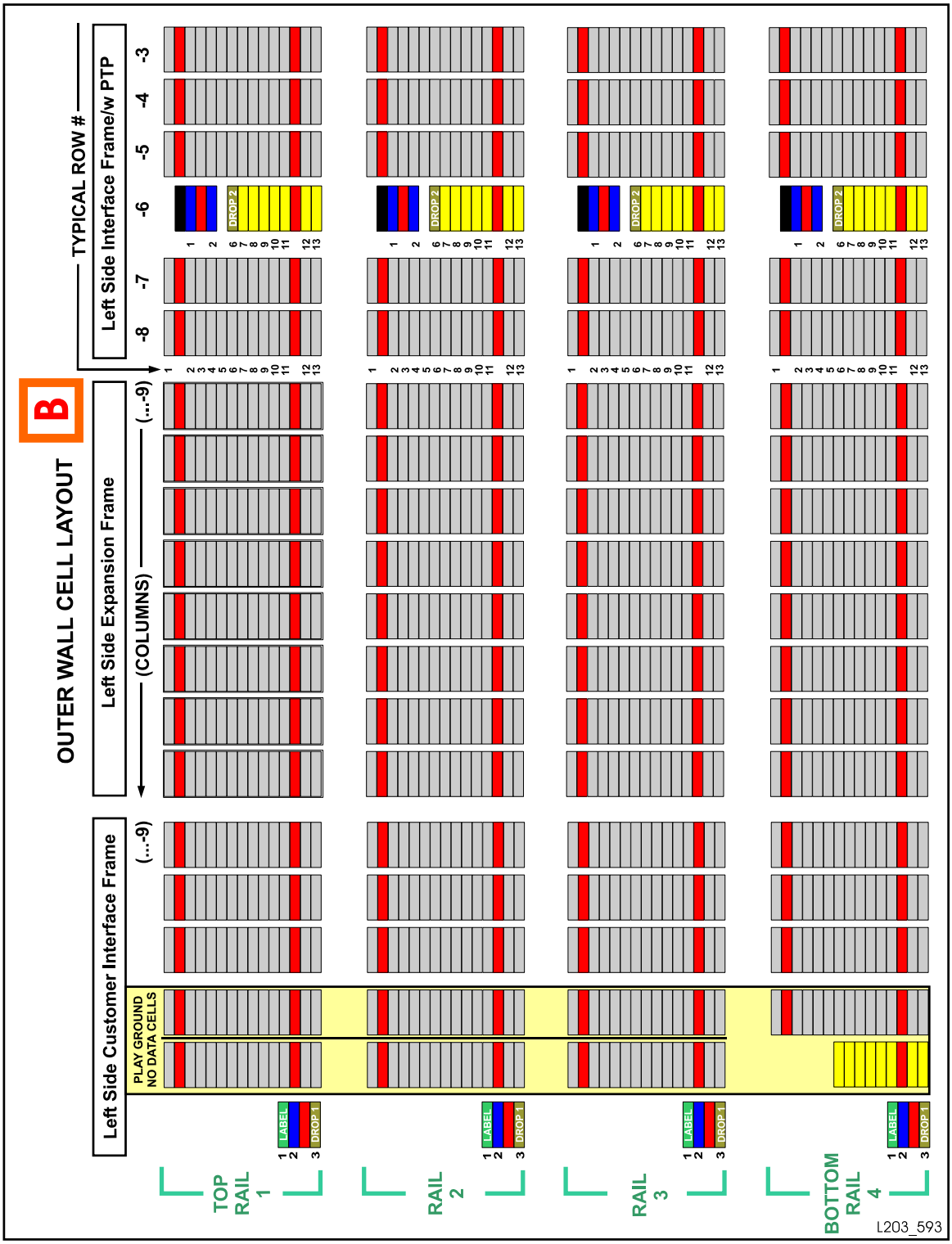


Figure 15. Cartridge and Drive Locations – Internal Firmware (5 of 8)(L203_594)

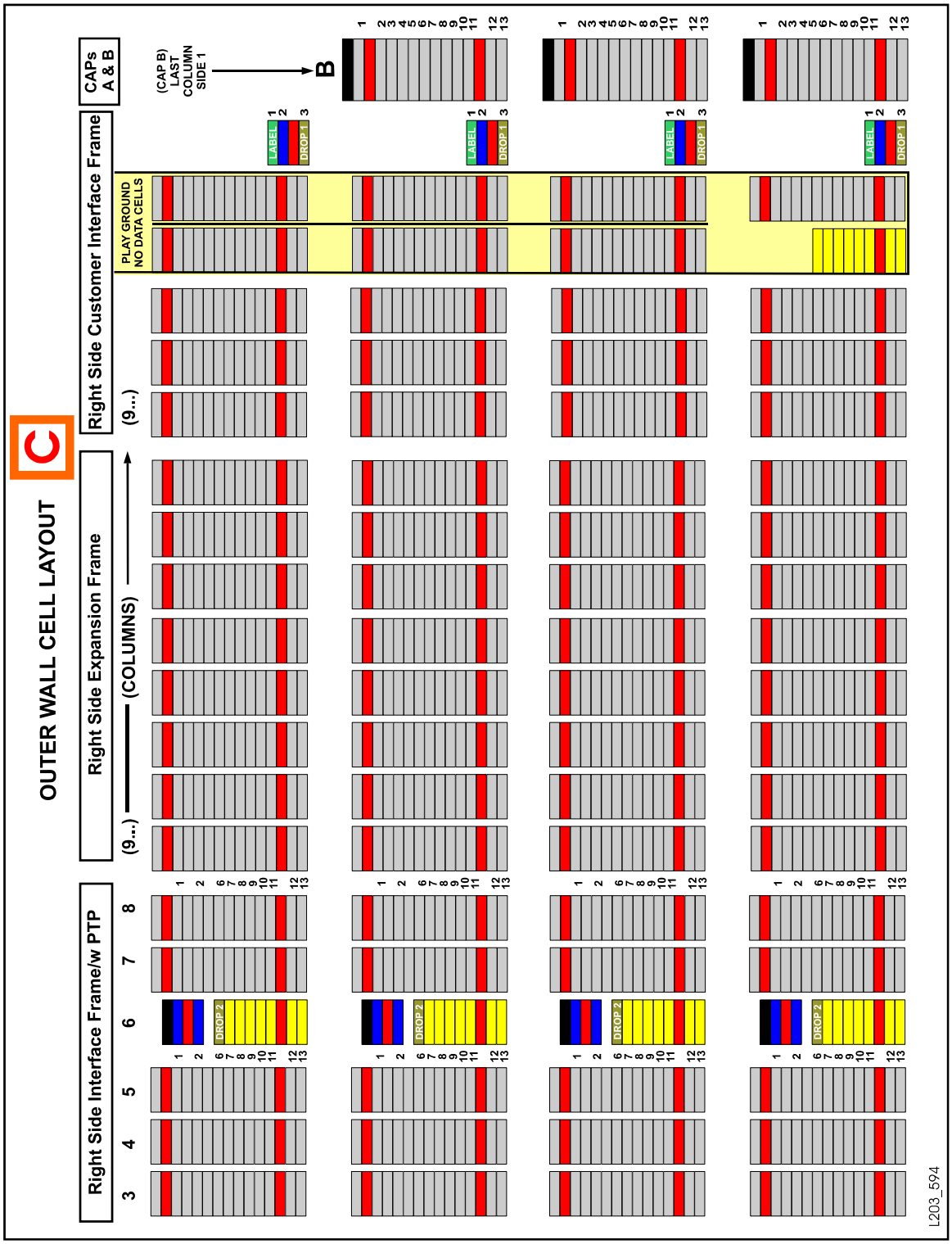


Figure 16. Cartridge and Drive Locations – Internal Firmware (6 of 8)(L203_595)

