IBM System Storage TS3500 Tape Library

SCSI Reference

GA32-0561-03

IBM System Storage TS3500 Tape Library

SCSI Reference

GA32-0561-03

Note!
Before using this information and the product it supports, read the information in “Safety and environmental notices” on page xi and “Accessibility and Notices,” on page 113.

Edition notice

This edition applies to the *IBM System Storage TS3500 Tape Library SCSI Reference* and to all subsequent releases and modifications until otherwise indicated in new editions.

Read this first

This is the forth edition of the *IBM System Storage TS3500 Tape Library SCSI Reference* (August 2011).

What's new in this edition (August 2011)

Revision bars (|) appear next to all of the information that was added or changed since the release of the last edition (GA32–0561–02). Changes include:

- Introduction of the TS3500 Tape Library shuttle complex
- Added a new range of import/export element (IEE) addresses for shuttle stations in a TS3500 Tape Library shuttle complex
- Updated Write Buffer command information for a TS3500 Tape Library shuttle complex
- New Library Device Attributes log page
- New Physical Library Utilization log page

Third edition (September 2009)

The following information was new or updated in the third edition:

- Removed references to specific drive models
- Removed DLT drive support, including control port references
- Modified Initialize Element Status with range command for HD frames
- The Logical Unit Number (LUN) field in the Command Descriptor Block (CDB) is obsolete

Second edition (November 2008)

The following information was new or updated in the second edition:

- Introduction of the High Density Frames (Models S24 and S54)
- New and updated TapeAlert Flags

First edition (June 2006)

The following information was new or updated in the first edition:

- Introduction of the enhanced frame control assembly, a power structure that integrates drive power, library power, and dual line cord capabilities into a simple and compact 2N power design with no single point of failure or single point of repair.
- Connection to the IBM System Storage Tape Library Web interface and to the IBM System Storage TS3000 System Console (TSSC) through dual Ethernet ports in the Medium Changer Assembly, a device in the new enhanced frame control assembly.
- New option for ordering the TSSC as an alternate master console for remote support.
- New frame models that use the enhanced frame control assembly power structure. They include base frame models L23 and L53 and expansion frame models D23 and D53.

- Nondisruptive library firmware update, which is the ability to update 3584 Tape Library firmware without scheduling downtime.

Send us your feedback

Your feedback is important in helping to provide the most accurate and high-quality information. If you have comments or suggestions for improving this publication, you can send us comments by e-mail to starpubs@us.ibm.com or by using the Readers' Comments form at the back of this publication. Be sure to include the following information in your correspondence:

- Exact publication title
- Form number (for example, GA32–0689–00), part number, or EC level (located on the back cover)
- Page numbers to which you are referring

Note: For suggestions on operating enhancements or improvements, please contact your IBM Sales team.

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Safety and environmental notices

This section contains information about safety notices that are used in this guide and environmental notices for this product.

Safety notices

Observe the safety notices when using this product. These safety notices contain danger and caution notices. These notices are sometimes accompanied by symbols that represent the severity of the safety condition.

Most danger or caution notices contain a reference number (Dxxx or Cxxx). Use the reference number to check the translation in the *IBM Systems Safety Notices*, G229-9054 manual.

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

Danger notice

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

DANGER: An electrical outlet that is not correctly wired could place hazardous voltage on metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock. *(D004)*

Caution notice

A caution notice calls attention to a situation that is potentially hazardous to people because of some existing condition, or to a potentially dangerous situation that might develop because of some unsafe practice. A caution notice can be accompanied by one of several symbols:

If the symbol is...	It means...
	A generally hazardous condition not represented by other safety symbols.
 Class II	This product contains a Class II laser. Do not stare into the beam. (*C029*) Laser symbols are always accompanied by the classification of the laser as defined by the U. S. Department of Health and Human Services (for example, Class I, Class II, and so forth).
	A hazardous condition due to mechanical movement in or around the product.

If the symbol is...	It means...
	This part or unit is heavy but has a weight smaller than 18 kg (39.7 lb). Use care when lifting, removing, or installing this part or unit. (*C008*)

Sample caution notices follow:

Caution

The battery is a lithium ion battery. To avoid possible explosion, do not burn. Exchange only with the IBM-approved part. Recycle or discard the battery as instructed by local regulations. In the United States, IBM® has a process for the collection of this battery. For information, call 1-800-426-4333. Have the IBM part number for the battery unit available when you call. (*C007*)

Caution

The system contains circuit cards, assemblies, or both that contain lead solder. To avoid the release of lead (Pb) into the environment, do not burn. Discard the circuit card as instructed by local regulations. (*C014*)

Caution

When removing the Modular Refrigeration Unit (MRU), immediately remove any oil residue from the MRU support shelf, floor, and any other area to prevent injuries because of slips or falls. Do not use refrigerant lines or connectors to lift, move, or remove the MRU. Use handholds as instructed by service procedures. (*C016*)

Caution

Do not connect an IBM control unit directly to a public optical network. The customer must use an additional connectivity device between an IBM control unit optical adapter (that is, fibre, ESCON®, FICON®) and an external public network . Use a device such as a patch panel, a router, or a switch. You do not need an additional connectivity device for optical fibre connectivity that does not pass through a public network.

Environmental notices

The environmental notices that apply to this product are provided in the *Environmental Notices and User Guide*, Z125-5823-*xx* manual. A copy of this manual is located on the publications CD.

About this publication

This guide contains information about how to use and program the IBM® System Storage™ TS3500 Tape Library, also referred to as the 3584 Tape Library. An overview section introduces the TS3500 Tape Library and explains how it can interact in both mainframe and Open Systems environments. This guide then presents the library SCSI commands, along with the sense keys, additional sense codes (ASCs), and additional sense qualifiers (ASCQs) that are supported by the TS3500 Tape Library. Additional chapters present details about SCSI ID, Loop ID, and logical unit number (LUN) assignments, as well as the locations and addresses of SCSI elements in the TS3500 Tape Library. This guide also lists the TapeAlert messages that are supported by LTO Ultrium tape drives, 3592 tape drives, and the TS3500 Tape Library.

Related information

Refer to the following sources for additional information about the TS3500 Tape Library and its associated products.

Note that the most recent publications are available on the World Wide Web. To ensure that you have the latest publications, visit the web at:

`http://www.ibm.com/support/us/en/`

Also note that the most up-to-date information is available at the IBM System Storage TS3500 Tape Library Information Center. To view this information center, go to:

`http://publib.boulder.ibm.com/infocenter/ts3500tl/v1r0/index.jsp`

Publications about the TS3500 Tape Library

Note: There are two versions of the TS3500 Tape Library Introduction and Planning Guide, as well as two versions of the TS3500 Tape Library Operator Guide. One version of each document is specific to the TS3500 Tape Library with the Advanced Library Management System (ALMS) and provides details about features and functions that are only available for libraries with ALMS installed and enabled. Refer to the titles of each guide in order to determine which version you need.

- *IBM System Storage TS3500 Tape Library with ALMS Introduction and Planning Guide*, GA32-0593
- *IBM System Storage TS3500 Tape Library Introduction and Planning Guide*, GA32-0559
- *IBM System Storage TS3500 Tape Library with ALMS Operator Guide*, GA32-0594
- *IBM System Storage TS3500 Tape Library Operator Guide*, GA32-0560
- *IBM System Storage TS3500 Tape Library 3584 Maintenance Information* (provided with the TS3500 Tape Library)
- *IBM System Storage TS3500 Tape Library with ALMS Tape System Reporter User's Guide*, GA32–0589

IBM System z source

For information about IBM System z servers, visit the web at `http://www.ibm.com/servers/eserver/zseries`.

Other publications and sources

- `http://www.storage.ibm.com/storage/`
- For a list of compatible software, operating systems, and servers for Ultrium tape drives, visit the web at `http://www.ibm.com/storage/lto`. Under `IBM System Storage TS3500 Tape Library`, select `Product details`. Under `Learn more`, select `Interoperability matrix` or select `Independent Software Vendor (ISV) matrix for LTO`.
- For a list of compatible software, operating systems, and servers for TS1100 series tape drives, visit the web at `http://www.ibm.com/servers/storage/tape/drives`. Under the appropriate tape drive, select `Product details`. Under `Learn more`, select `Interoperability matrix` or `Independent Software Vendor (ISV) matrix`.

- *IBM System Storage 3592 SCSI Reference*, GA32-0968
- *IBM TotalStorage SMI-S Agent for Tape on Linux Systems Installation Guide*, GC35-0512. This book is available through the IBM Publications Center on the web at `http://www.elink.ibmlink.ibm.com/public/applications/publications/cgibin/pbi.cgi`.
- *IBM TotalStorage LTO Ultrium Tape Drive SCSI Reference*, GA32-0450
- *IBM Ultrium Device Drivers Installation and User's Guide*, GA32-0430
- *IBM Ultrium Tape Device Drivers Programming Reference*, GC35-0483
- *IBM TotalStorage and System Storage Tape Device Drivers Installation and User's Guide*, GC35-0154
- *IBM TotalStorage and System Storage Tape Device Drivers Programming Reference*, GC35-0346
- *Implementing IBM Tape in Linux and Windows*, SG24-6268. This book is available on the web at `http://www.redbooks.ibm.com/redpieces/pdfs/sg246268.pdf`.
- *Implementing IBM Tape in Unix Systems*, SG24-6502. This book is available on the web at `http://www.redbooks.ibm.com/redbooks/pdfs/sg246502.pdf`.
- *The IBM TotalStorage Tape Libraries Guide for Open Systems*, SG24-5946

Data storage values

TS3500 Tape Library documentation displays data storage values using both decimal (base-10) prefixes and binary (base-2) units of measurement.

Decimal units such as K, MB, GB, and TB have commonly been used to express data storage values, though these values are more accurately expressed using binary units such as KiB, MiB, GiB, and TiB. At the kilobyte level, the difference between decimal and binary units of measurement is relatively small (2.4%). This difference grows as data storage values increase, and when values reach terabyte levels the difference between decimal and binary units approaches 10%.

To reduce the possibility of confusion, the TS3500 Tape Library documentation represents data storage using both decimal and binary units. Data storage values are displayed using the following format:

```
#### decimal unit (binary unit)
```

By this example, the value 512 terabytes is displayed as:

```
512 TB (465.6 TiB)
```

Table 1 compares the names, symbols, and values of the binary and decimal units. Table 2 shows the increasing percentage of difference between binary and decimal units.

Table 1. Comparison of binary and decimal units and values

Decimal			Binary		
Name	**Symbol**	**Value (base-10)**	**Name**	**Symbol**	**Value (base-2)**
kilo	K	10^3	kibi	Ki	2^{10}
mega	M	10^6	mebi	Mi	2^{20}
giga	G	10^9	gibi	Gi	2^{30}
tera	T	10^{12}	tebi	Ti	2^{40}
peta	P	10^{15}	pebi	Pi	2^{50}
exa	E	10^{18}	exbi	Ei	2^{60}

Table 2. Percentage difference between binary and decimal units

Decimal Value	Binary Value	Percentage Difference
100 kilobytes (KB)	97.65 kibibytes (KiB)	2.35%
100 megabytes (MB)	95.36 mebibytes (MiB)	4.64%
100 gigabytes (GB)	93.13 gibibytes (GiB)	6.87%
100 terabytes (TB)	90.94 tebibytes (TiB)	9.06%
100 petabytes (PB)	88.81 pebibytes (PiB)	11.19%
100 exabytes (EB)	86.73 exbibytes (EiB)	13.27%

Chapter 1. Introduction to the TS3500 Tape Library

This section describes the IBM System Storage TS3500 Tape Library, machine type 3584, also referred to as the 3584 Tape Library. This section provides the maximum quantity of frames and drives in the TS3500 Tape Library, describes the library's cartridge capacity, and gives the supported interface for each type of drive.

Figure 1 shows a 6-frame version of the TS3500 Tape Library. An individual library, or *library string*, consists of one base frame and up to 15 expansion frames and can include up to 192 tape drives and more than 20 000 tape cartridges. The flexibility to connect multiple library strings to create a *shuttle complex* greatly increases opportunities for growth, as well as the maximum cartridge capacity. In addition to scalability, the TS3500 Tape Library offers the following enhancements:

- Enhanced data accessibility through dual accessors that increase speed and provide failover protection
- Enhanced data security through support for tape drive encryption and write-once-read-many (WORM) cartridges
- Increased storage capacity with high-density frames that greatly increase capacity without requiring more floor space
- Increased growth flexibility with shuttle technology, even in physically constrained environments
- Greatly increased cartridge capacity in a shuttle complex without the need for additional tape drives

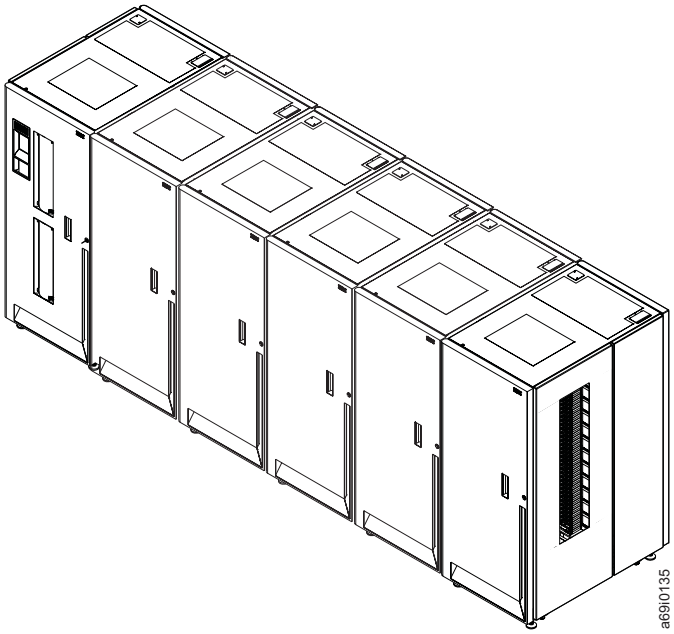

Figure 1. The TS3500 Tape Library

The TS3500 Tape Library comes with several tape drive, frame model, and feature options in order to meet your specific needs. Some additional features of the TS3500 Tape Library are listed below:

- Ability to attach multiple simultaneous heterogeneous servers

- Remote management using a web browser or the TS3500 Command Line Interface program
- Remote monitoring using Simple Network Management Protocol (SNMP)
- Multipath architecture
- Drive/media exception reporting
- In-depth reporting using the Tape System Reporter
- Host-based path failover
- Up to 224 I/O slots (16 I/O slots standard)

Table 3 gives potential library capacity based on supported frames and configurations.

Table 3. TS3500 Tape Library configurations

Supported configurations			
A library including these models	**With these drives**	**Can contain this many cartridges[1, 2]**	**And has this maximum native capacity[3]**
L5x, D5x, and S54	Ultrium tape drives	> 20 000	30 PB (26.65 PiB)
L32, D32, and S54	Ultrium tape drives	> 20 000	30 PB (26.65 PiB)
L2x, D2x, and S24	3592 tape drives	> 15 000	60 PB (53.3 PiB)
L5x, D5x, S54, and SC1	Ultrium tape drives	> 300 000	450 PB (399.68 PiB)
L32, D32, S54, and SC1	Ultrium tape drives	> 300 000	450 PB (399.68 PiB)
L2x, D2x, S24, and SC1	3592 tape drives	> 225 000	900 PB (799.36 PiB)

Notes:

1. In order to support code level 9500 or higher, all node cards in the library must be xx3-equivalent node cards. For xx2 models, this requires a xx3 model conversion OR the enhanced node card(s) feature (FC 1700 or 1701).
2. In order to increase the maximum number of cartridges to more than 6 887, or to support a shuttle complex, logical libraries must use LTO Ultrium 4, 3592 E05, or later tape drives as control path drives. In order to support more than 6 887 cartridges, Ultrium 4 control path drives require a minimum code level of 97F0. In order to support a shuttle complex, Ultrium 4 control path drives require a minimum code level of A480 and Ultrium 5 control path drives require a minimum code level of B170.
3. The maximum native capacity figures are based on library configurations with high density (HD) frames and all Ultrium 5 or 3592 E07 tape drives. In addition, the figures for libraries with Model SC1 (shuttle connection) are based on the maximum shuttle complex configuration.

Chapter 2. Supported SCSI Commands

This section introduces the SCSI commands that are recognized by the TS3500 Tape Library.

Table 4 lists all of the commands that are defined by the referenced SCSI-3 standard for medium changer devices and that are supported or not supported by the IBM System Storage® TS3500 Tape Library. For each command, the operation code, applicable SCSI-3 standard, and applicable conditions are shown.

For the SCSI commands supported by the IBM Ultrium Tape Drives, see the *IBM TotalStorage LTO Ultrium Tape Drive SCSI Reference*.

For the SCSI commands supported by the IBM 3592 Tape Drives, see the *IBM System Storage 3592 Tape Drive SCSI Reference*.

Table 4. SCSI Commands for the TS3500 Tape Library

Command Name	Operation Code	SCSI Document	Applicable Conditions:		
			RVC[1]	UAT[2]	NRD[3]
Exchange Medium	X'A6'	SMC[4]	Y[5]	Y	Y
Initialize Element Status	X'07'	SMC	Y	Y	Y
Initialize Element Status with Range	X'E7'	VU[6]	Y	Y	Y
Inquiry	X'12'	SPC[7]	N[8]	N	N
Log Select (not supported)	X'4C'	SPC	Y	Y	Y
Log Sense	X'4D'	SPC	Y	N	N
Mode Select (6)	X'15'	SPC	Y	Y	N
Mode Select (10)	X'55'	SPC	Y	Y	N
Mode Sense (6)	X'1A'	SPC	N	Y	Y[9]
Mode Sense (10)	X'5A'	SPC	N	Y	Y[9]
Move Medium	X'A5'	SMC	Y	Y	Y
Position to Element	X'2B'	SMC	Y	Y	Y
Prevent Allow Medium Removal	X'1E'	SPC	Y[10]	Y	Y
Read Buffer	X'3C'	SPC	Y	N	N
Read Element Status	X'B8'	SMC	N	Y	Y[11]
Receive Diagnostic Results (not supported)	X'1C'	SPC	Y	Y	N
Release Element (6)	X'17'	SMC	N	Y	N
Request Sense	X'03'	SPC	N	N	N
Request Volume Element Address	X'B5'	SMC	Y	Y	N
Reserve Element (6)	X'16'	SMC	Y	Y	N
Rezero Unit (not supported)	X'01'	SPC	Y	Y	N
Send Diagnostic	X'1D'	SPC	Y	Y	Y
Send Volume Tag	X'B6'	SMC	Y	Y	Y
Test Unit Ready	X'00'	SPC	Y	Y	Y
Write Buffer	X'3B'	SPC	Y	Y	N

Table 4. SCSI Commands for the TS3500 Tape Library (continued)

Command Name	Operation Code	SCSI Document	Applicable Conditions:		
			RVC[1]	UAT[2]	NRD[3]

Notes:

1. RVC = Reservation Conflict status. When multiple logical libraries or control paths are configured, the library has multiple Medium Changer device ports (via LUN 1 of the drives). Medium changer device reservations only prevent access for those initiators using the same device port as the initiator that has sent the Reserve command. Initiators using another device port (for example, for a different logical library or different control path) are not affected.
2. UAT = CHECK CONDITION status for Unit Attention.
3. NRD = CHECK CONDITION status for Not Ready.
4. SMC = *SCSI-3 Medium Changer* specification.
5. Y = Yes (command checked for applicable conditions).
6. VU = The command is unique to the vendor.
7. SPC = *SCSI Primary Commands-2 (SPC-2)* specification.
8. N = No (command not checked for applicable conditions).
9. The reporting of Not Ready conditions for Mode Sense (6) and Mode Sense (10) is limited to reset conditions with associated sense data of 2/0401.
10. RVC status is only reported if the Prevent field = B'01'. The command is allowed if the Prevent field = B'00'.
11. The reporting of Not Ready conditions for Read Element Status with DVCID=B'1' is limited to reset conditions with associated sense data of 2/0401.

Each SCSI command is detailed in the sections that follow. The tables in the descriptions of each SCSI command indicate the fields in each Command Descriptor Block (CDB). The tables are similar to the style used in the applicable SCSI-3 standard. The descriptions specify the supported options, values, and ranges for each field. For a description of a CDB and its fields, see the applicable SCSI-3 standard.

Note: The Logical Unit Number (LUN) field in the CDB has been obsoleted in SCSI-3 and is ignored for every command.

Related reference

"Exchange Medium - X'A6'" on page 6
"Initialize Element Status - X'07'" on page 8
"Initialize Element Status with Range - X'E7'" on page 9
"Inquiry - X'12'" on page 11
"Inquiry Page X'80': Unit Serial Number" on page 15
"Inquiry Page X'83': Device Identification" on page 16
"Log Sense - X'4D'" on page 17
"Mode Select (6) - X'15'" on page 22
"Mode Select (10) - X'55'" on page 25
"Mode Sense (6) - X'1A'" on page 28
"Mode Sense (10) - X'5A'" on page 30
"Move Medium - X'A5'" on page 36
"Position to Element - X'2B'" on page 39
"Prevent Allow Medium Removal - X'1E'" on page 40
"Read Buffer - X'3C'" on page 41
"Read Element Status - X'B8'" on page 43
"Release Element (6) - X'17'" on page 57
"Request Sense - X'03'" on page 58
"Request Volume Element Address - X'B5'" on page 62
"Reserve Element (6) - X'16'" on page 64
"Send Diagnostic - X'1D'" on page 65
"Send Volume Tag - X'B6'" on page 66
"Test Unit Ready - X'00'" on page 67
"Write Buffer - X'3B'" on page 68

Exchange Medium - X'A6'

Table 5 shows the format of the Exchange Medium command for the 3584 Tape Library.

Table 5. Exchange Medium command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation code (X'A6')							
1	LUN (Obsolete)			Reserved				
2	Transport Element Address							
3								
4	Source Address							
5								
6	First Destination Address							
7								
8	Second Destination Address							
9								
10	Reserved						Inv2 (B'0')	Inv1 (B'0')
11	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The medium in the source element is moved to the first destination element and the medium which previously occupied the first destination element is moved to the second destination element. The second destination element may be the same as the source element.

The following 3584 Tape Library-specific parameters apply:

- **Transport Element Address:** A value of X'0000', X'0001', or X'0002' is allowed for this field. For any of these values, the library selects an MTE based on optimal availability and performance.
- **Source/Destination Addresses:** The valid element addresses for this field are dependent upon library model and library configuration. For additional details, go to the section about locations and addresses of SCSI elements in the 3584 Tape Library.

Notes:

1. The Medium Transport Elements are not capable of an exchange. If this element address is specified as a Destination Address in an Exchange Medium command, the command is presented CHECK CONDITION status with associated sense data of 5/2101 (Illegal Request, Invalid Element Address).
2. If a destination element is an Ultrium 1 Tape Drive and the source element address contains an Ultrium 2 cartridge (VolTag of `xxxxxxL2`), the command is presented CHECK CONDITION status with associated sense data of 5/3000 (Illegal Request, Incompatible Medium Installed).
3. If a destination element is an Ultrium 1 or Ultrium 2 tape drive and the source element address contains an Ultrium 3 cartridge (VolTag of

xxxxxxL3), the command is presented CHECK CONDITION status with associated sense data of 5/3000 (Illegal Request, Incompatible Medium Installed).

For additional information on element addresses and descriptions, go to the sections about Mode Page X'1D': Element Address Assignment, Mode Page X'1F': Device Capabilities, and Read Element Status - X'B8'.

Related concepts

"Overview of Locations and Addresses of SCSI Elements" on page 77
This section discusses the SCSI element address that the firmware of the 3584 Tape Library assigns to each storage slot, I/O slot, and drive in the library. It describes how the address is used to indicate the location of an element.

Related reference

"Mode Page X'1D': Element Address Assignment" on page 32

"Mode Page X'1F': Device Capabilities" on page 34

"Read Element Status - X'B8'" on page 43

Initialize Element Status - X'07'

Table 6 shows the format of the Initialize Element Status command for the 3584 Tape Library.

Table 6. Initialize Element Status Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'07')							
1	LUN (Obsolete)			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							
5	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The 3584 Tape Library keeps all element status current and valid by performing an automatic inventory operation as required. Therefore, the Initialize Element Status command is allowed and ignored (the library returns GOOD status without performing another inventory). To re-inventory specific elements as part of application error handling, go to the section about the SCSI command Initialize Element Status with Range - X'E7'.

Related reference

"Initialize Element Status with Range - X'E7'" on page 9

Initialize Element Status with Range - X'E7'

Table 7 shows the format of the Initialize Element Status with Range command for the 3584 Tape Library.

Table 7. Initialize Element Status with Range Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'E7')							
1	LUN (Obsolete)			Reserved				Range
2	Starting Element Address							
3								
4	Reserved							
5	Reserved							
6	Number of Elements							
7								
8	Reserved							
9	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The Initialize Element Status with Range command causes the library to check a range of elements for media present and any other status relevant to that element including the bar code label. The 3584 Tape Library keeps all element status current and valid by automatically performing an inventory operation as required. The intent of this command is to retry the library inventory operation for a specific element address when an unexpected condition is detected by the host application software.

The following 3584 Tape Library-specific parameters apply:

- **Range:** The following values apply:

  B' 0' Requests the library to check all elements. This value is allowed but no action is taken by the library (it returns GOOD status).

  B'1' Requests the library to check any valid elements within the range specified by the Starting Element Address and Number of Elements fields.

- **Starting Element Address:** Specifies the minimum element address that is to be checked.
- **Number of Elements:** Specifies the range of elements that are to be checked, beginning with the Starting Element Address. If ALMS is disabled, any valid elements in the range are checked by the library. If ALMS is enabled, and the number of elements in the range is one and the element is valid, the element is checked. If the number of elements is greater than one, no action is taken and a GOOD state is returned.

  The valid element addresses are dependent upon library model and library configuration. For element addresses that fall within HD slots of HD frames, the entire HD slot is inventoried. This could include up to five LTO cartridges or four 3592 cartridges. For additional details, go to the section about locations and addresses of SCSI elements in the 3584 Tape Library.

For additional information on element addresses and descriptions, go to the sections about Mode Page X'1D': Element Address Assignment, Mode Page X'1F': Device Capabilities, and Read Element Status - X'B8'.

Related concepts

"Overview of Locations and Addresses of SCSI Elements" on page 77
This section discusses the SCSI element address that the firmware of the 3584 Tape Library assigns to each storage slot, I/O slot, and drive in the library. It describes how the address is used to indicate the location of an element.

