Quantum

Software Interface Guide Software Interface Guide Software Interface Guide

Quantum DX30, DX100, DX3000, and DX5000

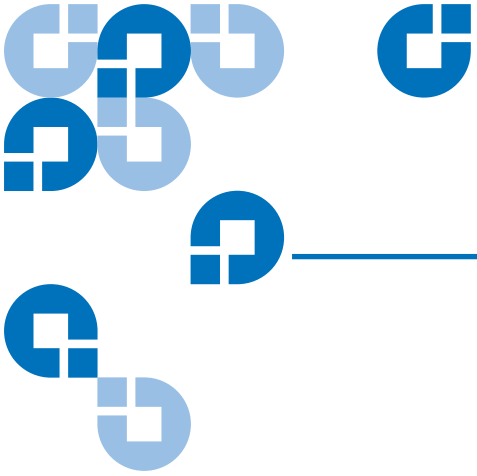
DX-Series

81-81495-01 A01

Quantum DX-Series Software Interface Guide, 81-81495-01 A01, November 2005, Made in USA.

COPYRIGHT STATEMENT

TRADEMARK STATEMENT



Contents

Figures

Tables

Preface

This guide describes the procedures and issues involved in the development of hierarchical mass storage software applications and utilities to communicate with the Quantum DX-Series enhanced data protection system and this includes the following models:

- DX30
- DX100
- DX3000
- DX5000

Audience

This guide is designed for use by software engineers who have a basic understanding of SCSI principles and technology.

Purpose

This document provides information about DX-Series software including:

- Theory of operation
- Software interfaces for both the DX-Series system and the virtual DLT7000 tape drives
- Sense data values

Document Organization

This guide is organized as follows:

- Chapter 1, "Theory of Operation," explains medium changer elements, events, operational sequences, configuration, error recovery, system performance, and diagnostic support issues.
- Chapter 2, "Emulated Software Interfaces," describes SCSI-2 terminology in relation to the DX-Series enhanced data protection system. This includes required and optional SCSI-2 messages, and operational commands.
- Chapter 3, "Emulated DLT7000 SCSI Commands," describes SCSI terminology in relation to the DLT7000 tape drive. This includes required and optional SCSI-2 messages, and operational commands.
- Appendix A, Sense Key Values provides information on the supported sense keys for request sense.
- Appendix B, Media Changer Sense Code Values provides sense code values for the medium changer.
- Appendix C, DLT7000 Sense Code Values provides sense code values for the DLT7000 tape drive.
- Appendix D, Fibre Channel Topology provides an overview of Fibre Channel topology available with the DX30 and DX100 and as an option with DX3000 and DX5000.
- Appendix E, DX-Series Software Deviations provides an overview of the implemented changes to the DX-Series software.
- This guide concludes with a glossary and an index.

Notational Conventions

This manual uses the following conventions:

Caution: Cautions indicate potential hazards to equipment and are included to prevent damage to equipment. Cautions may advise you that failure to take or avoid an action could result in corrupt data or loss of data.

Note: Notes emphasize important information related to the main topic.

Warning: Warnings indicate potential hazards to personal safety and are included to prevent injury.

Tech Tip: Tech tips indicate an area that deviates from normal DLT tape drive or changer behavior.

This manual uses the following:

- All binary numbers are succeeded by "**b**"
- All hexadecimal numbers are succeeded by "**h**"
- Error or attention conditions are represented in parenthesis that translate as follows:

(SK=S ASC=AA ASCQ=QQ)

where:

S = hexadecimal sense key value

AA = hexadecimal additional sense code

QQ = hexadecimal additional sense code qualifier

Related Documents

Manuals associated with DX-Series system:

Document Number	Title	Description
6513501	DX30/DX100 User's Guide	Contains sections on installation, operation, and diagnostic software.
6513503	DX30/DX100 Field Service Manual	Provides removal and replacement instructions for all field replaceable units.
81-81493	DX3000/DX5000 User's Guide	Contains sections on installation, operation, and diagnostic software.

SCSI-2 Specification

The SCSI-2 communications specification is the proposed American National Standard for information systems, dated March 9, 1990. Copies may be obtained from:

Global Engineering Documents
15 Inverness Way, East
Englewood, CO 80112
(800) 854-7179 or (303) 397-2740

Contacts

Quantum Corporation company contacts are listed below.

Quantum Documentation

To order documentation on the DX-Series system or other products contact:

Quantum
P. O. Box 57100
Irvine, CA 92619-7100
(949) 856-7800
(800) 284-5101

Technical Publications

To comment on existing documentation send e-mail to:

`doc-comments@quantum.com`

Visit the Quantum home page at:

`http://www.quantum.com`

Customer Support

The Quantum Customer Support Department provides a 24-hour help desk that can be reached at:

North/South America:	(949) 725-2100 or (800) 284-5101
Asia/Pacific Rim:	(International Code) +61 7 3839 0988
Europe/Middle East/Africa:	(International Code) +44 (0) 1256 848748

Send faxes for the Customer Support Department to:

North/South America:	(949) 725-2176
Asia/Pacific Rim:	(International Code) +61 7 3839 0955
Europe/Middle East/Africa:	(International Code) +44 (0) 1256 848777

Send e-mail for the Customer Support Department to:

North/South America:	helpdesk@quantum.com
Asia/Pacific Rim:	apachelp@quantum.com
Europe/Middle East/Africa:	ukhelpdesk@quantum.com

Chapter 1

Theory of Operation

This chapter discusses these topics:

Enhanced Data Protection Overview

The Quantum DX-Series system takes advantage of high speed hard drives to greatly reduce the time required for backup/restore functions and also improve confidence in completing the backup in the time allowed.

SCSI-2 Implementation Philosophy

Using the SCSI-2 standard, the DX-Series system is designed so that the host can adapt to changes in the configuration. For example, the host can detect a change in the number of virtual tape drives configured in the DX-Series system.

The DX-Series system uses the SCSI-2 medium changer command set. This command set is complete and includes all primitive (elemental) commands required by a host to carry out any required complex operation.

The DX-Series system relies on the host computer to perform complex operations by issuing a sequence of elemental commands in the correct order. The DX-Series system does not execute operations that could result in damage to the device.

Medium Changer Elements

The medium changer command set accesses address space for the set of physical locations and mechanisms within the DX-Series system. This guide uses the SCSI-2 term *element* to refer to one member of the DX-Series system address space.

Each element is a discrete physical entity that can hold a single tape cartridge and is represented by a unique 16-bit element address.

The DX-Series system consists of these medium changer elements:

- Medium transport element
- Storage elements
- Data transfer elements

Issue the **Mode Sense** command to determine:

- DX-Series system configuration
- First address
- Number of elements of each type (medium transport, storage, or data transfer)

Medium Transport Element

The medium transport element consists of the following component:

- Virtual gripper

This mechanism can hold a single cartridge and is considered to be a single medium transport element. It moves media between elements within the DX-Series system.

Storage Elements and Data Transfer ELements

The DX-Series system emulation is described in the following tables:

- DX30 Storage Elements
- DX100 Storage Elements
- DX3000 Storage Elements
- DX5000 Storage Elements

Table 1 DX30 Storage Elements

DX30 Storage Elements	
Virtual tape drives	2 to 30
Virtual tape cartridges	2 to 160 per array (250GB drives), 320 per array(400 GB drives)
Number of arrays	1 to 4
Total number of virtual cartridges	640 (250GB drives), 1280 (400GB drives)

Table 2 DX100 Storage Elements

DX100 Storage Elements	
Virtual tape drives	2 to 55
Virtual tape cartridges	2 to 320 per array (250GB drives), 640 per array (400GB drives)

DX100 Storage Elements	
Number of arrays	1 to 16
Total number of virtual cartridges	2560 (250GB drives), 5120 (400GB drives)

Table 3 DX3000 Storage Elements

DX3000 Storage Elements	
Virtual tape drives	1 to 32
Virtual tape cartridges	1 to 80 per LUN
Number of RAID Sets	1 to 2
Total number of virtual cartridges	1 to 400 per LUN (800 max)

Table 4 DX5000 Storage Elements

DX5000 Storage Elements	
Virtual tape drives	1 to 64
Virtual tape cartridges	1 to 80 per LUN
Number of RAID Sets	1 to 4
Total number of virtual cartridges	1 to 400 per LUN (1600 max)

Events

Events are system conditions created by failures or operator actions, such as changing the DX-Series system state to offline. Some events appear as states on the control panel.

Events are recorded in sense data. Depending on the interface, the host can obtain the sense data either in response to a **Request Sense** command or as an unsolicited message.

The DX-Series system does not support asynchronous event notification. This simplifies the host/DX-Series interface and is acceptable because events happen infrequently and do not require an immediate host response.

DX-Series system events are queued. To check for DX-Series system events, the SCSI host can issue a **Request Sense** command to the device. This command causes the DX-Series system to return event sense data. The host can issue a **Request Sense** command repeatedly to obtain sense data for each queued event.

The most significant events are detailed in this section:

- Power Cycle
- DX-Series Unit On-Line Initialization Failure

Power Cycle

When the DX-Series system is powered on, it generates a **Power On/ Reset Occurred** event (SK=6 ASC=29 ASCQ=00).

DX-Series Unit On-Line Initialization Failure

When a DX-Series system is placed on-line and initialization fails, the DX-Series system generates an event for the error condition that caused the failure.

Operational Sequences

Operational sequences are listed in order of precedence. These operational sequences are detailed in this section:

- **Power On**
- **System Stopped**
- **On-Line Initialization**
- **DX-Series System Unit Inventory**
- **Off-Line**

Power-On

When the DX-Series system is powered-on it goes through an initialization sequence, during which:

- System goes through power sequencing and intitialization
- DX-Series system responds to these commands:
  - **Inquiry**
  - **Request Sense**
  - **Log Sense**
  - **Mode Sense**
- All other commands return a **Logical Unit is Not Ready** check condition (SK=2 ASC=04 ASCQ=00)

When the power-on initialization is complete:

1. DX-Series system generates a **Power On/Reset Occurred** event (SK=6 ASC=29 ASCQ=00).
2. System performs additional operational sequences, depending on the condition of the system.

On-Line Initialization

To start the on-line initialization sequence:

1. Power on the DX-Series system.

During the on-line initialization sequence:

- Browser indicates that the DX-Series system is performing the on-line initialization sequence
- DX-Series system responds to these commands:
  - **Inquiry**
  - **Request Sense**
  - **Log Sense**
  - **Mode Sense**
- All other commands return a Logical Unit is Not Ready check condition (SK=2 ASC=04 ASCQ=00)
- DX-Series system performs an inventory of its elements
- When initialization completes, the web based GUI changes to `System On-Line` and the DX-Series system is fully operational

DX-Series Unit Inventory

The DX-Series system inventories its storage elements after power up, upon receipt of an **Initialize Element Status** command, or after the door is closed and the DX-Series system is placed on-line.

- The local controller for the DX-Series system checks the state of the medium transport element (gripper)
- If there is a virtual tape cartridge in the medium transport element, the inventory cannot be performed
  - If this is the case and the inventory was requested by the host, then a check condition is set, and **Transfer Full** (SK=5 ASC=80 ASCQ=01) sense data is sent
  - If the inventory was not requested by the host, the DX-Series system generates a **Transfer Full** (SK=5 ASC=80 ASCQ=01) on-line initialization failure event
- Each element of the DX-Series system is inventoried if it is the first inventory made since power-on or issuing an **Initialize Element Status** command
- An inventory is attempted for each virtual tape drive present
- The results of the inventory are returned with the **Read Element Status** command.

Off-Line

Changing the DX-Series system status to **Off-line** through the web GUI causes the DX-Series system to go off-line. When a DX-Series system is placed off-line, this sequence is performed:

1. The local controller for the DX-Series system completes any currently processing command.
2. When all commands are complete, the web GUI displays `System Off-Line`.
3. The DX-Series system generates a **Unit Standby Button Was Pressed** event (SK=6 ASC=80 ASCQ=09).