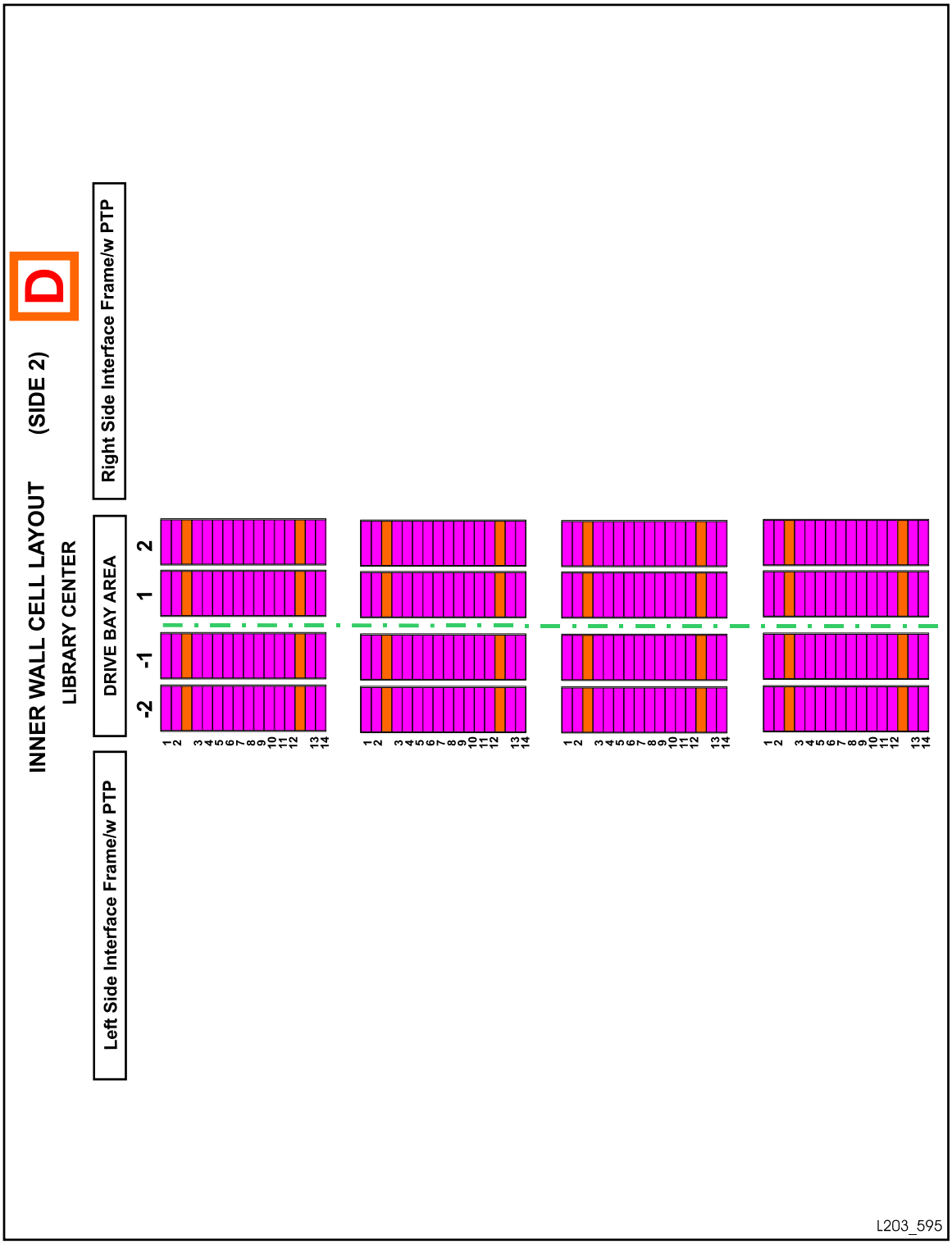


Figure 17. Cartridge and Drive Locations – Internal Firmware (7 of 8)(L203_596)