Related reference

"Mode Page X'1D': Element Address Assignment" on page 32

"Mode Page X'1F': Device Capabilities" on page 34

"Read Element Status - X'B8'" on page 43

Inquiry - X'12'

Table 8 shows the format of the Inquiry command for the 3584 Tape Library.

Table 8. Inquiry Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation code (X'12')							
1	LUN (Obsolete)			Reserved			CmdDt (B'0')	EVPD
2	Page Code							
3	Reserved							
4	Allocation Length							
5	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

There are several forms of Inquiry data. The following are supported. For more detail, go to each "Related Reference."

- Inquiry Standard Data: Valid LUN (Logical Unit Number)
- Inquiry Page X'00'
- Inquiry Page X'80': Unit Serial Number
- Inquiry Page X'83': Device Identification
- Inquiry Page X'D0' (the contents of this page are not specified in this document)

Related reference

“Inquiry Standard Data: Valid LUN (Logical Unit Number)” on page 12

“Inquiry Page X'00'” on page 14

“Inquiry Page X'80': Unit Serial Number” on page 15

“Inquiry Page X'83': Device Identification” on page 16

Inquiry Standard Data: Valid LUN (Logical Unit Number)

The following 3584 Tape Library-specific parameters apply to this request:

- CmdDt: B'0'
- EVPD (Enable Vital Product Data): B'0'
- Page Code: X'00'
- Allocation Length: X'38' (56) bytes available

Table 9 shows the standard inquiry data that is returned (character fields are in ASCII) for a logical unit number (LUN) that is configured as a SCSI Medium Changer. For additional detail, go to the section about default SCSI ID and Loop ID (AL_PA) assignments for the 3584 Tape Library.

Table 9. Standard Inquiry Data Returned for a SCSI Medium Changer

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Peripheral Qualifier (B'000')			Peripheral Device Type (X'08')				
1	RMB (B'1')	Reserved						
2	ISO/IEC Version (B'00')		ECMA Version (B'000')			ANSI Approved Version (B'011')		
3	AERC (B'0')	Obsolete (B'0')	NormACA (B'0')	HiSupport (B'0')	Response Data Format (B'0010')			
4	Additional Length (n-4) (X'33' or X'35')							
5	SCCS (B'0')	Reserved						
6	BQue	EncServ (B'0')	BarC (B'1')	MultiP (B'0')	MChngr (B'0')	AckReqQ (B'0')	Addr32 (B'0')	Addr16
7	RelAdr (B'0')	WBus32 (B'0')	WBus16	Sync	Linked (B'0')	TranDis (B'0')	CmdQue	SftRe (B'0')
8-15	Manufacturer ('IBM ') (in ASCII)							
16-31	Product Identification ('03584L22' or '03584L32' or '03584L42')							
32-35	Product Revision Level							
36-37	IBM Plant of Manufacture Code							
38-49	Serial Number of Device							
50-51	'0' (in ASCII)							
52-55	Reserved							
56	Reserved				Clocking		QAS (B'0')	IUS (B'0')
57	Reserved							

For Ultrium 1 control path tape drives, bytes 56 and 57 are not returned.

For SCSI control path drives and control ports, the following values apply:

- **BQue:** set to 0, which indicates that the drive does not support tagged queueing.
- **Adr16:** set to 1, which indicates that the drive supports 16 SCSI IDs.
- **WBus16:** set to 1, which indicates that the drive supports a 16-bit wide data path on a single cable.
- **Sync:** set to 1, which indicates that the drive supports synchronous data transfers.
- **CmdQue:** set to 0.

- **Clocking:** is supported on Ultrium 2 devices only and is set to 11b because the drive supports both ST and DT modes.

For Fibre Channel control path drives, the following values apply:

- **BQue:** set to 0 (except for Ultrium 1 and Ultrium 2 control path drives with earlier versions of firmware).
- **Adr16:** set to 0.
- **WBus16:** set to 0.
- **Sync:** set to 0.
- **CmdQue:** set to 1 (except for Ultrium 1 and Ultrium 2 control path drives with earlier versions of firmware).
- **Clocking:** set to 00b (the Clocking field is not used in Fibre Channel devices).

For all control paths, the following values apply:

- **Product Identification:**

For 3592 logical libraries in Models L22, D22, L23, D23:	'03584L22	' (in ASCII)
For LTO logical libraries in Models L32, D32, L52, D52, L53, D53:	'03584L32	' (in ASCII)

- **Product Revision Level:** 3584 Tape Library Firmware Revision Level (in ASCII).
- **Serial Number of Device:** right justified with leading zeroes (in ASCII).

Related reference

"Default SCSI ID and Loop ID (AL_PA) Assignments for Drives" on page 73

Inquiry Page X'00'

The following 3584 Tape Library-specific parameters apply to this request:

- CmdDt: B'0'
- EVPD (Enable Vital Product Data): B'1'
- Page Code: X'00'
- Allocation Length: X'08' bytes available

Table 10 shows the data that is returned.

Table 10. Data Returned for Inquiry Page X'00'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Peripheral Qualifier (B'000')			Peripheral Device Type (X'08')				
1	Page Code (X'00')							
2	Reserved							
3	Page Length (n-3) (X'04')							
4	Supported page (X'00')							
5	Supported page (X'80')							
6	Supported page (X'83')							
7	Supported page (X'D0')							

Inquiry Page X'80': Unit Serial Number

The following 3584 Tape Library-specific parameters apply to this request:

- CmdDt: B'0'
- EVPD (Enable Vital Product Data): B'1'
- Page Code: X'80'
- Allocation Length: X'14' (20) bytes available

Table 11 shows the data that is returned.

Table 11. Data Returned for Inquiry Page X'80'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Peripheral Qualifier (B'000')			Peripheral Device Type (X'08')				
1	Page Code (X'80')							
2	Reserved							
3	Page Length (X'10')							
4-15	Serial Number of Device							
16-19	First Storage Element Address							

- **Serial Number of Device:** Right justified with leading zeroes, in ASCII (same as Inquiry Standard Data bytes 38-49).
- **First Storage Element Address:** ASCII representation of four hexadecimal digits from Mode Page X'1D', bytes 6-7.

Inquiry Page X'83': Device Identification

The following 3584 Tape Library-specific parameters apply to this request:

- CmdDt: B'0'
- EVPD (Enable Vital Product Data): B'1'
- Page Code: X'83'
- Allocation Length: X'30' (48) bytes available

Table 12 shows the data that is returned.

Table 12. Data Returned for Inquiry Page X'83'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Peripheral Qualifier (B'000')			Peripheral Device Type (X'08')				
1	Page Code (X'83')							
2	Reserved							
3	Page Length (X'2C')							
4	Reserved				Code Set (X'2')			
5	Reserved		Association (B'00')		Identifier Type (X'1')			
6	Reserved							
7	Identifier Length (X'28')							
8-15	Vendor ID							
16-31	Device Type and Model Number							
32-43	Serial Number of Device							
44-47	First Storage Element Address							

- **Code Set:** Identifier is all ASCII.
- **Vendor ID:** Same as Inquiry Standard Data bytes 8-15.
- **Device Type and Model Number:** Same as Inquiry Standard Data bytes 16-31.
- **Serial Number of Device:** Right justified with leading zeroes, in ASCII (same as Inquiry Standard Data bytes 38-49).
- **First Storage Element Address:** ASCII representation of four hexadecimal digits from Mode Page X'1D', bytes 6-7.

Log Sense - X'4D'

The Log Sense command is supported by the 3584 Tape Library. Table 13 shows the command format.

Table 13. Log Sense Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation code (X'4D')							
1	LUN (Obsolete)			Reserved			PPC (B'0')	SP (B'0')
2	PC		Page Code					
3	Reserved							
4	Reserved							
5-6	Parameter Pointer (X'0000')							
7-8	Allocation Length							
9	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The following 3584 Tape Library-specific parameters apply:

- **PPC:** Parameter pointer control.
- **SP:** Save parameters.
- **PC:** Page control. The following values apply:

  B'00' Threshold Values. Supported for all log pages with log counters (the LP field is set to B'0' in the Log Parameter Control Byte).

  B'01' Cumulative Values. Supported for all log pages.

  B'10' Default Threshold Values. Supported for all log pages with log counters. The default threshold value for all 2-byte log counter fields is X'FFFF'. The default threshold value for all 4-byte log counter fields is X'FFFF FFFF'.

  B'11' Default Cumulative Values. Not supported. The default cumulative value for all 2-byte log counter fields is X'0000'. The default cumulative value for all 4-byte log counter fields is X'0000 0000'.

- **Page Code**: Indicates the log page to be returned.

The log pages supported for the Log Sense command are:

- Log Page X'00': Supported Log Pages
- Log Page X'2E': TapeAlert
- Log Page X'30': Library Device Attributes
- Log Page X'31': Physical Library Utilization

For additional detail, refer to the related references below.

Related reference

"Log Page X'00': Supported Log Pages" on page 18
"Log Page X'2E': TapeAlert" on page 18
"Log Page X'30': Library Device Attributes" on page 18
"Log Page X'31': Physical Library Utilization" on page 20

Log Page X'00': Supported Log Pages

The Supported Log Page returns the list of log pages that are supported by the 3584 Tape Library. Table 14 shows the data that is returned.

Table 14. Data Returned for Log Sense Page X'00'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved		Page Code (B'000000')					
1	Reserved							
2-3	Page Length (X'0002')							
4	Supported Log Pages (X'00')							
5	TapeAlert Page (X'2E')							

Log Page X'2E': TapeAlert

Table 15 shows the data that is returned for the TapeAlert Page of the 3584 Tape Library.

Table 15. Data Returned for Log Sense Page X'2E'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved		Page Code (X'2E')					
1	Reserved							
2-3	Page Length (X'0140')							
5n-1 to 5n	Parameter Code (n)							
5n+1	DU (B'0')	DS (B'1')	TSD (B'0')	ETC (B'0')	TMC (B'00')		Reserved	LP (B'0')
5n+2	Parameter Length (X'01')							
5n+3	Reserved							Value of Flag

- **Parameter Code:** n equals 1 to 64.
- **Value of Flag:** The following values apply:

  B'0' Indicates that the flag is not set.
  B'1' Indicates that the flag is set.

Log Page X'30': Library Device Attributes

Table 16 shows the data that is returned for the Library Attributes Page of the 3584 Tape Library.

Table 16. Data returned for Log Sense Page X'30'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved		Page Code					
1	Reserved							
2–3	Page Length (n - 3)							
Log Parameters (see Log Parameter Format)								

Table 16. Data returned for Log Sense Page X'30' (continued)

4 x + 3	Log Parameter (first) Length = x
:	
n - y + 3 n	Log Parameter (last) Length = y

Log parameter format

Each log parameter begins with a 4-byte parameter header, followed by 1 or more bytes of parameter data. Table 17 shows the log parameter format.

Table 17. Log parameter format

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0–1	Parameter Code							
2	DU (B'0')	DS (B'1')	TSD (B'0')	ETC (B'0')	TMC (B'0')		Reserved	LP (B'1')
3	Parameter Length (n - 3)							
4 n	Parameter Value							

Log Parameter Byte 2-Control Byte

A Log Parameter Control Byte is returned for each parameter code described in the log pages. The Log Parameter Control Byte is described here one time only. Any parameters using a different Log Parameter Control Byte have that byte described within that parameter.

Note: The contents of this byte are constant; the user cannot set these values. This byte is part of the returned data described in the SCSI standard; it is described in the following list:

Bit	Description
7	DU (Disable Update): B'0'
6	DS (Disable Save): B'1'
5	TSD (Target Save Disable): B'0'
4	ETC (Enable Threshold Comparison): B'0'
3–2	TMC (Threshold Met Comparison): B'00'
1	Reserved
0	LP (List Parameter): B'1' (Indicates this is a list parameter)

Parameter definitions

Table 18 on page 20 lists the parameter codes for Log Page X'30'.

Note: All ASCII parameters are left justified padded with X'00'.

Table 18. Log Page X'30' parameter codes

Code	Description	Type	Size
X'0001'	Number of Frames in Library String	Binary	1
X'0002'	Library Web Page URL	ASCII	255
X'0003'	Logical Library Name	ASCII	16
X'0004'	Physical Library Serial Number	ASCII	12

Log Page X'31': Physical Library Utilization

Table 19 shows the data that is returned for the Physical Library Utilization Log Page of the 3584 Tape Library.

Table 19. Data Returned for Log Sense Page X'31'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved		Page Code					
1	Reserved							
2–3	Page Length (n–3)							
Log Parameters (see Log Parameter Format)								
4 x+3	Log Parameter (first) Length = x							
:								
n–y+3 n	Log Parameter (last) Length = y							

Log parameter format

A Log Parameter Control Byte is returned for each parameter code described in the log pages. The Log Parameter Control Byte is described here one time only. Any parameters using a different Log Parameter Control Byte have that byte described within that parameter.

Note: The contents of this byte are constant; the user cannot set these values. This byte is part of the returned data described in the SCSI standard; it is described in the following list:

Bit	Description
7	DU (Disable Update): B'0'
6	DS (Disable Save): B'1'
5	TSD (Target Save Disable): B'0'
4	ETC (Enable Threshold Comparison): B'0'
3–2	TMC (Threshold Met Comparison): B'00'
1	Reserved
0	LP (List Parameter): B'1' (Indicates this is a list parameter)

Parameter definitions

Table 20 lists the parameter codes for Log Page X'31'.

Note: Log Page X'31' parameters are returned for the supported media type only (LTO or 3592).

Table 20. Log Page X'31' parameter codes

Code	Description	Size
X'0000'	Licensed Storage Slot Capacity	2
X'0001'	Unlicensed Storage Slot Capacity	2
X'0002'	Number of Data Cartridges	2
X'0003'	Number of Cleaning Cartridges	2

Mode Select (6) - X'15'

The Mode Select (6) command is supported by the 3584 Tape Library. Table 21 shows the command format.

Note: In the future, the length of the mode parameter list for Mode Sense Page Code X'3F' (return all pages) may exceed 255 bytes. At that time, use of the Mode Select (10) and Mode Sense (10) commands will be required in order to transfer all mode pages with one command. For this reason, use of the Mode Select (6) and Mode Sense (6) commands is not recommended.

Table 21. Mode Select (6) Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'15')							
1	LUN (Obsolete)			PF (B'1')	Reserved			SP (B'0')
2	Reserved							
3	Reserved							
4	Parameter List Length							
5	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The following 3584 Tape Library-specific parameters apply:

- **PF:** Page format. The PF bit is explicitly **not** checked.
- **Parameter List Length:** Specifies the length (in bytes) of the mode parameter list that is transferred from the initiator to the target. A parameter list length of 0 indicates that no data is transferred. This condition is not considered an error. The target terminates the command with CHECK CONDITION status with associated sense data of 5/1A00 (Illegal Request, Parameter List Length Error) if the parameter list length results in the truncation of the mode parameter header, the mode parameter block descriptor, or any mode page.

Note: Issuing a Mode Sense for current values before a Mode Select is generally recommended to avoid accidentally attempting to set fields that cannot be changed by the initiator.

The following mode pages are supported by the 3584 Tape Library. For more detail, go to each "Related Reference."

- Mode Page X'18': Fibre Channel Logical Unit Control Page (Fibre Channel control paths only)
- Mode Page X'1C': Informational Exceptions Control
- Mode Page X'1D': Element Address Assignment
- Mode Page X'1E': Transport Geometry Parameters
- Mode Page X'1F': Device Capabilities
- Mode Page X'20': VU Mode Parameters Page

Related reference

"Mode Page X'18': Fibre Channel Logical Unit Control Page" on page 31
"Mode Page X'1C': Informational Exceptions Control" on page 32
"Mode Page X'1D': Element Address Assignment" on page 32
"Mode Page X'1E': Transport Geometry Parameters" on page 33
"Mode Page X'1F': Device Capabilities" on page 34
"Mode Page X'20': VU Mode Parameters Page" on page 35

Mode Parameter Header for Mode Select (6)

For the 3584 Tape Library, the Mode Pages for the Mode Select (6) command are preceded by a 4-byte Mode Parameter Header. There is one copy of this header for each initiator.

Table 22. Mode Parameter Header for Mode Select (6)

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Mode Data Length (X'00')							
1	Medium Type (X'00')							
2	Device-Specific Parameter (X'00')							
3	Block Descriptor Length (X'00')							

- **Mode Data Length:** Reserved when used with the Mode Select (6) command. (When used with the Mode Sense commands, this field specifies the length (in bytes) of the following data that is available to be transferred. The length field does not include itself.)
- **Medium Type:** Reserved on Medium Changer Devices.
- **Device-Specific Parameter:** Reserved on Medium Changer Devices.
- **Block Descriptor Length:** Not used on the 3584 Tape Library.

Mode Select (10) - X'55'

The Mode Select (10) command is supported by the 3584 Tape Library. Table 23 shows the command format.

Table 23. Mode Select (10) Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation code (X'55')							
1	LUN (Obsolete)			PF (B'1')	Reserved			SP (B'0')
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Parameter List Length							
8								
9	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The following library-specific parameters apply:

- **PF:** Page format. The PF bit is explicitly **not** checked.
- **Parameter List Length:** Specifies the length (in bytes) of the mode parameter list that is transferred from the initiator to the target. A parameter list length of 0 indicates that no data is transferred. This condition is not considered an error. The target terminates the command with CHECK CONDITION status with associated sense data of 5/1A00 (Illegal Request, Parameter List Length Error) if the parameter list length results in the truncation of the mode parameter header, the mode parameter block descriptor, or any mode page.

Note: Issuing a Mode Sense for current values before a Mode Select is generally recommended to avoid accidentally attempting to set fields that cannot be changed by the initiator.

The following mode pages are supported by the 3584 Tape Library. For more detail, go to each "Related Reference."

- Mode Page X'18': Fibre Channel Logical Unit Control Page (Fibre Channel control paths only)
- Mode Page X'1C': Informational Exceptions Control
- Mode Page X'1D': Element Address Assignment
- Mode Page X'1E': Transport Geometry Parameters
- Mode Page X'1F': Device Capabilities
- Mode Page X'20': VU Mode Parameters Page

Related reference

"Mode Page X'18': Fibre Channel Logical Unit Control Page" on page 31
"Mode Page X'1C': Informational Exceptions Control" on page 32
"Mode Page X'1D': Element Address Assignment" on page 32
"Mode Page X'1E': Transport Geometry Parameters" on page 33
"Mode Page X'1F': Device Capabilities" on page 34
"Mode Page X'20': VU Mode Parameters Page" on page 35

Mode Parameter Header for Mode Select (10)

For the 3584 Tape Library, the Mode Pages for the Mode Select (10) command are preceded by an 8-byte Mode Parameter Header. There is one copy of this header for each initiator.

Table 24. Mode Parameter Header for Mode Select (10)

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	Mode Data Length (X'0000')							
2	Medium Type (X'00')							
3	Device-Specific Parameter (X'00')							
4-5	Reserved							
6-7	Block Descriptor Length (X'0000')							

- **Mode Data Length:** Reserved when used with the Mode Select (10) command. (When used with the Mode Sense commands, this field specifies the length (in bytes) of the following data that is available to be transferred. The length field does not include itself.)
- **Medium Type:** Reserved on Medium Changer Devices.
- **Device-Specific Parameter:** Reserved on Medium Changer Devices.
- **Block Descriptor Length:** Not used on the 3584 Tape Library.

Mode Sense (6) - X'1A'

The Mode Sense (6) command is supported by the 3584 Tape Library. Table 25 shows the command format.

Note: In the future, the length of the mode parameter list for Mode Sense Page Code X'3F' (return all pages) may exceed 255 bytes. At that time, use of the Mode Select (10) and Mode Sense (10) commands will be required in order to transfer all mode pages with one command. For this reason, use of the Mode Select (6) and Mode Sense (6) commands is not recommended.

Table 25. Mode Sense (6) Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'1A')							
1	LUN (Obsolete)			Reserved	DBD	Reserved		
2	PC		Page Code					
3	Reserved							
4	Allocation Length							
5	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The following 3584 Tape Library-specific parameters apply:

- **DBD:** Disable block descriptors. Supported values are B'0' or B'1'.
- **PC:** Page control. Supported values are B'00', B'01', or B'10'.
- **Page Code:** Supported values are X'18', X'1C', X'1D', X'1E', X'1F', X'20', and X'3F' (return all pages).
- **Allocation Length:** The maximum number of bytes to be transferred. If the allocation length specified is less than the amount available, then the allocated amount is transferred and no error is reported.

The following mode pages are supported by the 3584 Tape Library. For more detail, go to each "Related Reference."

- Mode Page X'18': Fibre Channel Logical Unit Control Page (Fibre Channel control paths only)
- Mode Page X'1C': Informational Exceptions Control
- Mode Page X'1D': Element Address Assignment
- Mode Page X'1E': Transport Geometry Parameters
- Mode Page X'1F': Device Capabilities
- Mode Page X'20': VU Mode Parameters Page

Related reference

“Mode Page X'18': Fibre Channel Logical Unit Control Page” on page 31

“Mode Page X'1C': Informational Exceptions Control” on page 32

“Mode Page X'1D': Element Address Assignment” on page 32

“Mode Page X'1E': Transport Geometry Parameters” on page 33

“Mode Page X'1F': Device Capabilities” on page 34

“Mode Page X'20': VU Mode Parameters Page” on page 35

Mode Parameter Header for Mode Sense (6)

For the 3584 Tape Library, the Mode Pages for the Mode Sense (6) command are preceded by a 4-byte Mode Parameter Header. There is one copy of this header for each initiator.

Table 26. Mode Parameter Header for Mode Select (6)

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Mode Data Length							
1	Medium Type (X'00')							
2	Device-Specific Parameter (X'00')							
3	Block Descriptor Length (X'00')							

- **Mode Data Length:** Specifies the length (in bytes) of the following data that is available to be transferred. The length field does not include itself. (This field is reserved when used with the Mode Select (6) command.)
- **Medium Type:** Reserved on Medium Changer Devices.
- **Device-Specific Parameter:** Reserved on Medium Changer Devices.
- **Block Descriptor Length:** Not used on the 3584 Tape Library.

Mode Sense (10) - X'5A'

The Mode Sense (10) command is supported by the 3584 Tape Library. Table 27 shows the command format.

Table 27. Mode Sense (10) Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation code (X'5A')							
1	LUN (Obsolete)			Reserved	DBD	Reserved		
2	PC		Page Code					
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Allocation Length							
8								
9	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The following 3584 Tape Library-specific parameters apply:

- **DBD:** Disable block descriptors. Supported values are B'0' or B'1'.
- **PC:** Page control. Supported values are B'00', B'01', or B'10'.
- **Page Code:** Supported values are X'18', X'1C', X'1D', X'1E', X'1F', X'20', and X'3F' (return all pages).
- **Allocation Length:** The maximum number of bytes to be transferred. If the allocation length specified is less than the amount available, then the allocated amount is transferred and no error is reported.

The following mode pages are supported by the 3584 Tape Library. For more detail, go to each "Related Reference."

- Mode Page X'18': Fibre Channel Logical Unit Control Page (Fibre Channel control paths only)
- Mode Page X'1C': Informational Exceptions Control
- Mode Page X'1D': Element Address Assignment
- Mode Page X'1E': Transport Geometry Parameters
- Mode Page X'1F': Device Capabilities
- Mode Page X'20': VU Mode Parameters Page

Related reference

“Mode Page X'18': Fibre Channel Logical Unit Control Page” on page 31
“Mode Page X'1C': Informational Exceptions Control” on page 32
“Mode Page X'1D': Element Address Assignment” on page 32
“Mode Page X'1E': Transport Geometry Parameters” on page 33
“Mode Page X'1F': Device Capabilities” on page 34
“Mode Page X'20': VU Mode Parameters Page” on page 35

Mode Parameter Header for Mode Sense (10)

For the 3584 Tape Library, the Mode Pages for the Mode Sense (10) command are preceded by an 8-byte Mode Parameter Header. There is one copy of this header for each initiator.

Table 28. Mode Parameter Header for Mode Select (10)

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	Mode Data Length							
2	Medium Type (X'00')							
3	Device-Specific Parameter (X'00')							
4-5	Reserved							
6-7	Block Descriptor Length (X'0000')							

- **Mode Data Length:** Specifies the length (in bytes) of the following data that is available to be transferred. The length field does not include itself. (This field is reserved when used with the Mode Select (10) command.)
- **Medium Type:** Reserved on Medium Changer Devices.
- **Device-Specific Parameter:** Reserved on Medium Changer Devices.
- **Block Descriptor Length:** Not used on the 3584 Tape Library.

Mode Page Format

For the 3584 Tape Library, Table 29 shows the format of the mode parameter list. The individual mode page descriptions that follow this table include the field descriptions. Each field is non-changeable unless specifically identified otherwise.

Table 29. Mode Page Format

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	PS	Reserved	Page code					
1	Page Length (n-1)							
2-n	Mode Parameters							

Mode Page X'18': Fibre Channel Logical Unit Control Page

For the 3584 Tape Library, this page is defined for Fibre Channel-attached devices only. There is only one copy of this page for each initiator.

Table 30. Data Returned for Mode Page X'18'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	PS (B'0')	Reserved	Page Code (X'18')					
1	Page Length (X'06')							
2	Reserved							
3	Reserved							EPDC
4-7	Reserved							

Enable Precise Delivery Control (EPDC): setting to B'0' or B'1' is allowed but ignored (returns GOOD status without action).

Mode Page X'1C': Informational Exceptions Control

See the SCSI-3 standard.

For the 3584 Tape Library, this page is defined as common for all initiators. This page is a static page. There are no changeable parameters in this mode page.

Table 31. Data Returned for Mode Page X'1C'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	PS (B'0')	Reserved	Page Code (X'1C')					
1	Page Length (X'0A')							
2	Perf (B'0')	Reserved			DExcept (B'1')	Test (B'0')	Reserved	LogErr (B'0')
3	Reserved				MRIE (X'3')			
4-7	Interval Time (X'00000000')							
8-11	Report Count/Test Flag Number (X'00000000')							

Mode Page X'1D': Element Address Assignment

See the SCSI-3 standard. For the 3584 Tape Library, this page is defined as common for all initiators. This page is a static page. Addresses defined here are those which should be used by the Move Medium command.

The fields in Mode Page X'1D' depend on the model of the library and the library's configuration. For additional details, go to the section about locations and addresses of SCSI elements in the 3584 Tape Library.

Note: The fields in Mode Page X'1D' are not changeable. If a Mode Select command is issued with values other than those returned by a Mode Sense command, the device returns CHECK CONDITION status with associated sense data of 5/2600 (Illegal Request, Invalid Field in Parameter List).