When the DX-Series system is off-line it responds to these commands:

- **Inquiry**
- **Request Sense**
- **Log Sense**
- **Mode Sense**
- Check condition is set for all other commands and **Unit Is Turned Off-Line** (SK=2 ASC=80 ASCQ=09) is set in the sense data

The DX-Series system remains off-line until one of the other operational sequences occur.

Typical Application Enhancements

For optimum system performance, please note:

- Direct the host to check for any attention or error conditions the tape DX-Series system may have buffered by issuing **Request Sense** commands until “no sense data available” exists.
- The internal software does not support command queueing. It is up to the host application to queue commands to the unit. It may be advantageous for the application to group queued commands to require the least amount of actuator motion.

Chapter 2

Emulated Medium Changer SCSI Commands

This chapter describes the specific Small Computer Systems Interface (SCSI-2) terminology in relation to the DX-Series system. Table 5 lists the SCSI-2 terms and their equivalent DX-Series terms.

Table 5 SCSI-2 Terms

SCSI-2 Term	Equivalent DX-Series Term
Logical Unit	DX-Series system
Initiator	Host computer
Data Transfer Element	Virtual tape drive
Medium Transport Element	Virtual gripper mechanism
Storage Element	Storage bin

DX-Series system:

- Is a SCSI-2 medium changer devices - the host computer serves as the SCSI initiator and issues commands to the DX-Series system and tape drives, which act as SCSI targets
- SCSI target support - does not perform any initiator functions (each DX-Series system has its own SCSI address separate from any other SCSI devices, including the tape drives)

- Support asynchronous SCSI
- Is intended for use with:
  - iSCSI 10, 100, 1000Mbit/sec. initiators for DX3000 and DX5000
    - Fully support RFC 3720 with error handling level 0
  - 1 or 2 Gb/s initiators for Fibre Channel initiators for DX30 and DX100 (optional on DX3000 and DX5000)
- Does not support:
  - SCSI queuing or linked commands - all element addresses must be specified absolutely; no relative addressing is permitted
  - **Change Definition** command
  - Asynchronous event notification
  - Extended contingent allegiance
  - Overlapped command support - if this command is received from the same host, the DX-Series system aborts the previous command and returns a check condition with **Overlapped Commands Attempted** sense data code (SK=5 ASC=54 ASCQ=00)

Supported Operational Commands

The DX-Series system supports all commands that the SCSI-2 specification indicates are required by all devices.

Table 6 Supported Operational Commands

Command Name	OperCode	Type
Initialize Element Status	07h	Optional
Initialize Element Status with Range	E7h	Vendor
Inquiry	12h	Mandatory
Log Sense	4Dh	Optional
Mode Select	15h	Optional
Mode Sense	1Ah	Optional
Move Medium	A5h	Mandatory
Position to Element	2Bh	Optional
Prevent/Allow Medium Removal	1Eh	Optional
Read Element Status	B8h	Optional
Read Buffer	3Ch	Optional
Release	17h	Optional
Request Sense	03h	Mandatory
Request Volume Element Address	B5h	Optional
Reserve	16h	Optional
Rezero Unit	01h	Optional
Send Diagnostic	1Dh	Mandatory
Send Volume Tag	B6h	Optional

Command Name	OperCode	Type
Test Unit Ready	00h	Mandatory
Write Buffer	3Bh	Optional

Initialize Element Status (07h)

This command allows the host to request an inventory of the tape cartridges held in a DX-Series system. The inventory reads each tape's bar code. Inventory information is returned to the host, only if requested, using the **Read Element Status** command.

The DX-Series system does not accept any other commands from the host during the inventory process.

The host can issue an **Abort** of the inventory for the DX-Series system. If another **Initialize Element Status** command is then issued, the inventory process is restarted from the beginning.

The format for this command data block is shown in table 3.

Table 7 Initialize Element Status Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (07h)							
1	Logical Unit Number			Reserved (00h)				
2	Reserved (00h)							
3	Reserved (00h)							
4	Reserved (00h)							
5	NBL	Reserved (00h)						

- **Logical Unit Number**

  The **Logical Unit Number** must be set to 0. Field indicates the logical unit to which the command is sent.

- **NBL**
  - A **No Bar Code Labels** value of 1 specifies the inventory to not scan the bar codes of the elements and set the corresponding primary volume tags to empty
  - A value of 0 specifies element bar code labels are to be scanned and placed in the primary volume tags

Initialize Element Status with Range (E7h)

The **Initialize Element Status with Range** command allows the host to request an inventory of a range of elements in the DX-Series system. The DX-Series system conducts the inventory and determines if each element within the range contains a tape cartridge. The inventory reads each tape's bar code (unless commanded not to).

The DX-Series system does not accept any other commands from the host during the inventory process.

The host can issue an **Abort** of the inventory for the DX-Series system. If another **Initialize Element Status** command is then issued, the inventory process is restarted from the beginning.

The format for this command data block is shown in table 8.

Table 8 Initialize Element Status with Range Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (E7h)							
1	Logical Unit Number			Reserved (00h)				Range
2 3	(MSB) Starting Element Address (LSB)							
4	Reserved (00h)							
5	Reserved (00h)							
6 7	(MSB) Number of Elements (LSB)							
8	Reserved (00h)							
9	NBL	Reserved (00h)						

- **Logical Unit Number**

  The **Logical Unit Number** must be set to 0. Field indicates the logical unit to which the command is sent.

- **Range**
  - **Range** value of 1 specifies performing the inventory over the range specified by the **Starting Element Address** and **Number of Elements** fields
  - A value of 0 specifies performing the inventory on all elements in the DX-Series system, ignoring the **Starting Element Address** and **Number of Elements** fields
- **Starting Element Address** and **Number of Elements**
  - These fields select the range of elements to be inventoried and are only valid when **Range** value is 1
  - The inventory range begins with the first element with an address greater than or equal to the **Starting Element Address**, and includes all defined elements until the indicated number of elements have been inventoried or the last element is reached
- **NBL**
  - A **No Bar Code Labels** value of 1 specifies the inventory to not scan the bar codes of the elements and set the corresponding primary volume tags to empty.
  - A value of 0 specifies element bar code labels are to be scanned and placed in the primary volume tags.

Inquiry (12h)

The host uses the **Inquiry** command to determine devices attached to the SCSI bus and request a description from each device.

Inquiry Command Data Format

The description provided by the DX-Series system identifies the device type, manufacturer, and nature of the SCSI interface. The format for this command data block is shown in table 9.

Table 9 Inquiry Command Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (12h)							
1	Logical Unit Number			Reserved (0h)				EVPD
2	Page Code							
3	Reserved (00h)							
4	Allocation Length							
5	Reserved (00h)							

- **Logical Unit Number**

  The **Logical Unit Number** must be set to 0. Field indicates the logical unit to which the command is sent.

- **EVPD**
  - When the **Enable Vital Product Data (EVPD)** bit is set to 0, only Standard Inquiry Data is returned
  - When the bit is set to 1, the target returns the optional vital product data specified by **Page Code** field (see table 11)

- **Allocation Length**

  Field contains the maximum data amount that the DX-Series system may return.

- **Page Code**

  The **Page Code** (Byte 2 in table 9) specifies which page of vital product data information the target shall return.

  The supported **Page Code** is (80h) to return the **Serial Number Page** (see table 11).

Standard Inquiry Data Format

The format for the Standard Inquiry Data block returned by the DX-Series system to the initiator is shown in table 10.

Table 10 Standard Inquiry Data

Bit/Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type (8)				
1	RMB (1)	Device-Type Modifier (00h)						
2	ISO Version (0)		ECMA Version (0)			ANSI-Approved Version (2)		
3	AENC (0)	TrmIOP (0)	Reserved (0)		Response Data Format (02h)			
4	Additional Length (1Fh)							
5	Reserved (0000h)							
6								
7	RelAdr (0)	WBus32 (0)	WBus16 (0)	Sync (0)	Linked (0)	Rsvrd (0)	CmdQue (0)	SftRes (0)
8 - 15	(MSB) Vendor ID (LSB)							
16 - 31	(MSB) Product ID (LSB)							
32 - 35	(MSB) Product Revision Level (LSB)							

- **Peripheral Qualifier**
  - 0 indicates the specified DX-Series system is currently connected
  - 3 indicates the specified DX-Series system cannot be supported
- **Peripheral Device Type**
  - 08h indicates medium changer device
  - 1Fh indicates unknown or no device type used in conjunction with **Peripheral Qualifier** 3
- **RMB**

  A **Removable Medium Bit** of 1 indicates medium is removable.
- **Device-Type Modifier**

  This field is not supported and should return a value of 0.
- **ISO** and **ECMA Version**

  0 code value indicates target does not claim compliance to ISO version of SCSI (ISO IS 9316) or ECMA version of SCSI (ECMA-111).
- **ANSI-Approved Version**

  2 indicates the device complies with the SCSI-2 specification.
- **AENC**

  The asynchronous event notification capability bit of 0 indicates the device does not support asynchronous event notification capability.
- **TrmIOP**

  A terminate I/O process value of 0 indicates the device does not support the **TERMINATE I/O PROCESS** message.
- **Response Data Format**

  2 indicates data must be in format specified in SCSI-2 spec.
- **Additional Length**

  The length (in bytes) of additional inquiry data available.
- **RelAdr**

  A **Relative Address** of 0 indicates the device does not support relative addressing for this DX-Series system.
- **WBus32**

  0 bit value - DX-Series system does not support 32-bit wide transfers.

- **WBus16**

  1 bit value indicates the DX-Series system supports 16-bit wide transfers.

- **Sync**

  Synchronous transfer value of 0 indicates the device does not support synchronous data transfer.

- **Linked**

  Linked command value of 0 indicates the device does not support linked commands for this DX-Series system.

- **CMDQue**

  Command queuing value of 0 indicates the device does not support tagged command queuing for this DX-Series system.

- **SftRes**

  - A soft reset bit of 0 indicates the device responds to the RESET condition with a hard reset
  - A soft reset bit of 1 indicates the device responds to the RESET condition with a soft reset

- **Vendor ID**

  The vendor ID string is selectable. The default inquiry string is P1000 and the alternate inquiry string is DX30 or DX100.

  For the P1000 inquiry - this field contains the string *ATLbbbbb*.

  For the DX30 inquiry - this field contains the string *QUANTUMb*

  For the DX100 inquiry - this field contains the string *QUANTUMb*

  For the DX3000 inquiry - this field contains the string *QUANTUMb*

  For the DX5000 inquiry - this field contains the string *QUANTUMb*

- **Product ID**

  The product ID is selectable. The default product ID is P1000 and the alternate product ID are DX30 and DX100.

  For the P1000 inquiry - *P1000bbbb6220050*

  For the DX30 inquiry - *DX30bbbbb6220050*

  For the DX100 inquiry - *DX100bbbb6220050*

  For the DX3000 inquiry - *DX3000bbb6532501*

  For the DX5000 inquiry - *DX5000bbb6532502*

  > **Note:** In the ASCII strings above, each *b* represents a space (20h) and *6220050* represents the DX30 and DX100 system part number. *6532501* represents the DX3000 system part number. *6532502* represents the DX5000 system part number.

- **Product Revision Level**

  Both the P1000, DX30, DX100, DX3000, and DX5000 firmware revision level are in the format *xxxx*.

Supported Vital Product Data Page

The supported vital product data pages page provides a directory of the vital product data pages that are supported. The pages that are supported are:

- Unit Serial Number Page (80h)
- Device Identification VPD page (Page 83h)

Table 11 Supported Vital Product Data Page

Bit/Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral device type				
1	Page Code (00h)							
2	Reserved							
3	Page length (3)							

Bit/Byte	7	6	5	4	3	2	1	0
4	00h - (this page)							
5	80h - Unit Serial Number Page							
6	83h - Device Identification Page							

Unit Serial Number Page (80h)

The **Unit Serial Number Page** (Byte 2 in table 9) specifies which page of vital product data information the target shall return.