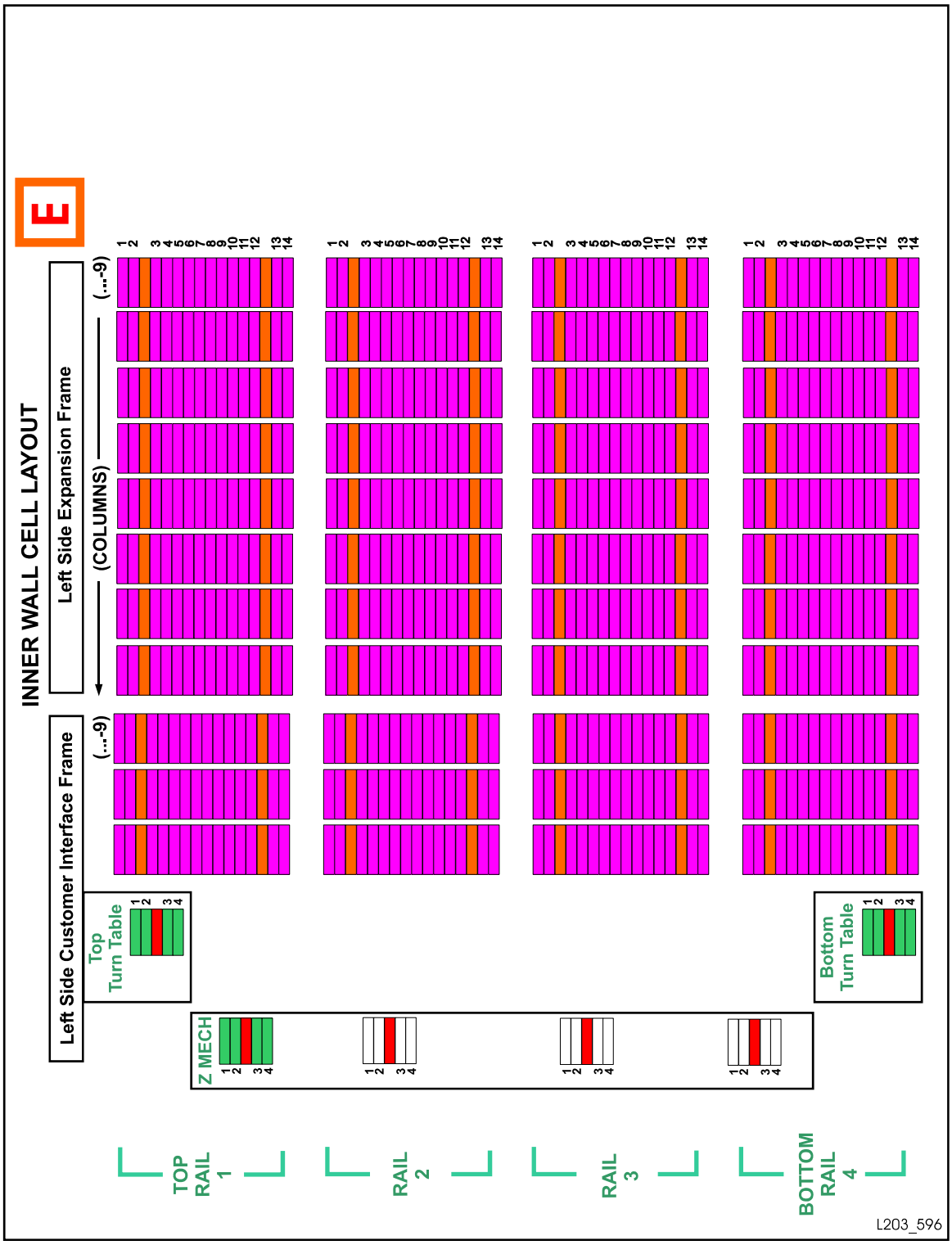


Figure 18. Cartridge and Drive Locations – Internal Firmware (8 of 8)(L203_597)

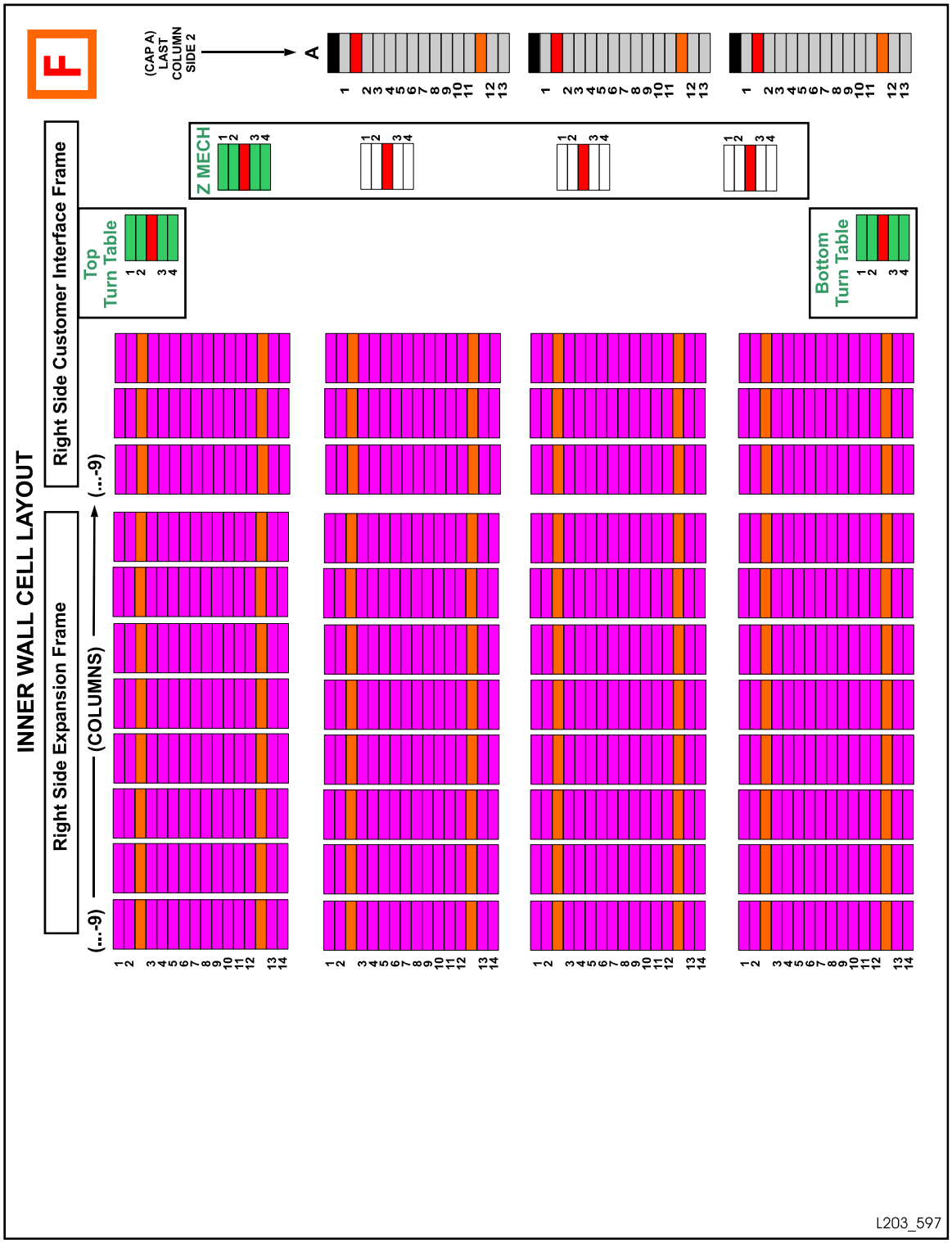


Table 7. Cartridge Locations (1 of 3)

Left Outer Wall (1)

Rail	Row	Customer Module			Robotics Module						Left Drive Module	
		Columns										
		-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1
Rail 1	Rows	1	1	1	1	1	6	1	1	1	1	1
		13	13	13	13	13	13	13	13	13	4	4
Rail 2	Rows	1	1	1	1	1	6	1	1	1	1	1
		13	13	13	13	13	13	13	13	13	4	4
Rail 3	Rows	1	1	1	1	1	6	1	1	1	1	1
		13	13	13	13	13	13	13	13	13	4	4
Rail 4	Rows	1	1	1	1	1	6	1	1	1	1	1
		13	13	13	13	13	13	13	13	13	4	4

Notes: Negative numbering starts from the left, center column of drives within the drive module. If an expansion module is added, numbering will be consecutive, starting with column -9 for the expansion module.

Column -6 is a PTP area and therefore contains 8-cell arrays, numbered 6 – 13. Slot 6 is designated a drop-off slot.

If an storage expansion module is added, column numbering will be consecutive, starting from column -9.

Table 8. Cartridge Locations (2 of 3)

Right Outer Wall (1)											
Rail	**Row**	**Right Drive Module**		**Robotics Module**						**Customer Module**	
		Columns									
		+1	+2	+3	+4	+5	+6	+7	+8	+9	+10	+11
Rail 1	Rows	1 4	1 4	1 13	1 13	6 13	1 13	1 13	1 13	1 13	1 13	1 13
Rail 2	Rows	1 4	1 4	1 13	1 13	1 13	6 13	1 13	1 13	1 13	1 13	1 13
Rail 3	Rows	1 4	1 4	1 13	1 13	1 13	6 13	1 13	1 13	1 13	1 13	1 13
Rail 4	Rows	1 4	1 4	1 13	1 13	1 13	6 13	1 13	1 13	1 13	1 13	1 13

Notes: The positive numbering starts from the right, center column of drives within the drive module. If an expansion module is added, numbering will be consecutive, starting from Column +9 for the next expansion module.

Column +6 is a PTP area and therefore contains 8-cell arrays, numbered 6 – 13. Slot 6 is designated a drop-off slot.