Table 32. Data Returned for Mode Page X'1D'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	PS (B'0')	Reserved	Page Code (X'1D')					
1	Parameter Length (X'12')							
2-3	Medium Transport Element Address (X'0001')							
4-5	Number of Medium Transport Elements: (X'0002')							
6-7	First Storage Element Address							
8-9	Number of Storage Elements							
10-11	First Import/Export Element Address							
12-13	Number of Import/Export Elements							
14-15	First Data Transfer Element Address							
16-17	Number of Data Transfer Elements							
18-19	Reserved							

Note: A valid configuration might include a 'gap' in the drive positions (for example, drives might be installed in positions 1 and 3 but not position 2). The Data Transfer Element information reported in Mode Sense and Read Element Status data will always include these 'gaps' (for the example, the Number of Data Transfer Elements is 3). However, a command to move a cartridge to a non-existent drive will be terminated with CHECK CONDITION status and associated sense data of 5/3B82 (Illegal Request; Element Not Accessible, Drive is Not Present).

Related concepts

"Overview of Locations and Addresses of SCSI Elements" on page 77
This section discusses the SCSI element address that the firmware of the 3584 Tape Library assigns to each storage slot, I/O slot, and drive in the library. It describes how the address is used to indicate the location of an element.

Mode Page X'1E': Transport Geometry Parameters

The transport geometry parameters page defines whether each medium transport element is a member of a set of elements that share a common robotics subsystem and whether the element is capable of medium rotation. One transport geometry descriptor is returned for each medium transport element. Because the 3584 Tape Library has one or two medium transport elements, one or two descriptors are returned.

This page is defined as common to all initiators. This page is a static page.

There are no changeable parameters in this mode page.

Table 33. Data Returned for Mode Page X'1E'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	PS (B'0')	Reserved	Page Code (X'1E')					
1	Page Length (X'02' or X'04')							
2	Reserved							Rotate (B'0')
3	Member Number in Transport Element Set (X'00')							
4	Reserved							Rotate (B'0')
5	Member Number in Transport Element Set (X'01')							

- **Rotate:** The 3584 Tape Library does not support media rotation.

Mode Page X'1F': Device Capabilities

See the SCSI-3 standard.

For the 3584 Tape Library, this page is defined as common for all initiators. This page is a static page.

Note: The fields in Mode Page X'1F' are not changeable. If a Mode Select command is issued with values other than those returned by a Mode Sense command, the device returns CHECK CONDITION status with associated sense data of 5/2600 (Illegal Request, Invalid Field in Parameter List).

Table 34. Data Returned for Mode Page X'1F'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	PS (B'0')	Reserved	Page Code (X'1F')					
1	Parameter Length (X'0E')							
2	**Store XX Field**							
	Reserved				StorDT (B'1')	StorI/E (B'1')	StorST (B'1')	StorMT (B'0')
3	Reserved							
4	**Medium Transport Capabilities**							
	Reserved				MT->DT (B'1')	MT->I/E (B'1')	MT->ST (B'1')	MT->MT (B'0')
5	**Storage Element Capabilities**							
	Reserved				ST->DT (B'1')	ST->I/E (B'1')	ST->ST (B'1')	ST->MT (B'0')
6	**Import/Export Element Capabilities**							
	Reserved				I/E->DT (B'1')	I/E->I/E (B'1')	I/E->ST (B'1')	I/E->MT (B'0')
7	**Data Transfer Element Capabilities**							
	Reserved				DT->DT (B'1')	DT->I/E (B'1')	DT->ST (B'1')	DT->MT (B'0')
8-11	Reserved							
12	**Medium Transport Element Exchange Capabilities**							
	Reserved				MT<>DT (B'0')	MT<>I/E (B'0')	MT<>ST (B'0')	MT<>MT (B'0')
13	**Storage Element Exchange Capabilities**							
	Reserved				ST<>DT (B'1')	ST<>I/E (B'1')	ST<>ST (B'1')	ST<>MT (B'0')
14	**Import/Export Element Exchange Capabilities**							
	Reserved				I/E<>DT (B'1')	I/E<>I/E (B'1')	I/E<>ST (B'1')	I/E<>MT (B'0')
15	**Data Transport Element Exchange Capabilities**							
	Reserved				DT<>DT (B'1')	DT<>I/E (B'1')	DT<>ST (B'1')	DT<>MT (B'0')

Mode Page X'20': VU Mode Parameters Page

For the 3584 Tape Library, this page is defined as common to all initiators.

Table 35. Data Returned for Mode Page X'20'

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	PS (B'0')	Reserved	Page Code (X'20')					
1	Page Length (X'08')							
2	Reserved (Vendor Unique)					AutoClean	Reserved (Vendor Unique)	
3-9	Reserved (Vendor Unique)							

- **AutoClean:** This field is not changeable. Automatic drive cleaning may only be enabled or disabled at the library's operator panel. The following values apply:

  B'0' Automatic drive cleaning is disabled.
  B'1' Automatic drive cleaning is enabled.

Move Medium - X'A5'

Table 36 shows the format of the Move Medium command for the 3584 Tape Library.

Table 36. Move Medium Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation code (X'A5')							
1	LUN (Obsolete)			Reserved				
2	Transport Element Address							
3								
4	Source Address							
5								
6	Destination Address							
7								
8	Reserved							
9	Reserved							
10	Reserved							Invert (B'0')
11	HD control		Reserved (B'0000')				Flag (B'0')	Link (B'0')

- **Transport Element Address:** For any of these values, the library will select an MTE based on optimal availability and performance. The following values apply:

  X'0000'
  X'0001'
  X'0002'

- **Source/Destination Addresses:** The valid element addresses for these fields depend on the library's configuration. For additional details, go to the section about locations and addresses of SCSI elements in the 3584 Tape Library.

  Notes:

  1. The Medium Transport Element is not capable of storing a media element. If this element address is specified as a Destination Address in a Move Medium command, the command is presented CHECK CONDITION status with associated sense data of 5/2101 (Illegal Request, Invalid Element Address).
  2. If a destination element is an Ultrium 1 Tape Drive and the source element address contains an Ultrium 2 cartridge (VolTag of xxxxxxL2), the command is presented CHECK CONDITION status with associated sense data of 5/3000 (Illegal Request, Incompatible Medium Installed).
  3. If a destination element is an Ultrium 1 or Ultrium 2 Tape Drive and the source element address contains an Ultrium 3 cartridge (VolTag of xxxxxxL3), the command is presented CHECK CONDITION status with associated sense data of 5/3000 (Illegal Request, Incompatible Medium Installed).

4. If the source element address contains a cartridge assigned to another logical library (for example, exported to the shared I/O station or inserted into a shared tape drive), the command is presented CHECK CONDITION status with associated sense data of 5/3B81 (Illegal Request, Element Not Accessible, Cartridge is Assigned to Another Logical Library).

- **HD Control:** The following values apply:

B'00' Default behavior (Cache optimized)

B'01' Tier 0 bypass (When the Source Move Element is a drive); Tier 0 destage (When the Source Move Element is a Tier 0 storage slot); Ignored for all other element types

B'10' No unshuffle (Does not unshuffle cartridges that are shuffled out of an HD slot when the Source Move Element is from a Tier 3, 4, or 5 location)

B'11' Reserved

Note:

The depth of a cartridge location in an HD slot is known as a *tier*. The cartridge immediately accessible in an HD slot is a Tier 1 cartridge. Behind that is Tier 2 and so on. The maximum tier in an LTO HD slot is Tier 5. The maximum tier in a 3592 HD slot is Tier 4. The single-deep slots on the door-side of HD frames and in non-HD frames are referred to as Tier 0 slots.

A *shuffle* operation is required in order to access any cartridge in Tier 2 or beyond. A shuffle is the process of moving cartridges in lower tiers into the gripper or other available slots in order to access cartridges in higher tiers. Tier 2 cartridges only require a swap using the dual grippers (assuming both grippers are usable).

In order to reduce the occurrence of shuffle operations and to take advantage of the typical repeated accesses of cartridges, the role of a *cartridge cache* is given to all single-deep (Tier 0) slots in an HD library. ALMS is required for libraries with HD frames so that cartridge placement is automatically optimized; however, the library supports some manual cache management operations via the Move Medium HD Control bits.

The HD Control bits allow an application to bypass cache on demount (drive-to-storage move, HD = B'01'), destage from cache to Tier 1 (storage-to-storage move, HD = B'01'), or to prestage a cartridge to cache from Tiers 3-5 (storage-to-storage move, HD = B'00'). With ALMS enabled, storage-to-storage moves previously resulted in no physical motion. The library now conditionally moves the cartridge between Tier 0 and HD slots for these cache operations.

Drive-to-storage or storage-to-storage moves have the effect of updating the cartridge "usage" date and time for consideration in subsequent LRU (Least Recently Used) cache destage operations. Hence, an application does not need awareness of the physical locations of cartridges in order to prepare a set of cartridges for faster future access. The application need only send storage-to-storage moves for the entire set of cartridges. The cartridges are protected from LRU destage (if currently in Tier 0), moved to cache (if currently in Tiers 3-5), or left alone (if currently in Tiers 1-2).

For additional information on element addresses and descriptions, go to the sections about Mode Page X'1D': Element Address Assignment, Mode Page X'1F': Device Capabilities, and Read Element Status - X'B8'.

Related concepts

“Overview of Locations and Addresses of SCSI Elements” on page 77
This section discusses the SCSI element address that the firmware of the 3584 Tape Library assigns to each storage slot, I/O slot, and drive in the library. It describes how the address is used to indicate the location of an element.

Related reference

“Mode Page X'1D': Element Address Assignment” on page 32

“Mode Page X'1F': Device Capabilities” on page 34

“Read Element Status - X'B8'” on page 43

Position to Element - X'2B'

Table 37 shows the format of the Position to Element command for the 3584 Tape Library.

Table 37. Position to Element Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'2B')							
1	LUN (Obsolete)			Reserved				
2	Transport Element Address							
3								
4	Destination Element Address							
5								
6	Reserved							
7	Reserved							
8	Reserved							Invert (B'0')
9	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

This command will position the transport element (the picker) in front of the destination element specified.

The following 3584 Tape Library-specific parameters apply:

- **Transport Element Address:** The following values apply. For any of these values, the library will select an MTE based on optimal availability and performance.

  X'0000'
  X'0001'
  X'0002'

- **Destination Address:** The valid element address for this field depends on the library's configuration. See Chapter 5, “Addresses of SCSI Elements,” on page 77 for additional details.

  Note: The Medium Transport Element is not capable of storing a media element. If this element address is specified as a Destination Address in a Position to Element command, the command is presented CHECK CONDITION status with associated sense data of 5/2101 (Illegal Request, Invalid Element Address).

For further information on element addresses and descriptions, go to the sections about Mode Page X'1D': Element Address Assignment and Read Element Status - X'B8'.

Related reference

“Mode Page X'1D': Element Address Assignment” on page 32

“Read Element Status - X'B8'” on page 43

Prevent Allow Medium Removal - X'1E'

The Prevent Allow Medium Removal command is supported by the 3584 Tape Library. Table 38 shows the command format.

Table 38. Prevent Allow Medium Removal Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'1E')							
1	LUN (Obsolete)			Reserved				
2	Reserved							
3	Reserved							
4	Reserved						Prevent	
5	Lock Shared	Vendor Specific (B'00')	Reserved (B'0000')				Flag (B'0')	Link (B'0')

- **Prevent:** The following values apply:

  B'00' Allow Cartridge Removal
  B'01' Prevent Cartridge Removal
  B'10' Not Supported
  B'11' Not Supported

- **LockShared:** This field should not be set by device drivers or commercial applications. It is intended for use by user-developed applications in specific environments where sharing and locking of the I/O station are both required.

If the I/O station is not shared by multiple logical libraries, the 3584 Tape Library supports Prevent Cartridge Removal by locking the I/O station. The Prevent Cartridge Removal option will only cause a shared I/O station to be locked if the LockShared bit is set to B'1'. If the I/O station is shared and the LockShared bit is set to B'0', the Prevent Cartridge Removal option is allowed and ignored (returns GOOD status without action). Cartridge removal is enabled again when any initiator issues the Prevent Allow Medium Removal command, with the Prevent field set to B'00' (Allow Cartridge Removal). A power-on reset also restores the 3584 Tape Library to the allow removal state.

For physical security in an unattended environment, the 3584 Tape Library supports a manual lock on the library door. The locked door prevents access to the cartridges in the library.

Read Buffer - X'3C'

The Read Buffer command is supported by the 3584 Tape Library. Table 39 shows the command format.

Table 39. Read Buffer Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'3C')							
1	LUN (Obsolete)			Reserved		Mode		
2	Buffer ID							
3	Buffer Offset							
4								
5								
6	Allocation Length							
7								
8								
9	Vendor Specific (B'00')		Reserved (B'0000')				Flag B'0'	Link B'0'

The following 3584 Tape Library-specific parameters apply:

- **Mode:** The following values apply.

  B'001' Vendor Specific mode. Returns data contained in the buffer specified by the Buffer ID.

  B'011' Descriptor mode. Returns the offset boundary and buffer size (in bytes) for the buffer specified in the Buffer ID.

- **Buffer ID:** The buffers supported in the 3584 Tape Library are described in Table 40 on page 42.
- **Buffer Offset:** In mode B'001', the starting address in the buffer to be read. For mode B'011', this field must be X'000000'.
- **Allocation Length:** The maximum number of bytes to be transferred. The device transfers the number of bytes specified in the Allocation Length field or the number of bytes in the header and buffer being read, whichever is less. This is not an error.

Each buffer image has its own unique format, describing where certain key data may be found. Certain buffers contain embedded data in the buffer image describing the length of the total buffer image, and a CRC field that checks the total buffer image. Uploading the microcode buffer is one such example.

Table 40 on page 42 lists the accessible buffers.

Table 40. Read Buffer IDs

Buffer ID	Description
X'01'	Error Log Accessor 1
X'03'	NVRAM Event Log Accessor 1
X'04'	Servo Log Accessor 1
X'05'	Statistics Log Accessor 1
X'06'	Error Log Accessor 2
X'07'	NVRAM Event Log Accessor 2 (Buffer Size of 0 is returned if not installed)
X'08'	Servo Log Accessor 2 (Buffer Size of 0 is returned if not installed)
X'09'	Statistics Log Accessor 2 (Buffer Size of 0 is returned if not installed)
X'0A'	NVRAM Event Log OPC
X'0B'	NVRAM Dump Accessor 1
X'0C'	NVRAM Dump Accessor 2 (Buffer Size of 0 is returned if not installed)
X'11'	XYC Event Log Accessor 1
X'12'	XYC Event Log Accessor 2 (Buffer Size of 0 is returned if not installed)
X'13'	XYC1 Exception Log
X'14'	XYC2 Exception Log (Buffer size of 0 is returned if not installed)
X'21'	OPC Event Log
X'23'	OPC Exception Log
X'25'	OPC ES Data Log
X'31'	ACC Event Log Accessor 1
X'32'	ACC Event Log Accessor 2 (Buffer Size of 0 is returned if not installed)
X'33'	ACC1 Exception Log
X'34'	ACC2 Exception Log (Buffer Size of 0 is returned if not installed)
X'35'	ACC1 ES Data Log
X'36'	ACC2 ES Data Log (Buffer Size of 0 is returned if not installed)
X'41'-X'50'	MCC Event Log (Frames 1-16, Buffer Size of 0 is returned if not installed)
X'71'-X'80'	MCC Exception Log (Frames 1-16, Buffer Size of 0 is returned if not installed)
X'81'-X'90'	MCC ES Data Log (Frames 1–16, Buffer Size of 0 is returned if not installed)

Read Element Status - X'B8'

Table 41 shows the format of the Read Element Status command for the 3584 Tape Library.

Table 41. Read Element Status Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation code (X'B8')							
1	LUN (Obsolete)			VolTag	Element Type Code			
2	Starting Element Address							
3								
4	Number of Elements							
5								
6	Reserved						CURDATA	DVCID
7	Allocation Length							
8								
9								
10	Reserved							
11	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The following 3584 Tape Library-specific parameters apply:

- **VolTag (Volume Tags):** The following values apply:

  B'0' Requests the device to not report volume tag information.
  B'1' Requests the device to report volume tag information.

- **Element Type Code:** The following values apply:

  X'0' Reports all element types.
  X'1' Reports Medium Transport Elements only.
  X'2' Reports Storage Elements only.
  X'3' Reports Import/Export Elements only.
  X'4' Reports Data Transfer Elements only.

- **Starting Element Address:** The minimum element address to report.
- **Number of Elements:** The maximum number of elements to be included in this report. For Element Type Code X'2', when the DVCID bit is set to B'1' and the VolTag bit is set to B'1', the maximum number of elements that can be requested is 5,376 (X'1500'). Any request over this amount returns Illegal Request with the ASC/ASCQ set to 24/00 (Invalid Field in CDB).
- **DVCID (Device ID):** The following values apply:

  B'0' Requests the library to report status for the element indicated in the Element Type Code field.

B'1' Requests the library to report device identifiers, if available, for the following elements:

- Data Transfer Elements: If this bit is set to 1b, the VolTag field must be set to 0b and the Element Type Code field must be set to 4h. Only the device identifier data is valid in the response. All other data is returned as invalid with an ASC/ASCQ in each element descriptor set to 81/00 or 82/00 (Status is Questionable).
- Storage Elements: If this bit is set to 1b, all element descriptor data for the element is returned the same as when the bit is set to 0b. Additionally, device identifier data is returned that contains the physical location of the cartridge.
  Note: Cartridge physical location reporting is not supported if the control path drive is an LTO Ultrium 1 or LTO Ultrium 2 drive.

- **CURDATA:** The following values apply:

  B'0' Motion is allowed as needed to return a maximum set of valid element status data.

  B'1' Motion is not allowed; a minimum set of valid data may be returned. This field is supported for SCSI-3 compliance, but it is not required to be set to B'1' in order to obtain the Device IDs for the Data Transfer Elements.

- **Allocation Length:** The maximum number of bytes of data to be returned for this report.

Element Status Data

For the 3584 Tape Library, this data is a header that precedes the specific element type information, if any. Following this data are zero or more Element Status Pages, up to one for each of the four Element Types supported, if the command permits. Following each Element Status Page are zero or more Element Descriptors, up to one Element Descriptor for each element cell of that element type in the library, again if the data in the CDB permits.

Table 42. Header for Element Type Information

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	First Element Address Reported							
2-3	Number of Elements							
4	Reserved							
5-7	Byte Count of Report Available							

- **First Element Address Reported:** The smallest element address found to meet the CDB request.
- **Number of Elements:** The number of elements meeting the request in the CDB.

Element Status Page

For the 3584 Tape Library and the Read Element Status SCSI command, there is one status page for each of the element types to be reported.

Table 43. Element Status Page

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Element Type Code							

Table 43. Element Status Page (continued)

1	PVolTag	AVolTag (X'0')	Reserved
2-3	Element Descriptor Length		
4	Reserved		
5-7	Byte Count of Descriptor Data Available		

- **Element Type Code:** Indicates the element type reported by this page.
- **PVolTag (Primary volume tag):** The following values apply:

  B'0' Indicates that the primary volume tag information is omitted from the element descriptors that follow.
  B'1' Indicates that the primary volume tag information field is present in each of the element descriptors that follow.

- **AVolTag (Alternate volume tag):** The 3584 Tape Library does not support AVolTag.
- **Element Descriptor Length:** The following values apply:

  X'0010'If DVCID=B'0' and VolTag=B'0'
  X'0032'If DVCID=B'1' and VolTag=B'0' for an LTO logical library
  X'0034'If DVCID=B'1' and VolTag=B'0' for a 3592 logical library
  X'0034'If DVCID=B'0' and VolTag=B'1'
  X'004C'If DVCID=B'1' and VolTag=B'1'

- **Byte Count of Descriptor Data Available:** The number of bytes of element descriptor data available for elements of this element type that meet the request in the CDB.

Element Descriptors

For each Element Type of the Read Element Status SCSI command for the 3584 Tape Library, there is a set of Element Descriptors, one descriptor for each element in the library of that Element Type, up to the limit imposed by the CDB. These pages are described below.

Element Type 1: Medium Transport Element Descriptor. This is the element associated with the transport mechanism. Cartridges are never stored in the transport mechanism. However, this element descriptor can indicate the transport contains a cartridge in certain error conditions.

Table 44. Element Type 1: Medium Transport Element Descriptor

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	Element Address							
2	Reserved					Except	Reserved	Full
3	Reserved							
4-5	ASC/ASCQ							
6-8	Reserved							
9	SValid	Invert (B'0')	Reserved					
10-11	Source Storage Element Address							
12-47	Primary Volume Tag Information							

Table 44. Element Type 1: Medium Transport Element Descriptor (continued)

48-51 or 12-15	Reserved

- **Element Address:** There are two medium transport elements in the library. The following values apply:

  X'0001'
  X'0002'

- **Except:** The following values apply:

  B'0' The transport is in a normal state.
  B'1' The transport is in an abnormal state.

- **Full:** The following values apply:

  B'0' The transport does not contain a cartridge.
  B'1' The transport contains a cartridge. A value of B'1' indicates an error has occurred and recovery is required. Recovery of the cartridge from the transport can be performed by the host using the Move Medium command or by the operator using operator panel menus.

- **ASC/ASCQ:** Additional Sense Code/Additional Sense Code Qualifier. The ASC/ASCQ field may provide specific information on an abnormal element state when the Except bit is set to B'1'. The following values apply:

  11/00 Unable to Read Bar Code Label
  81/00 Status is Questionable (for example, the door is open)

- **SValid:**

  B'0' Indicates that the Source Storage Element Address field is not valid.
  B'1' Indicates that the Source Storage Element Address field is valid.

- **Invert:** The 3584 Tape Library does not invert cartridges.
- **Source Storage Element Address:** When SValid is B'1', this field provides the address of the last storage element from which this cartridge was moved.
- **Primary Volume Tag Information:** The presence or absence of this field is indicated by the PVolTag field in byte 1 of the Element Status Page (to view the content of this page, go to the section about Element Status Page). This is a 36-byte ASCII field that contains the cartridge bar code label, left-adjusted and padded on the right with blanks. Normally, there is no cartridge present in the picker when this command is processed; however, if a cartridge is present and label information is available, it will be returned.
- **Reserved:** Bytes 48-51 (bytes 12-15 if PVolTag is set to B'0').

Element Type 2: Storage Element Descriptor. This is the element used for cartridge storage.

Table 45. Element Type 2: Storage Element Descriptor (w/DVCID=0)

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	Element Address							

Table 45. Element Type 2: Storage Element Descriptor (w/DVCID=0) (continued)

2	Reserved		Access	Except	Reserved	Full
3	Reserved					
4-5	ASC/ASCQ					
6-8	Reserved					
9	SValid	Invert (B'0')	Reserved			
10-11	Source Storage Element Address					
12-47	Primary Volume Tag Information					
48-51 or 12-15	Reserved					

- **Element Address:** The range of element addresses reported in this field depend on the library's configuration. For additional details, see Chapter 5, "Addresses of SCSI Elements," on page 77.
- **Access:** The following values apply:

  B'0' Indicates that access to the storage element by a medium transport element is denied.
  B'1' Indicates that access to the storage element by a medium transport element is allowed.

  Note: An example of when access would be denied is when the storage element contains a cleaner cartridge and the auto-clean option is enabled.
- **Except:** The following values apply:

  B'0' The element is in a normal state.
  B'1' The element is in an abnormal state.

- **Full:** The following values apply:

  B'0' The element does not contain a cartridge.
  B'1' The element cell contains a cartridge.

- **ASC/ASCQ:** Additional Sense Code/Additional Sense Code Qualifier. The ASC/ASCQ field may provide specific information on an abnormal element state when the Except bit is set to B'1'. The following values apply:

  11/00 Unable to Read Bar Code Label
  30/03 Cleaning Cartridge Installed
  81/00 Status is Questionable (for example, the door is open)

- **SValid:**

  B'0' Indicates that the Source Storage Element Address field provides vendor-specific information
  B'1' This value is not reported for a Storage Element Descriptor.

- **Invert:** The 3584 Tape Library does not invert cartridges.
- **Source Storage Element Address:** When SValid is B'0', this field provides the following vendor-specific information:

Bit 15–1	Reserved
Bit 0	B'0' Element is located in the preferred zone of accessor A or is not currently assigned to a physical location. B'1' Element is located in preferred zone of accessor B.

- **Primary Volume Tag Information:** The presence or absence of this field is indicated by the PVolTag field in byte 1 of the Element Status Page (to view the content of this page, go to the section about Element Status Page). This is a 36-byte ASCII field that contains the cartridge bar code label, left-adjusted and padded on the right with blanks.
- **Reserved:** Bytes 48-51 (bytes 12-15 if PVolTag is set to B'0').

Table 46. Element Type 2: Storage Element Descriptor (w/DVCID=1)

Bit/byte	7	6	5	4	3	2	1	0
0–1	Element Address							
2	Reserved				Access	Except	Reserved	Full
3	Reserved							
4–5	ASC/ASQC							
6–8	Reserved							
9	SValid	Invert(B'0')	Reserved					
10–11	Source Storage Element Address							
12–47	Primary Volume Tag Information							
	Device ID							
48	Reserved				Code Set (2h)			
49	Reserved				Identifier Type (0h)			
50	Reserved							
51	Identifier Length 0h to 18h (valid identifier data)							
52–75	Device Identifier ASCII Element Information (Always padded to 24 byte length)							

Note: If the PVoltag bit is set to 0 in the CDB the Device ID starts at byte 12.

Element Descriptor bytes 0-47 are the same as Storage Element Descriptor w/DVCID=0, as shown in Table 45 on page 46. If the DVCID bit in the CDB is set to 0, the bytes 48-75 are omitted. If the DVCID bit in CDB is set to 1, bytes 48–75 are included and the following information applies:

- **Code Set:** This field is set to 2h indicating the Identifier data contains ASCII printable characters.
- **Identifier Type:** This field is set to 0h indicating the Identifier Type is Vendor Specific.
- **Identifier Length:** This field contains the length in bytes of valid Device Identifier information. If no device identifier is available, the Identifier Length field is 0h. If the DCVID bit is set, the Identifier Length can be set between 0 and 24 (18h) bytes.
- **Device Identifier:** The Device Identifier contains information about the element reported that can include physical location or other status. The format is ASCII. If location information is reported, it is ASCII comma separated values that

represent Frame, Column, Row and Tier (F3,C7,R34,T3). Other strings such as "Empty" or "Unknown" are reported if no cartridge is present, or if the location or status of the cartridge is unknown. The Device Identifier field is padded with ASCII 'space' (20h) characters to fill the complete 24 bytes. If the DVCID bit is set and the Identifier Length is 0, this field still contains 24 bytes.