The supported **Page Code** is (80h) to return the **Serial Number Page** (see table 12).

Table 12 Unit Serial Number Page (Page 80h)

Bit/Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral device type				
1	Page Code (80h)							
2	Reserved (00h)							
3	Page length (n-3) (size of the product serial number)							
4-n	Product serial number (up to 12 bytes)							

Device Identification VPD page (Page 83h)

The device identification VPD page provides the means to retrieve identification descriptors applying to the logical unit. Logical units may have more than one identification descriptor (e.g. if several types of associations of identifier are supported.

Device identifiers shall be assigned to the peripheral device and not to the currently mounted media, in the case of removable media devices.

Table 13 Device Identification VPD Page 83h

Bit/Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type (8)				
1	Page Code (83h)							
2	Reserved (00h)							
3	Page Length (n-3)							
4	Identification Descriptor list							
	Identification descriptor (first)							
	. . .							
	Identification descriptor (last)							
n								

- Identification Descriptor

  Each identification descriptor (see table 14) contains information identifying the logical unit, physical device, or access path used by the command and returned parameter data. The association field indicates the entity that the identification descriptor describes. If a physical or logical device returns the identification descriptor with the association field set to 0h, it shall return the same descriptor when it is accessed through any other path.

Table 14 Identification Descriptor

Bit/Byte	7	6	5	4	3	2	1	0
0	Reserved				Code Set			
1	Reserved		Association		Identifier Type			
2	Reserved							

Bit/Byte	7	6	5	4	3	2	1	0
3	Identifier length (n-3)							
4	(MSB)							
	Identifier							
n								(LSB)

- Code set

The code set field specifies the code set used for the identifier field, as described in table 15. This field is intended to be an aid to software that displays the identifier field.

Table 15 Code Set

Value	Description
0h	Reserved
1h	The identifier field shall contain binary values
2h	The identifier field shall contain ASCII graphic codes (e.g. code values 20h through 7Eh)
3h-Fh	Reserved

- Association

The association field specifies the entity with which the identifier field is associated, as described in table 16.

Table 16 Association

Value	Description
0h	The identifier field is associated with the addressed physical or logical device
1h	The identifier field is associated with the port that received the request
2h - 3h	Reserved

- Identifier Type.

The identifier type is described in table 17

Table 17 Identifier Type

Value	Description
00h	Reserved
1h	Vendor ID followed by the product identification field from the standard inquiry data and the serial number field from the Serial Number Inquiry Page.
2h	Canonical form of the IEEE Extended Unique Identifier, 64 bit (EIU-64)
3h	FC-PH Name_Identifier
4h to fh	Reserved

Table 18 Device Identification VPD Logical Unit

Bit/Byte	7	6	5	4	3	2	1	0
0	Protocol Identifier (0)			Code Set (2)				
1	Rsvd (0)		Association (0)		Identifier Type (1)			
2	Reserved (0)							
3	Identifier Length (n-3)							
4-n	MSB Vendor and Product ID Serial Number LSB							

Table 19 Device Identification VPD World Wide Name

Bit/Byte	7	6	5	4	3	2	1	0
0	Protocol Identifier (0)			Code Set (1)				
1	Rsvd (0)		Association (0)		Identifier Type (2)			
2	Reserved (0)							
3	Identifier Length (8)							
4-11	MSB IEEE extended Unique Identifier LSB							

Log Sense (4Dh)

The **Log Sense** command (see table 20) retrieves statistical information maintained by the logical unit. Data is returned from the logical unit in the **Medium Changer Statistics Page** (see table 22).

Table 20 Log Sense Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (4Dh)							
1	Logical Unit Number			Reserved (0)			PPC(0)	SP(0)
2	PC (1)		Page Code					
3	Reserved (0000h)							
4								
5	(MSB) Parameter Pointer							
6	(LSB)							
7	(MSB) Allocation Length							
8	(LSB)							
9	Reserved (00h)							

- **Logical Unit Number**

  Logical Unit Number must be set to 0. Field indicates the logical unit to which the command is sent.

- **PPC**

  Parameter Pointer Control field is not supported and must be set to 0.

- **SP**

  Save Parameters field is not supported and must be set to 0.

- **PC**

  Page Control field defines type of parameter values to be selected. Only cumulative values are supported, therefore this field must be set to 1.

- **Page Codes**

  Currently, there are 3 supported page codes:

  - **00h — Supported Log Page** (see table 21).
  - **30h — Medium Changer Statistic Page** (see table 22).
  - **3Fh** — Return all supported pages. This is a composite of all pages, returned sequentially. Order is **Supported Log Page** followed by **Medium Changer Statistic Page**.

- **Parameter Pointer**

  Field allows host to request parameter data beginning from a specific parameter code to the maximum allocation length or the maximum parameter code supported by the target, whichever is less. For parameter codes, see table 24.

- **Allocation Length**

  Field specifies how much memory host has set aside to store log sense information returned by the DX-Series system.

- **Supported Log Page**

  Page returns the list of log pages supported (see table 21).

Table 21 Supported Log Page

Bit/Byte	7	6	5	4	3	2	1	0
0	Reserved (0)		Page Code (00h)					
1	Reserved (00h)							
2	(MSB) Page Length (0002h)							
3	(LSB)							
SUPPORTED PAGE LIST								
4	(00h)							
5	(30h)							

- **Page Length**

  Field specifies length in bytes of the supported page list.

- **Supported Page List**

  List of all log page codes supported. Currently, there are 2 pages supported:

  - **Supported Log Page (00h)**
  - **Medium Changer Statistics Page (30h)**

- **Medium Changer Statistics Page**

  Page returns medium changer statistical data (see table 22).

Table 22 Medium Changer Statistics Page

Bit/Byte	7	6	5	4	3	2	1	0
0	Reserved (0)		Page Code (30h)					
1	Reserved (00h)							
2	(MSB) Page Length							
3	(LSB)							
LOG PARAMETER LIST								
4 - 11	Log Parameter (First)							

Bit/Byte	7	6	5	4	3	2	1	0
	. .							
x-7 - x	Log Parameter (Last)							

- **Page Length**

  Field specifies length in bytes of the log parameter list.

- **Log Parameter**

  Each log parameter begins with a 4-byte parameter header followed by 4 bytes of parameter value data. For the log parameter format, see table 23.

Table 23 Log Parameter

Bit/Byte	7	6	5	4	3	2	1	0
0	(MSB) Parameter Code							
1	(LSB)							
2	DU(0)	DS(0)	TSD(0)	ETC(0)	TMC(0)		Rsv(0)	LP(0)
3	Parameter Length (04h)							
4 - 7	(MSB) Parameter Value (LSB)							

- **Parameter Code**

  Parameter Code field identifies which log parameter is being transferred for that log page. For parameter codes, see table 24.

- **DU**

  Disable Update. Not supported, always 0.

- **DS**

  Disable Save. Not supported, always 0.

- **TSD**

  Target Save Disable. Not supported, always 0.

- **ETC**

  Enable Threshold Comparison. Not supported, always 0.

- **TMC**

  Threshold Met Criteria. Not supported, always 0.

- **LP**

  List Parameter. Not supported, always 0.

- **Parameter Length**

  All log parameter values supported in the **Medium Changer Statistics** page have a length of 4 bytes.

- **Parameter Value**

  The cumulative count of parameter as described in table 24.

Table 24 Supported Log Parameter Codes for 30h Page

Parameter Code	Description	Size (bytes)
8000	Number of seconds system has been powered on	4
8001	Reserved	4
8010	Number of attempted moves from a bin	4
8011	Number of attempted moves to a bin	4
8012	Number of attempted moves from a drive	4
8013	Number of attempted moves to a drive	4
8014	Number of attempted moves from load port	4
8015	Number of attempted moves to load port	4
8020	Reserved	4
8021	Reserved	4
8022	Reserved	4

Parameter Code	Description	Size (bytes)
8023	Reserved	4
8024	Reserved	4
8025	Reserved	4
8026	Reserved	4
8030	Reserved	4
8031	Reserved	4
8032	Reserved	4
8033	Reserved	4
8035	Reserved	4
8036	Reserved	4
8040	Reserved	4
8041	Reserved	4
8042	Reserved	4
8043	Reserved	4
8044	Reserved	4
8045	Reserved	4
8050	Reserved	4
8051	Reserved	4
8052	Reserved	4

Mode Select (15h)

The **Mode Select** command provides a means for the host to specify parameters to the DX-Series system. The DX-Series system supports:

- **Element Address Assignment Page 1Dh**
- **Vendor Unique Page 20h**
- **Vendor Unique Page 00h**

Table 25 Mode Select Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (15h)							
1	Logical Unit Number			PF (1)	Reserved (0)			SP
2	Reserved (0000h)							
3								
4	Parameter List Length							
5	Reserved (00h)							

- **Logical Unit Number**

  The **Logical Unit Number** field must be set to 0. This field indicates the logical unit to which the command is sent.

- **SP - Save Page**
  - When set to 0, the **Save Page** field performs mode select without saving
  - When set to 1, **Save Page** performs **Mode Select** and saves it in nonvolatile memory
- **PF**

  When set to 1, the **Page Format** field indicates the **Mode Select Parameters** are formatted as specified in the SCSI-2 specification.

- **Parameter List Length**

The **PLL** field indicates the length of the parameter list. The list length should reflect the combined length of all data pages being sent with the **Mode Select** command. **Mode Select Data** pages are shown in table 26, table 27, and table 28.

The format for **Mode Select Vendor Unique Page 20h** is shown in table 26.

Table 26 Mode Select Data - Vendor Unique Page 20h

Bit/Byte	7	6	5	4	3	2	1	0
0	PS (0)	Rsvd (0)	Page Code (20h)					
1	Page Length (02h)							
2	Reserved (00h)					SER(1)	AC	DLR
3	Reserved (00h)						ADU	EXB(0)

- **PS - Parameters Savable**

  This bit is only used with the **Mode Sense** command. This bit is reserved for **Mode Select** command and should be set to 0.

- **DLR-Drive Load Retry**

  This bit is ignored. It can be set to 1 or 0 for compatibility with hosts.

- **SER**

  This bit enables **Drive Serialization**, which enables the reporting of drive serial numbers in the **Alternative Volume Tag (AVoltag)** field of the drive **Read Element Status**. The default setting is Enabled.

  Note: This must always be set to 1. Any attempt to disable this bit will result in a check condition (05 26 00).

- **AC-Auto Clean**

  When this bit is set to 1, automatic drive cleaning feature is enabled When set to 0, automatic drive cleaning is disabled. This bit is ignored. It can be set to 0 or 1 for compatibility with hosts

  Note: The normal state of automatic drive cleaning is "disabled."

- **ADU-Auto Drive Unload**
  - When this bit is set to 1, the DX-Series system unloads a tape drive as part of the **Move Medium** command (default condition)
  - When set to 0, the auto drive unload feature is disabled
- **EXB-Exabyte Emulation**
  - When this bit is set to 1, the DX-Series system emulates an **Exabyte EXB-120** - this setting changes the SCSI command set's behavior
  - When set to 0, the DX-Series system SCSI interface operates in the default manner as described in this document

The format for **Mode Select Vendor Unique Page 00h** is shown in table 27.

Table 27 Mode Select Data - Vendor Unique Page 00h

Bit/Byte	7	6	5	4	3	2	1	0
0	PS (0)	Rsrvd (0)	Page Code (00h)					
1	Page Length (3Eh)							
2	AInit	UInit (0)	Parity (0)	NBL	Rsrvd (0)	NRDC (0)	MDC (0)	
3	Maximum Parity Retries (00h)							
4 - 63	Display Messages (00h)							

- **PS - Parameters Savable**

  This bit is only used with the **Mode Sense** command (see table 32). This bit is reserved for **Mode Select** command and should be set to 0.
- **AInit**
  - When set to 1 the DX-Series system ensures that all elements have been inventoried before entering the On-line state
  - If set to 0, the DX-Series system only inventories itself when commanded to by the **Init Element Status** or **Init Element Status with Range** command

- **UInit**

  Not supported.