If an storage expansion module is added, column numbering will be consecutive, starting from Column +9.

Table 9. Cartridge Locations (3 of 3)

Inner Walls (2)										
Rail	**Row**	**Left Side (Customer Module)**			**Wall Opposite Drive Module**				**Right Side (Customer Module)**		
		Columns									
		-11	-10	-9	-2	-1	+1	+2	+9	+10	+11
Rail 1	Rows	1 14	1 14	1 14	1 14	1 14	1 14	1 14	1 14	1 14	1 14
Rail 2	Rows	1 14	1 14	1 14	1 14	1 14	1 14	1 14	1 14	1 14	1 14
Rail 3	Rows	1 14	1 14	1 14	1 14	1 14	1 14	1 14	1 14	1 14	1 14
Rail 4	Rows	1 14	1 14	1 14	1 14	1 14	1 14	1 14	1 14	1 14	1 14

Note: Inner walls begin their numbering from -9 on the left, and +9 on the right.

If a storage expansion module is added, column numbering will be consecutive, starting from column -3 on the left and +3 on the right.

Example One:

As viewed from the front of the library, cartridge location 1, 4, -3, 1, 13 would be the slot next to drive number one (lower left drive). Listing this location breaks down as follows:

1 = **L**ibrary number
4 = Bottom **r**ail
-3 = The first cartridge **c**olumn to the left of the drive bay area
1 = **S**ide number (*outer* wall)
13 = Bottom **r**ow, next to the bottom, left drive

Example Two:

Cartridge location 1, 1, 3, 2, 1 would be the slot next to drive number 61 (top, left drive):

1 = **L**ibrary number
1 = Top **r**ail
3 = The first cartridge **c**olumn to the right of the drive bay area
1 = **S**ide number *(outer* wall)
1 = Top **r**ow, opposite the top, right drive

HLI-PRC Address

HLI-PRC (Host LMU Interface - Panel, Row, Column) address is a four digit comma-separated value (L,P,R,C) representing LSM, Panel, Row, Column. This addressing scheme is used by HLI (Host LMU Interface) clients, including ACSLS and HSC, to represent library components accessible to those HLI clients.

The slot location appears in the following format:

	l	l	p	p	r	r	c	c	

where:

ll: LSM number (0-3)
pp: Panel
rr: Row in the panel
cc: Column in the row

See “Locating a Cartridge and Drive” on page 43 to locate a cartridge using the Library Console.

Although the library management software follows a five digit numbering scheme as that of the SL8500 address there are significant differences in slot designations, CAP behavior, and other operational considerations as described below.

Library Storage Module (LSM)

The SL8500 library has four rails on which robots travel. The host software considers each SL8500 rail as a separate LSM. From top to bottom, SL8500 rails are numbered from 1 - 4 while the host LSMs are numbered from 0 - 3. For example, SL8500 rail 1 is Host LSM 0.

Table 10. Rail Numbering

Host	SL8500 Firmware
LSM 0	Rail 1
LSM 1	Rail 2
LSM 2	Rail 3
LSM 3	Rail 4

Panel Designations

- Panel 0 = cartridge access port (CAP)
- Panel 1 = drive panel
- The data cartridge slots start their numbering after the drive bay (Panel 1) forward.

Row

Within each LSM (rail) rows are numbered consecutively from the top down. These start with 1 for the SL8500 and 0 for host.

CAP

The CAP behavior controlled by host software is as follows:

- The CAPs service all the LSMs in the library.
- CAPs span across three LSMs (1-3).
- Each CAP has three magazines with 13 slots each. Each magazine is adjacent to a separate rail, and can only be accessed by robots on that rail. There is no adjacent section in the CAP for the top LSM (1), which requires pass-thru operations with the elevator.
- When loading cartridges in the CAP, slots can be skipped or magazines missing.
- The CAP is treated as an independent component, and does not belong to any one rail.

Examples of CAP Behavior:

- A CAP can be online and operational even though the LSM (rail) identified in the CAP ID is offline or not operational.
- If an LSM is offline, the associated CAPs are not automatically offline.
- If an LSM is online, the associated CAP is not automatically placed online.
- Even if LSMs 1 through 3 are offline, CAPs can be used to enter/eject cartridges for LSM 0.

Elevators

Elevators are considered a type of pass-thru port. Each elevator has three pass-thru operations per rail. Each rail can pass-thru to the other three rails and operate as such.

Operational Considerations

To optimize HandBot operations:

- Mount scratch tapes- Selects cartridges based on the LSM (rail)
- Enter cartridges from the CAP to the closest LSM with free slots
- The software tries to enter the cartridge to an LSM (rail) adjacent to the CAP.
- The software also tries to eject the cartridge to the CAP adjacent to the LSM.

Note: When HandBot optimization is not possible by the host, the library controller manages the moving of cartridges using a pass-thru operation (elevator).

Drive Bay Locations

B

The SL8500 library features automatic detection of drives that are added or replaced.

There are four types of addressing schemes for drives:

- SL8500 drive bay address (the physical location)
- SL8500 address (assigned by the library firmware)
- HLI-PRC (Host LMU Interface - panel, row, column address assigned by the host software)
- System addresses (assigned by the operating system)

SL8500 Drive Bay Address

The drive bay address is a two-digit number (01-64) representing the physical locations into which drive tray assemblies are inserted. The bay number of a drive is strictly internal to the library, defined by a drive's position within a drive array. A drive is automatically assigned a number from 1– 64 by the library controller after the drive is installed and the library is re-initialized.

A decal on the rear of the Drive and Electronics Module depicts the bay numbers, as shown in Table 11 on page 84. The bay numbers indicate the physical location of drives. You have to be familiar with the bay numbers to locate a drive to perform a manual mount (see "Manual Mode of Operation" on page 39).

Table 11. Hardware Drive Address

Rail Number	Drive Bay Assembly Number 4			
1	Drive 61	Drive 62	Drive 63	Drive 64
	Drive 57	Drive 58	Drive 59	Drive 60
	Drive 53	Drive 54	Drive 55	Drive 56
	Drive 49	Drive 50	Drive 51	Drive 52
Rail Number	**Drive Bay Assembly Number 3**			
2	Drive 45	Drive 46	Drive 47	Drive 48
	Drive 41	Drive 42	Drive 43	Drive 44
	Drive 37	Drive 38	Drive 39	Drive 40
	Drive 33	Drive 34	Drive 35	Drive 36
Rail Number	**Drive Bay Assembly Number 2**			
3	Drive 29	Drive 30	Drive 31	Drive 32
	Drive 25	Drive 26	Drive 27	Drive 28
	Drive 21	Drive 22	Drive 23	Drive 24
	Drive 17	Drive 18	Drive 19	Drive 20
Rail Number	**Drive Bay Assembly Number 1**			
4	Drive 13	Drive 14	Drive 15	Drive 16
	Drive 9	Drive 10	Drive 11	Drive 12
	Drive 5	Drive 6	Drive 7	Drive 8
	Drive 1	Drive 2	Drive 3	Drive 4

Note: Numbers shown are referenced from the rear of the tape drive and electronics module.