Element Type 3: Import/Export Element Descriptor. This is the element used for moving volumes into and out of the medium changer. In the 3584 Tape Library, this element is also known as the I/O station and bulk I/O slots. In a shuttle complex, this element type is also known as the shuttle station for elements addresses 512 through 768.

Table 47. Element Type 3: Import/Export Element Descriptor (DVCID = B'0')

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	Element Address							
2	OIR (B'0')	CMC	InEnab	ExEnab	Access	Except	ImpExp	Full
3	Reserved							
4-5	ASC/ASCQ							
6-8	Reserved							
9	SValid	Invert (B'0')	Reserved					
10-11	Source Storage Element Address							
12-47	Primary Volume Tag Information							
48-51 or 12-15	Reserved							

- **Element Address:** The range of element addresses reported in this field depends on the library configuration. For additional details, see Chapter 5, "Addresses of SCSI Elements," on page 77.
- **CMC:** Connected Media Changer. The following values apply:

  B'0' Exports are to the I/O station and Imports are from the I/O station.
  B'1' Exports are to a connected media changer and Imports are from a connected media changer.

- **InEnab:** Import Enable. InEnab indicates that this element supports movement of media into the scope of the library.
- **ExEnab:** Export Enable. Indicates that this element supports movement of media out of the scope of the library.
- **Access:** The following values apply:

  B'0' Indicates that access to the Import/Export element by a Medium Transport Element is denied.
  B'1' Indicates that access to the Import/Export element by a Medium Transport Element is allowed.

Note: Examples of when access would be denied include (1) when the I/O Station door is open and (2) when a cartridge has been moved to the I/O

slot from a storage slot or drive that is part of a logical library different from the logical library reporting the status.

- **Except:** The following values apply:

  B'0' The element is in a normal state.
  B'1' The element is in an abnormal state.

- **ImpExp:** Import/Export. The following values apply:

  When the CMC bit = B'0'

  B'0' Indicates the unit of media in the Import/Export Element was placed there by the Medium Transport Element.
  B'1' Indicates the unit of media in the Import/Export Element was placed there by an operator.

  When the CMC bit = B'1'

  B'0' Indicates the unit of media in the Shuttle Station was placed there by the Medium Transport Element.
  B'1' Indicates the unit of media in the Shuttle Station was placed there by the shuttle car.

- **Full:** The following values apply:

  B'0' The element does not contain a cartridge.
  B'1' The element cell contains a cartridge.

- **ASC/ASCQ:** Additional Sense Code/Additional Sense Code Qualifier. The ASC/ASCQ field may provide specific information on an abnormal element state when the Except bit is set to B'1'. The following values apply:

  11/00 Unable to Read Bar Code Label
  81/00 Status is Questionable (for example, the door is open)

- **SValid:**

  B'0' Indicates that the Source Storage Element Address field is not valid.
  B'1' Indicates that the Source Storage Element Address field is valid.

- **Invert:** The 3584 Tape Library does not invert cartridges.
- **Source Storage Element Address:** When SValid is B'1', this field provides the address of the last storage element from which this cartridge was moved.
- **Primary Volume Tag Information:** The presence or absence of this field is indicated by the PVolTag field in byte 1 of the Element Status Page (to view the content of this page, go to the section about Element Status Page). This is a 36-byte ASCII field that contains the cartridge bar code label, left-adjusted and padded on the right with blanks.
- **Reserved:** Bytes 48-51 (bytes 12-15 if PVolTag is set to B'0').

Table 48. Element Type 3: Import/Export Element Descriptor (DVCID = B'1')

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0–1	Element Address							
2	OIR (B'0')	CMC	InEnab	ExEnab	Access	Except	ImpExp	Full

Table 48. Element Type 3: Import/Export Element Descriptor (DVCID = B'1') (continued)

3	Reserved			
4–5	ASC/ASCQ			
6–8	Reserved			
9	SValid	Invert (B'0')	Reserved	
10–11	Source Storage Element Address			
12–47	Primary Volume Tag Information			
	Device Identifier			
48	Reserved		Code Set (X'2')	
49	Reserved	Association (B'00')	Identifier Type (X'1')	
50	Reserved			
51	Identifier Length (X'00' or X'2C')			
52–59	Vendor ID			
60–75	Device Type and Model Number			
76–87	Serial Number of Device			
88–91	First Storage Element Address			
92–94	Frame Number			
95	Reserved			

- **CMC:** Connected Media Changer. The following values apply:

  B'0' Exports are to the I/O station and Imports are from the I/O station.
  B'1' Exports are to a connected media changer and Imports are from a connected media changer.

Note: If the DVCID bit is set to B'1' in the CDB, the Voltag bit must also be set to B'1', otherwise Illegal Request, Invalid Field in the CDB is returned.

Element Descriptor bytes 0–47 are the same as the Import/Export Element Descriptor bytes 0–47 with DVCID=0, as shown in Table 47 on page 49. If the DVCID bit in the CDB is set to B'0', bytes 48–91 are omitted.

For libraries where there is at least one shuttle station assigned to a logical library:

If the DVCID bit in the CDB is set to B'1' and the Import/Export element is present and the CMC bit is set to B'1', bytes 48–95 are reported and the following information applies. If the Import/Export element is not present or if the CMC bit is set to B'0', bytes 48–95 are reported and are set to X'0' and the Identifier Length is set X'00'.

For libraries where there are no shuttle stations assigned to a logical library:

If the DVCID bit in the CDB is set to B'1', the device returns CHECK CONDITION status with associated sense data of 5/2400 (Illegal Request, Invalid Field) in the CDB.

Note: Each IE device identifier reports the same information as reported in Inquiry Data Device Identifier page X'83' for the associated logical library, with the addition of the frame number, bytes 92–95.

- **Code set:** This field is set to X'2' indicating the Identifier data contains ASCII printable characters.
- **Identifier Type:** This field is set to X'1' indicating the Identifier Type is T10 vendor ID based.
- **Identifier Length:** This field contains the length in bytes of valid Device Identifier information. If the DCVID bit is set to B'1', the Identifier Length can be X'00' (no element present or CMC bit = B'0') or X'2C' (element present).
- **Vendor ID:** This is the same as Inquiry Standard Data bytes 8–15 of the associated logical library.
- **Device Type and Model Number:** This is the same as Inquiry Standard Data bytes 16–31 of the associated logical library.
- **Serial Number of Device:** This is right justified with leading zeroes, in ASCII (same as Inquiry Standard Data bytes 38–49 of the associated logical library).
- **First Storage Element Address:** ASCII representation of four hexadecimal digits from Mode Page X'1D', bytes 6–7 of the associated logical library.
- **Frame Number:** ASCII representation of 'Fxx' where xx is the frame number of the destination shuttle station ranging from '01' to '16'.

Element Type 4: Data Transfer Element Descriptor (DVCID=B'0'). This is the element descriptor block used to report the status of the drive.

Table 49. Element Type 4: Data Transfer Element Descriptor (DVCID=B'0')

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	Element Address							
2	Reserved				Access	Except	Reserved	Full
3	Reserved							
4-5	ASC/ASCQ							
6	Not Bus	Reserved	ID Valid	LU Valid	Reserved	Logical Unit Number (B'000')		
7	SCSI Bus Address							
8	Reserved							
9	SValid	Invert (B'0')	Reserved					
10-11	Source Storage Element Address							
12-47	Primary Volume Tag Information							
48-51 or 12-15	Reserved							

- **Element Address:** The range of element addresses reported in this field depend on the library's configuration. For additional details, see Chapter 5, “Addresses of SCSI Elements,” on page 77.

  Note: A valid configuration might include a 'gap' in the drive positions (for example, drives might be installed in positions 1 and 3 but not position 2). The Data Transfer Element information reported in Mode Sense and Read Element Status data will always include these 'gaps' (in the example above, the range of Data Transfer Element addresses will include X'0101' , X'0102', and X'0103'). The ASC/ASCQ field of the Data Transfer Element Descriptor indicates if the associated drive is not present.

- **Access:**

  B'0' Indicates that access to the Data Transfer element by a Medium Transport Element is denied.
  B'1' Indicates that access to the Data Transfer element by a Medium Transport Element is allowed.

  Note: Examples of when access would be denied include (1) when the tape drive contains a cartridge in the loaded position and (2) when a shared tape drive contains a cartridge that is assigned to another logical library.

- **Except:** The following values apply:

  B'0' The element is in a normal state.
  B'1' The element is in an abnormal state.

- **Full:** The following values apply:

  B'0' The element does not contain a cartridge.
  B'1' The element contains a cartridge in a loaded or ejected position.

Note: A cartridge in the loaded position is indicated by the Full bit set to B'1' and the Access bit set to B'0'. A cartridge in the ejected position is indicated by the Full bit set to B'1' and the Access bit set to B'1'.

- **ASC/ASCQ:** Additional Sense Code/Additional Sense Code Qualifier. The ASC/ASCQ field may provide specific information on an abnormal element state when the Except bit is set to B'1'. The following values apply:

11/00	Unable to Read Bar Code Label
81/00	Status is Questionable (for example, the door is open)
82/00	Drive is Not Present or is Unable to Communicate
83/00	Medium in Drive (Unable to Access Bar Code Label)

- **Not Bus:** Not this bus. This bit is not supported.
- **ID Valid:** The following values apply:

B'0'	Indicates the SCSI Bus Address field is not valid.
B'1'	Indicates that the SCSI Bus Address field contains valid information.

- **LU Valid:** The following values apply:

B'0'	Indicates the Logical Unit Number field is not valid.
B'1'	Indicates that the Logical Unit Number field contains valid information.

- **Logical Unit Number:** The LUN is always 0.
- **SCSI Bus Address:** Set to the SCSI ID of the drive.
- **SValid:**

B'0'	Indicates that the Source Storage Element Address field provides vendor-specific information. The SValid field is set to B'0' when the Full field is set to B'0'.
B'1'	Indicates that the Source Storage Element Address field is valid.

- **Invert:** The 3584 Tape Library does not invert cartridges.
- **Source Storage Element Address:** When SValid is B'1', this field provides the address of the last storage element from which this cartridge was moved. When SValid is B'0' and the Full field is set to B'0', this field provides the following vendor-specific information:

Bit 15–1	Reserved
Bit 0	B'0' Element is located in the preferred zone of accessor A or is not currently assigned to a physical location. B'1' Element is located in preferred zone of accessor B.

- **Primary Volume Tag Information:** The presence or absence of this field is indicated by the PVolTag field in byte 1 of the Element Status Page (to view the content of this page, go to the section about Element Status Page). This is a 36-byte ASCII field that contains the cartridge bar code label, left-adjusted and padded on the right with blanks.
- **Reserved:** Bytes 48-51 (bytes 12-15 if PVolTag is set to B'0').

Element Type 4: Data Transfer Element Descriptor (DVCID=B'1')

This is the element descriptor block used to report the device identifiers for the drive.

Table 50. Element Type 4: Data Transfer Element Descriptor (DVCID=B'1')

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	Element Address							
2	Reserved				Access (B'0')	Except (B'1')	Reserved	Full (B'0')
3	Reserved							
4-5	ASC/ASCQ							
6	Not Bus (B'0')	Reserved	ID Valid (B'0')	LU Valid (B'0')	Reserved	Logical Unit Number (B'000')		
7	SCSI Bus Address (X'00')							
8	Reserved							
9	SValid (B'0')	Invert (B'0')	Reserved					
10-11	Source Storage Element Address (X'0000')							
12-49 or 12-51	Identification Descriptor							

- **Element Address:** The range of element addresses reported in this field depend on the library's configuration. For additional details, see Chapter 5, “Addresses of SCSI Elements,” on page 77. The range is X'0101–0148'.

  Note: A valid configuration might include a 'gap' in the drive positions (for example, drives might be installed in positions 1 and 3 but not position 2). The Data Transfer Element information reported in Mode Sense and Read Element Status data will always include these 'gaps' (in the example above, the range of Data Transfer Element addresses will include X'0101' , X'0102', and X'0103'). The ASC/ASCQ field of the Data Transfer Element Descriptor indicates if the associated drive is not present.
- **Access:** Not supported when DVCID = B'1'.
- **Except:** Always set when DVCID = B'1'.
- **Full:** Not supported when DVCID = B'1'.
- **ASC/ASCQ:** Additional Sense Code/Additional Sense Code Qualifier. The ASC/ASCQ field may provide specific information on an abnormal element state when the Except bit is set to B'1'. The following values apply:

  8100 Status is Questionable, Drive is Present
  8200 Status is Questionable, Drive is Not Present

- **Not Bus:** Not this bus.
- **ID Valid:** Not supported when DVCID = B'1'.
- **LU Valid:** Not supported when DVCID = B'1'.
- **Logical Unit Number:** The LUN is always 0.
- **SCSI Bus Address:** Not supported when DVCID = B'1'.

- **SValid:** Not supported when DVCID = B'1'.
- **Identification Descriptor:** Indicates the following:
  - If no drive is present, all bytes are set to X'00'.
  - For LTO or 3592 devices, these bytes are the same as reported by the drive in Inquiry Page X'83', specifically the Identification Descriptor with Identifier Type of X'1'.

Related concepts

"Overview of Locations and Addresses of SCSI Elements" on page 77
This section discusses the SCSI element address that the firmware of the 3584 Tape Library assigns to each storage slot, I/O slot, and drive in the library. It describes how the address is used to indicate the location of an element.

Related reference

"Element Status Page" on page 44

Release Element (6) - X'17'

Table 51 shows the format of the Release Element command for the 3584 Tape Library.

Table 51. Release Element (6) Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'17')							
1	LUN (Obsolete)			3rdPty (B'0')	Third Party Device ID (B'000')			Element (B'0')
2	Reservation Identification (X'00')							
3	Reserved							
4	Reserved							
5	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The following 3584 Tape Library-specific parameters apply:

- **3rdPty:** Third Party. This release is not supported by the 3584 Tape Library.
- **Third Party Device ID:** Not supported by the 3584 Tape Library.
- **Element:** Element reservation. Not supported by the 3584 Tape Library.
- **Reservation Identification:** Not supported by the 3584 Tape Library.

Request Sense - X'03'

The Request Sense command is supported by the 3584 Tape Library. Table 52 shows the command format.

Table 52. Request Sense Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'03')							
1	LUN (Obsolete)			Reserved				
2	Reserved							
3	Reserved							
4	Allocation Length							
5	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

The following 3584 Tape Library-specific parameter applies:

- **Allocation Length:** The maximum number of bytes to be transferred. This device has up to 78 bytes of sense data. If the allocation length specified is less, then the allocated amount is transferred, the remaining sense data is lost, and no error is reported. If the allocated length specified is greater, then only up to 78 bytes of sense data are transferred and no error is reported.

Library Sense Data

For the 3584 Tape Library and the Request Sense SCSI command, the format of the sense data follows:

Table 53. Format of Library Sense Data

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Valid (B'0')	Error Code (X'70')						
1	Segment Number (X'00')							
2	Filemark (B'0')	EOM (B'0')	ILI (B'0')	Reserved	Sense Key			
3–6	Information (X'0000 0000')							
7	Additional Sense Length (n-7)							
8–11	Command-Specific Information (X'0000 0000')							
12	ASC							
13	ASCQ							
14	Field Replaceable Unit Code (X'00')							
15–17	Sense Key Specific (see explanation that follows)							
18	Hardware Error Code							
19	Hardware Error Code Qualifier							
20–22	Reserved							
23	Mechanism Status Bit Map							
24	Control Path Frame/Device							
25	Failing Frame/Device							
26	TapeAlert Flag Number							
27	Retry Count							
28	Object ID							
29–30	Object Error Code							
31–34	Reserved							
35	Source Element Bit Map							
36–37	Source Element Address							
38	Destination Element Bit Map							
39–40	Destination Element Address							
41	Secondary Source Element Bit Map							
42–43	Secondary Source Element Address							
44	Second Destination Element Bit Map							
45–46	Second Destination Element Address							
47–77	Reserved							

- **Sense Key:** Go to the section about SCSI Error Sense in the 3584 Tape Library.
- **Additional Sense Length:** When the Sense Key field is Recovered Error (1) or Hardware Error (4), the library reports a total of 78 bytes of sense data. For any other Sense Key, the library reports a total of 18 bytes of sense data. Supported values for this field are:

X'0A' (10)
X'46' (70)

- **Command-Specific Information:** The 3584 Tape Library does not support the commands associated with this field.
- **Additional Sense Code (ASC):** Go to the section about SCSI Error Sense in the 3584 Tape Library.
- **Additional Sense Code Qualifier (ASCQ):** Go to the section about SCSI Error Sense in the 3584 Tape Library.
- **Sense Key Specific:** Values vary, depending on the following conditions.
  - When the sense key field value is not Illegal Request, the SKSV bit is B'0' and bytes 15-17 are all set to X'00'.
  - When the sense key field value is Illegal Request and the SKSV bit is B'1', bytes 15-17 are interpreted as follows:

Table 54. Sense Key Specific Values

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
15	SKSV (B'1')	C/D	Reserved		BPV	Bit Pointer		
16-17	Field Pointer							

- **SKSV:** Sense key specific valid.
- **C/D:** Control/data

  B'0' Specifies that the error is in a data field of the parameter list.
  B'1' Specifies that the error is in a CDB field.

- **BPV:** Bit Pointer Valid.

  B'0' Specifies that the Bit Pointer Field is not valid.
  B'1' Specifies that the Bit Pointer Field is valid.

- **Bit Pointer:** When BPV is set to B'1', this field points to the bit in error of the field specified by the Field Pointer.
- **Field Pointer:** Points to the CDB byte or parameter byte in error.
- **Mechanism Status Bit Map (byte 23):** This is the state of the accessor after the termination of any retry or recovery algorithms. This byte is bit-mapped, as shown below, from Most Significant Bit (7) to Least Significant Bit (0):

Table 55. Mechanism Status Bit Map Values

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
23	Move capability	Last SCSI state	Completed	All returned	PKR1 full	PKR2 full	Determines which accessor failed	Fail 2

- **Move capability:** A "1" indicates that the accessor is capable of performing movement commands.
- **Last SCSI state:** A "1" indicates that the accessor is in the same condition as before the execution of the failed command.
- **Completed:** A "1" indicates that the cartridges were moved and the last command completed successfully.

- **All returned:** A "1" indicates that the cartridges were restored to the locations they occupied prior to the previous failed command.
- **PKR1 full:** A "1" indicates a cartridge is in the first media transport element. The transport was either unexpectedly full. or a cartridge remained in it after an attempt to recover from a failure. If the latter is true, the appropriate Element Bit Map byte will indicate which cartridge is in the transport.
- **PKR2 full:** A "1" indicates a cartridge is in the second media transport element. The transport was either unexpectedly full, or a cartridge remained in it after an attempt to recover from a failure. If the latter is true, the appropriate Element Bit Map byte will indicate which cartridge is in the transport.
- **Accessor:** A "0" indicates accessor A. A "1" indicates accessor B.
- **Fail2:** A "1" indicates the failure occurred on the second move of an EXCHANGE MEDIUM command (from the First Destination Element to the Second Destination Element). A "0" indicates that the failure occurred on the first move (from the Source Element to the First Destination Element).

When the Sense Key field value is Recovered Error (1) or Hardware Error (4), the library reports additional sense bytes 18 through 77. For additional information, see the *IBM System Storage TS3500 Tape Library Maintenance Information* manual.

Related information

Chapter 3, “SCSI Error Sense Information,” on page 71
This section introduces all possible combinations of Sense Keys, Additional Sense Codes (ASC), and Additional Sense Code Qualifiers (ASCQ) that are reported by the 3584 Tape Library

Request Volume Element Address - X'B5'

For the 3584 Tape Library, the Request Volume Element Address command transfers the results of a Send Volume Tag command. Multiple Request Volume Element Address commands may be used to retrieve the results of a single Send Volume Tag command with the translate option. Table 56 shows the command format.

Table 56. Request Volume Element Address Command

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Operation Code (X'B5')							
1	Reserved			Voltag	Element Type Code			
2-3	Element Address							
4-5	Number of Elements to Report							
6	Reserved							
7-9	Allocation Length							
10	Reserved							
11	Control							

The following 3584 Tape Library-specific behaviors apply:

Element Type Code shall act as a filter similar to (Minimum) Element Address, which, if the criteria are met, shall advance the most recent element address reported. Once information for a given element address has been reported, only higher element addresses will be reported by subsequent Request Volume Element Address commands (even if this means some Send Volume Tag element list matches are skipped and never reported). If the criteria are not met based on the Element Type Code or Element Address (and there are still element addresses to be reported), this command will respond with an empty volume element address header but the most recent element address reported will not be advanced and the element list will not be considered completely reported.

Table 57 shows the volume element address header format. For the format of the Element Status Pages, see “Read Element Status - X'B8'” on page 43.

Table 57. Volume Element Address Header

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-1	First Element Address Reported							
2-3	Number of Elements Reported							
4	Reserved			Send Action Code				
5-7	Byte Count of Report Available (all pages, x - 7)							
8-x	Element status page(s)							

If a Request Volume Element Address command is received and no prior Send Volume Tag command has been executed or the element list has been completely reported for the most recently successful Send Volume Tag command, the library will return command response data consisting of only the volume element address header with First Element Address Reported set to X'0000', Number of Elements Reported set to X'0000', and Byte Count of Report Available set to X'000000'.

Related reference

"Read Element Status - X'B8'" on page 43

Reserve Element (6) - X'16'

Table 58 shows the format of the Reserve Element command for the 3584 Tape Library.

Table 58. Reserve Element (6) Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'16')							
1	LUN (Obsolete)			3rdPty (B'0')	Third Party Device ID (B'000')			Element (B'0')
2	Reservation Identification (X'00')							
3-4	Element List Length (X'0000')							
5	Vendor Specific (B'00')		Reserved (B'0000'				Flag (B'0')	Link (B'0')

Note: When multiple logical libraries or control paths are configured (see the *IBM System Storage TS3500 Tape Library Introduction and Planning Guide*), the library has multiple medium changer device ports (via LUN 1 of the drives in LTO Ultrium or 3592 frames). Medium changer device reservations only prevent access for those initiators using the same device port as the initiator that has sent the Reserve command. Initiators that use another device port (for example, for a different logical library or different control path) are not affected.

The following 3584 Tape Library-specific parameters apply:

- **3rdPty:** Third Party. Not supported by the 3584 Tape Library.
- **Third Party Device ID:** Not supported by the 3584 Tape Library.
- **Element:** Element reservation. Not supported by the 3584 Tape Library.
- **Reservation Identification:** Not supported by the 3584 Tape Library.
- **Element List Length:** Not supported by the 3584 Tape Library.

Send Diagnostic - X'1D'

The Send Diagnostic command is supported by the 3584 Tape Library. Send Diagnostic is used to initiate the library's self-test diagnostics. Table 59 shows the command format.

Table 59. Send Diagnostic Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'1D')							
1	LUN (Obsolete)			PF (B'0')	Reserved	SlfTst (B'1')	DevOfl (B'0')	UnitOfl (B'0')
2	Reserved							
3	Parameter List Length (X'0000')							
4								
5	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

Send Volume Tag - X'B6'

For the 3584 Tape Library, the Send Volume Tag command transfers a volume tag template to be used for a search of existing volume tag information. The Request Volume Element Address command may be used to transfer the results of a translate search operation. Table 60 shows the command format.

Table 60. Send Volume Tag Command

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Operation Code (X'B6')							
1	Reserved				Element Type Code			
2-3	Element Address							
4	Reserved							
5	Reserved			Send Action Code				
6-7	Reserved							
8-9	Parameter List Length							
10	Reserved							
11	Control							

The following 3584 Tape Library-specific behaviors apply:

- **Send Action Code**: The following values are the only supported values:

  X'4' Translate - search all defined tags - ignore sequence numbers

  X'5' Translate - search primary tags - ignore sequence numbers
- **Parameter List Length**: Must be X'20' or X'28', otherwise the command is presented CHECK CONDITION status with associated sense data of 5/2400 (Illegal Request, Invalid CDB).

Table 61 shows the Send Volume Tag Parameters Format.

Table 61. Send Volume Tag Parameters Format

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0-31	Volume Identification Template							
32-33	Reserved							
34-35	Minimum Volume Sequence Number (ignored)							
36-37	Reserved							
38-39	Maximum Volume Sequence Number (ignored)							

The only 3584 Tape Library-specific behavior to apply is the **Volume Identification Template**, with the following special characters:

- '*' (X'2A') will match any string of characters. When it appears in a template, the remainder of the template at higher offsets is not used.
- '?' (X'3F'), blank character (X'20'), or null character (X'00') in a template will each be treated the same as an '*'.

Test Unit Ready - X'00'

The Test Unit Ready command is supported by the 3584 Tape Library. Table 62 shows the command format.

Table 62. Test Unit Ready Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'00')							
1	LUN (Obsolete)			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							
5	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

Write Buffer - X'3B'

Table 63 shows the format of the Write Buffer command for the 3584 Tape Library.

Table 63. Write Buffer Command

Byte	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB
0	Operation Code (X'3B')							
1	LUN (Obsolete)			Reserved		Mode		
2	Buffer ID							
3	Buffer Offset							
4								
5								
6	Parameter List Length							
7								
8								
9	Vendor Specific (B'00')		Reserved (B'0000')				Flag (B'0')	Link (B'0')

Mode: Supported modes are:

Mode 2	Data Mode
Mode 4	Download Microcode
Mode 5	Download Microcode and Save
Mode 6	Download Microcode With Offsets
Mode 7	Download Microcode With Offsets and Save

The following 3584 Tape Library-specific parameters apply for Modes 4–7:

- **Buffer ID:** X'00' For microcode.
- **Buffer Offset:** The 3584 Tape Library defines the buffer offset field to be the address of the first location to be written by the current Write Buffer command.
- **Parameter List Length:** The number of bytes to be transferred.

The following 3584 Tape Library-specific parameters apply for Data Mode 2:

- **Buffer ID:** The following Buffer IDs are used to transfer data associated with a shuttle complex detected error or the shuttle complex configuration. The data associated with these buffers is not defined in this specification.

  Note: When Buffer IDs X'00'–X'05' are to be sent in succession, they are sent in ascending order starting with Buffer ID X'00'.

Buffer ID	Buffer Description	Data Type
X'00'	Library Identifiers	ASCII
X'01'	Station Connection Map	binary
X'02'	Library Frames Map	binary
X'03'	Station Locked Map	binary
X'04'	Library Ethernet Address	ASCII
X'05'	Logical Library Names	ASCII

Buffer ID	Buffer Description	Data Type
X'06'	SCS Error	binary

- **Buffer Offset:** The 3584 Tape Library defines the buffer offset field to be the address of the first location to be written by the current Write Buffer command.
- **Parameter List Length:** The number of Data Mode bytes to be transferred with the current Write Buffer command.
- **Data Total Length:** For each Buffer ID, when Buffer Offset = 00, the Data Total Length shall be contained in the first four bytes of data transferred (Data Total Length = Parameter List Length – 4).