- **Parity**

  Not supported.

- **NBL - No bar code Labels**

  - Valid only if the **AInit** field value is 1 - when DX-Series system performs an inventory due to going on-line, and the **NBL** field value is 1, bar codes are not scanned and primary volume tags are set to empty
  - If **NBL** field is set to 0, when the DX-Series system performs an inventory due to going on-line bar codes are scanned and their value placed in the corresponding primary volume tag

- **NRDC - Not Ready Display Control**

  Not supported.

- **MDC - Message Display Control**

  Not supported.

- **Maximum Parity Retries**

  Not supported.

- **Display Message**

  Not supported.

The format for the **Element Address Assignment Page** is shown in table 28.

Table 28 Mode Select Data - Element Address Assign. Page

Bit/Byte	7	6	5	4	3	2	1	0
0	PS (0)	Rsrvd (0)	Page Code (1Dh)					
1	Parameter Length (12h)							
2	(MSB) First Medium Transport Element Address							
3	(LSB)							

Bit/Byte	7	6	5	4	3	2	1	0
4	(MSB) Number of Medium Transport Elements (0001h)							
5								(LSB)
6	(MSB) First Storage Element Address							
7								(LSB)
8	(MSB) Number of Storage Elements							
9								(LSB)
10	(MSB) First Import Export Element Address							
11								(LSB)
12	(MSB) Number of Import Export Elements							
13								(LSB)
14	(MSB) First Data Transport Element Address							
15								(LSB)
16	(MSB) Number of Data Transport Elements							
17								(LSB)
18	Reserved (0000h)							
19								

- **PS - Parameters Savable**

  This bit is only used with the **Mode Sense** command (see table 32). Reserved for **Mode Select** command and should be set to 0.

- **First Medium Transport Element Address**

  Field specifies the first medium transport element contained in the medium changer (other than default medium transport address of 0).

- **Number of Medium Transport Elements**

  Field defines total number of medium transport elements contained in the medium changer.

- **First Storage Element Address**

  Field specifies the first storage element contained in the medium changer.

- **Number of Storage Elements**

  Field defines total number of storage elements contained in the medium changer.

- **First Import/Export Element Address**

  Field specifies the first import/export element contained in the medium changer.

> **Tech Tip:** The DX-Series system does not support First Import/Export Element Address.

- **Number of Import/Export Elements**

  Field defines the total number of import/export elements contained in the medium changer.

> **Tech Tip:** The DX-Series does not support Number of Import/Export Elements.

- **First Data Transport Element Address**

  The **First Data Transfer Element Address** field specifies the first data transfer element contained in the medium changer.

- **Number of Data Transport Elements**

  Field defines the total number of data transfer elements contained within the medium changer and accessible to the medium transport elements.

Table 29 Changeable Parameters within MODE SELECT

Parameter	Default	Minimum	Maximum
AInit(00h)	1	0	1
NBL(00h)	0	0	1
AC(20h)	0	0	1

Parameter	Default	Minimum	Maximum
DLR(20h)	0	0	1
ADU(20h)	1	0	1

Mode Sense (1Ah)

The SCSI **Mode Sense** command provides a general method for a host to obtain current parameter settings of a target device. The host selects the set parameters to be returned by setting the **Page Code** field in the command block. This code selects the page of parameter information to be returned by the target.

The DX-Series system supports the three medium changer device parameter pages defined in the SCSI-2 specification and two vendor unique pages:

- **Element Address Assignment Page**
- **Transport Geometry Parameters Page**
- **Device Capabilities Page**
- **Vendor Unique Page 20h**
- **Vendor Unique Page 00h**

The host can request all pages with a single command using the **Return All Pages** page code as described in the SCSI-2 specification.

The format for the **Mode Sense** command block is shown in table 30.

Table 30 Mode Sense Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Ah)							
1	Logical Unit Number			Rsrvd (0)	DBD	Reserved (00)		
2	PC		Page Code					
3	Reserved (00h)							
4	Allocation Length							
5	Reserved (00h)							

- **Logical Unit Number**

  The **Logical Unit Number** field must be set to 0. This field indicates the logical unit to which the command is sent.

- **DBD**
  - When the **Disable Block Descriptors** field is set to 0, the target may return 0 or more block descriptors in the returned **Mode Sense** data at the target's discretion
  - A **DBD** bit of 1 specifies the target does not return any block descriptors in the returned **Mode Sense** data

- **PC**

  The **Page Control** field defines parameter type values to return:
  - 0 — requests current parameter values for the specified page code for the DX-Series system - current values returned are the default values
  - 1 — requests the target to return the changeable parameter mask for the page code specified - the page indicates which parameters are changeable
  - 2 — requests the target return the default values for the page code specified
  - 3 — requests the target return saved values for the page code specified - only the **Vendor Unique Page** has changeable/ savable parameters

- Otherwise, the current setting for each parameter is always the same as the setting that parameter had when the DX-Series system was turned on

- **Page Codes**

  The valid page codes are:

  - **00h — Vendor Unique Page, length 44h**
  - **1Dh — Element Address Assignment Page, length 18h**
  - **1Eh — Transport Geometry Parameters Page, length 08h**
  - **1Fh — Device Capabilities Page, length 18h**
  - **20h — Vendor Unique Page, length 08h**
  - **3Fh — Return All Pages, length 74h**

The parameter data returned for each **Mode Sense** command is preceded by a **Mode Parameter** header block. The header block is then followed by either the requested parameter page or all pages if the **Return All Pages** page code was used.

The format for the **Mode Sense** header block is shown in table 31.

Table 31 Mode Sense Data Header

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

- **Mode Data Length**

  Field is set to the data amount following the **Data Length** field in bytes. This includes the last 3 bytes in the header block as well as all bytes in the parameter page or pages.

- **Medium Type Code**

  Field is reserved for medium changer devices.

- **Device-Specific Parameter**

  Field is reserved for medium changer devices.

- **Block Descriptor Length**

  Field is reserved for medium changer devices.

The format for **Mode Sense Vendor Unique Page 00h** is shown in table 32.

Table 32 Mode Sense Data - Vendor Unique Page 00h

Bit/Byte	7	6	5	4	3	2	1	0
0	PS (1)	Rsrvd (0)	Page Code (00h)					
1	Page Length (3Eh)							
2	AInit	UInit (0)	Parity (0)	NBL	Rsrvd (0)	NRDC (0)	MDC (0)	
3	Maximum Parity Retries (00h)							
4 - 63	Display Messages (00h)							

- **PS-Parameters Savable**

  This bit is always set to 1 indicating this page can be saved to nonvolatile memory.

- **AInit**
  - When this value is set to 1, the DX-Series system insures all elements have been inventoried before entering the on-line state
  - If set to 0, the DX-Series system only inventories itself when commanded by a **Init Element Status or Init Element Status with Range** command
- **UInit**

  Not supported.

- **Parity**

  Not supported.

- **NBL - No Bar Code Labels**
  - Field is valid only if the **AInit** field value is 1-when the DX-Series system performs an inventory due to going on-line, and **NBL** field is 1, bar codes are not scanned and primary volume tags are set to empty
  - If this field is set to 0, when the DX-Series system performs an inventory due to going on-line, bar codes are scanned and their value placed in the corresponding primary volume tag
- **NRDC - Not Ready Display Control**

  Not supported.
- **MDC - Message Display Control**

  Not supported.
- **Maximum Parity Retries**

  Not supported.
- **Display Message**

  Not supported.

The format for the **Element Address Assignment Page** is shown in table 33.

Table 33 Mode Sense Data - Element Address Assign. Page

Bit/Byte	7	6	5	4	3	2	1	0
0	PS (1)	Rsrvd (0)	Page Code (1Dh)					
1	Parameter Length (12h)							
2	(MSB) First Medium Transport Element Address							
3	(LSB)							
4	(MSB) Number of Medium Transport Elements (0001h)							
5	(LSB)							
6	(MSB) First Storage Element Address							
7	(LSB)							

Bit/Byte	7	6	5	4	3	2	1	0
8	(MSB) Number of Storage Elements							
9								(LSB)
10	(MSB) First Import Export Element Address							
11								(LSB)
12	(MSB) Number of Import Export Elements							
13								(LSB)
14	(MSB) First Data Transport Element Address							
15								(LSB)
16	(MSB) Number of Data Transport Elements							
17								(LSB)
18	Reserved (0000h)							
19								

- **PS-Parameters Savable**

  This bit is always set to 1 indicating this page can be saved to nonvolatile memory.

- **First Medium Transport Element Address**

  Field identifies the first medium transport element contained in the medium changer (other than the default medium transport address of 0).

- **Number of Medium Transport Elements**

  Field defines total number of medium transport elements contained in the medium changer.

- **First Storage Element Address**

  Field identifies the first storage element contained in the medium changer.

- **Number of Storage Elements**

  Field defines total number of storage elements contained in the medium changer.

- **First Import/Export Element Address**

  Field identifies the first import/export element contained in the medium changer.

> **Tech Tip:** The DX-Series system does not support First Import/Export Element Address.

- **Number of Import/Export Elements**

  Field defines total number of import/export elements in the medium changer.

> **Tech Tip:** The DX-Series system does not support Number of Import/Export Elements.

- **First Data Transport Element Address**

  The **First Data Transfer Element Address** field identifies the first data transfer element contained in the medium changer.

- **Number of Data Transport Elements**

  Field defines total number of data transfer elements contained within the medium changer and accessible to medium transport elements.

  The format for the **Transport Geometry Parameters Page** is shown in table 34.

Table 34 Mode Sense Data - Trans. Geometry Para. Page

Bit/Byte	7	6	5	4	3	2	1	0
0	PS (0)	Rsrvd (0)	Page Code (1Eh)					
1	Parameter Length (02h)							
TRANSPORT GEOMETRY DESCRIPTOR								
2	Reserved (00h)							Rotate (0)
3	Member Number In Transport Element Set (00h)							

- **PS- Parameters Savable**

  This bit of 0 indicates the target is not capable of saving the page in a nonvolatile vendor-specific location.

- **Parameter Length**

  There are 2 bytes of parameter information.

- **Transport Geometry Descriptor**

  The geometry of each medium transport element is defined using a two-byte field.

- **Rotate**

  A rotate bit of 0 indicates the medium transport element does not support media rotation.

- **Member Number In Transport Element Set**

  The first element in a set has a member number of 0.

The format for the **Device Capabilities Page** is shown in table 35.

Table 35 Mode Sense Data - Device Capabilities Data

Bit/Byte	7	6	5	4	3	2	1	0
0	PS (0)	Rsrvd (0)	Page Code (1Fh)					
1	Parameter Length (12h)							
2	Reserved (0h)				StorDT[a] (1)	StorIE[b] (0)	StorST[c] (1)	StorMT[d] (1)
3	Reserved (0h)							
4	Reserved (0h)				MT→DT (1)	MT→IE (0)	MT→ST (1)	MT→MT (0)
5	Reserved (0h)				ST→DT (1)	ST→IE (0)	ST→ST (1)	ST→MT (1)
6	Reserved (0h)				IE→DT (0)	IE→IE (0)	IE→ST (0)	IE→MT (0)
7	Reserved (0h)				DT→DT (1)	DT→IE (0)	DT→ST (1)	DT→MT (1)
8 - 11	Reserved (00000000h)							
12	Reserved (0h)				MT↔DT (0)	MT↔IE (0)	MT↔ST (0)	MT↔MT (0)
13	Reserved (0h)				ST↔DT (0)	ST↔IE (0)	ST↔ST (0)	ST↔MT (0)
14	Reserved (0h)				IE↔DT (0)	IE↔IE (0)	IE↔ST (0)	IE↔MT (0)
15	Reserved (0h)				DT↔DT (0)	DT↔IE (0)	DT↔ST (0)	DT↔MT (0)
16 - 19	Reserved (00000000h)							

a. DT = Data Transfer Element (Tape Drive)
b. IE = Import/Export Element (load port)
c. ST = Storage Element (Bin)
d. MT = Medium Transport Element (Gripper Mechanism)

The **StorDT**, **StorIE**, **StorST**, and **StorMT** fields indicate if an element of the indicated type (**DT**, **IE**, **ST**, or **MT**) is capable of storing a tape cartridge.