SL8500 Address

The SL8500 address is a five-digit comma-separated value (L,R,C,S,W) representing Library, Rail, Column, Side, Row, *viewed from inside the library facing the drive bays.* This addressing scheme is used by the SL8500 firmware and internal communications to represent all devices and locations within the library.

Library number (within a library complex)

Rail number: Rails are numbered 1 through 4, rail 1 is the top rail

Column number: Columns, where +1 is right of the center of the drive bays and -1 is left of the center of the drive bays

Side number: Outer walls = 1, inner walls = 2 (all drives are side 1, the outer walls)

Row number: Numbered consecutively, from the top (1) down

Firmware numbering is listed in Table 12.

Table 12. Firmware Drive Address

		Drive Column -2	Drive Column -1	Drive Column 1	Drive Column 2
Rail Number	**Row Number**	**Drive Number**	**Drive Number**	**Drive Number**	**Drive Number**
1	1	x, 1, -2, 1, 1	x, 1, -1, 1, 1	x, 1, 1, 1, 1	x, 1, 2, 1, 1
	2	x, 1, -2, 1, 2	x, 1, -1, 1, 2	x, 1, 1, 1, 2	x, 1, 2, 1, 2
	3	x, 1, -2, 1, 3	x, 1, -1, 1, 3	x, 1, 1, 1, 3	x, 1, 2, 1, 3
	4	x, 1, -2, 1, 4	x, 1, -1, 1, 4	x, 1, 1, 1, 4	x, 1, 2, 1, 4
2	1	x, 2, -2, 1,1	x, 2, -1, 1, 1	x, 2, 1, 1, 1	x, 2, 2, 1, 1
	2	x, 2, -2, 1, 2	x, 2, -1, 1, 2	x, 2, 1, 1, 2	x, 2, 2, 1, 2
	3	x, 2, -2, 1, 3	x, 2, -1, 1, 3	x, 2, 1, 1, 3	x, 2, 2, 1, 3
	4	x, 2, -2, 1, 4	x, 2, -1, 1, 4	x, 2, 1, 1, 4	x, 2, 2, 1, 4
3	1	x, 3, -2, 1, 1	x, 3, -1, 1, 1	x, 3, 1, 1, 1	x, 3, 2, 1, 1
	2	x, 3, -2, 1, 2	x, 3, -1, 1, 2	x, 3, 1, 1, 2	x, 3, 2, 1, 2
	3	x, 3, -2, 1, 3	x, 3, -1, 1, 3	x, 3, 1, 1, 3	x, 3, 2, 1, 3
	4	x, 3, -2, 1, 4	x, 3, -1, 1, 4	x, 3, 1, 1, 4	x, 3, 2, 1, 4

Table 12. Firmware Drive Address

		Drive Column -2	Drive Column -1	Drive Column 1	Drive Column 2
4	1	x, 4, -2, 1, 1	x, 4, -1, 1, 1	x, 4, 1, 1, 1	x, 4, 2, 1, 1
	2	x, 4, -2, 1, 2	x, 4, -1, 1, 2	x, 4, 1, 1, 2	x, 4, 2, 1, 2
	3	x, 4, -2, 1, 3	x, 4, -1, 1, 3	x, 4, 1, 1, 3	x, 4, 2, 1, 3
	4	x, 4, -2, 1, 4	x, 4, -1, 1, 4	x, 4, 1, 1, 4	x, 4, 2, 1, 4
Note: Perspective is from the *front* of the Customer Interface Module. “x” = library #					

As examples:

- Drive firmware number 1, 4, -2, 1, 4 is the bottom, left drive in rail 1, as viewed from inside *the library looking at the drive bays.*
- Drive firmware number 1, 1, 2, 1, 1 is the top, right drive in rail 1, as viewed from inside *the library looking at the drive bays.*

HLI-PRC Address

The HLI-PRC addressing is a four-digit comma-separated value (L,P,R,C) representing Library, Panel, Row, and Column. The HLI (Host LMU Interface) clients (ACSLS, HSC) use this addressing scheme to represent library components accessible to the host.

The tape drives are associated with and belong to each LSM (numbered 0-3). Each LSM is assigned 16 drives (0-15). Panel 1 is designated as the drive panel. To mount a cartridge tape in a different LSM, the cartridge must go through an internal pass-thru port (the elevator) to the drive.

Table 13. Host Software Drive Address

LSM Number	Host Software Number			
0	Drive 0	Drive 4	Drive 8	Drive 12
	Drive 1	Drive 5	Drive 9	Drive 13
	Drive 2	Drive 6	Drive 10	Drive 14
	Drive 3	Drive 7	Drive 11	Drive 15
1	Drive 0	Drive 4	Drive 8	Drive 12
	Drive 1	Drive 5	Drive 9	Drive 13
	Drive 2	Drive 6	Drive 10	Drive 14
	Drive 3	Drive 7	Drive 11	Drive 15

Table 13. Host Software Drive Address

2	Drive 0	Drive 4	Drive 8	Drive 12
	Drive 1	Drive 5	Drive 9	Drive 13
	Drive 2	Drive 6	Drive 10	Drive 14
	Drive 3	Drive 7	Drive 11	Drive 15
3	Drive 0	Drive 4	Drive 8	Drive 12
	Drive 1	Drive 5	Drive 9	Drive 13
	Drive 2	Drive 6	Drive 10	Drive 14
	Drive 3	Drive 7	Drive 11	Drive 15

System Address

The operating system also assigns system addresses to drives. Because Fibre Channel is the operating mode for drives within a SL8500 library, you can minimize a network re-configuration resulting from the replacement of a defective drive by enabling dynamic World Wide Name (dWWN) through the library configuration process. See “Dynamic World Wide Name” on page 23. A system address, once assigned, is automatically re-assigned when a drive is replaced.

Manually Locating a Drive Bay

If you need to perform a manual mount to a drive, the Library Console provides mapping of the hardware, firmware, and software mapping for all the drives attached to a library.