Chapter 3. SCSI Error Sense Information

This section introduces all possible combinations of Sense Keys, Additional Sense Codes (ASC), and Additional Sense Code Qualifiers (ASCQ) that are reported by the 3584 Tape Library

Sense Key 2 (Not Ready)

Table 64 gives the ASC and ASCQ summary for Sense Key 2 (Not Ready) in the 3584 Tape Library.

Table 64. ASC and ASCQ Summary for Sense Key 2 (Not Ready)

ASC ASCQ	Description
04 00	Logical Unit Not Ready, Cause Not Reportable
04 01	Logical Unit Is in Process of Becoming Ready
04 03	Logical Unit Not Ready, Manual Intervention Required
04 82	Library has not been calibrated
04 83	Library has not been set up
04 84	I/O Station is open
04 85	Logical Unit Not Ready, Door is Open

Sense Key 4 (Hardware Error)

Table 65 gives the ASC and ASCQ summary for Sense Key 4 (Hardware Error) in the 3584 Tape Library.

Table 65. ASC and ASCQ Summary for Sense Key 4 (Hardware Error)

ASC ASCQ	Description
44 00	Internal Target Failure

Sense Key 5 (Illegal Request)

Table 66 gives the ASC and ASCQ summary for Sense Key 5 (Illegal Request) in the 3584 Tape Library.

Table 66. ASC and ASCQ Summary for Sense Key 5 (Illegal Request)

ASC ASCQ	Description
1A 00	Parameter List Length Error
20 00	Invalid Command Operation Code
21 01	Invalid Element Address
24 00	Invalid Field in CDB
25 00	Logical Unit Not Supported
26 00	Invalid Field in Parameter List
2C 00	Command Sequence Error

Table 66. ASC and ASCQ Summary for Sense Key 5 (Illegal Request) (continued)

ASC ASCQ	Description
30 00	Incompatible Medium Installed
39 00	Saving Parameters Not Supported
3B 0D	Medium Destination Element Full
3B 0E	Medium Source Element Empty
3B 80	Medium Transport Element Full
3B 81	Element Not Accessible, Cartridge Present is Assigned to Another Logical Library
3B 82	Element Not Accessible, Drive is Not Present
3D 00	Invalid Bits in Identify Message
53 02	Medium Removal Prevented

Sense Key 6 (Unit Attention)

Table 67 gives the ASC and ASCQ summary for Sense Key 6 (Unit Attention) in the 3584 Tape Library.

Table 67. ASC and ASCQ Summary for Sense Key 6 (Unit Attention)

ASC ASCQ	Description
28 00	Not Ready to Ready Transition, Medium May Have Changed
28 01	Import or Export Element Accessed
29 00	Power On, Reset, or Bus Device Reset Occurred
2A 01	Mode Parameters Changed
3F 01	Microcode Has Been Changed

Sense Key B (Aborted Command)

Table 68 gives the ASC and ASCQ summary for Sense Key B (Aborted Command) in the 3584 Tape Library.

Table 68. ASC and ASCQ Summary for Sense Key B (Aborted Command)

ASC ASCQ	Description
1B 00	Synchronous Data Transfer Error
43 00	Message Error
44 00	Internal Target Failure
45 00	Select or Reselect Failure
47 00	SCSI Parity Error
48 00	Initiator Detected Error Message Received
49 00	Invalid Message Error
4A 00	Command Phase Error
4B 00	Data Phase Error
4E 00	Overlapped Commands Attempted

Chapter 4. Implementation Considerations for the 3584 Tape Library

This section introduces points to consider when you implement the 3584 Tape Library.

Default SCSI ID and Loop ID (AL_PA) Assignments for Drives

Based on its physical position in the frame of a 3584 Tape Library, each tape drive is assigned a default SCSI ID (from 0 to 12) or a default Loop ID (Arbitrated Loop Physical Address, commonly abbreviated as AL_PA). Table 69 lists the default SCSI IDs.

Table 69. Default SCSI ID for each drive in the IBM System Storage TS3500 Tape Library

Device Position	SCSI ID
Drive 1	0
Drive 2	1
Drive 3	2
Drive 4	3
Drive 5	4
Drive 6	5
Drive 7	6
Drive 8	8
Drive 9	9
Drive 10	10
Drive 11	11
Drive 12	12

Note: You can change the SCSI IDs or Loop IDs for the drives by using the SETTINGS menu option on the operator panel, or by using the IBM System Storage Tape Library Specialist Web interface. To change the IDs, refer to the appropriate procedure in the *IBM System Storage TS3500 Tape Library Operator Guide*.

Table 70 lists the default Loop IDs (AL_PAs).

Table 70. Default Loop IDs and their associated AL_PAs for drives with single or dual ports. For drives with single ports, use the values for Port 1; for drives with dual ports, use Ports 1 and 2.

Drive	Frames 1, 7, 13		Frames 2, 8, 14		Frames 3, 9, 15		Frames 4, 10, 16		Frames 5, 11		Frames 6, 12	
	Loop ID	AL_PA	Loop ID	AL_PA	Loop ID	AL_PA	Loop ID	AL_PA	Loop ID	AL_PA	Loop ID	AL_PA
Row 1												
Port 1	17	X'CC'	33	X'B1'	49	X'97'	65	X'71'	81	X'54'	97	X'39'
Port 2	81	X'54'	97	X'39'	18	X'CB'	34	X'AE'	17	X'CC'	33	X'B1'
Row 2												

Table 70. Default Loop IDs and their associated AL_PAs for drives with single or dual ports (continued). For drives with single ports, use the values for Port 1; for drives with dual ports, use Ports 1 and 2.

Drive	Frames 1, 7, 13		Frames 2, 8, 14		Frames 3, 9, 15		Frames 4, 10, 16		Frames 5, 11		Frames 6, 12	
	Loop ID	AL_PA	Loop ID	AL_PA	Loop ID	AL_PA	Loop ID	AL_PA	Loop ID	AL_PA	Loop ID	AL_PA
Port 1	18	X'CB'	34	X'AE'	50	X'90'	66	X'6E'	82	X'53'	98	X'36'
Port 2	82	X'53'	98	X'36'	19	X'CA'	35	X'AD'	18	X'CB'	34	X'AE'
Row 3												
Port 1	19	X'CA'	35	X'AD'	51	X'8F'	67	X'6D'	83	X'52'	99	X'35'
Port 2	83	X'52'	99	X'35'	20	X'C9'	36	X'AC'	19	X'CA'	35	X'AD'
Row 4												
Port 1	20	X'C9'	36	X'AC'	52	X'88'	68	X'6C'	84	X'51'	100	X'34'
Port 2	84	X'51'	100	X'34'	21	X'C7'	37	X'AB'	20	X'C9'	36	X'AC'
Row 5												
Port 1	21	X'C7'	37	X'AB'	53	X'84'	69	X'6B'	85	X'4E'	101	X'33'
Port 2	85	X'4E'	101	X'33'	22	X'C6'	38	X'AA'	21	X'C7'	37	X'AB'
Row 6												
Port 1	22	X'C6'	38	X'AA'	54	X'82'	70	X'6A'	86	X'4D'	102	X'32'
Port 2	86	X'4D'	102	X'32'	23	X'C5'	39	X'A9'	22	X'C6'	38	X'AA'
Row 7												
Port 1	23	X'C5'	39	X'A9'	55	X'81'	71	X'69'	87	X'4C'	103	X'31'
Port 2	87	X'4C'	103	X'31'	24	X'C3'	40	X'A7'	23	X'C5'	39	X'A9'
Row 8												
Port 1	24	X'C3'	40	X'A7'	56	X'80'	72	X'67'	88	X'4B'	104	X'2E'
Port 2	88	X'4B'	104	X'2E'	25	X'BC'	41	X'A6'	24	X'C3'	40	X'A7'
Row 9												
Port 1	25	X'BC'	41	X'A6'	57	X'7C'	73	X'66'	89	X'4A'	105	X'2D'
Port 2	89	X'4A'	105	X'2D'	26	X'BA'	42	X'A5'	25	X'BC'	41	X'A6'
Row 10												
Port 1	26	X'BA'	42	X'A5'	58	X'7A'	74	X'65'	90	X'49'	106	X'2C'
Port 2	90	X'49'	106	X'2C'	27	X'B9'	43	X'A3'	26	X'BA'	42	X'A5'
Row 11												
Port 1	27	X'B9'	43	X'A3'	59	X'79'	75	X'63'	91	X'47'	107	X'2B'
Port 2	91	X'47'	107	X'2B'	28	X'B6'	44	X'9F'	27	X'B9'	43	X'A3'
Row 12												
Port 1	28	X'B6'	44	X'9F'	60	X'76'	76	X'5C'	92	X'46'	108	X'2A'
Port 2	92	X'46'	108	X'2A'	29	X'B5'	45	X'9E'	28	X'B6'	44	X'9F'
Note: Loop IDs are given in decimal format and AL_PA values are given in hexadecimal format.												

LUN Assignments for Ultrium and 3592 Tape Drives in the 3584 Tape Library

In the 3584 Tape Library, the logical unit number (LUN) for the Sequential Access device is always LUN 0 of the drive, and the LUN for the Medium Changer device is always LUN 1 (all other LUNs are invalid addresses). These devices are compatible with the SCSI-2 or SCSI-3 standard. For information about the SCSI commands for the tape drive and the library, go to the section about SCSI commands for the 3584 Tape Library or the *IBM TotalStorage LTO Ultrium Tape Drive SCSI Reference*.

Related information

Chapter 2, "Supported SCSI Commands," on page 3
This section introduces the SCSI commands that are recognized by the TS3500 Tape Library.

Status of 3584 Tape Library During Automatic Cleaning

For an overview of the methods that are supported for cleaning a drive in the 3584 Tape Library, see the section about drive cleaning in the *IBM System Storage TS3500 Tape Library Introduction and Planning Guide*.

The design of automatic cleaning is intended to make the cleaning process as transparent as possible to any host application using the library. The library performs the following steps during an automatic cleaning process:

1. Detect the need and opportunity to clean a drive.
2. Move the cleaning cartridge from the storage cell to the drive.
3. Wait for drive cleaning to complete (approximately 90 seconds for Ultrium Tape Drives and about 3 minutes for 3592 Tape Drives).

   While waiting for the drive cleaning to complete, the 3584 Tape Library (medium changer) will accept and process all SCSI commands except for a move to a drive that is cleaning. Any command to move a data cartridge to a drive that is being cleaned will be queued.

   While an automatic cleaning is in progress, movement of the cleaning cartridge is not reflected in the element descriptors reported in response to a Read Element Status command. The Storage Element descriptor reported for the cleaning cartridge slot does not change while the cleaning cartridge is in a drive (indicates the FULL bit set to 1). Similarly, the Data Transfer Element descriptor reported for the drive that is cleaning does not change (indicates the FULL bit set to 0).
4. Move the cleaning cartridge from the drive to the storage cell.
5. Increment the cleaning cartridge usage counter.

   This counter is used by the library to determine when the cleaning cartridge should be replaced. When the usage counter has exceeded the recommended threshold, the library will display a warning message on the operator panel indicating the need to replace the cleaning cartridge.

Cleaning Cartridge Presence Indicators in the 3584 Tape Library

The 3584 Tape Library can monitor up to 100 cleaning cartridges in the physical library for any supported method of cleaning (see the section about drive cleaning in the *IBM System Storage TS3500 Tape Library Introduction and Planning Guide*). The presence of a library-monitored cleaning cartridge is indicated in the Storage Element descriptor of Read Element Status data as follows:

- EXCEPT bit is set to 1
- FULL bit is set to 1
- ASC/ASCQ field is set to 30/03
- The first, second, and third characters of the Primary Volume Tag field, if available, are set to CLN in ASCII

In addition, when automatic cleaning is enabled, the ACCESS bit is set to 0; when automatic cleaning is disabled, the ACCESS bit is set to 1.

While an automatic cleaning is in progress, movement of the cleaning cartridge is not reflected in the element descriptors. The Storage Element descriptor reported for the cleaning cartridge slot does not change while the cleaning cartridge is in a drive. Similarly, the Data Transfer Element descriptor reported for the drive that is cleaning does not change (indicates the FULL bit set to 0).

While a host cleaning is in progress, movement of the cleaning cartridge is reflected in the element descriptors in the same manner as for a data cartridge.

Automatic Cleaning Enabled Indicator

In the 3584 Tape Library, you can enable or disable automatic cleaning from the operator panel or IBM System Storage Tape Library Specialist web interface. The current setting may be detected by sending a SCSI Mode Sense command to the library (Medium Changer). Bit 2 of byte 2 in Mode Page 20 is set to 1 when automatic cleaning is enabled. This field may not be changed using Mode Select.

Note: The tape drive has no knowledge of the automatic cleaning setting and therefore, the drive does not suppress drive cleaning indicators when automatic cleaning is enabled (see “Drive Cleaning Indicators”). It is recommended that the host application log these notifications rather than present them to the operator when automatic cleaning is enabled.

Related concepts

“Drive Cleaning Indicators”

Drive Cleaning Indicators

Automatic cleaning of the drives by the 3584 Tape Library may be disabled (although it is not recommended). When automatic cleaning is disabled, the cleaning of the drives must be managed by the host application or manually by the operator.

Note: Failure to clean a drive may result in data loss.

For a description of how cleaning indicators are presented from the drive, see the applicable drive's SCSI command reference. The cleaning indicators may be presented even with automatic cleaning enabled in a library environment.

Chapter 5. Addresses of SCSI Elements

This section introduces addresses of SCSI elements in the TS3500 Tape Library

Overview of Locations and Addresses of SCSI Elements

This section discusses the SCSI element address that the firmware of the 3584 Tape Library assigns to each storage slot, I/O slot, and drive in the library. It describes how the address is used to indicate the location of an element.

In the IBM System Storage TS3500 Tape Library, each storage slot, I/O slot, and drive is assigned a logical SCSI element address by the library's firmware. When moving a tape cartridge within the library, you can specify its source and destination by SCSI element address (although many operators prefer to specify a volume serial number (VOLSER), or a frame, column, and row address).

This section introduces the physical locations of storage slots and drives. To understand the rules for determining their SCSI element addresses (as well as the element addresses of the I/O slots), go to the section about determining the SCSI element address with Advanced Library Management System (ALMS) enabled.

Note: With ALMS enabled, storage element addresses do not vary based on the number of storage slots, drives, or I/O slots in the library.

Related concepts

"Determining SCSI Element Addresses with ALMS Disabled" on page 92
This section introduces the rules to follow when the Advanced Library Management System (ALMS) is disabled and when you want to determine the SCSI element addresses of storage elements (storage slots), import/export elements (I/O slots), and data transfer elements (drives) in the 3584 Tape Library.

"Determining SCSI Element Addresses" on page 95
This section introduces the rules to follow when you want to determine the SCSI element addresses of storage elements (storage slots), import/export elements (I/O slots or shuttle stations), and data transfer elements (drives) in the TS3500 Tape Library with ALMS.

Related reference

"Location and quantity of storage slots in Models L22 and L23" on page 78

"Location and quantity of storage slots in Models D22 and D23" on page 80

"Location and quantity of storage slots in Model L32 without Capacity Expansion Feature" on page 82

"Location and quantity of storage slots in Model L32 with Capacity Expansion Feature" on page 84

"Location and quantity of storage slots in Model D32" on page 86

"Location and quantity of storage slots in Models L52 and L53" on page 88

"Location and quantity of storage slots in Models D52 and D53" on page 90

Location and quantity of storage slots in Models L22 and L23

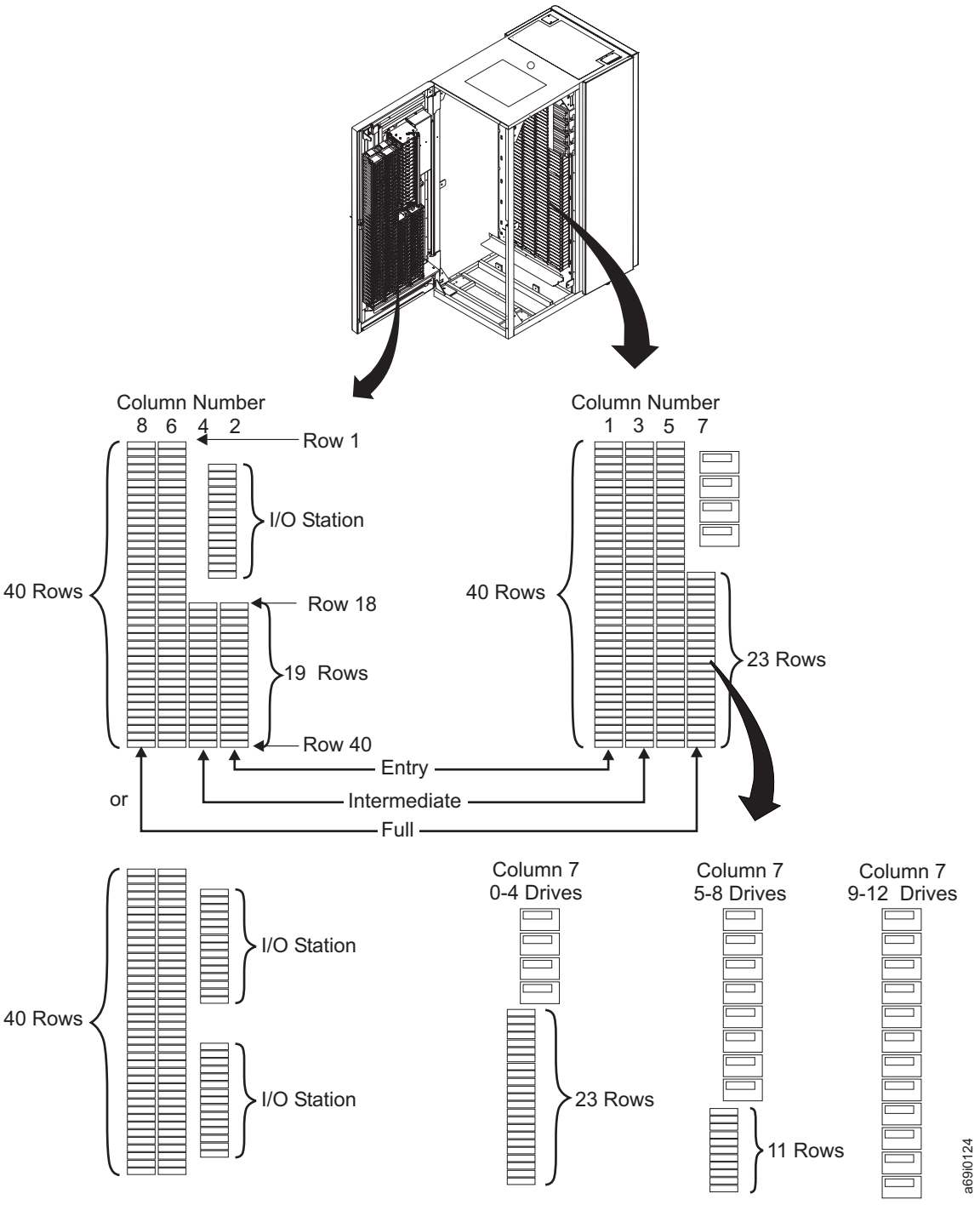

Figure 2. Location of storage slots in Models L22 or L23

Table 71. Quantity of storage slots (per column) in Model L22 or L23 frame with 16 or 32 I/O slots

Column Number	Capacity Configuration[1]	Quantity of Storage Slots in Model L22 or L23 Frame with 16 or 32 I/O Slots		
		1-4 Drives	5-8 Drives	9-12 Drives
1[2]	E, I, F	39	39	39
2	E, I, F	19	19	19
3	I, F	40	40	40
4	I, F	19	19	19
5	F	40	40	40
6	F	40	40	40
7	F	23	11	0
8	F	40	40	40
Total		260	248	237

Notes:

1. Abbreviations for capacity configurations are:
   - **E** Entry
   - **I** Intermediate
   - **F** Full
2. Column 1, Row 1 of the Model L22 and L23 is reserved for a diagnostic cartridge.

Location and quantity of storage slots in Models D22 and D23

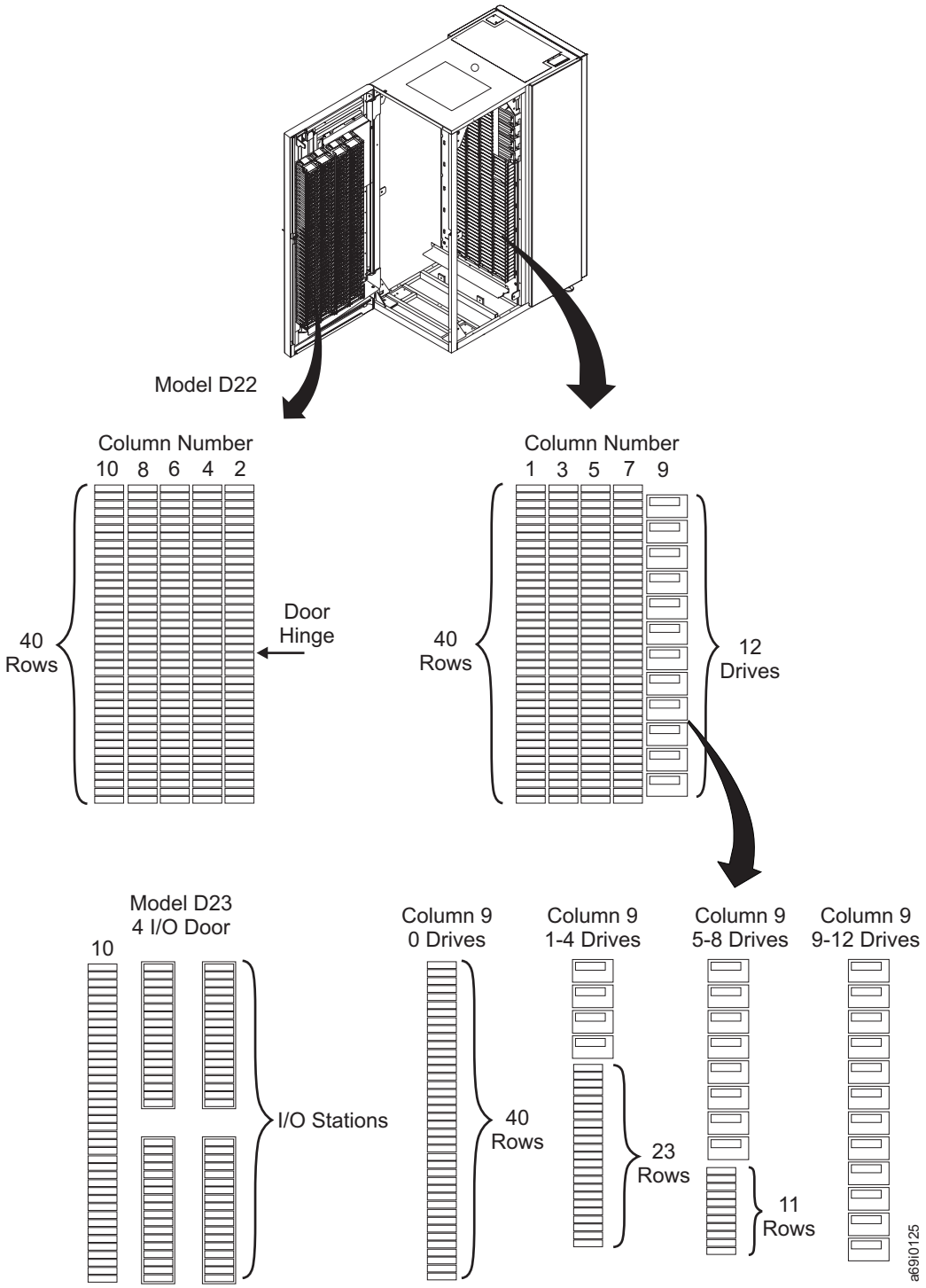

Figure 3. Location of storage slots in Models D22 or D23

Table 72. Quantity of storage slots (per column) in Model D22 or D23 frame

Column Number	Quantity of Storage Slots per Drives in Model D22 or D23 Frame			
	0 Drives	**1-4 Drives**	**5-8 Drives**	**9-12 Drives**
1 (see Note)	40	40	40	40
2	40	40	40	40
3	40	40	40	40
4	40	40	40	40
5	40	40	40	40
6	40	40	40	40
7	40	40	40	40
8	40	40	40	40
9	40	23	11	0
10	40	40	40	40
Total	400	383	371	360
Note: For the first Model D22 or D23 frame in a library based on Model L32 or L52, Column 1, Row 1 is reserved for a diagnostic cartridge. In this case, the quantity of slots in Column 1 (and the total) is reduced by one.				