The XX→YY fields indicate if a transfer from an element of type XX is possible to an element of type YY. A 1 in any of these fields indicates that all **Move Medium** commands where the source element is type XX and destination element is type YY are supported. A 0 in these fields indicates the move may or may not be valid depending on the particular element requested.

The DX-Series system does not support the **Exchange Medium** command. Bytes 12 through 15 in this parameter page contain the individual fields specifying the DX-Series system exchange capabilities. Since the DX-Series system has no exchange capability, all of these fields are 0.

The format for **Mode Sense Vendor Unique Page 20h** is shown in table 36.

Table 36 Mode Sense Data - Vendor Unique Page 20h

Bit/Byte	7	6	5	4	3	2	1	0
0	PS (1)	Rsvd (0)	Page Code (20h)					
1	Page Length (02h)							
2	Reserved (00h)					SER	AC	DLR
3	Reserved (00h)						ADU	EXB

- **PS-Parameters Savable**

  This bit is always set to 1 indicating that this page can be saved to nonvolatile memory.

- **Page Code**

  The page code value of 20h is used to indicate a vendor unique page, in page format.

- **Page Length**

  The page length is fixed at a value of 2 bytes.

- **SER**

  This bit enables Drive Serialization, which enables reporting the drive serial numbers in the **Alternative Volume Tag (AVoltag)** field of the drive **Read Element Status**. The default setting is Enabled.

- **AC-Auto Clean**
  - If this bit is set to 1 the current state of automatic drive cleaning is "enabled"
  - When it is set to 0, the feature is "disabled"
- **DLR-Drive Load Retry**

  This bit is ignored. Can be set to 1 or 0 for compatibility.
- **ADU-Auto Drive Unload**
  - When bit is set to 1, the DX-Series system unloads a tape drive as part of the **Move Medium** command (default condition)
  - When set to 0, the auto drive unload feature is disabled

Move Medium (A5h)

The host uses the **Move Medium** command to move a tape cartridge from one element to another within a DX-Series system. The host specifies the source element and the destination element in the command block. The DX-Series system then moves the tape cartridge contained in the source element to the empty destination element.

If the **Mode Select Data ADU** (auto drive unload) bit is set to 1, and the source element is a tape drive, the DX-Series system unloads the tape drive as part of the **Move Medium** command.

The source and destination elements can be of any type: storage, medium transport, import/export, or data transport element. The valid combinations of source element type and destination element type are summarized in the **Mode Sense Device Capabilities Parameter Page** (see table 35).

If a valid source element type and destination element type are specified, the command is valid but the operation may still not be possible. In this case the DX-Series system returns check condition status and sets the sense key to Illegal Request.

The **Additional Sense Code** and **Additional Sense Code Qualifier** indicate why an operation cannot be carried out. For example, this might occur if the specified source element or destination element does not contain a tape cartridge. For a summary of the conditions, sense key, and additional sense encoding, see table 226 on page 279.

The format for the **Move Medium** command block is shown in table 37.

Table 37 Move Medium Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (A5h)							
1	Logical Unit Number			Reserved (00h)				
2	(MSB) Transport Element Address (0000h)							
3	(LSB)							

Bit/Byte	7	6	5	4	3	2	1	0
4	(MSB) Source Element Address							
5								(LSB)
6	(MSB) Destination Element Address							
7								(LSB)
8	Reserved (0000h)							
9								
10	Reserved (00h)							Invert (0)
11	Reserved (00h)							

- **Logical Unit Number**

  The **Logical Unit Number** must be set to 0. This field indicates the logical unit to which the command is sent.

- **Transport Element Address**

  The default medium transport element address of 0 or the medium transport element address specified by the **Mode Sense Data** can be used.

- **Source Element Address**

  The source element address specifies the location from which the medium is taken.

- **Destination Element Address**

  The destination address specifies the location to which the medium is moved.

- **Invert**

  The medium changer does not support medium rotation for handling double-sided media. The **Invert** bit must be set to 0.

Position To Element (2Bh)

The **Position To Element** command is used by the host to position the medium transport element in front of another element within a DX-Series system. The host specifies the destination element in the command block. The DX-Series system then moves the transport element in front of the destination element.

The destination element can be one of these types:

- **Storage**
- **Import/Export**

> **Tech Tip:** The DX-Series system does not support import/export.

- **Data Transfer**

If the address is in error, the DX-Series system returns check condition status and sets the sense key to Illegal Request.

The format of the **Position To Element** command block is shown table 38.

Table 38 Position To Element Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (2Bh)							
1	Logical Unit Number			Reserved (00h)				
2	(MSB) Transport Element Address (0000h)							
3	(LSB)							
4	(MSB) Destination Element Address							
5	(LSB)							

Bit/Byte	7	6	5	4	3	2	1	0
6	Reserved (00h)							
7								
8	Reserved (00h)							Invert (0)
9	Reserved (00h)							

- **Logical Unit Number**

  The **Logical Unit Number** must be set to 0. This field indicates the logical unit to which the command is sent.

- **Transport Element Address**

  The default medium transport element address of 0 or the medium transport element address specified by the mode sense data can be used.

- **Destination Element Address**

  The destination address specifies the location to which the medium transport element is moved.

- **Invert**

  The medium changer does not support medium rotation for handling double-sided media. The invert bit must be set to 0.

Read Element Status (B8h)

The host can determine the status of any DX-Series system element by issuing a **Read Element Status** command. The command can specify the element type:

- **Medium Transfer**
- **Storage**
- **Import/Export**

> **Tech Tip:** The DX-Series system does not support import/export.

- **Data Transfer**
- **Starting Address**
- Number of elements for which status information is to be returned

The DX-Series system automatically updates its internal element status every time the status changes. The DX-Series system inventory initializes the information and it is updated with each move. Because the information is updated with each move, no action is required by the DX-Series system other than returning the information it has stored.

The format for the **Read Element Status** command block is shown in table 39.

Table 39 Read Element Status Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (B8h)							
1	Logical Unit Number			VolTag	Element Type Code			
2	(MSB) Starting Element Address							
3	(LSB)							
4	(MSB) Number of Elements							
5	(LSB)							

Bit/Byte	7	6	5	4	3	2	1	0
6	Reserved (00h)							
7	(MSB)							
8	Allocation Length							
9								(LSB)
10	Reserved (00h)							
11	Reserved (00h)							

- **Logical Unit Number**

  The **Logical Unit Number** is 0.

- **VolTag**
  - The **Volume Tag** field **(VolTag)** indicates whether the volume tag information associated with each tape cartridge should be returned as part of the status information.
  - The volume tag (or bar code) is updated for each tape cartridge whenever it is moved with a **Move Medium** command.
  - The volume tag information for all tape cartridges can also be updated using the **Initialize Element Status** command (see Initialize Element Status (07h) on page 13). Since tape cartridges are a single-sided media, only a single volume tag is supported per tape cartridge.
- **Element Type Code**

  This field indicates which element type is reported:
  - 0 indicates all element types reported
  - 1 indicates medium transport element
  - 2 indicates storage element
  - 3 indicates import/export element

> **Tech Tip:** The DX-Series system does not support import export elements.

- 4 indicates data transfer elements

- **Starting Element Address** and **Number of Elements**

  These fields are used to select the range of elements to report. Within this range, no status information is reported for an undefined element address.

  - Only elements matching the indicated type are returned
  - No elements with an address smaller than the **Starting Element Address** are reported
  - Beginning with the first defined element with an address greater than or equal to the **Starting Element Address**, all defined, type matching elements are reported until reports for the indicated number of elements have been returned

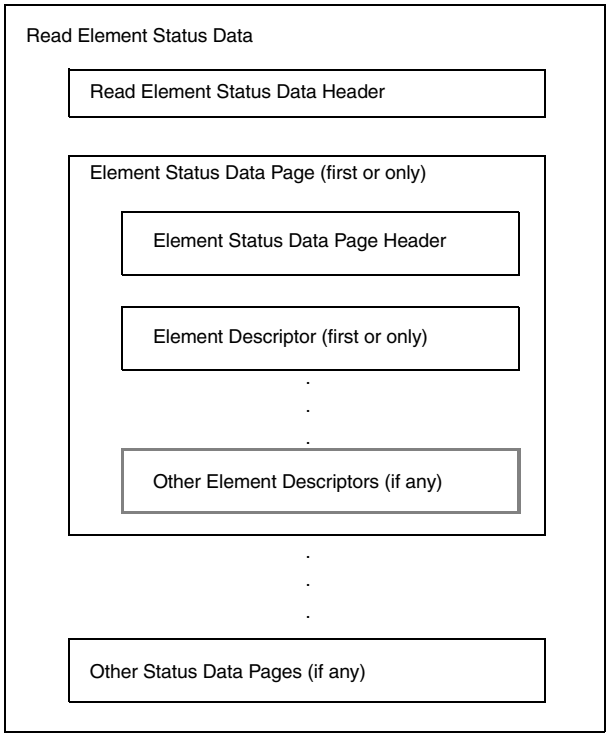
- **Allocation Length**

  This field specifies how much memory the host has set aside to store the status information returned by the DX-Series system.

  - This field should be set to a number that is large enough to store the status information for the requested number of elements
  - If the field is not large enough, the DX-Series system only reports the status information for the number of elements whose status information fits within the allocated space

The returned **Read Element Status Data** has the general structure as depicted in figure 1.

Figure 1 Read Element Status Data General Structure



A single **Read Element Status Data Header** is returned along with one or more element status pages. The **Read Element Status Data Header** indicates the address of the first element reported, number of elements reported, and the report size for all requested data.

The report size is given in bytes.

- The size is the total number of bytes that would be contained in the report for all requested data minus 7

The **Read Element Status** command can be given with an **Allocation Length** of 8 to determine how much space must be allocated to transfer all status data requested by the command.

The format for the **Read Element Status Data** is shown in table 40.

Table 40 Read Element Status Data

Bit/Byte	7	6	5	4	3	2	1	0
0	(MSB) First Element Address Reported							
1								(LSB)
2	(MSB) Number of Elements Reported							
3								(LSB)
4	Reserved (00h)							
5	(MSB) Byte Count of Report Available							
6								
7								(LSB)
8 - X	One or More Element Status Page(s)							

- **First Element Address Reported**

  Indicates element address of element with smallest element address found to meet the command description block request.

- **Number of Elements Reported**
  - Indicates number of elements meeting the request in the command descriptor block
  - Element status is returned if sufficient allocation length was specified

- **Byte Count of Report Available**

  Indicates number of bytes of element status page data available for all elements meeting the request in the command descriptor block.

From 1 to 4 **Element Status Pages** can be returned.

- One page is returned for each element type with status information
- Each page contains a header and 1 or more element descriptors
- Each element descriptor reports the status for a single DX-Series system element

The page header (bytes 0-7) defines the contents of the element descriptors for the elements of that type. The format of a status page is shown in table 41.

Table 41 Element Status Page

Bit/Byte	7	6	5	4	3	2	1	0
0	Element Type Code							
1	PVol Tag	AVol Tag	Reserved (00h)					
2	(MSB) Element Descriptor Length							
3	(LSB)							
4	Reserved (00h)							
5	(MSB) Byte Count of Descriptor Data Available							
6								
7	(LSB)							
8 - X	One or More Element Descriptors							

- **PVolTag**
  - A **Primary Volume Tag** field value of 1 indicates the primary volume tag information field is present in each of these element descriptor blocks
  - A value of 0 indicates these bytes are omitted from the element descriptors that follow
- **AVolTag**
  - An **Alternate Volume Tag** field value of 1 indicates the alternate volume tag information field is present in each of these element descriptor blocks
  - A value of 0 indicates these bytes are omitted from the element descriptors that follow
- **Element Descriptor Length**

  Field indicates the number of bytes in each element descriptor.