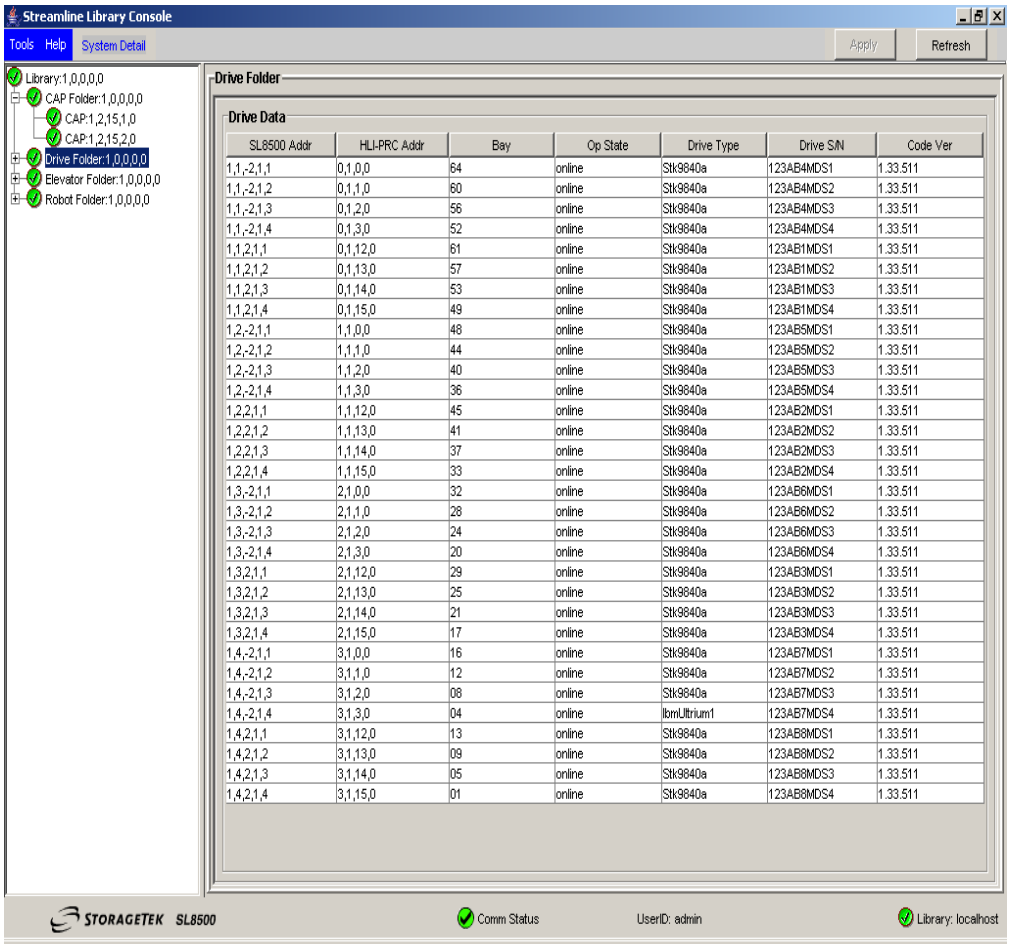
To locate a drive:

1. Logon to the Library Console.
2. Select **Tools > System Detail**.
3. From the device tree, select the **Drive folder**.

   Note: The device tree is the left panel that provides a list of devices attached to the library (drives, CAP, robots, elevator)

The status screen displays the SL8500 address, the corresponding drive bay, and the HLI-PRC addresses. For more information on the System Details module, see the online help documentation accessible through the Library Console application.

Figure 19. Library Console (Drives Data)



SL8500 Addr	HLI-PRC Addr	Bay	Op State	Drive Type	Drive S/N	Code Ver
1,1,-2,1,1	0,1,0,0	64	online	Stk9840a	123AB4MDS1	1.33.511
1,1,-2,1,2	0,1,1,0	60	online	Stk9840a	123AB4MDS2	1.33.511
1,1,-2,1,3	0,1,2,0	56	online	Stk9840a	123AB4MDS3	1.33.511
1,1,-2,1,4	0,1,3,0	52	online	Stk9840a	123AB4MDS4	1.33.511
1,1,2,1,1	0,1,12,0	61	online	Stk9840a	123AB1MDS1	1.33.511
1,1,2,1,2	0,1,13,0	57	online	Stk9840a	123AB1MDS2	1.33.511
1,1,2,1,3	0,1,14,0	53	online	Stk9840a	123AB1MDS3	1.33.511
1,1,2,1,4	0,1,15,0	49	online	Stk9840a	123AB1MDS4	1.33.511
1,2,-2,1,1	1,1,0,0	48	online	Stk9840a	123AB5MDS1	1.33.511
1,2,-2,1,2	1,1,1,0	44	online	Stk9840a	123AB5MDS2	1.33.511
1,2,-2,1,3	1,1,2,0	40	online	Stk9840a	123AB5MDS3	1.33.511
1,2,-2,1,4	1,1,3,0	36	online	Stk9840a	123AB5MDS4	1.33.511
1,2,2,1,1	1,1,12,0	45	online	Stk9840a	123AB2MDS1	1.33.511
1,2,2,1,2	1,1,13,0	41	online	Stk9840a	123AB2MDS2	1.33.511
1,2,2,1,3	1,1,14,0	37	online	Stk9840a	123AB2MDS3	1.33.511
1,2,2,1,4	1,1,15,0	33	online	Stk9840a	123AB2MDS4	1.33.511
1,3,-2,1,1	2,1,0,0	32	online	Stk9840a	123AB6MDS1	1.33.511
1,3,-2,1,2	2,1,1,0	28	online	Stk9840a	123AB6MDS2	1.33.511
1,3,-2,1,3	2,1,2,0	24	online	Stk9840a	123AB6MDS3	1.33.511
1,3,-2,1,4	2,1,3,0	20	online	Stk9840a	123AB6MDS4	1.33.511
1,3,2,1,1	2,1,12,0	29	online	Stk9840a	123AB3MDS1	1.33.511
1,3,2,1,2	2,1,13,0	25	online	Stk9840a	123AB3MDS2	1.33.511
1,3,2,1,3	2,1,14,0	21	online	Stk9840a	123AB3MDS3	1.33.511
1,3,2,1,4	2,1,15,0	17	online	Stk9840a	123AB3MDS4	1.33.511
1,4,-2,1,1	3,1,0,0	16	online	Stk9840a	123AB7MDS1	1.33.511
1,4,-2,1,2	3,1,1,0	12	online	Stk9840a	123AB7MDS2	1.33.511
1,4,-2,1,3	3,1,2,0	08	online	Stk9840a	123AB7MDS3	1.33.511
1,4,-2,1,4	3,1,3,0	04	online	lbmUltrium1	123AB7MDS4	1.33.511
1,4,2,1,1	3,1,12,0	13	online	Stk9840a	123AB8MDS1	1.33.511
1,4,2,1,2	3,1,13,0	09	online	Stk9840a	123AB8MDS2	1.33.511
1,4,2,1,3	3,1,14,0	05	online	Stk9840a	123AB8MDS3	1.33.511
1,4,2,1,4	3,1,15,0	01	online	Stk9840a	123AB8MDS4	1.33.511

Glossary

Numerics

2N A power configuration that gives the Product Name library full AC and DC power redundancy. This configuration allows AC line cords on two separate circuits, either of which can power the entire system. *See also* N+1.

A

access door A door on either side of the front facade through which service personnel can enter the library. Optional CAPs are attached to the right access door.

accessory rack An area of the drive and electronics module that is used for Product Name library electronic and power equipment and for other standard 19-inch rack-mount electronic equipment. Up to four racks are permitted in the electronics/drive assembly. Rack-mount equipment must be on the approved equipment list.

ACSLS *See* Automated Cartridge System Library Software.

addressing schemes *See the following:*

- SL8500 address
- SL8500 drive bay
- HLI-PRC address

Any Cartridge Any Slot™ technology The StorageTek technology that allows seamless sharing of different media types and drives without hard partitions.

array A partitioned unit that holds multiple objects, such as cartridges or tape drive tray assemblies.

asynchronous (ASYNC) Not synchronized; not occurring at regular, predetermined intervals. Asynchronous transmissions send one data character at a time, at irregular intervals, rather than in one steady stream; a start bit and a stop bit notify the receiver when the transmission begins and ends. *Contrast with* synchronous.

audit *See* host audit and security audit.

Automated Cartridge System Library Software (ACSLS) Software that manages ACS library contents and controls ACS library hardware to mount and dismount cartridges on ACS drives.

automation bezel A tape drive attachment with a locator target for positioning gets and puts to the tape drive.