Location and quantity of storage slots in Model L32 without Capacity Expansion Feature

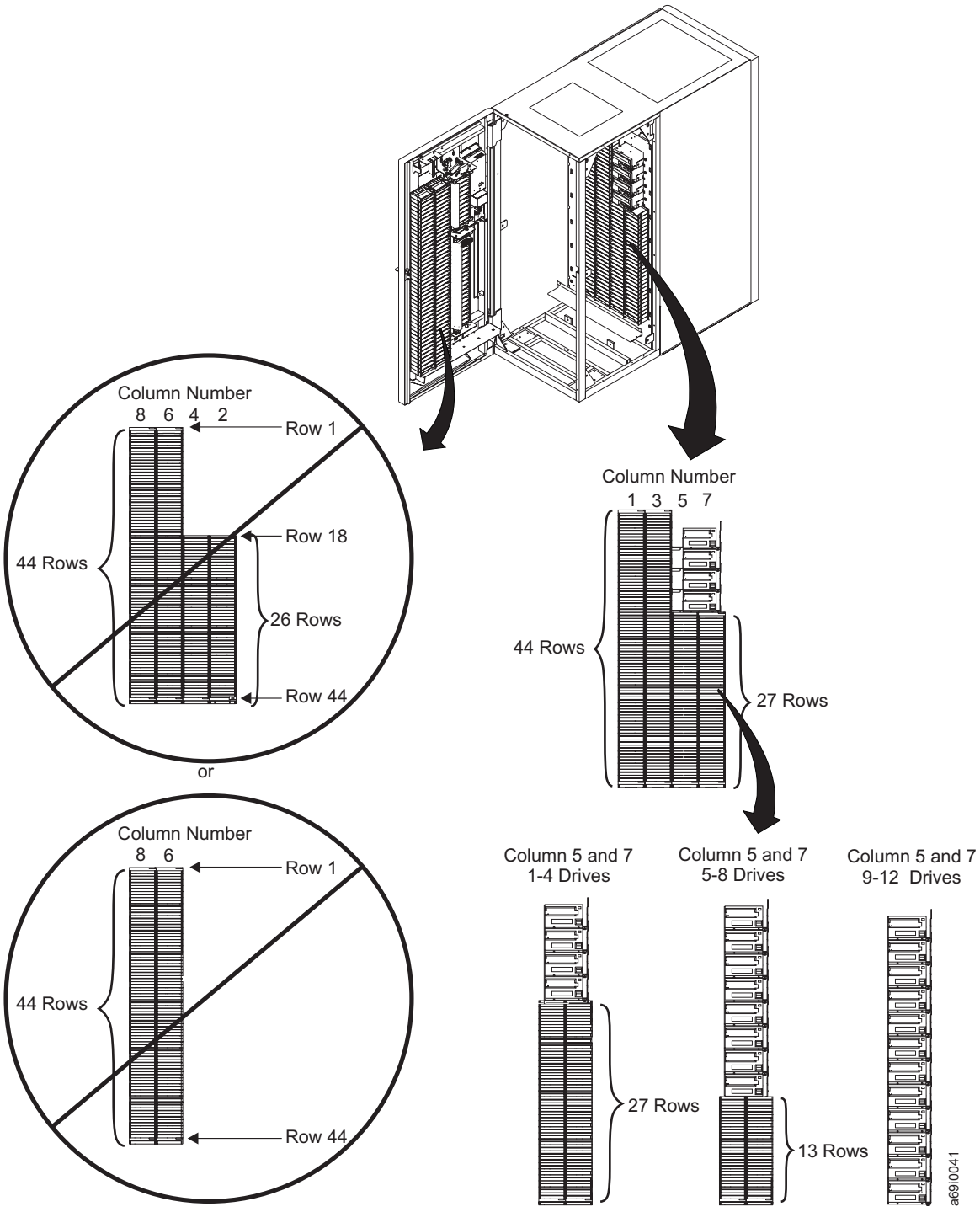

Figure 4. Location of storage slots in Model L32 without the capacity expansion feature. The storage slots on the door are unavailable.

Table 73. Quantity of storage slots (per column) in Model L32 frame without capacity expansion feature

Column Number	Quantity of Storage Slots in Model L32 Frame without Capacity Expansion Feature		
	1-4 Drives	**5-8 Drives**	**9-12 Drives**
1 (see Note)	43	43	43
2	0	0	0
3	44	44	44
4	0	0	0
5	27	13	0
6	0	0	0
7	27	13	0
8	0	0	0
Total	141	113	87
Note: Column 1, Row 1 of the Model L32 is reserved for a diagnostic cartridge.			

Location and quantity of storage slots in Model L32 with Capacity Expansion Feature

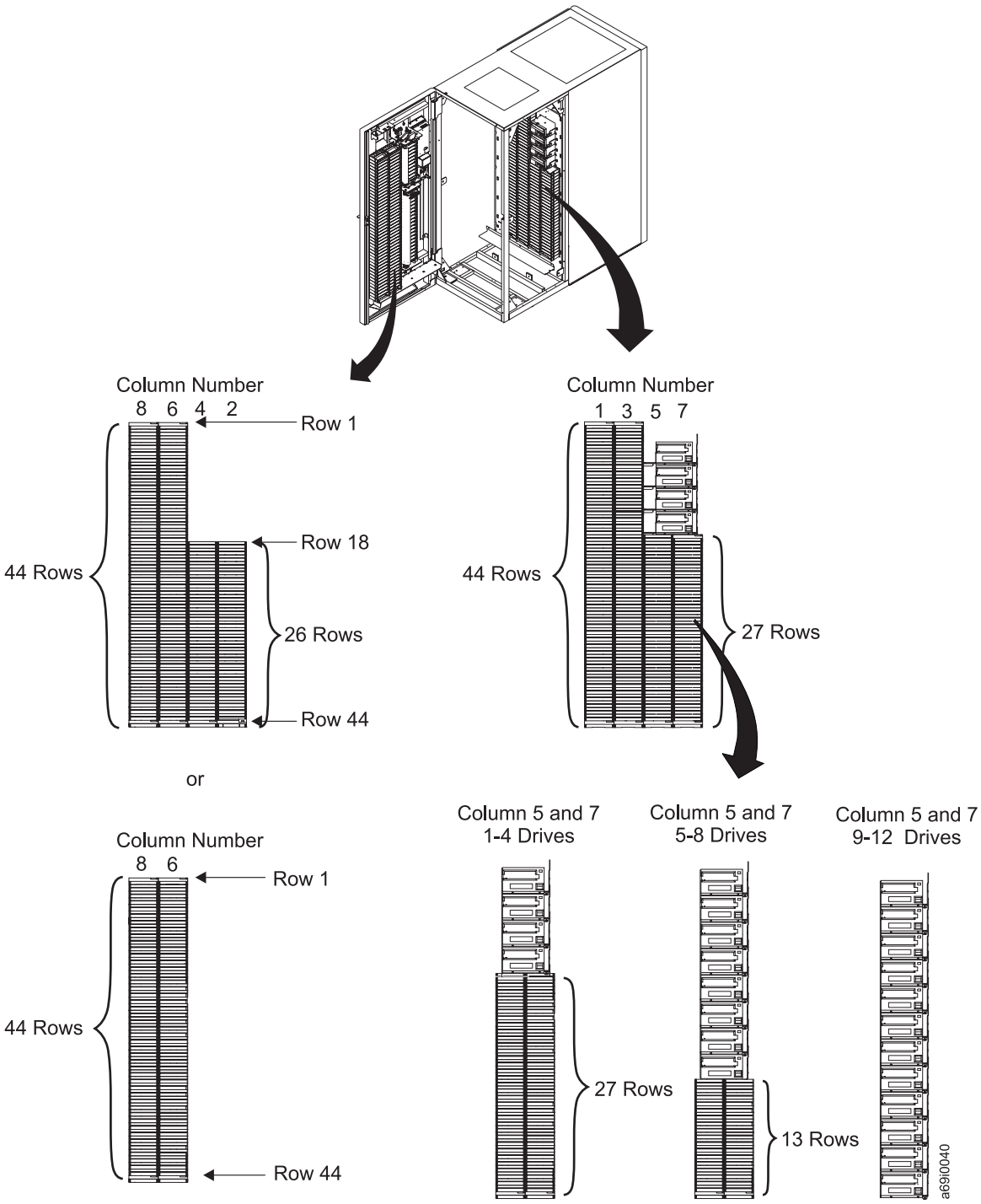

Figure 5. Location of storage slots in Model L32 with the capacity expansion feature. The storage slots on the door are available.

Table 74. Quantity of storage slots (per column) in Model L32 frame with capacity expansion feature and 10 I/O slots

Column Number	Quantity of Storage Slots in Model L32 Frame with Capacity Expansion Feature and 10 I/O Slots		
	0-4 Drives	**5-8 Drives**	**9-12 Drives**
1 (see Note)	43	43	43
2	26	26	26
3	44	44	44
4	26	26	26
5	27	13	0
6	44	44	44
7	27	13	0
8	44	44	44
Total	281	253	227
Note: Column 1, Row 1 of the Model L32 is reserved for a diagnostic cartridge.			

Table 75. Quantity of storage slots (per column) in Model L32 frame with capacity expansion feature and 26 or 30 I/O slots

Column Number	Quantity of Storage Slots in Model L32 Frame with Capacity Expansion Feature and 26 or 30 I/O Slots		
	0-4 Drives	**5-8 Drives**	**9-12 Drives**
1 (see Note)	43	43	43
2	0	0	0
3	44	44	44
4	0	0	0
5	27	13	0
6	44	44	44
7	27	13	0
8	44	44	44
Total	229	201	175
Note: Column 1, Row 1 of the Model L32 is reserved for a diagnostic cartridge.			

Location and quantity of storage slots in Model D32

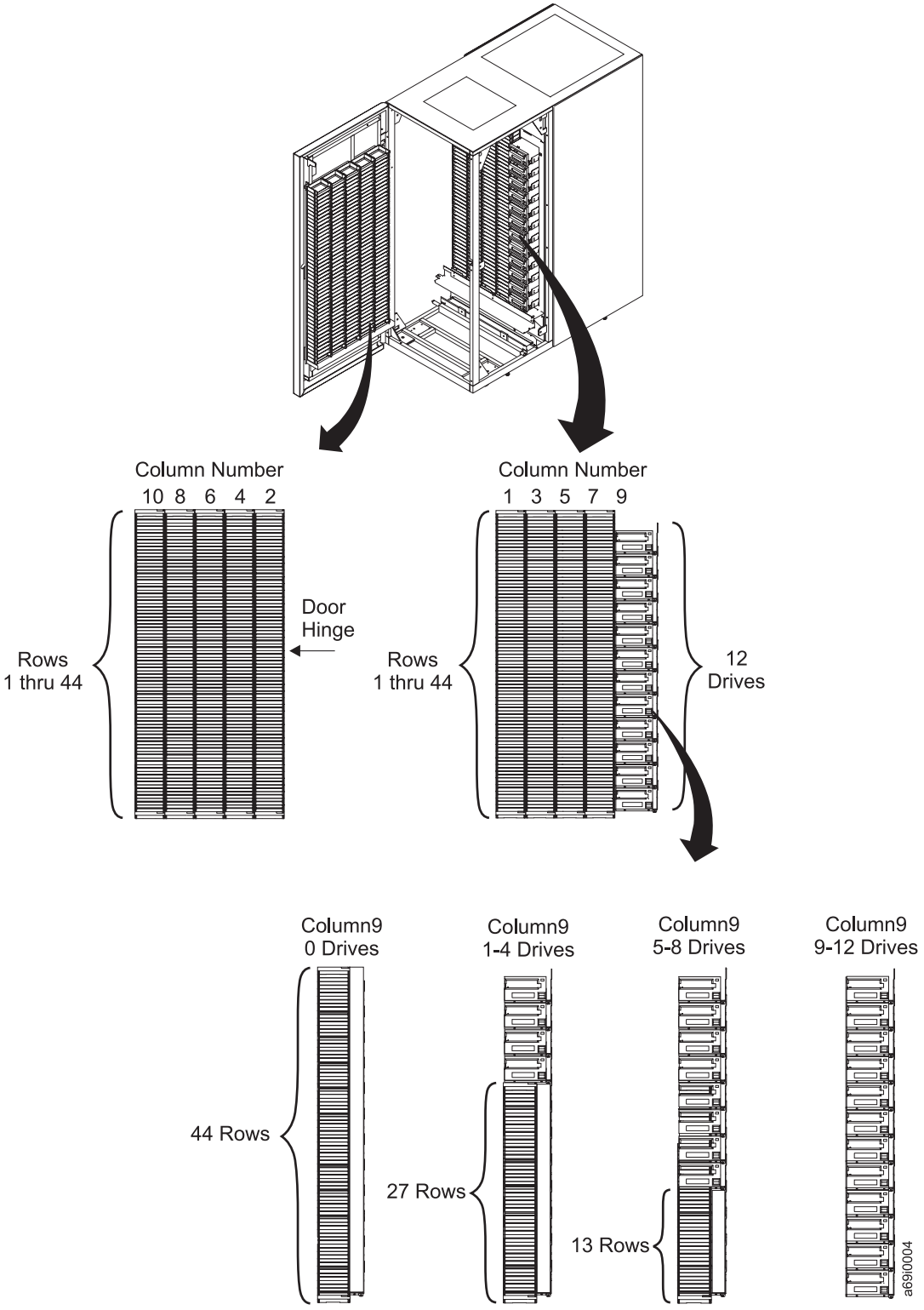

Figure 6. Location of storage slots in Model D32

Table 76. Quantity of storage slots (per column) in Model D32 frame

Column Number	Quantity of Storage Slots per Drives in Model D32 Frame			
	0 Drives	**1-4 Drives**	**5-8 Drives**	**9-12 Drives**
1	44	44	44	44
2	44	44	44	44
3	44	44	44	44
4	44	44	44	44
5	44	44	44	44
6	44	44	44	44
7	44	44	44	44
8	44	44	44	44
9	44	27	13	0
10	44	44	44	44
Total	440	423	409	396

Location and quantity of storage slots in Models L52 and L53

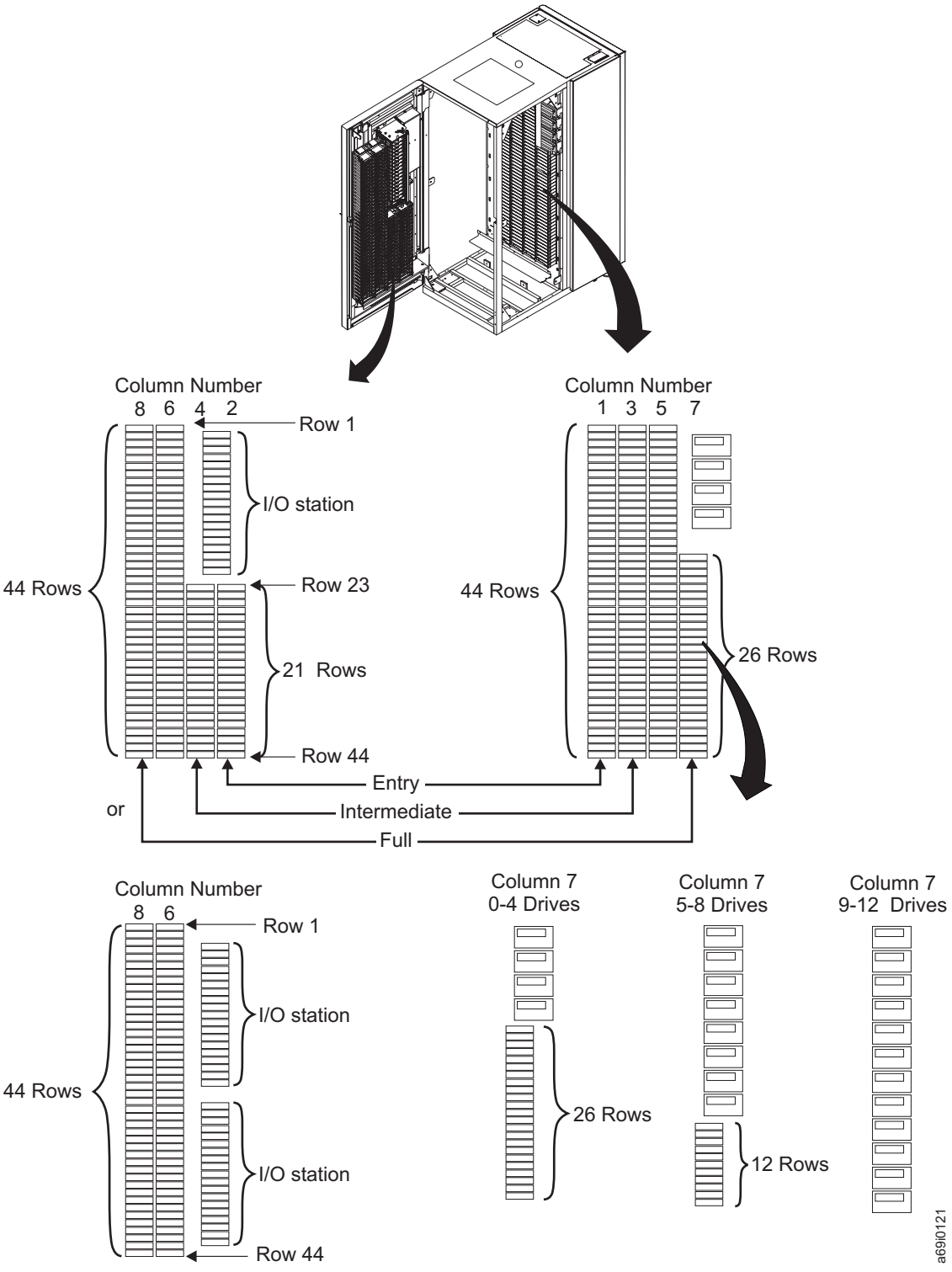

Figure 7. Location of storage slots in Models L52 or L53 with 16 or 32 I/O slots

Table 77. Quantity of storage slots (per column) in Models L52 or L53 frame with 16 or 32 I/O slots

Column Number	Capacity Configuration[1]	Quantity of Storage Slots in Model L52 or L53 Frame with Capacity Expansion Feature and 16 or 32 I/O Slots		
		0-4 Drives	5-8 Drives	9-12 Drives
1[2]	E, I, F	43	43	43
2	E, I, F	21	21	21
3	I, F	44	44	44
4	I, F	21	21	21
5	F	44	44	44
6	F	44	44	44
7	F	26	12	0
8	F	44	44	44
Total		287	273	261

Notes:

1. Abbreviations for capacity configurations are:
   - **E** Entry
   - **I** Intermediate
   - **F** Full
2. Column 1, Row 1 of the Model L52 and L53 is reserved for a diagnostic cartridge.

Location and quantity of storage slots in Models D52 and D53

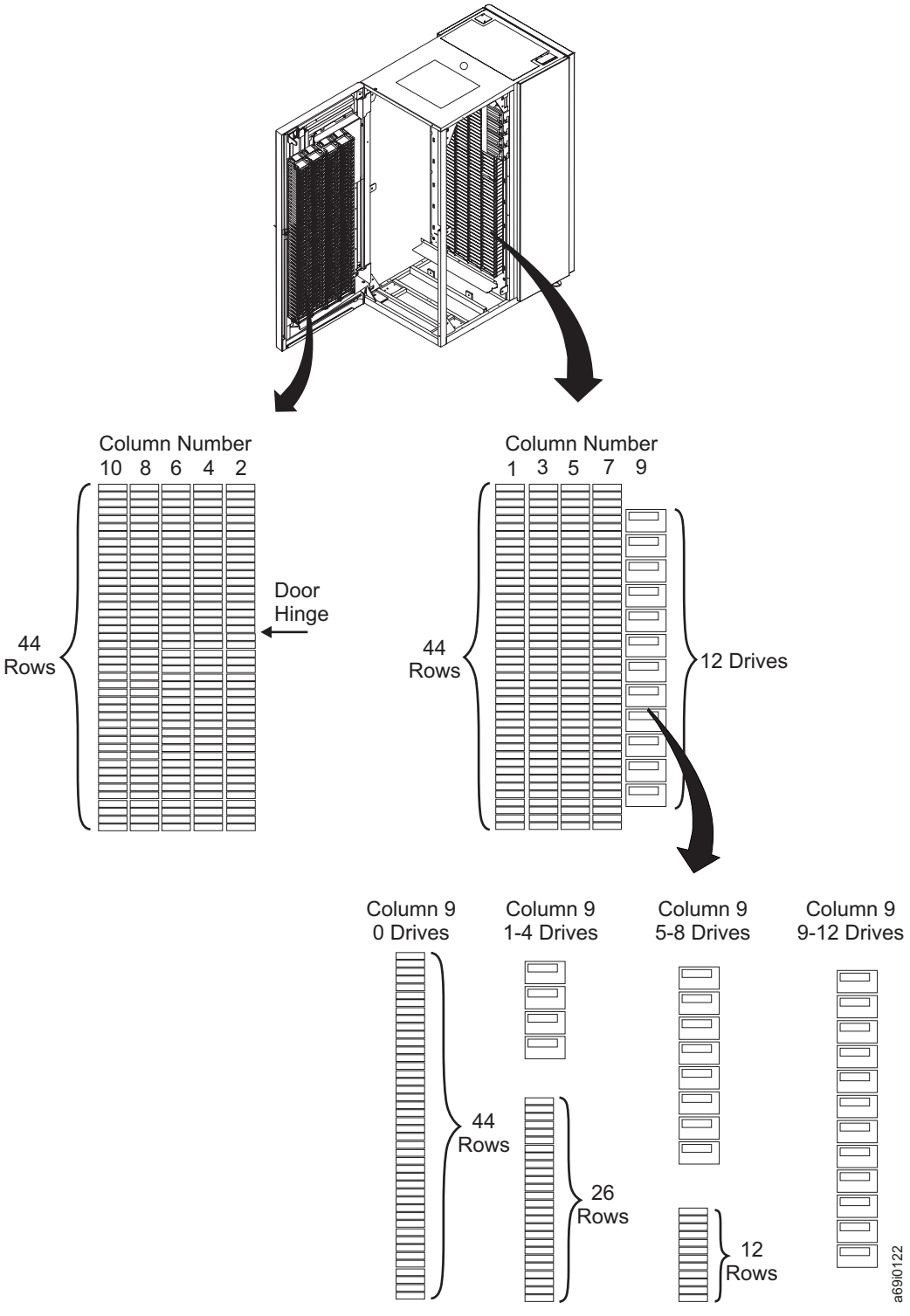

Figure 8. Location of storage slots in Models D52 or D53 with 16 or 32 I/O slots

Table 78. Quantity of storage slots (per column) in Model D52 or D53 frame

Column Number	Quantity of Storage Slots per Drives in Model D52 or D53 Frame			
	0 Drives	**1-4 Drives**	**5-8 Drives**	**9-12 Drives**
1 (see Note)	44	44	44	44
2	44	44	44	44
3	44	44	44	44
4	44	44	44	44
5	44	44	44	44
6	44	44	44	44
7	44	44	44	44
8	44	44	44	44
9	44	26	12	0
10	44	44	44	44
Total	440	422	408	396
Note: For the first Model D52 or D53 frame in a library based on Model L22 or L23, Column 1, Row 1 is reserved for a diagnostic cartridge. In this case, the quantity of slots in Column 1 (and the total) is reduced by one.				

Determining SCSI Element Addresses with ALMS Disabled

This section introduces the rules to follow when the Advanced Library Management System (ALMS) is disabled and when you want to determine the SCSI element addresses of storage elements (storage slots), import/export elements (I/O slots), and data transfer elements (drives) in the 3584 Tape Library.

Storage Element Addresses with ALMS Disabled

The 3584 Tape Library assigns storage element (StE) addresses sequentially to all storage slots in each frame, regardless of media type. When the Advanced Library Management System (ALMS) is disabled, it uses the following scheme for addressing:

1. Begin with the Model L22, L32, or L52 frame and assign the addresses from top to bottom, starting at Column 1, Row 1 with address 1024 (X'400').

   Note: Column 1, Row 1 of the first LTO Ultrium and 3592 frame is reserved for a diagnostic cartridge and is not addressable by the host application.
2. Move to Column 2 and continue the sequence from top to bottom, ignoring the I/O stations.
3. Continue to assign addresses in this manner (ignoring the I/O stations and drives) until each storage slot in the frame has been assigned a SCSI StE address.
4. If the library contains more than one frame, move right to the next frame and repeat this step (continuing with the next number in the sequence).

Figure 9 on page 93 shows one example of how the library assigns the SCSI

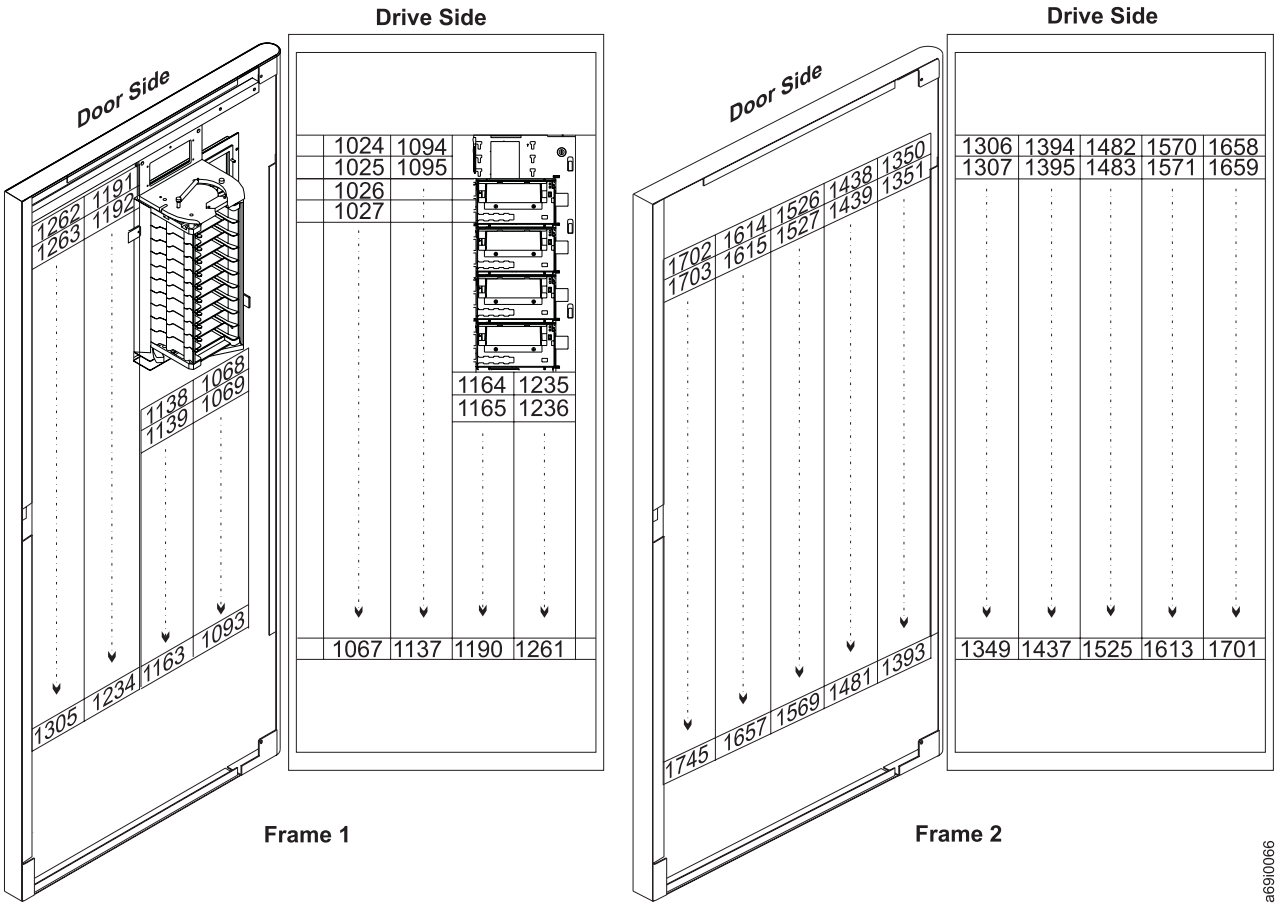

Figure 9. Assigning SCSI StE addresses to storage slots. The example shows a Model L32 and D32 frame, each with their front doors open. When assigning StE addresses, the library ignores the I/O stations and drives, and assigns the addresses to the slots beneath them.

storage element addresses.