- **Byte Count of Descriptor Data Available**

  Byte Count of Descriptor Data Available indicates the number of bytes (minus 7) of descriptor data (excluding this header) that are returned for the descriptors of the specified type if an adequate allocation length had been specified

There are 4 types of element descriptor blocks, 1 for each element type.

- There are several fields found in more than 1 element type descriptor, as well as fields which are unique to an element descriptor
- Fields found in more than 1 type of element descriptor are indicated by the same name in the following illustrations and descriptions
- The format of an descriptor for an element of the medium transport element type is shown in table 42.

Table 42 Medium Transport Element Descriptor

Bit/Byte	7	6	5	4	3	2	1	0
0	(MSB) Element Address							
1								(LSB)
2	Reserved (00h)					Except	Rsrvd (0)	Full
3	Reserved (00h)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Reserved (000000h)							
7								
8								
9	SValid (0)	Invert (0)	Reserved (00h)					
10	Source Storage Element Address (0000h)							
11								

Bit/Byte	7	6	5	4	3	2	1	0
12 - 47	Primary Volume Tag Information (Field omitted if PVolTag = 0)							
48 - 51	Reserved (00000000h)							
52	Vendor Unique (0000h)							
53								

- **Element Address**

  This field indicates the address of the element being reported by that element descriptor.

- **Except**
  - When the element is in a normal state, it is set to 0
  - When the element is in an abnormal state, it is set to 1
  - Information on the abnormal state is available in the **Additional Sense Code** and **Additional Sense Code Qualifier** fields

- **Full**
  - The **Full** field is set to 1 whenever the element contains a tape cartridge
  - It is set to 0 otherwise

- **Additional Sense Code** and **Additional Sense Code Qualifier**

  These fields are only valid if the Exception field is set to one.

- **SValid**, **Invert**, and **Source Storage Element Address**

  This field, and the invert bit information value of 0 indicates these fields are not valid (table 44).

- **Primary Volume Tag Information**

  If the **Volume Tag** information was requested in the command block (VolTag=1), the **Primary Volume Tag Information** field is included in the element descriptor. This field contains the information read from the tape cartridge bar code label; its format is shown in table 43.

Table 43 Primary Volume Tag Information

Bit/Byte	7	6	5	4	3	2	1	0
12 - 43	Volume Identification Field							
44	Reserved (0000h)							
45								
46	Volume Sequence Number (0000h)							
47								

- **Volume Identification Field**

  A left justified sequence of ASCII characters representing the bar code scanned from the cartridge followed by blanks 20h.

- **Volume Sequence Number**

  This field is reserved and set to 0.

Table 44 Storage Element Descriptor

Bit/Byte	7	6	5	4	3	2	1	0
0	(MSB) Element Address							
1	(LSB)							
2	Reserved (0h)				Access	Except	Rsrvd (0)	Full
3	Reserved (00h)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Reserved (000000h)							
7								
8								
9	SValid	Invert (0)	Reserved (00h)					

Bit/Byte	7	6	5	4	3	2	1	0
10	Source Storage Element Address							
11								
12 - 47	Primary Volume Tag Information (Field omitted if PVolTag = 0)							
48 - 51	Reserved (00000000h)							
52	Vendor Unique (0000h)							
53								

- **Element Address**

  This field indicates the address of the element being reported by that element descriptor.

- **Access**
  - An access bit value of 1 indicates that access to the element by a medium transport element is allowed
  - The access bit may be set to 0 or 1 for the bins in the 2 removable packs
  - Access bit is always set to 1 for the other non-removable bins in the system
- **Except**
  - When the element is in a normal state, it is set to 0
  - When the element is in an abnormal state, it is set to 1
  - Information on the abnormal state is available in the **Additional Sense Code** and **Additional Sense Code Qualifier** fields in the element descriptor. For the meaning of the codes contained in the two **Sense Code** fields, see Request Sense (03h) on page 75.
- **Full**
  - The **Full** field is set to 1 whenever the element contains a tape cartridge
  - It is set to 0 otherwise
- **Additional Sense Code** and **Additional Sense Code Qualifier**

These fields are only valid if the **Exception** field is set to 1. **SValid**

- The **SValid** bit is set to 1 if the information in the **Source Storage Element Address** field is valid
- If information is unknown (due to a door open or power on condition), the **SValid** bit is set to 0

- **Invert**

  The **Invert** field is not supported and is set to 0.

- **Source Storage Element Address**

  Source Storage Element Address represents the address of the last storage element that held the cartridge. The **SValid** field indicates whether this information is valid.

- **Primary Volume Tag Information**

  If the **Volume Tag** information is requested in the command block (VolTag=1), then the **Primary Volume Tag Information** field is included in the element descriptor. For format, see table 43.

The layout of an element descriptor for an element of the import /export element type is illustrated in table 45.

Table 45 Import/Export Element Descriptor

Bit/Byte	7	6	5	4	3	2	1	0
0	(MSB) Element Address							
1								(LSB)
2	Reserved (0)		Import Enable	Export Enable	Access	Except	Import Export	Full
3	Reserved (00h)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Reserved (000000h)							
7								
8								

Bit/Byte	7	6	5	4	3	2	1	0
9	SValid	Invert (0)	Reserved (00h)					
10	Source Storage Element Address							
11								
12 - 47	Primary Volume Tag Information (Field omitted if PVolTag = 0)							
48 - 51	Reserved (00000000h)							
52	Vendor Unique (0000h)							
53								

- **Import Element**

  The **Import Enable** field indicates if the element can import a tape cartridge into the DX-Series system. This field is always set to 1 because imports are possible through that element.

- **Import Enable**

  The **Import Enable** field indicates if the element can export a tape cartridge from the DX-Series system. It is set to 1.

- **Export Enable**

  The **Export Enable** field indicates whether the element can export a tape cartridge from the DX-Series system. It is set to 1.

- **Access**
  - An access bit value of 1 indicates access to the element by a medium transport element is allowed
  - This is set to 0 if the load port door is open, or if a load pack has been removed
- **Except**
  - When the element is in a normal state, it is set to 0
  - When the element is in an abnormal state, it is set to 1

  - Information on the abnormal state is available in the **Additional Sense Code** and **Additional Sense Code Qualifier** fields in that element descriptor. Appendix A, Sense Key Values for the meaning of the codes contained in the two **Sense Code** fields

- **Import Export**
  - The **Import/Export** field is set to 0 if the tape cartridge contained in the element was placed there by the transfer mechanism
  - It is set to 1 if the tape was placed there by an operator or if its source is unknown (e.g., after power cycle)
- **Full**
  - The **Full** field is set to 1 whenever the element contains a tape cartridge
  - It is set to 0 when the element contains no tape or the load port door is open
- **Additional Sense Code** and **Additional Sense Code Qualifier**

  These fields are only valid if the **Exception** field is set to 1. Currently the only valid values for these fields indicate:
  - **Element Contents Unknown** condition (ASC=80 ASCQ=22)
  - **Cleaning Cartridge Installed** (ASC=30 ASCQ=03)
  - **Operator Medium Removal Request** (ASC=5A ASCQ=01)
- **SValid**
  - The **SValid** bit is set to 1 if the information in the **Source Storage Element Address** field is valid
  - If the information is unknown, the **SValid** bit is set to 0
- **Invert**

  The **Invert** field is not supported and is set to 0.
- **Source Storage Element Address**

  The **Source Storage Element Address** represents the address of the last storage element that held the cartridge. The **SValid** field indicates if this information is valid.

The format of an element descriptor for an element of the data transfer element type is shown in table 46.

Table 46 Data Transfer Element Descriptor

Bit/Byte	7	6	5	4	3	2	1	0
0	(MSB) Element Address							
1	Element Address (LSB)							
2	Reserved (0h)				Access	Except	Rrsvd (0)	Full
3	Reserved (00)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Not Bus	Rsrvd	ID Valid	LU Valid	Rsrvd	Logical Unit Number		
7	SCSI Bus Address							
8	Reserved (00h)							
9	SValid	Invert (0)	Reserved (00h)					
10	Source Storage Element Address							
11	Source Storage Element Address							
12 - 47	Primary Volume Tag Information (Field omitted if PVolTag = 0)							
48 - 83	Alternate Volume Tag Information (Field omitted if AVolTag = 0)							
84 - 87	Reserved (00000000h)							
88	Vendor Unique (0000h)							
89	Vendor Unique (0000h)							

- **Element Address**

  This field indicates the address of the element being reported by that element descriptor.

- **Access**

  An access bit value of 1 indicates access to the element by a medium transport element is allowed.

- **Except**
  - When the element is in a normal state, field is set to 0
  - When the element is in an abnormal state, field is set to 1
  - Information on the abnormal state is available in the **Additional Sense Code** and **Additional Sense Code Qualifier** fields in that element descriptor - Sense Key Values on page 295 for the meaning of the codes contained in the two **Sense Code** fields

- **Full**
  - The **Full** field is set to 1 whenever the element contains a tape cartridge
  - It is set to 0 otherwise

- **Additional Sense Code** and **Additional Sense Code Qualifier**

  These fields are only valid if the **Exception** field is set to 1. Currently the only valid values for these fields indicate:
  - **Element Contents Unknown** condition (ASC=80 ASCQ=22)
  - **Tape Drive Requires Cleaning** (ASC=80 ASCQ=01)
  - **Cleaning Cartridge Installed** (ASC=30 ASCQ=03)
  - Any tape drive error (ASC=8D or ASC=F3)

- **Not Bus**

  This field is sent as 0. The data transfer element is on the same bus as the media changer device.

- **ID Valid**

  When set to 1, it indicates that the SCSI BUS address field contains valid information.

- **LU Valid**

  When set to 1, it indicates that the **Logical Unit Number** field contains valid information.

- **SCSI Bus Address**

  If valid, it provides the SCSI address of the primary device served by the media changer at this element address.

- **SValid**
  - The SValid bit is set to 1 if information in the **Source Storage Element Address** field is valid
  - If information is unknown (due to a door open or power on condition) the **SValid** bit is set to 0
- **Invert**

  The invert field is not supported and is set to 0.
- **Source Storage Element Address**

  The **Source Storage Element Address** represents the address of the last storage element that held the cartridge. The **SValid** field indicates whether this information is valid.
- **Primary Volume Tag Information**

  If **Volume Tag** information was requested in the command block (VolTag = 1), the **Primary Volume Tag Information** field is included in the element descriptor. This information is omitted if PVolTag = 0 in the element status page. For format, see table 43.
- **Alternate Volume Tag Information**

  If the **Volume Tag** information was requested in the command block (VolTag=1) and **Drive Serialization** is enabled (mode page 20h, SER=1), the **Alternate Volume Tag Information** field is included in the element descriptor and includes the drive serial number in an ASCII text string. The serial number is preceded by four null characters. For format, see table 47.

Note: For more information on enabling **Drive Serialization**, see the **Mode Select** command Vendor Unique Page 20h, **SER** bit and the **Mode Sense** command, **SER** bit.

Table 47 Alternate Volume Tag Information

Bit/Byte	7	6	5	4	3	2	1	0
0 - 3	Reserved							

Bit/Byte	7	6	5	4	3	2	1	0
4 - 16	Drive Serial Number							
17 - 35	Reserved							

- **Drive Serial Number**

  This field is 12 bytes.

Release (17h)

The **Release** command releases the DX-Series system or elements that match the specified release parameters.

> **Note:** It is not an error to attempt to release the DX-Series system if it is not currently reserved by the requesting initiator. However, if the DX-Series system is reserved by another initiator, the DX-Series system is not released.

Table 48 Release Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (17h)							
1	Logical Unit Number			3rdPty	3rd Party ID			Element 0
2	Reservation ID							
3	Reserved (00h)							
4	Reserved (00h)							
5	Unused		Reserved (00h)				Flag (0)	Link (0)

- **Logical Unit Number**

  The **Logical Unit Number** is 0. This field indicates the logical unit to which the command is sent.