B

backplane The main circuit board inside electronic equipment that contains the central processing unit, the bus, memory sockets, expansion slots, and other components.

bar-code line scan camera A component of the robot that is used for cartridge identification and position calibration.

blind mate connector A connector that allows hot plugging instead of manually placing a cable between two fixed connectors.

bulk load Manually loading cartridges into the library, for example, during library installation.

C

camera In an Product Name library, one of two types:

- The bar-code line scanner that is part of the robot hand assembly.
- The two LibCam monitoring cameras that display activity inside the library on the touch screen operator control panel.

CAP *See* cartridge access port.

card *Synonymous with* printed wire assembly.

cartridge access port (CAP) A device in the library that allows an operator to insert or remove cartridges during library operations.

Synonymous with import/export mail slot in SCSI and open system libraries.

See also unlocked.

cartridge array An array that holds multiple cartridges.

Product Name arrays contain 8, 13, or 14 slots, depending on their location.

cartridge bias Left or right justification of a cartridge within a storage slot, CAP, or tape drive.

cartridge mover *See* robot.

cartridge proximity detector A component that determines if a slot is empty or contains an unlabeled cartridge during a label reading error recovery procedure. *Synonymous with* empty slot detector.

CCD (1) Charge couple device.

(2) Cell contents database.

CIM controller The module that houses the controls for the elevators, CAPs, turntables, and service safety door.

cleaning cartridge A tape cartridge that contains special material to clean the tape path in a transport or drive.

CLI Command line interface.

cold swap To remove and replace a system component (typically one such as a logic board that has no redundant backup) after system operations have been stopped and system power has been disabled. *Contrast with* hot swap.

CompactPCI (cPCI®) Industry standard bus used for card-to-card bus expansion.

cPCI *See* CompactPCI.

customer interface module The front module of the SL8500 library at which the customer has access to the touch screen operator panel and CAPs, and service personnel have access to the library and service bay.

D

data cartridge A term used to distinguish a cartridge onto which a tape drive may write data from a cartridge used for cleaning or diagnostic purposes.

diagnostic cartridge A data cartridge with a “DG” label that is used for diagnostic routines.

DLE Data link escape.

drive and electronics module The module in an Product Name library that contains the electronics control module, power distribution units (PDUs), power supplies, accessory racks and equipment, and tape drives for the library.

drive array assembly An array that is installed in the drive and electronics module for mounting tape drive tray assemblies. The

drive and electronics module holds up to four array assemblies, and each array holds up to 16 tape drive tray assemblies.

drive bay A partitioned section of the tape drive array assembly that holds one tape drive tray assembly.

drop-off slots Slots used to hold a cartridge in the event of a robot failure that occurs while a cartridge is in the robot hand.

E

ECM *See* electronics control module.

electronics control module The assembly that:

- Processes commands from a host system
- Coordinates the activities of robots, elevators, pass-thru ports, and tape drives
- Monitors status inputs from sensors and switches

elevator The device that transports cartridges vertically, across rail boundaries.

emergency power-off (EPO) (1) A safety scheme that allows a “power down” of a subsystem or a system as a whole instead of powering it down component-by-component.

(2) A safety switch on a machine or in a data center that allows a user to immediately power down a machine or a data center power supply by cutting off the external source power.

See also Emergency Robotics Stop.

Emergency Robotics Stop A button on the Customer Interface Module keypad that removes power to the robotics power grid, leaving the remaining library power on.

Enterprise Systems Connection (ESCON) A set of fiber-optic based products and services developed by IBM that allows devices within a storage environment to be dynamically configured. A channel-to-control unit I/O interface that uses optical cables as a transmission medium.

environmental monitors A collective term for the sensors that track temperatures, fan speeds, and the status of various other mechanism within a library.

EPO *See* emergency power-off.

ESCON *See* Enterprise Systems Connection.

Ethernet A local-area, packet-switched network technology. Originally designed for coaxial cable, it is now found running over shielded, twisted-pair cable. Ethernet is a 10- or 100-megabytes-per-second LAN.

export The action in which the library places a cartridge into the cartridge access port so that the operator can remove the cartridge from the library. *Synonymous with* eject.

F

failover The act of moving to a secondary or redundant path when the primary path fails.

FFC Flat flexible cable.

Fibre Channel A bidirectional, full-duplex, point-to-point, serial data channel structured for high performance capacity. The Fibre Channel is an interconnection of multiple communication ports, called N_Ports. These N_Ports are interconnected by a switching network, called a fabric, to a point-to-point link, or an arbitrated loop. Fibre Channel is a generalized transport mechanism with no protocol of its own. A Fibre Channel does not have a native input/output command set, but can transport existing Upper Level Protocols (ULP) such as SCSI and IPI. Fibre

Channel operates at speeds of 100 MB per second (full speed), 50 MB per second (half speed), 25 MB (quarter speed), or 12.5 MB (eighth speed). Fibre Channel operates over distances of up to 100 m over copper media or up to 10 km over optical links.

fibre connection (FICON) An IBM S/390-based channel architecture that provides up to 256 channels in a single connection, each having a capacity of 100 MB per second.

FICON *See* fibre connection.

front facade The external portion of the customer interface module, between the access doors, that holds the:

- Membrane keypad
- Product logos
- Optional touch screen operator control panel

G

get An activity in which a robot obtains a cartridge from a slot or drive.

gripper (1) The portion of the hand assembly that grasps the cartridge.

(2) The part of the hand assembly that grasps and holds a cartridge during transport.

H

hand assembly A part of the library robot whose function is to grasp cartridges and move them between storage slots and drives. A bar-code line scan camera on the hand assembly reads cartridge volume labels.

HandBot™ High performance small robot. Four or eight HandBots are used in an SL8500 library. *Contrast with* TallBot™.

The full name is StreamLine™ HandBot™ high performance robotics.

HBZ module *See* CIM Controller.

HLI-PRC address A four-digit, comma-separated value (L,P,R,C) that represents LSM, Panel, Row, and Column. This addressing scheme is used by host LMU interface (HLI) clients, including ACSLS and HSC, to represent library components accessible to those HLI clients.

host audit The process of updating the cartridge VOLIDs and locations (collected by a security audit) in a host CDS. This audit is initiated by a host command.

hot swap Removal and replacement of a system component while system power remains on and system operations continue. *Contrast with* cold swap. *Contrast with* hot-pluggable.

Synonymous with online servicing.

hot-pluggable The capability that allows a service representative to replace FRUs while power to the FRU is maintained. This feature allows hardware maintenance actions and hardware upgrades to proceed without disrupting subsystem availability. *Contrast with* hot swap.

I

import The process of placing a cartridge into the cartridge access port so that the library can insert it into a storage slot.

Synonymous with enter.

interlock switch A switch that disconnects power to library mechanisms, excluding tape drives, when the front door is opened.

initial program load (IPL) (1) A process that activates a machine reset and loads system programs to prepare a computer system for operation. Processors having diagnostic programs activate these programs at initial program load execution. Devices running firmware usually reload the functional firmware from a diskette or disk

drive at initial program load execution. *Synonymous with* initial microprogram load (IML).