Note: When ALMS is enabled, all element addresses in Figure 9 are not used.

Import/Export Element Addresses with ALMS Disabled

When the Advanced Library Management System (ALMS) is disabled, the 3584 Tape Library assigns import/export element (IEE) addresses sequentially to all I/O slots, from top to bottom, and regardless of media type, beginning at I/O slot 1 of the Model L22, L32, or L52, with address 769 (X'301').

Data Transfer Element Addresses with ALMS Disabled

When the Advanced Library Management System (ALMS) is disabled, the 3584 Tape Library assigns data transfer element (DTE) addresses sequentially to all 12 possible drive positions in each frame, regardless of media type. It uses the following scheme for addressing:

1. Begin with the Model L22, L32, or L52 frame and assign the addresses from top to bottom.
2. If the library contains more than one frame, move right to the next frame and continue the sequence from top to bottom.
3. Continue to assign addresses in this manner until each drive in every frame has been assigned a SCSI DTE address

Table 79 lists the SCSI addresses for the DTEs.

Table 79. Range of SCSI Data Transfer Element (DTE) addresses for tape drives in frames 1 through 16

Frame	Range of SCSI DTE Addresses for Tape Drives	
	Row 1	**Row 12**
1	257(X'101')	268(X'10C')
2	269(X'10D')	280(X'118')
3	281(X'119')	292(X'124')
4	293(X'125')	304(X'130')
5	305(X'131')	316(X'13C')
6	317(X'13D')	328(X'148')
7	329(X'149')	340(X'154')
8	341(X'155')	352(X'160')
9	353(X'161')	364(X'16C')
10	365(X'16D')	376(X'178')
11	377(X'179')	388(X'184')
12	389(X'185')	400(X'190')
13	401(X'191')	412(X'19C')
14	413(X'19D')	424(X'1A8')
15	425(X'1A9')	436(X'1B4')
16	437(X'1B5')	448(X'1C0')
Note: Addresses are given in decimal and hexadecimal format.		

Determining SCSI Element Addresses

This section introduces the rules to follow when you want to determine the SCSI element addresses of storage elements (storage slots), import/export elements (I/O slots or shuttle stations), and data transfer elements (drives) in the TS3500 Tape Library with ALMS.

Storage element addresses

With the Advanced Library Management System (ALMS) enabled in the TS3500 Tape Library, each storage element address is no longer associated with a specific storage slot. Instead, storage slots are virtualized by dynamically associating element addresses to them, as required. An element address is associated with a storage slot that is selected by the library as cartridges are moved and inventoried. In the case of a storage element that is empty due to a move, that source element address will be unassociated. Association of storage element addresses is accomplished in a way that is completely transparent to the application software.

With ALMS enabled, the first storage element address of any logical library is equal to 1024 plus the logical library number. For example, logical library 3 will have a starting storage element address of 1027 (X'403').

You can select the number of storage element addresses for a logical library (as reported to the host application software by the SCSI Mode Page X'1D') by changing the `Maximum Number of Cartridges` setting for that logical library through the Web user interface. For each logical library, the default value for `Maximum Number of Cartridges` is the number of accessible storage slots that are installed in the library for that cartridge type at the time that ALMS is first enabled, or after ALMS is enabled at the time that the logical library is created. You can change the `Maximum Number of Cartridges` setting for each logical library, but the value must always be greater than or equal to the number of actual cartridges that are currently assigned to that logical library. It is possible to set `Maximum Number of Cartridges` to a value that is higher than the number of accessible storage slots that are installed at the time in order to allow future library capacity expansion to be transparent to the host application software. However, application performance may degrade slightly due to the greater number of addresses. Take care not to exceed the license limitations of the host application software.

Import/export element addresses with virtual I/O slots disabled

When ALMS is enabled and virtual I/O slots are disabled, the TS3500 Tape Library assigns import/export element (IEE) addresses sequentially to all I/O slots. These assignments occur from top to bottom, regardless of media type, beginning at I/O slot 1 of the Model L22, L32, or L52, with address 769 (X'301').

Related concepts

"Import/Export Element Addresses with ALMS Disabled" on page 93

Import/export element addresses with virtual I/O slots enabled

With ALMS and virtual I/O slots enabled on the TS3500 Tape Library, each import/export element (IEE) address is no longer associated with a specific physical I/O station slot. Instead, I/O slots are virtualized by dynamically associating element addresses to them as required. The association of IEE addresses is accomplished in a way that is completely transparent to the application software.

By using the IBM System Storage Tape Library Specialist web interface, you can select the number of IEE addresses for a logical library (as reported to the host application software by the SCSI Mode Page X'1D') by changing the Max VIO Slots setting for that logical library up to a value of 255. For each logical library, the default value for the quantity of that logical library's IEE addresses is one of the following, depending on when ALMS and virtual I/O slots are enabled:

- If you enable ALMS and virtual I/O slots **before** creating a logical library, the number of virtual I/O slots is 255.

  For example:

  1. ALMS and virtual I/O slots are enabled.
  2. One or more logical libraries are created.

     Virtual I/O slots for each logical library defaults to 255 (the maximum number possible).

- If you enable ALMS and virtual I/O slots **after** creating a logical library, the number of virtual I/O slots equals the number of physical I/O slots.

  For example:

  1. One or more logical libraries are created.
  2. ALMS and virtual I/O slots are enabled.

     The virtual I/O slots for each logical library equals the number of physical slots in the convenience I/O station for that logical library's media type. Two examples are presented in the following list:

     a. If the physical library has one 16-slot convenience I/O station and one or more logical libraries are created for the LTO media type, you would have 16 virtual I/O slots per each logical library. This number is equal to the number of physical I/O slots.

     b. If the physical library has two 16-slot LTO convenience I/O stations or two 16-slot 3592 convenience I/O stations, and a logical library is created for each media type, the logical library for LTO would have 32 virtual I/O slots and the logical library for 3592 would also have 32 virtual I/O slots.

When you use virtual import/export element addressing, the IEE address range includes addresses from 769 (X'301') to 1023 (X'3FF'), allowing for a maximum of 255 IEE addresses for each logical library.

Each logical library has a unique virtual IEE address space that is not accessible by other logical libraries. In previous firmware releases, the IEE space was made up of physical I/O station slots that were shared by all logical libraries. If a cartridge was moved to and remained in the I/O station, all logical libraries had one less IEE address with which to process imports and exports. Virtual IEEs, however, allow each logical library to use all 255 elements without impacting other logical libraries. For example, two logical libraries might both have 255 cartridges in virtual IEEs 769 through 1023, but the cartridges are actually located in different physical storage slots. Thus, competition for IEE space between logical libraries is eliminated and the effective quantity of IEEs is enhanced without physical modifications to the library. The automatic queuing of a cartridge's moves between the I/O station and the virtual storage slots makes it appear to the host application that the library contains more physical I/O slots than actually exist. Thus, instead of sharing a maximum of 32 I/O slot addresses in Frame 1, each logical library can have up to 255 I/O slot addresses that are not shared. For information about configuring virtual I/O slots, see the sections about configuring the library in the *IBM System Storage TS3500 Tape Library with ALMS Operator Guide*.

Import/export element addresses for shuttle connections

This topic describes import/export element (IEE) addresses for shuttle connections in a TS3500 Tape Library shuttle complex.

In a TS3500 Tape Library shuttle complex that has one or more shuttle stations assigned to a logical library, the library has an additional set of IEE addresses that are automatically enabled for that logical library. The IEE address range reserved for the shuttle stations is 512 (X'200') through 768 (X'300'). The Mode Sense Element Address Assignment page X'1D' is updated to report the new range. Each element address in this range represents a specific shuttle station either on the local library or on remote library strings.

See the Read Element Status Import/Export element descriptor in "Element Descriptors" on page 45 for more detail on shuttle connection elements.

Data transfer element addresses

When the Advanced Library Management System (ALMS) is enabled for the first time in the TS3500 Tape Library, the Data Transfer Element (DTE) addresses of all installed or assigned tape drives are not changed from how they were set with ALMS disabled. However, after ALMS has been enabled, the DTE addresses for any newly installed or assigned drives are no longer dependent on drive position. Instead, the DTE address for any newly installed or assigned drive is determined by the sequence in which the drive is assigned to each logical library.

After ALMS is enabled, drives are assigned to logical libraries by using the Drive Assignment page of the IBM System Storage Tape Library Specialist Web interface. In the Web interface, the DTE address for the first drive that is assigned to a new logical library is 257 (X'101'). The DTE address for any other drive that is assigned to the logical library is based on the next available DTE address in that particular logical library. The next available DTE address is the lowest available DTE address after the starting DTE address (this fills any gaps between previously assigned DTE addresses that were created when the assignments for drives were removed or the drives themselves were removed). When a drive assignment is removed from a logical library through the Web interface, only that DTE address is made available for future assignment; no other DTE addresses are affected.

The Drive Assignment page also supports the option to share a drive between two or more logical libraries. The drive will be assigned a DTE address in more than one logical library. Note that the DTE addresses that are assigned to a shared drive may differ by logical library.

By using the flexible Drive Assignment capability of ALMS, any drive in any position within any frame is available to be assigned to any logical library without creating gaps in DTE addresses.

Chapter 6. TapeAlert flags

This section introduces the TapeAlert flags for the Ultrium tape drives, 3592 tape drives, and TS3500 Tape Library.

Overview of TapeAlert flags

This section describes the TapeAlert flags that are used to resolve problems with the TS3500 Tape Library and its tape drives.

TapeAlert is a standard that defines status conditions and problems experienced by devices such as tape drives, autoloaders, and libraries. The standard enables a server to read TapeAlert messages (called *flags*) from a tape drive or library. The server reads the flags from Log Sense Page 0x2E.

The IBM System Storage TS3500 Tape Library is compatible with TapeAlert technology, which provides error and diagnostic information about the drives and the library to the server.

TapeAlert flags supported by the Ultrium tape drives

This section lists the TapeAlert Flags that are supported by the Ultrium tape drives.

Table 80 lists the TapeAlert flags that are supported by the Ultrium tape drives.

Table 80. TapeAlert Flags that are supported by the Ultrium tape drives

TapeAlert Flags Supported by the Ultrium tape drives					
Flag Number and Name		**Description**	**Action Required**	**SNMP Trap**	**Call Home**
3	Hard error	Set for any unrecoverable read, write, or positioning error. (This flag is set in conjunction with flags 4, 5, or 6.)	See the Action Required column for Flag Number 4, 5, or 6 in this table.	Yes	No
4	Media	Set for any unrecoverable read, write, or positioning error that is due to a faulty tape cartridge.	Replace the tape cartridge.	Yes	No
5	Read failure	Set for any unrecoverable read error where isolation is uncertain and failure could be due to a faulty tape cartridge or to faulty drive hardware.	If Flag Number 4 is also set, the cartridge is defective. Replace the tape cartridge. If Flag Number 4 is not set, see Error Code 6 in the list of drive error codes in the *IBM System Storage TS3500 Tape Library Maintenance Information* guide.	Yes	No

Table 80. TapeAlert Flags that are supported by the Ultrium tape drives (continued)

TapeAlert Flags Supported by the Ultrium tape drives					
Flag Number and Name		**Description**	**Action Required**	**SNMP Trap**	**Call Home**
6	Write failure	Set for any unrecoverable write or positioning error where isolation is uncertain and failure could be due to a faulty tape cartridge or to faulty drive hardware.	If Flag Number 9 is also set, make sure that the write-protect switch is set so that data can be written to the tape. (See the section about setting the write-protect switch in the *IBM System Storage TS3500 Tape Library with ALMS Operator Guide*.) If Flag Number 4 is also set, the cartridge is defective. Replace the tape cartridge. If Flag Number 4 is not set, see Error Code 6 in the list of drive error codes in the *IBM System Storage TS3500 Tape Library Maintenance Information* guide.	Yes	No
7	Media life	Set when the tape cartridge reached its end of life (EOL).	1. Copy the data to another tape cartridge 2. Discard the old (EOL) tape.	Yes	No
8	Not data grade	Set when the cartridge is not data-grade. Any data that you write to the tape is at risk.	Replace the tape with a data-grade tape.	No	No
9	Write protect	Set when the tape drive detects that the tape cartridge is write-protected.	Make sure that the cartridge's write-protect switch is set so that the tape drive can write data to the tape. (See the section about setting the write-protect switch in the *IBM System Storage TS3500 Tape Library with ALMS Operator Guide*.)	No	No
10	No removal	Set when the tape drive receives an UNLOAD command after the server prevented the tape cartridge from being removed.	Refer to the documentation for your server's operating system.	No	No

Table 80. TapeAlert Flags that are supported by the Ultrium tape drives (continued)

TapeAlert Flags Supported by the Ultrium tape drives					
Flag Number and Name		**Description**	**Action Required**	**SNMP Trap**	**Call Home**
11	Cleaning media	Set when you load a cleaning cartridge into the drive.	No action required.	No	No
12	Unsupported format	Set when you load an unsupported cartridge type into the drive or when the cartridge format has been corrupted.	Use a supported tape cartridge.	No	No
14	Unrecoverable snapped tape	Set when the tape split apart.	Do not attempt to extract the old tape cartridge. Call the tape drive supplier's help line.	Yes	Yes
15	Cartridge memory chip failure	Set when a cartridge memory (CM) failure is detected on the loaded tape cartridge.	Replace the tape cartridge. If this error occurs on multiple cartridges, see Error Code 6 in the list of drive error codes in the *IBM System Storage TS3500 Tape Library Maintenance Information* guide.	Yes	No
16	Forced eject	Set when you manually unload the tape cartridge while the drive was reading or writing.	No action required.	No	No
17	Read Only format	Set when a cartridge marked as read only is loaded into the drive. The flag is cleared when the cartridge is ejected (this flag is not supported for Ultrium 1 or Ultrium 2).	No action required.	No	No
18	Tape directory corrupted in the cartridge memory	Set when the drive detects that the tape directory in the cartridge memory has been corrupted.	Re-read all data from the tape to rebuild the tape directory.	Yes	No
19	Nearing media life	Set when the tape cartridge is nearing its specified end of life. It is cleared when the cartridge is removed from the drive.	1. Copy the data to another tape cartridge. 2. Replace the tape cartridge.	No	No
20	Clean now	Set when the tape drive detects that it needs cleaning.	Clean the tape drive. See the section about the methods for cleaning drives in the *IBM System Storage TS3500 Tape Library with ALMS Introduction and Planning Guide*.	No	No

Table 80. TapeAlert Flags that are supported by the Ultrium tape drives (continued)

TapeAlert Flags Supported by the Ultrium tape drives					
Flag Number and Name		**Description**	**Action Required**	**SNMP Trap**	**Call Home**
21	Clean periodic	Set when the drive detects that it needs routine cleaning.	Clean the tape drive as soon as possible. The drive can continue to operate, but you should clean the drive soon. See the section about the methods for cleaning drives in the *IBM System Storage TS3500 Tape Library with ALMS Introduction and Planning Guide*.	No	No
22	Expired clean	Set when the tape drive detects a cleaning cartridge that has expired.	Replace the cleaning cartridge. See the section about removing a cleaning cartridge in the *IBM System Storage TS3500 Tape Library with ALMS Operator Guide*.	Yes	No
23	Invalid cleaning tape	Set when the drive expects a cleaning cartridge and the loaded cartridge is not a cleaning cartridge.	Use a valid cleaning cartridge.	Yes	No
30	Hardware A	Set when a hardware failure occurs that requires that you reset the tape drive to recover.	If resetting the drive does not recover the error, note the error code on the single-character display and see the list of drive error codes in the *IBM System Storage TS3500 Tape Library Maintenance Information* guide for the appropriate instructions.	Yes	No
31	Hardware B	Set when the tape drive fails its internal Power-On Self Tests.	Note the error code on the single-character display and see the list of drive error codes in the *IBM System Storage TS3500 Tape Library Maintenance Information* guide for the appropriate instructions.	Yes	Yes

Table 80. TapeAlert Flags that are supported by the Ultrium tape drives (continued)

TapeAlert Flags Supported by the Ultrium tape drives					
Flag Number and Name		**Description**	**Action Required**	**SNMP Trap**	**Call Home**
32	Interface	Set when the tape drive detects a problem with the SCSI, Fibre Channel, or RS-422 interface.	Locate Error Code 8 or 9 in the list of drive error codes in the *IBM System Storage TS3500 Tape Library Maintenance Information* guide.	Yes	Yes
33	Eject media	Set when a failure occurs that requires you to unload the cartridge from the drive.	Unload the tape cartridge, then reinsert it and restart the operation.	Yes	No
34	Download fail	Set when an FMR image is unsuccessfully downloaded to the tape drive through the SCSI or Fibre Channel interface.	Ensure that it is the correct FMR image. Download the FMR image again.	No	No
36	Drive temperature	Set when the drive's temperature sensor indicates that the drive's temperature is exceeding the recommended temperature of the library.	See Error Code 1 in the list of drive error codes in the *IBM System Storage TS3500 Tape Library Maintenance Information* guide.	Yes	No
37	Drive voltage	Set when the drive detects that the externally supplied voltages are either approaching the specified voltage limits or are outside the voltage limits (see the power specifications in the *IBM System Storage TS3500 Tape Library Introduction and Planning Guide*)..	See Error Code 2 in the list of drive error codes in the *IBM System Storage TS3500 Tape Library Maintenance Information* guide.	Yes	Yes
38	Predictive failure	Set when a hardware failure of the tape drive is predicted.	Contact your IBM Service Representative.	Yes	Yes
39	Diagnostics required	Set when the drive detects a failure that requires diagnostics for isolation.	See Error Code 6 in the list of drive error codes in the *IBM System Storage TS3500 Tape Library Maintenance Information* guide.	No	No
51	Tape directory invalid at unload	Set when the tape directory on the tape cartridge that was previously unloaded is corrupted. The file-search performance is degraded.	Use your backup software to rebuild the tape directory by reading all the data.	No	No

Table 80. TapeAlert Flags that are supported by the Ultrium tape drives (continued)

TapeAlert Flags Supported by the Ultrium tape drives					
Flag Number and Name		**Description**	**Action Required**	**SNMP Trap**	**Call Home**
52	Tape system area write failure	Set when the tape cartridge that was previously unloaded could not write its system area successfully.	Copy the data to another tape cartridge, then discard the old cartridge.	Yes	No
53	Tape system area read failure	Set when the tape system area could not be read successfully at load time.	Copy the data to another tape cartridge, then discard the old cartridge.	Yes	No
55	Load failure	The operation failed because the media cannot be loaded and threaded.	Remove the tape and try another. If the problem persists, contact your IBM Service Representative.	Yes	No
56	Unrecoverable unload failure	The operation failed because the media cannot be unloaded.	Contact your IBM Service Representative.	Yes	No
58	Firmware failure	The operation failed because of a problem with the firmware.	Contact your IBM Service Representative.	Yes	Yes
59	WORM Medium - Integrity Check Failed	Drive determined that data on tape is suspect, from a WORM point of view.	1. Copy the data to another WORM tape cartridge. 2. Discard the faulty WORM tape cartridge.	Yes	No
60	WORM Medium - Overwrite Attempted	This flag is set when the drive rejects a write operation because the rules for allowing WORM writes have not been met. Data can only be appended to WORM media. Overwrites to WORM media are not allowed.	Write the data to a WORM tape cartridge or write the data to a non-WORM tape cartridge.	Yes	No

TapeAlert flags supported by the 3592 tape drives

This section lists the TapeAlert flags that are supported by the 3592 tape drives.

Table 81 lists the TapeAlert flags that are supported by the 3592 tape drives.

Table 81. TapeAlert flags that are supported by the 3592 tape drives

TapeAlert Flags Supported by the 3592 tape drives					
Flag Number and Name		**Description**	**Action Required**	**SNMP Trap**	**Call Home**
1	Read warning	Set when the tape drive is having problems reading data. No data has been lost, but there has been a reduction in the performance of the tape.	Isolate the fault between drive and media by doing the following: Use a known good tape cartridge in the suspect drive. If the drive fails, contact your IBM Service Representative. Use the suspect tape cartridge in a known good drive. If the test fails, discard the cartridge.	No	No
2	Write warning	Set when the tape drive is having problems writing data. No data has been lost, but there has been a reduction in the capacity of the tape.	Isolate the fault between drive and media by doing the following: Use a known good tape cartridge in the suspect drive. If the drive fails, contact your IBM Service Representative. Use the suspect tape cartridge in a known good drive. If the test fails, discard the cartridge.	No	No
3	Hard error	Set for any unrecoverable read, write, or positioning error. The flag is cleared when the cartridge is removed from the drive (this flag is set in conjunction with flags 4, 5, or 6).	Determine if flags 4, 5, or 6 exist; follow the actions there.	Yes	No
4	Media	Set for any unrecoverable read, write, or positioning error that is due to faulty media. The flag is cleared when the cartridge is removed from the drive.	Discard the media.	Yes	No

Table 81. TapeAlert flags that are supported by the 3592 tape drives (continued)

TapeAlert Flags Supported by the 3592 tape drives					
Flag Number and Name		**Description**	**Action Required**	**SNMP Trap**	**Call Home**
5	Read failure	Set for any unrecoverable read error where the isolation is uncertain and the failure could be faulty media or drive hardware. The flag is cleared when the cartridge is removed from the drive.	Discard the media. If the failure persists, contact your IBM Service Representative.	Yes	Yes
6	Write failure	Set for any unrecoverable write or positioning error where isolation is uncertain and failure could be faulty media or drive hardware. The flag is cleared when the cartridge is removed from the drive.	Discard the media. If the failure persists, contact your IBM Service Representative.	Yes	No
7	Media life	Set when the tape cartridge reached its end of life (EOL).	1. Copy the data to another tape cartridge 2. Discard the old (EOL) tape.	Yes	No
8	Not data grade	Set when the tape cartridge is not data-grade. Any data that you back up to the tape is at risk. The flag is set when severe servo problems are detected while loading a cartridge.	Discard the media. If the failure persists, contact your IBM Service Representative.	No	No
9	Write protect	Set when the tape drive detects that the tape cartridge is physically write-protected and the device driver sees a write command. The flag is cleared when the cartridge is removed from the drive.	Set the write-protect switch on the cartridge to OFF. Ensure that the cartridge is not logically protected. If the problem persists, contact your IBM Service Representative.	No	No
10	No removal	Set when an unload is attempted and SCSI Prevent Media Removal is set to ON. The flag is cleared when the cartridge is removed from the drive.	If the error is an operator error, no action is required; if the error is a customer software error, see the documentation for your server's operating system.	No	No
11	Cleaning media	Set when a cleaning tape is loaded into the drive.	None. Status only.	No	No

Table 81. TapeAlert flags that are supported by the 3592 tape drives (continued)

TapeAlert Flags Supported by the 3592 tape drives					
Flag Number and Name		**Description**	**Action Required**	**SNMP Trap**	**Call Home**
12	Unsupported format	Set when a non-supported cartridge type is loaded into the drive. It is cleared when the cartridge is removed from the drive. Can also be caused by FMR tape loaded for Read/Write or a tape that is formatted for a TS1120 tape drive but loaded in an emulated drive.	Remove the invalid cartridge. If the problem persists, contact your IBM Service Representative.	No	No
14	Unrecoverable snapped tape	Set when the tape in the drive snapped. The operator cannot remove the tape.	Contact your IBM Service Representative.	Yes	Yes
15	Memory chip in cartridge	Set when the memory in the tape cartridge failed.	Do not use the cartridge for further backup operation.	Yes	No
16	Forced eject	Set when a tape cartridge was manually removed while reading and writing. It is cleared when a cartridge is loaded into the drive.	None. Status only.	No	No
17	Read-only format	Set when a "read-only," formatted tape is loaded into the drive. The flag is cleared when the cartridge is removed from the drive.	None. Status only.	No	No
18	Tape directory corrupted on load	Set when the tape drive detects that the directory has been corrupted. The flag is cleared when the cartridge is removed from the drive.	Operator action required. Re-read all data from the tape to rebuild the tape directory.	Yes	No
19	Nearing media life	Set when the tape cartridge is nearing its specified end of life. It is cleared when the cartridge is removed from the drive.	1. Copy the data to another tape cartridge. 2. Replace the tape cartridge.	No	No
20	Clean now	Set when the tape drive detects that it needs cleaning.	Clean the tape drive. See the section about the methods for cleaning drives in the *IBM System Storage TS3500 Tape Library with ALMS Introduction and Planning Guide*.	No	No

Table 81. TapeAlert flags that are supported by the 3592 tape drives (continued)

TapeAlert Flags Supported by the 3592 tape drives					
Flag Number and Name		**Description**	**Action Required**	**SNMP Trap**	**Call Home**
21	Clean periodic	Set when the tape drive detects that it needs routine cleaning.	Clean the tape drive as soon as possible. The drive can continue to operate, but you should clean it soon. See the section about drive cleaning in the *IBM System Storage TS3500 Tape Library with ALMS Introduction and Planning Guide*.	No	No
22	Expired cleaning media	Set when the tape drive detects a cleaning cartridge that has expired. It is cleared when a valid cleaning cartridge is loaded.	Replace the cleaning cartridge. See the section about removing a cleaning cartridge in the *IBM System Storage TS3500 Tape Library with ALMS Operator Guide*.	Yes	No
23	Invalid cleaning cartridge	Set when the drive expects a cleaning cartridge to be loaded and the loaded cartridge is not a cleaning cartridge.	Use a valid cleaning cartridge.	Yes	No
25	Dual-port interface error	Set when a redundant Fibre interface port on the tape drive failed.	Contact your IBM Service Representative.	Yes	Yes
26	Cooling fan failure	Set when a tape drive or power supply cooling fan failed.	Contact your IBM Service Representative.	Yes	Yes
27	Power supply	Set when a power supply failed.	Contact your IBM Service Representative.	Yes	Yes
30	Hardware A	Set when a hardware failure occurred that requires a drive reset to recover.	Contact your IBM Service Representative.	Yes	Yes
31	Hardware B	Set when the tape drive fails its internal Power-On Self-Tests (POSTs), and is not cleared until the drive is powered OFF.	Contact your IBM Service Representative.	Yes	Yes
32	Interface	Set when the tape drive detects a problem with the SCSI, Fibre Channel, or RS-422 interface. It is cleared when the drive is powered OFF.	Contact your IBM Service Representative.	Yes	Yes

Table 81. TapeAlert flags that are supported by the 3592 tape drives (continued)

TapeAlert Flags Supported by the 3592 tape drives					
Flag Number and Name		**Description**	**Action Required**	**SNMP Trap**	**Call Home**
33	Eject media	Set when a failure occurs that requires the tape cartridge to be ejected from the drive and retried. The flag is cleared when the cartridge is removed from the drive.	Try different media. If the problem persists, contact your IBM Service Representative.	Yes	No
34	Download fail	Set when an FMR image is unsuccessfully downloaded to the tape drive via the SCSI, Fibre Channel, or RS-422 interface. It is cleared when the drive is powered OFF or a successful microcode update is performed.	Contact your IBM Service Representative.	No	No
36	Drive temperature	Set when the drive temperature sensor indicates that the drive is too hot.	Contact your IBM Service Representative.	Yes	No
37	Drive voltage	Set when the drive detects power supply voltages outside of the specified voltage limits. It is cleared when the drive is powered OFF.	Contact your IBM Service Representative.	Yes	Yes
38	Predictive failure	Set when a hardware failure of the tape drive is predicted.	Contact your IBM Service Representative.	Yes	Yes
39	Diagnostics required	Set when a tape cartridge or drive FID or ATTN DRV message is posted. The flag is cleared when the drive is powered OFF.	Contact your IBM Service Representative.	No	No
50	Lost statistics	Set when media statistics were lost at some time in the past.	None. Status only.	No	No
51	Tape directory invalid at unload	Set when the tape directory on the tape cartridge that was previously unloaded is corrupted. The file-search performance is degraded.	Use your backup software to rebuild the tape directory by reading all the data.	No	No
52	Tape system area write failure	Set when the tape cartridge that was previously unloaded could not write its system area successfully.	Try another tape.	Yes	No
53	Tape system area read failure	Set when the tape system area could not be read successfully at load time.	Try another tape.	Yes	No
54	No start of data	Set when the start of data could not be found on the tape.	Try another tape.	Yes	No

Table 81. TapeAlert flags that are supported by the 3592 tape drives (continued)

TapeAlert Flags Supported by the 3592 tape drives					
Flag Number and Name		**Description**	**Action Required**	**SNMP Trap**	**Call Home**
55	Load failure	The operation failed because the media cannot be loaded and threaded.	Remove the tape and try another. If the problem persists, contact your IBM Service Representative.	Yes	No
56	Unrecoverable unload failure	The operation failed because the media cannot be unloaded.	Contact your IBM Service Representative.	Yes	No
58	Firmware failure	The operation failed because of a problem with the firmware.	Contact your IBM Service Representative.	Yes	Yes
59	WORM Medium - Integrity Check Failed	Drive determined that data on tape is suspect, from a WORM point of view.	1. Copy the data to another WORM tape cartridge. 2. Discard the faulty WORM tape cartridge.	Yes	No
60	WORM Medium - Overwrite Attempted	This flag is set when the drive rejects a write operation because the rules for allowing WORM writes have not been met. Data can only be appended to WORM media. Overwrites to WORM media are not allowed.	Write the data to a WORM tape cartridge or write the data to a non-WORM tape cartridge.	Yes	No

TapeAlert flags supported by the library

This section lists the TapeAlert flags that are supported by the TS3500 Tape Library.