- **3rdPty** and **3rd Party ID**

  The 3rd party release option allows an initiator to release a logical unit or elements that were previously reserved using the 3rd party reservation option.

  - If the **3rdPty** bit is 0, then the 3rd party release option is not requested and the command only releases a unit or elements that were reserved without 3rd party reservation

- If the **3rdPty** bit is 1, the unit or elements released were originally reserved by the same initiator using the 3rd party reservation option, and if the device is the same SCSI device that was specified in the 3rd party device ID (3rd Party ID) field

- **Element ID**

  The Element field specifies whether this command is a **Unit Release**.

  - If the value is 0, the command releases a reservation placed on this unit by the requesting initiator that meets 3rd party release requirements, if applicable.

- **Reservation ID**

  If the value is 1, the command releases all elements reserved by the requesting initiator that were reserved with the same **Reservation ID** value as this release attempt and that meet 3rd party release requirements, if applicable.

- **Flag Bit**

  The Flag bit is used in conjunction with the Link bit to notify the initiator in an expedient manner that a command has been completed.

  Flag bits are not supported by the DX-Series system.

- **Link Bit**

  A Link bit set to 1 indicates that the initiator requests continuation of a task (an I/O process) across two or more SCSI commands.

  If the Link bit is 1 and the Flag bit is 0, and the task completes successfully, the drive continues the task and returns a status of INTERMEDIATE and a LINKED COMMAND COMPLETE message.

  If the Link bit and the Flag bit within a Control word are both set to 1, and the drive completes a command with a status of INTERMEDIATE, the drive returns a LINKED COMMAND COMPLETE message (with Flag).

  Link bits are not supported by the DX-Series system.

Report LUNS (A0h)

The Report LUNS command requests that the peripheral device logical unit numbers of known logical units in the target be sent to the applications client. The command only returns information about the logical units to which commands may be sent.

Table 49 Report LUNS Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (A0h)							
1	Reserved							
2	Select Report							
3-5	Reserved							
6-9	(MSB) Allocation Length (LSB)							
10	Reserved							
11	Control							

- Allocation Length

  If the Allocation Length is not sufficient to contain the logical unit number values for all configured logical units, the device server still reports as many logical number values as will fit in the Allocation Length.

  The format of the report of configured logical units is shown in table 50.

Table 50 LUN Reporting Parameter List

Bit/Byte	7	6	5	4	3	2	1	0
0-3	(MSB) LUN List Length (n-7) (LSB)							
4-7	Reserved							
8-15	(MSB) LUN (first LUN) (LSB)							
	. . .							
n-7 - n	LUN (last LUN, if more than one)							

The LUN List Length field contains the length in bytes of the LUN list that can be transferred. The LUN list length equals the number of logical unit numbers reported multiplied by eight. If the allocation length in the CDB is too small to allow transfer of information about all of the logical units configured, the LUN list length value is not adjusted to reflect the truncation.

Request Sense (03h)

The **Request Sense** command allows the host to receive sense data from the DX-Series system.

The DX-Series system supports reporting of current errors only. A current error (error code 70h) is returned when the error was generated during the execution of a command indicating the check condition.

The DX-Series system supports unit attention condition queuing as described in the SCSI-2 specification. Other details of processing for this command are consistent with the SCSI-2 specification.

The format of the **Request Sense** command is shown in table 51.

- **Logical Unit Number**

  The **Logical Unit Number** is 0. This field indicates the logical unit to which the command is sent.

Table 51 Request Sense Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (03h)							
1	Logical Unit Number			Reserved (00h)				
2	Reserved (0000h)							
3								
4	Allocation Length							
5	Reserved (00h)							

- **Allocation Length**

  This field contains the maximum amount of data that may be returned to the host. Anything greater than 24 returns the full 24 bytes of data.

The format of the **Request Sense** data is shown in table 52.

Table 52 Request Sense Data

Bit/Byte	7	6	5	4	3	2	1	0
0	Valid (0)	Error Code (70h)						
1	Segment Number (00h)							
2	Filemark (0)	EOM (0)	ILI (0)	Rsrvd (0)	Sense Key			
3	(MSB) Information Bytes (00000000h)							
4								
5								
6								(LSB)
7	Additional Sense Length (0Dh)							
8	(MSB) Command Specific Information Bytes (0h)							
9								
10								
11								(LSB)
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Field Replaceable Unit Code (00h)							
15	SKSV (0)							
16	Reserved							
17								
18	Vendor Unique ASC							
19	Vendor Unique ASCQ							
20	Vendor Specific							

Bit/Byte	7	6	5	4	3	2	1	0
21	Reserved							
22	Reserved							
23	Reserved							

- **Valid**

  This field is set to 0 indicating that the field is not being used.

- **Segment Number**, Filemark, **EOM**, and **ILI**

  These fields are not supported and are set to 0.

- **Error Code**

  This error value is supported: 70h current error

- **Sense Key**

  These **Sense Key** values are supported:

  - **0h NO SENSE**
  - **1h RECOVERED ERROR**
  - **2h NOT READY**
  - **4h HARDWARE ERROR**
  - **5h ILLEGAL REQUEST**
  - **6h UNIT ATTENTION**
  - **9h VENDOR SPECIFIC**
  - **Bh ABORTED COMMAND**

- **Information**

  This field is not supported and is set to 0.

- **SKSV**

  Sense Key Specific fields are not supported and always set to 0.

- **Additional Sense Length**, **Additional Sense Code**, **Additional Sense Code Qualifier**, **Vendor Unique ASC** and **Vendor Unique ASCQ**

  For a list of possible sense information returned from the DX-Series system, see Sense Key Values on page 279.

- **Command-Specific Information** and **Field Replaceable Unit Code**

  These fields are not supported and are set to 0.

Request Volume Element Address (B5h)

Tech Tip: The DX-Series system does not support Request Volume Element Address (B5h).

The **Request Volume Element Address** command reports the element descriptors found by a **Send Volume Tag** command. The type of element (medium transfer, storage, import/export or data transfer) can be specified in the command as well as the starting address and number of elements for which status information is to be returned.

The format of the **Request Volume Element Address** command is shown in table 53.

Table 53 Request Volume Element Address Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (B5h)							
1	Logical Unit Number			VolTag	Element Type Code			
2	(MSB) Starting Element Address							
3	(LSB)							
4	(MSB) Number of Elements							
5	(LSB)							
6	Reserved (00h)							
7	(MSB) Allocation Length							
8								
9	(LSB)							
10	Reserved (00h)							
11	Reserved (00h)							

- **Logical Unit Number**

  The **Logical Unit Number** is 0.

- **VolTag**

  - The **Volume Tag** field **(VolTag)** indicates if the volume tag information associated with each tape cartridge should be returned as part of the status information
  - The volume tag (or bar code) is updated for each tape cartridge whenever it is moved with a **Move Medium** command
  - The volume tag information for all tape cartridges can also be updated using the **Initialize Element Status** command. Since tape cartridges are a single-sided media, only a single-volume tag is supported per tape cartridge

- **Element Type Code**

  This field is used to indicate which type of element (medium transport, storage, import/export, data transfer, or all) is to be reported by this command.

  - 0 indicates all element types reported
  - 1 indicates medium transport element
  - 2 indicates storage element
  - 3 indicates import/export element

  > **Tech Tip:** The DX-Series system does not support import/export elements.

  - 4 indicates data transfer elements

- **Starting Element Address** and **Number of Elements**

  These fields are used to select the range of elements to be reported. Within this range, no status information is reported for an undefined element address.

  - Only elements matching the indicated type are returned
  - No elements with an address smaller than the **Starting Element Address** is reported

- Beginning with the first defined element with an address greater than or equal to the **Starting Element Address**, all defined, type-matching elements are reported until reports for the indicated number of elements have been returned

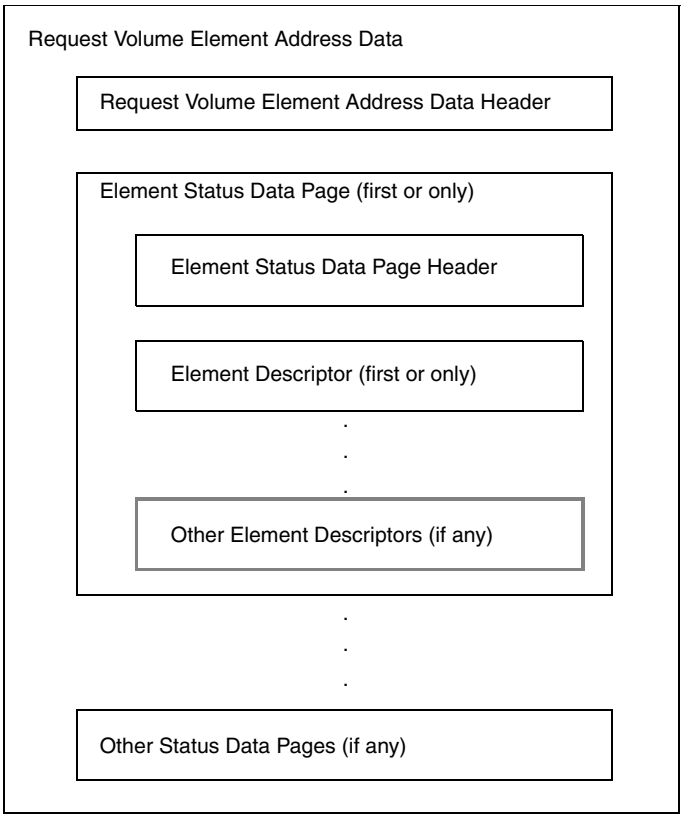
- **Allocation Length**

  This field specifies how much memory the host has set aside to store the status information returned by the DX-Series system.

  - This field should be set to a number that is large enough to store the status information for the requested number of elements
  - If the field is not large enough, the DX-Series system only reports the status information for the number of elements whose status information fits within the allocated space

The returned **Request Volume Element Address Data** has the general structure as depicted in figure 2.

Figure 2 Request Volume Element Address Data



A single **Volume Element Address Header** is returned along with 1 or more element status pages. The **Volume Element Address** indicates:

- Address of the first element reported
- Number of elements reported
- Action code of the reported **Send Volume Tag** command
- Size of the report for all requested data

The size of the report is given in bytes. The size is the total number of bytes that would be contained in the report for all requested data minus 7. The **Request Volume Element Address** command can be given with an **Allocation Length** of 8 to determine how much space must be allocated to transfer all of the status data requested by the command.

The format for the **Volume Element Address Header** is shown in table 54.

Table 54 Volume Element Address Header

Bit/Byte	7	6	5	4	3	2	1	0
0	(MSB) First Element Address Reported							
1	(LSB)							
2	(MSB) Number of Elements Reported							
3	(LSB)							
4	Reserved (00h)			Send Action Code (05h)				
5	(MSB) Byte Count of Report Available							
6								
7	(LSB)							
8 - X	One or More Element Status Page(s)							

- **First Element Address Reported**

  This field indicates the element address of the element with the smallest element address found to meet the command description block request.

- **Number of Elements Reported**

  This field indicates the number of elements meeting the request in the command descriptor block. The status for these elements is returned if sufficient allocation length was specified.

- **Send Action Code**

  The **Send Action Code** is specified by the previous **Send Volume Tag** command. The DX-Series system only supports **Action** code 05h.

- **Byte Count of Report Available**

  This field indicates the number of bytes of element status page data available for all elements meeting the request in the command descriptor block.

From 0 to 4 **Element Status Pages** can be returned. One page is returned for each type of element with status information. Each page contains a header and 1 or more element descriptors. Each element descriptor reports the status for a single DX-Series system element.

The page header (bytes 0-7) contains information that defines the contents of the element descriptors for the elements of that type. The format of a status page is shown in table 55.