(2) The initialization procedure that activates a machine reset, initiates wake-up diagnostics (from EPROMs) and loads functional code.

IPL *See* initial program load.

K

keypad interface *See* membrane keypad.

L

LibCam Monitoring A feature that provides two cameras, one for each leg of the horseshoe, for viewing activity inside the library. The touch screen operator control panel is required. *Not available at this time. Do not use this definition*.

library complex (1) Two or more Product Name libraries attached to each other with PTPs.

(2) Two Product Name libraries attached to each other with PTPs in which one library is the Master library and the other is the Standby library for pass-through purposes.

library console *See* Streamline™ Library Console™.

library controller (LC) The HBC card within the Product Name library that controls operations and communicates with the operator panel.

library operator panel *See* touch screen operator control panel.

library storage module (LSM) A term used to identify each level of the SL8500, including the rail assembly, robotics, tape drives, power supplies, electronics modules, and accessory rack. The LSMs are numbered top-to-bottom, 0–3.

logical library A virtual representation of a physical library. *Synonymous with* virtual library partition.

M

magazine A removable array that holds cartridges and is placed into the cartridge access port (CAP).

Each SL8500 CAP holds up to three magazines, each of which holds up to 13 cartridges.

master (pass-thru port) The side of a pass-thru port (PTP) that contains the electronics that control the actions of the PTP. *See also* standby (pass-thru port).

membrane keypad A keypad mounted on the front facade used to monitor the status of the SL8500 library and to operate the CAPs.

N

N+1 A power configuration that provides AC power and redundant DC power by adding a second DC power supply to each DC bus. *See also* 2N.

O

online replacement Replacement or service of a module while the library remains operational. The service person may be required to power off the module before removing or replacing it. *Synonymous with* hot swap.

operator panel *See* touch screen operator control panel.

P

pass-thru port (PTP) A mechanism that enables a cartridge to pass through from one library to another in a multiple modular library complex.

PCI Peripheral component interconnect.

PDU *See* power distribution unit.

physical library A single Product Name library consisting of a customer interface module, robotics interface module, and a drive and electronics module, with one to three storage expansion modules optional. *See also* logical library.

PLC Power line communications.

PLI *See* primary library interface.

power distribution unit (PDU) A device for the distribution of AC line power from one inlet to multiple outlets. Multiple PDUs provide higher availability because the power continues if one PDU (or its alternating current [AC] source if the PDUs use separate AC sources) loses power.

power grid A power circuit that minimizes power failures that cause the library to cease operations.

An Product Name library has five power grids, two for AC power and three for DC power.

power/communication bus rail A rail that sits on the robot track to provide 48 VDC power and communication to the robot.

primary library interface (PLI) The communication path between the operator panel and the library controller (the HBC card.) This consists of Ethernet with TCP/IP and XML.

PTP *See* pass-thru port.

put An activity in which a robot places a cartridge into a slot or drive.

PWA Printed wiring assembly.

R

RaceTrack™ architecture The design and implementation of the SL8500 library's multiple high performance robotics.

rail That portion of the upper robot track assembly that provides power and communication to the robot.

rail assembly The mechanism on which the robot travels between cartridge arrays and tape drives.

reach mechanism A component of the robot that moves the gripper to get or put a cartridge at a designated location.

RealTime Growth™ capability The capability to add pass-thru ports dynamically while the library is operating.

remote operator console The customer's operator panel that interfaces with the PLI. *See also* security software layer.

reserved slots Cartridge slots that are used only for cleaning and diagnostic cartridges and as drop-off slots.

robot A mechanism that moves horizontally along a track in the Product Name to transport tape cartridges to and from other locations in the library. *Also called* an HandBot or TallBot.

robotics interface module The module containing the curved rails and pass-through port (PTP) assemblies. *See also* StreamLine™ RaceTrack™.

S

security audit The process of reading and storing in Product Name library memory the VOLIDs and locations of all cartridges in the library. *See also* host audit.

security software layer (SSL) The communication path between the PLI and the remote operator console.

service area An area between the access doors of the customer interface assembly and the service safety door in which an inoperable robot is stored for service and

other mechanisms can be repaired or replaced.

service safety door A motor-driven barrier that separates the service areas of the front interface assembly from the rest of the library so that service personnel can safely repair or replace failed library mechanisms while the library continues normal operations. *Synonymous with* safety barrier.

SL8500 *See* StreamLine™ SL8500 Modular Library System.

SL8500 address A five-digit, comma-separated value (L,C,R,S,W) that represents Library, Rail, Column, Side, and Row. This addressing scheme is used by SL8500 firmware and internal communications to represent all devices and locations within the library.

SL8500 drive bay A two-digit integer (01–64) that represents the physical locations into which drive tray assemblies are inserted.

slot The location in the library in which a tape cartridge is stored. *Synonymous with* cell.

SSi System Server infrastructure.

standby (pass-thru port) The side of a pass-thru port (PTP) that operates in response to actions initiated by the master side of the PTP. *See also* master (pass-thru port).

storage cell *See* slot.

storage expansion module An optional module for the Product Name library that provides up to 1728 additional cartridge storage slots. Up to three modules can be attached to each SL8500 library.

StreamLine™ Library Console™ The operator panel software application used for the SL8500.

StreamLine™ RaceTrack™ The design and implementation of the SL8500 library's multiple high performance robotics.

StreamLine™ RealTime Growth™ The capability to add pass-thru ports dynamically while the library is operating.

StreamLine™ SL8500 Modular Library System An automated tape library comprised of:

- Customer interface module
- Robotics interface module
- Drive and electronics module
- Storage expansion module (optional)

T

TallBot™ High capacity tall robot. One or two TallBots are used in an SL8500 library. *Contrast with* HandBot™.

The full name is StreamLine™ TallBot™ high capacity robotics.

tape cartridge A container holding magnetic tape that can be processed without separating the tape from the container.

The library uses data, diagnostic, and cleaning cartridges. These cartridges are not interchangeable.

tape drive An electromechanical device that moves magnetic tape and includes mechanisms for writing and reading data to and from the tape.

tape drive tray assembly The mechanical structure that houses a tape drive, fan assembly, power and logic cards, cables, and connectors for data and logic cables. *Synonymous with* drive tray assembly.

tape storage area The area in the Product Name library where cartridges are stored.

tape transport interface (TTI) An interface to control/monitor tape movement.

touch screen operator control panel An optional feature consisting of a flat-panel display with a touch screen interface and a panel mount computer. This feature is attached to the front facade.

track The horizontal path upon which a robot travels.

track drive mechanism The component that moves the robot along the track between the storage arrays, CAPs, and tape drives.

TTI *See* tape transport interface.

turntable A mechanism that transfers cartridges between the aisles within a single library.

U

U A standard unit of measurement of vertical space inside a rack-mount cabinet equal to 44.5 mm (1.75 in.).

unlocked In the SL8500, status indicating that software has made a CAP available for operator use. An LED is lit when a CAP is unlocked.

UART Universal asynchronous receiver/transmitter.

V

vacancy plate A plate that covers an unused bay, such as a drive bay or power supply bay.

W

wrist (1) A mechanism in the robot assembly that allows the robot to access the outer and inner storage walls. (2) A component of the hand assembly that rotates the hand horizontally.

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