Table 82 lists the TapeAlert flags that are supported by the TS3500 Tape Library.

Table 82. TapeAlert flags that are supported by the TS3500 Tape Library

TapeAlert Flags Supported by the TS3500 Tape Library					
Flag Number and Name		**Description**	**Action Required**	**SNMP Trap**	**Call Home**
1	Library hardware A	The library has trouble communicating with the drive.	1. Restart the operation. 2. If the problem persists, call your IBM service representative.	Yes	Yes
2	Library hardware B	The library has a hardware failure.	1. Restart the operation. 2. If the problem persists, call your IBM service representative.	Yes	Yes
4	Library hardware D	The library has a hardware fault that is not mechanically related.	1. Restart the operation. 2. If the problem persists, call your IBM service representative.	Yes	Yes
7	Predictive failure	The library detected that a hardware component is degraded but still operational.	Call your IBM service representative.	Yes	No
11	Library voltage limits	A potential failure of a power supply exists.	Call your IBM Service Representative.	Yes	Yes
16	Library door	A library door is open and prevents the library from functioning.	1. Close the library door. 2. If the problem persists, call your IBM service representative.	Yes	No
17	Library I/O station	A problem with an I/O station exists.	1. Ensure that there is no obstruction in the I/O station. 2. Restart the operation. 3. If the problem persists, call your IBM service representative.	Yes	Yes

Table 82. TapeAlert flags that are supported by the TS3500 Tape Library (continued)

TapeAlert Flags Supported by the TS3500 Tape Library					
Flag Number and Name		**Description**	**Action Required**	**SNMP Trap**	**Call Home**
23	Library scan retry	The operation to scan the bar code on a cartridge had to perform an excessive number of retries before succeeding. A potential problem exists with the bar code label or the scanner hardware in the library mechanism.	1. Check for damaged, misaligned, or peeling bar code labels on cartridges. 2. If the problem persists, call your IBM service representative.	Yes	No
24	Library inventory	An inventory of the media was inconsistent.	1. Run a library inventory to correct the inconsistency. 2. Restart the operation. 3. If the problem persists, call your IBM service representative.	Yes	No
25	Library illegal operation	The library detected an illegal operation.	If the problem persists, call your IBM service representative.	Yes	No
28	Power supply	A redundant power supply failure exists inside the library.	Call your IBM service representative.	Yes	Yes
30	Shuttle mechanism failure	A failure has occurred in the shuttle mechanism while attempting to transfer a cartridge between two library strings.	1. Restart the operation. 2. If the problem persists, call your IBM service representative.	Yes	Yes
32	Unreadable bar code label	During an inventory or scan, the library was unable to read a bar code label on a cartridge.	1. Check for damaged, misaligned, or peeling bar code labels on the cartridge. 2. If no problem is found, call your IBM service representative.	Yes	No

Appendix. Accessibility and Notices

Accessibility features for the *IBM System Storage TS3500 Tape Library SCSI Reference*

Accessibility features help users who have a disability, such as restricted mobility or limited vision, to use information technology products successfully.

Accessibility Features

The following list includes the major accessibility features in the *IBM System Storage TS3500 Tape Library SCSI Reference*:

- Keyboard-only operation
- You can use screen-reader software and a digital speech synthesizer to hear what is displayed on the screen.

Keyboard navigation

This product uses standard Microsoft; Windows navigation keys. You can navigate the *IBM System Storage TS3500 Tape Library SCSI Reference* information from the keyboard by using the shortcut keys for your browser or screen-reader software. See your browser or screen-reader software Help for a list of shortcut keys that it supports.

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Responsible Manufacturer:

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

European community contact:

IBM Deutschland GmbH
IBM Technical Regulations, Department M456
IBM-Allee 1, 71139 Ehningen, Germany

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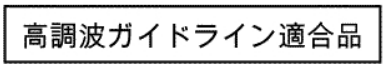

jijeta1

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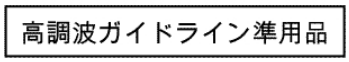

jijeta2

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rusemi

Glossary

This glossary defines the special terms, abbreviations, and acronyms used in this publication and other related publications. if you do not find the term you are looking for, see the *IBM Glossary of Computing Terms* at the following Web site: www.ibm.com/ibm/terminology.

Numbers

2:1 or 3:1 compression. The relationship between the quantity of data that can be stored with compression as compared to the quantity of data that can be stored without compression. In 2:1 compression, twice as much data can be stored with compression as can be stored without compression. In 3:1 compression, three times as much data can be stored with compression as can be stored without compression.

3584 Tape Library. See *IBM System Storage TS3500 Tape Library*.

3592 Tape Controller Model J70. See *IBM TotalStorage 3592 Tape Controller Model J70*.

3592 Tape Drive. See *IBM TotalStorage 3592 Tape Drive*.

3953 Tape System. The IBM 3953 Tape Frame Model F05 and the IBM 3953 Library Manager Model L05.

A

adapter. See *adapter card*.

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

Advanced Library Management System (ALMS). An extension of IBM's patented Multi-Path Architecture. ALMS enables logical libraries to consist of unique drives and ranges of VOLSERs, instead of fixed locations. It offers the ability to assign tape drives to any logical library by using the IBM Storage Tape Library Specialist web interface. Logical libraries can also be added, deleted, or easily changed without disruption. ALMS is optional and requires a license key.

ALMS. See *Advanced Library Management System*.

AL_PA. See *Arbitrated Loop Physical Address*.

ANSI. American National Standards Institute.

Arbitrated Loop Physical Address (AL_PA). An 8-bit value used to identify a device in an arbitrated loop. Device ports communicate by using AL_PAs.

ASC. Additional Sense Code.

ASCQ. Additional Sense Code Qualifier.

automatic cleaning. A method by which the 3584 Tape Library automatically responds to any tape drive's request for cleaning by beginning the cleaning process. An operator enables or disables automatic cleaning by using the menus on the library's touchscreen or the Tape Library Specialist web interface.

automatic inventory. A survey of the location of cartridges in the 3584 Tape Library. The library performs the survey at power-on or whenever the front door of any frame is opened during operation.

B

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

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

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

bar code reader. Located on the dual-gripper transport mechanism of the 3584 Tape Library, a laser device specialized for scanning and reading bar codes and converting them into the ASCII or EBCDIC digital character code. The bar code reader reads the bar code on the labels of cartridges or at the rear of empty storage slots.

base frame. The primary unit of the 3584 Tape Library (also known as Models L22, L23, L32, L52, or L53). The base frame is distinguished from an expansion frame by its I/O stations and operator panel. The base frame includes a rail assembly for the cartridge accessor, and up to 12 tape drives.

bit. Either of the digits 0 or 1 when used in the binary numbering system.

block. A collection of contiguous records recorded as a unit. Blocks are separated by interblock gaps, and each block may contain one or more records.

buffer. A routine or storage used to compensate for a difference in rate of flow of data, or time of occurrence of events, when transferring data from one device to another.

bus. See *SCSI bus*.

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

C

calibration. Adjustment, tuning.

calibration sensor. Located on the cartridge accessor of the 3584 Tape Library, the component that provides the means to find certain positions within the library very precisely during the calibration operation.

Call Home. A feature that allows the 3584 Tape Library to report failures to a support center by using a modem.

capacity. See *media capacity*.

Capacity Expansion Feature. Applicable only to the base frame (Models L22, L23, L32, L52, or L53) of the 3584 Tape Library, the cartridge storage slots that are located on the interior of the front door and enabled for additional storage. The Capacity Expansion Feature increases the maximum quantity of storage slots in the base frame.

cartridge. See *tape cartridge*.

cartridge accessor. The mechanism in the 3584 Tape Library that moves cartridges between the storage slots, tape drives, and the I/O stations. The accessor includes the X-axis motion assembly, Y-axis motion assembly, pivot assembly, cartridge gripper, bar code reader, and calibration sensor.

cartridge gripper. An electromechanical device on the cartridge accessor of the 3584 Tape Library that gets or puts cartridges from or to a storage slot, tape drive, or I/O station. Two grippers (Gripper 1 and Gripper 2) are located on the pivot assembly of the accessor. One gripper can grip a single cartridge.

cartridge memory. See *LTO cartridge memory*.

cartridge storage slot. One of several containers that are mounted inside the frames of the 3584 Tape Library and are used to store tape cartridges. See also *HD slot*.

CDB. See *command description block*.

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

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

command. A control signal that initiates an action or the beginning of a sequence of actions.

command descriptor block (CDB). A structure that is used to communicate a command from an application client to a device server. A CDB may have a fixed length of up to 16 bytes.

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

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

control path. (1) Designated by the operator of the 3584 Tape Library, a logical path into the library through which a server sends standard SCSI Medium Changer commands to control a specific logical library. (2) A tape drive that is designated by the operator of the 3584 Tape Library to manage communication to and from a server and the library.

D

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

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

data transfer element (DTE). In SCSI terms, a tape drive.

data transfer element address. In SCSI terms, the physical location of a tape drive.

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

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

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

differential. See *High Voltage Differential*.

disable. To make nonfunctional.

drive. See *IBM TotalStorage LTO Ultrium Tape Drive* or *IBM TotalStorage 3592 Tape Drive* .

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

DTE. See *data transfer element*.

dual-gripper transport mechanism. Located on the cartridge accessor of the 3584 Tape Library and mounted on the pivot assembly, the device that contains the two grippers which get and put cartridges into storage slots, drives, or the I/O stations.

E

eject. To remove or force out from within.

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

e-mail. See *electronic mail*.

enable. To make functional.

expansion frame. A unit that may be added to the base frame of the 3584 Tape Library. Also known as the Model D22, D23, D32, D52, D53, S24, or S54, the expansion frame includes a rail assembly for the cartridge accessor and up to 12 tape drives. Sxx models do not contain drives.

F

Fibre Channel. A high-speed, full-duplex, serial communications technology that is capable of interconnecting Ultrium and 3592 Tape Drives to servers which are separated by as much as 11 kilometers (7 miles). Fibre Channel technology combines features of the input/output (I/O) and networking interfaces.

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

firmware. Proprietary code that is usually delivered as part of an operating system. Firmware is more efficient than software loaded from an alterable medium and is more adaptable to change than pure hardware circuitry. An example of firmware is the Basic Input/Output System (BIOS) in read-only memory (ROM) on a PC motherboard.

frame. (1) In Fibre Channel technology, a unit of transmission that includes delimiters, control characters, information, and checking characters. (2) See *library frame*.

front door. Located at the front of each frame in the 3584 Tape Library, the swinging barrier by which entry is closed or opened to the frame.

full duplex. Simultaneous transmission and reception of data between two nodes of a network.

G

GB. See *gigabyte*.

get. (1) In library operation, the act of a cartridge gripper retrieving a tape cartridge from a storage slot, drive, or I/O station. (2) In Simple Network Management Protocol (SNMP), a request for information about the library that the operator issues through a monitoring server and which is transmitted by SNMP.

GiB. See *gibibyte*.

gibibyte (GiB). 1 073 741 824 bytes.

gigabyte (GB). 1 000 000 000 bytes.

H

HD frame. See *High density frame*.

HD slot. See *High density slot*.

head. See *drive head*.

hex, hexadecimal. (1) Pertaining to a selection, choice, or condition that has 16 possible different values or states. (2) Pertaining to a fixed-radix numeration system, with radix of 16. (3) Pertaining to a system of numbers to the base 16; hexadecimal digits range from 0 through 9 and A through F, where A represents 10 and F represents 15.

High density frame. An expansion frame that contains HD slots.

High density slot. A four-deep or five-deep container for cartridges in an HD frame.

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

host cleaning. A method that enables the host (server) to detect the need to clean a tape drive and to control the cleaning process. Host cleaning with a cleaning cartridge is only supported when automatic cleaning is disabled, and only for the logical library in which each cleaning cartridge is stored.

I

IBM LTO Ultrium Tape Drive. Located within the 3584 Tape Library, a data-storage device that controls the movement of the magnetic tape in IBM LTO Ultrium Tape Cartridges. The drive houses the mechanism (drive head) that reads and writes data to the tape.

IBM System Storage 3592 Tape Drive. Located within the 3584 Tape Library, high-performance, high-capacity streaming cartridge tape product designed for efficient

back-up for mid-range and high-end computing systems. The drive houses the mechanism (drive head) that reads and writes data to the tape.

IBM System Storage TS3500 Tape Library. Formerly known as the IBM TotalStorage 3584 Tape Library, a device that can be attached to one or more supported servers and used to write data to and from magnetic tape. The library, also known as the 3584 Tape Library, can include up to 16 frames and 192 drives, and any combination of Ultrium Tape Drives in Ultrium frames, and 3592 Tape Drives in 3592 frames.

IBM System Storage Tape Library Specialist web interface. A platform-independent, web-based interface that allows a user to configure and monitor the 3584 Tape Library from a remote location.

IBM TotalStorage 3592 Tape Controller Model J70. Located in the Tape Frame Model F05, a device that links the IBM @server zSeries server (mainframe host), the L05 Library Manager, and the 3592 Tape Drives in the 3584 Tape Library.

ID. Identifier.

IEE. See *import/export element*.

IEEA. See *import/export element address*.

import/export element (IEE). In SCSI terms, an I/O slot.

import/export element address (IEEA). In SCSI terms, the location of an I/O slot.

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

input/output (I/O) station. On the front door of the 3584 Tape Library, one or two compartments into which you insert and remove cartridges into and from the library. Both stations are accessed by the cartridge accessor.

insert. Pertaining to the 3584 Tape Library, a term used to describe the act of putting a tape cartridge into an I/O station.

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

interchange. The ability to process (read or write) given tape data on any one of a set of tape devices that support the form factor and recording format of the tape data.

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

inventory. (1) A survey of tape cartridges in the library and frames. (2) To make an inventory of.

I/O station. See *input/output station*.

L

label. See *bar code label*.

LCD. See *liquid crystal display*.

Linear Tape-Open (LTO). A type of tape storage technology developed by the IBM Corporation, Hewlett-Packard, and Certance. LTO technology is an "open format" technology, which means that its users have multiple sources of product and media. The "open" nature of LTO technology enables compatibility between different vendors' offerings by ensuring that vendors comply with verification standards. The LTO technology is implemented in two formats: the Accelis format focuses on fast access; the Ultrium format focuses on high capacity. The Ultrium format is the preferred format when capacity (rather than fast access) is the key storage consideration.

liquid crystal display. A low-power display technology used in computers and other I/O devices.

load. Pertaining to the 3584 Tape Library and following the insertion of a tape cartridge into a cartridge storage slot, the act (performed by the cartridge accessor) of transferring the cartridge from the storage slot to the drive and of positioning the tape (performed by the tape drive) for reading or writing by the drive head.

logical library. A set of cartridge storage slots and tape drives that are defined as a library by an operator. The operator identifies the slots and drives to the 3584 Tape Library by their location or count. The ability of the library to create logical libraries makes it possible for similar and dissimilar hosts (servers) to share its robotics. As a result, hosts can simultaneously run separate applications in separate logical libraries.

logical unit number (LUN). A number associated with the target address of a drive. The server uses the number to identify the address of the drive.

loop ID. In Fibre Channel technology, the identifier that the 3584 Tape Library assigned to an Ultrium or 3592 Tape Drive. The ID is based on the drive's physical location within the library and is used by other devices in the topology to communicate.

LSB. Least significant bit.

LTO. See *Linear Tape-Open*.

LUN. See *logical unit number*.

M

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

Management Information Base (MIB). Units of managed information that specifically describe an aspect of a system, such as the system name, hardware number, or communications configuration. A collection of related MIB objects is defined as a MIB. The 3584 Tape Library can use the MIB to interpret problem alerts that are transmitted by SNMP traps.

MB. See *megabyte*.

Mbps. Megabits per second.

mebibyte (MiB). 1 048 576 bytes.

media. The plural of *medium*.

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

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

Medium Changer Device. In SCSI terms, an instrument that moves removable storage units from and to storage slots and tape drives. The 3584 Tape Library is a Medium Changer Device.

megabyte (MB). 1 000 000 bytes.

MiB. See *Mebibyte*.

MIB. See *Management Information Base*.

MSB. Most significant bit.

N

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

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

O

operating environment. The temperature, relative humidity rate, and wet bulb temperature of the room in which the 3584 Tape Library routinely conducts processing.

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

operator panel. A functional unit that contains buttons to control the tape library. The unit's LCD touchscreen provides information about the operation of the 3584 Tape Library, and one or two I/O stations for inserting and removing cartridges.

optimized dual gripper. Mounted on the pivot assembly, the electromechanical device that gets or puts cartridges from or to a storage slot, tape drive, or I/O station. There are two grippers on the pivot assembly. The grippers are located on the dual-gripper transport mechanism, and they act like claws that remove and replace the cartridges. In libraries that mix drive types, the optimized dual grippers can house both Ultrium and 3592 Tape Cartridges. Thus, if one gripper fails another will act as backup to process a cartridge.

P

pivot assembly. On the cartridge accessor of the 3584 Tape Library, a group of parts that provides a mounting platform for the gripper mechanism and the bar code reader. The pivot assembly is capable of 180° rotation about the vertical axis.

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

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

power supply. The electrical component of a computer system that converts standard ac current to the lower voltage dc current used by the computer. The amount of current a power supply can provide is rated in amperes.

protocol. The meanings of, and the sequencing rules for, requests and responses used for managing a network, transferring data, and synchronizing the states of network components.

put. Pertaining to the 3584 Tape Library, to place, by means of a robotic device, a tape cartridge into a storage slot, drive, or I/O station.

R

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

ready. The operating condition that the 3584 Tape Library is in when the host applications can interact with it.

robotics. The cartridge accessor and any associated mechanisms that move a tape cartridge within the 3584 Tape Library.

RS-422 interface. An electrical interface standard approved by the Electronic Industries Association (EIA) for connecting serial devices. The RS-422 standard, which supports higher data rates and greater immunity to electrical interference, is an alternative to the older RS-232 interface and uses individual differential signal pairs for data transmission. Depending on data transmission rates, RS-422 can be used at distances to 1275 m (4000 ft). The RS-422 interface also supports multi-point connections.

S

s. Abbreviation for *second*.

SCSI. See *Small Computer Systems Interface*.

SCSI-2. A variation of the SCSI interface. See *Small Computer Systems Interface*.

SCSI address. See *SCSI ID*.

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

SCSI element address. A value that defines a logical location in the 3584 Tape Library to the SCSI interface. This logical address is represented on the operator panel or Tape Library Specialist web interface as xxxx(yyyh), where xxxx is a decimal value and yyyh is a hexadecimal value. It is assigned and used by the server when the server processes SCSI commands. The SCSI element address is not unique to a storage slot, drive, or I/O slot; it varies, depending on the quantity of drives in the library, whether the Capacity Expansion feature is installed, and whether an Expanded I/O Station is included.

SCSI ID. The hexadecimal representation of the unique address (0-F) assigned to a SCSI device. This identifier would normally be assigned and set in the SCSI device during system installation.

second. The 60th part of a minute of time.

Sequential Access Device. In SCSI terms, a tape drive.

serial number. See *volume serial number*.

server. A functional unit that provides services to one or more clients over a network. Examples include a file server, a print server, and a mail server. The IBM System i5, IBM System p5, HP, and Sun are servers. Synonymous with *host*.

shuffle. In HD frames, the process of moving cartridges in lower tiers into the gripper or other available slots in order to access cartridges in higher tiers.

shuttle complex. Two or more parallel high density (HD) library strings that are interconnected by one or more shuttle connections.

shuttle connection. Also referred to as Model SC1, the shuttle connection is comprised of one shuttle car, two or more shuttle stations, and one or more spans between these shuttle stations. Each shuttle connection supports one shuttle car.

shuttle station. The shuttle station mounts on top of an HD frame. It consists of a base pad and a shuttle slot. The shuttle slot docks into the base pad. When the shuttle slot is all the way down into the frame station it can accept or deliver a cartridge. Each shuttle station has its own import/export element (IEE) address.

Simple Network Management Protocol (SNMP). In the Internet suite of protocols, a network management protocol that is used to monitor routers and attached networks. SNMP is an application layer protocol. Information on devices that are managed is defined and stored in the application's Management Information Base (MIB).

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

- Fast/Wide SCSI: Uses a 16-bit bus, and supports data rates of up to 20 MBps.
- SCSI-1: Uses an 8-bit bus, and supports data rates of 4 MBps.
- SCSI-2: Same as SCSI-1, but uses a 50-pin connector instead of a 25-pin connector, and supports multiple devices.
- Ultra SCSI: Uses an 8- or 16-bit bus, and supports data rates of 20 or 40 MBps.
- Ultra2 SCSI: Uses an 8- or 16-bit bus and supports data rates of 40 or 80 MBps.
- Ultra3 SCSI: Uses a 16-bit bus and supports data rates of 80 or 160 MBps.
- Ultra160 SCSI: Uses a 16-bit bus and supports data rates of 80 or 160 MBps.

SNMP. See *Simple Network Management Protocol*.

Specialist web interface. See *IBM System Storage Tape Library Specialist web interface*.

StE. See *storage element*.

storage element (StE). In SCSI terms, a cartridge storage slot.

T

TapeAlert. A patented technology from Hewlett-Packard that monitors the status of a tape device and media, and detects problems as they occur.

TapeAlert flags. Status and error messages that are generated by the TapeAlert utility and display on the host console. The messages indicate the type of problem and tell how to resolve it.

tape cartridge. A removable storage device that consists of a housing containing a belt-driven magnetic tape wound on a supply reel and a takeup reel.

tape drive. See *IBM LTO Ultrium Tape Drive* or *IBM System Storage 3592 Tape Drive*.

target. A SCSI device that performs an operation requested by the initiator. A target can also be an initiator.

TB. Terabyte.

terabyte. 1 000 000 000 000 bytes.

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

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

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

touchscreen. See *liquid crystal display*.

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

transport mechanism. See *dual-gripper transport mechanism*.

U

Ultrium Tape Drive. See *IBM LTO Ultrium Tape Drive*.

unload. Pertaining to the 3584 Tape Library, a term used to describe the act of the drive unthreading the tape from the internal tape path and returning the leader block to the tape cartridge.

V

virtual I/O slots (VIOS). An enhancement to the Advanced Library Management System (ALMS) that virtualizes and expands the addresses for Import/Export slots in the 3584 Tape Library so that there is no longer a maximum IEE address limitation that is based on the actual physical slots in the I/O stations.

VIOS. See *virtual I/O slots*.

vital product data (VPD). Pertaining to the 3584 Tape Library, information about a product such as a library, drive, or node card. The VPD may include a machine type, model number, serial number, part number, or level of firmware.

VOLSER. Volume serial number.

volume. (1) A certain portion of data, together with its data carrier, that can be handled conveniently as a unit. (2) A data carrier that is mounted and demounted as a unit, for example, a reel of magnetic tape, a disk pack.

volume serial number (VOLSER). A number that a computer assigns to a tape cartridge when it prepares (initializes) the cartridge for use.

VPD. See *vital product data*.

W

web. See *World Wide Web*.

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

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

write protected. A tape cartridge is write protected if some logical or physical mechanism causes the device that is processing the tape to prevent the program from writing on the tape.

write-protect switch. Located on the LTO Ultrium Tape Cartridge or 3592 Tape Cartridge, a switch that prevents accidental erasure of data. Pictures of a locked and unlocked padlock appear on the switch. When you slide the switch to the locked padlock, data cannot be written to the tape. When you slide the switch to the unlocked padlock, data can be written to the tape.

X

X-axis and Y-axis motion assemblies. Within the 3584 Tape Library, a group of parts that includes a controller (circuit board) for the Controller Area Network interface, servo motor, pinion drive gear and lead screw. Provides the motive force to move the accessor side to side (on the X-axis) and up and down (on the Y-axis).

Y

Y-axis motion assembly. See *X-axis and Y-axis motion assemblies*.

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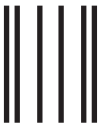

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