Table 55 Element Status Page

Bit/Byte	7	6	5	4	3	2	1	0
0	Element Type Code							
1	PVolTag	AVolTag	Reserved (00h)					
2	(MSB) Element Descriptor Length							
3	(LSB)							
4	Reserved (00h)							
5	(MSB) Byte Count of Descriptor Data Available							
6								
7	(LSB)							
8 - X	One or More Element Descriptors							

- **PVolTag**
  - A **Primary Volume Tag** field value of 1 indicates the **Primary Volume Tag Information** field is present in each of these element descriptor blocks
  - A value of 0 indicates that these bytes are omitted from the element descriptors that follow
- **AVolTag**

  Alternate Volume Tag is not supported. This field is set to 0.
- **Element Descriptor Length**

  This field indicates the number of bytes in each element descriptor.
- **Byte Count of Descriptor Data Available**

The **Byte Count of Descriptor Data Available** indicates the number of bytes (minus 7) of descriptor data (excluding this header) that are returned for the descriptors of the specified type if an adequate allocation length had been specified.

There are 4 different types of element descriptor blocks, one for each type of element. There are several fields which are found in more than 1 type of element descriptor as well as fields which are unique to an element descriptor. The fields common to more than 1 type of element descriptor have the same name in the illustrations and descriptions that follow. The format of an element descriptor for an element of the medium transport element type is shown in table 56.

Table 56 Medium Transport Element Descriptor

Bit/Byte	7	6	5	4	3	2	1	0
0	(MSB) Element Address							
1								(LSB)
2	Reserved (00h)					Except	Rsvd (0)	Full
3	Reserved (00h)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Reserved (000000h)							
7								
8								
9	SValid (0)	Invert (0)	Reserved (00h)					
10	Source Storage Element Address (0000h)							
11								
12 - 47	Primary Volume Tag Information (if present)							

Bit/Byte	7	6	5	4	3	2	1	0
48 - 51	Reserved (00000000h)							
52	Vendor Unique (0000h)							
53								

- **Element Address**

  This field indicates the address of the element being reported by that element descriptor.

- **Except**
  - When the element is in a normal state, it is set to zero
  - When the element is in an abnormal state, it is set to 1
  - Information on the abnormal state is available in the **Additional Sense Code** and **Additional Sense Code Qualifier** fields

- **Full**
  - The **Full** field is set to 1 whenever the element contains a tape cartridge
  - It is set to 0 otherwise

- **Additional Sense Code** and **Additional Sense Code Qualifier**

  These fields are only valid if the **Exception** field is set to 1.

- **SValid**, **Invert**, and **Source Storage Element Address**

  Source Valid, **Source Storage Element Address** field and the **Invert** bit information value of 0 indicates these fields are not valid.

- **Primary Volume Tag Information**

  If the **Volume Tag** information was requested in the command block, the **Primary Volume Tag Information** field is included in the element descriptor. This field contains the information read from the bar code affixed to each tape cartridge; its format is shown in table 57.

- **Volume Identification Field**

  This is a left-justified sequence of ASCII characters that represents the bar code scanned from the cartridge followed by 20h (blanks) (see table 58).

- **Volume Sequence Number**

  This field is reserved and set to 0.

Table 57 Primary Volume Tag Information

Bit/Byte	7	6	5	4	3	2	1	0
12 - 43	Volume Identification Field							
44	Reserved (0000h)							
45								
46	Volume Sequence Number (0000h)							
47								

Table 58 Alternate Volume Tag Information

Bit/Byte	7	6	5	4	3	2	1	0
0 - 4	Reserved							
5 - 17	Drive Serial Number							
18 -	Reserved							

The format of an element descriptor for an element of the storage element type is shown in table 59.

Table 59 Storage Element Descriptor

Bit/Byte	7	6	5	4	3	2	1	0
0	(MSB) Element Address							
1								(LSB)
2	Reserved (0h)				Access	Except	Rsrvd (0)	Full

Bit/Byte	7	6	5	4	3	2	1	0
3	Reserved (00h)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Reserved (000000h)							
7								
8								
9	SValid	Invert (0)	Reserved (00h)					
10	Source Storage Element Address							
11								
12 - 47	Primary Volume Tag Information (if present)							
48 - 51	Reserved (00000000h)							
52	Vendor Unique (0000h)							
53								

- **Element Address**

  This field indicates the address of the element being reported by that element descriptor.

- **Access**

  An access bit value of 1 indicates that access to the element by a medium transport element is allowed.

- **Except**
  - When the element is in a normal state, it is set to zero
  - When the element is in an abnormal state it is set to 1
  - Information on the abnormal state is available in the **Additional Sense Code** and **Additional Sense Code Qualifier** fields in that element descriptor. For the meaning of the codes contained in the 2 **Sense Code** fields, see Request Sense (03h) on page 75.

- **Full**
  - The **Full** field is set to 1 whenever the element contains a tape cartridge
  - It is set to 0 otherwise
- **Additional Sense Code** and **Additional Sense Code Qualifier**

  These fields are only valid if the **Exception** field is set to 1. Currently, the only valid values for these fields indicate:
  - **Element Contents Unknown** condition (ASC=80 ASCQ=22)
  - **Cleaning Cartridge Installed** (ASC=30 ASCQ=03)
  - **Operation Medium Removal Requested** (ASC=5A ASCQ=01).
- **SValid**
  - The **SValid** bit is set to 1 if information in the **Source Storage Element Address** field is valid
  - If information is unknown (due to a door open or power-on condition) the **SValid** bit is set to 0
- **Invert**

  The **Invert** field is not supported and is set to 0.
- **Source Storage Element Address**

  The **Source Storage Element Address** represents the address of the last storage element that held the cartridge. The **SValid** field indicates whether or not this information is valid.
- **Primary Volume Tag Information**

  If the **Volume Tag** information was requested in the command block, the **Primary Volume Tag Information** field is included in the element descriptor. For format, see table 57.

The layout of an element descriptor for an element of the **Import/Export** element type is illustrated in table 60.

Table 60 Import/ Export Element Descriptor

Bit/Byte	7	6	5	4	3	2	1	0
0	(MSB) Element Address							
1								(LSB)
2	Reserved (0)		Import Enable	Export Enable	Access	Except	Import Export	Full
3	Reserved (00h)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Reserved (000000h)							
7								
8								
9	SValid	Invert (0)	Reserved (00h)					
10	Source Storage Element Address							
11								
12 - 47	Primary Volume Tag Information (if present)							
48 - 51	Reserved (00000000h)							
52	Vendor Unique (0000h)							
53								

- **Import Element**
  - A 1 in the **Import Enable** field indicates the element can import a tape cartridge into the DX-Series system
  - 0 indicates the element cannot import a cartridge
  - This field is always set to 1

- **Export Enable**

  The **Export Enable** field indicates whether the element can export a tape cartridge from the DX-Series system. It is set to 1 (01h).

- **Access**
  - An access bit value of 1 indicates access to the element by a medium transport element is allowed
  - This is set to 0 (0h) if the load port door is open
- **Except**
  - When the element is in a normal state, it is set to 0
  - When that element is in an abnormal state it is set to 1
  - Information on the abnormal state is available in the **Additional Sense Code** and **Additional Sense Code Qualifier** fields in that element descriptor - for the meaning of the codes contained in the 2 **Sense Code** fields, see Appendix A, Sense Key Values.
- **Import Export**
  - The **Import/Export** field is set to 0 if the tape cartridge contained in the element is placed there by the transfer mechanism
  - It is set to 1 if the cartridge is placed there by an operator or if its source is unknown (e.g., after power cycle)
- **Full**
  - The **Full** field is set to 1 whenever the element contains a tape cartridge
  - It is set to 0 when the element contains no tape or the load port door is open
- **Additional Sense Code** and **Additional Sense Code Qualifier**

  These fields are only valid if the **Exception** field is set to one. Currently the only valid values for these fields indicate:
  - **Element Contents Unknown** condition (ASC=80 ASCQ=22)
  - **Cleaning Cartridge Installed** (ASC=30 ASCQ=03)
  - **Operator Medium Removal Request** (ASC=5A ASCQ=01).
- **SValid**
  - The **SValid** bit is set to one if the information in the **Source Storage Element Address** field is valid

- If the information is unknown the **SValid** bit is set to 0

- **Invert**

  The **Invert** field is not supported and is set to 0.

- **Source Storage Element Address**

  The **Source Storage Element Address** represents the address of the last storage element that held the cartridge. The **SValid** field indicates whether this information is valid.

The format of an element descriptor for an element of the data transfer element type is shown in table 61.

Table 61 Data Transfer Element Descriptor

Bit/Byte	7	6	5	4	3	2	1	0
0	(MSB) Element Address							
1	Element Address (LSB)							
2	Reserved (0h)				Access	Except	Rsrvd (0)	Full
3	Reserved (00)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Not Bus	Rsrvd	ID Valid	LU Valid	Rsvd	Logical Unit Number		
7	SCSI Bus Address							
8	Reserved (00h)							
9	SValid	Invert (0)	Reserved (00h)					
10	Source Storage Element Address							
11	Source Storage Element Address							
12 - 47	Primary Volume Tag Information (Field omitted if AVolTag = 0)							

Bit/Byte	7	6	5	4	3	2	1	0
48 - 83	Alternate Volume Tag Information (Field omitted if AVolTag = 0)							
84 - 87	Reserved (00000000h)							
88	Vendor Unique (0000h)							
89								

- **Element Address**

  This field indicates the address of the element being reported by that element descriptor.

- **Access**

  An access bit value of 1 indicates access to the element by a medium transport element is allowed.

- **Except**
  - When the element is in a normal state, it is set to 0
  - When the element is in an abnormal state, it is set to 1
  - Information on the abnormal state is available in the **Additional Sense Code** and **Additional Sense Code Qualifier** fields in that element descriptor. For the meaning of the codes contained in the two **Sense Code** fields, see Request Sense (03h) on page 75.

- **Full**
  - The **Full** field is set to 1 whenever the element contains a tape cartridge
  - It is set to 0 otherwise

- **Additional Sense Code** and **Additional Sense Code Qualifier**

  These fields are only valid if the Exception field is set to 1. Currently the only valid values for these fields indicate
  - **Element Contents Unknown** condition (ASC=80 ASCQ=22)
  - **Cleaning Cartridge Installed** (ASC=30 ASCQ=03)
  - Any tape drive error (ASC=8D or ASC=F3)

- **SValid**

  - **SValid** bit is set to 1 if information in the Source Storage Element Address field is valid
  - If information is unknown (due to a door open or power on condition), the **SValid** bit is set to 0

- **Invert**

  The **Invert** field is not supported and is set to 0.

- **Source Storage Element Address**

  The **Source Storage Element Address** represents the address of the last storage element that held the cartridge. The **SValid** field indicates whether this information is valid.

- **Primary Volume Tag Information**

  If the **Volume Tag** information was requested in the command block, the **Primary Volume Tag Information** field is included in the element descriptor. For format, see table 57.

- **Alternate Volume Tag Information**

  If the **Volume Tag** information was requested in the command block and **Drive Serialization** is enabled, the **Alternate Volume Tag** Information field is included in the element descriptor and includes the drive serial number in an ASCII text string. The serial number is preceded by 4 null characters. For format, table 58.

Note: For more information on enabling **Drive Serialization**, see the **Mode Select** command, **SER** bit and the **Mode Sense** command, **SER** bit.

Reserve (16h)

This command reserves the specified DX-Series system or elements for exclusive use by the requesting initiator or another specified SCSI device. The reservation remains in effect until one of these conditions is met:

- The initiator that made the reservation sends a valid **Reserve** command (see table 62) capable of overriding the reservation
  - Element reservations replace all previous element reservations with the same **Reservation ID** from the same initiator, and cannot override **Unit** reservations
  - Unit reservation can override any previous reservation from the same initiator, regardless of **Reservation ID**
- The DX-Series system or element is released by a valid **Release** command from the same initiator
- A **Bus Device Reset** message is received from any initiator.
- A hard reset occurs

The occurrence of the last two conditions is indicated by the DX-Series system returning a check condition status with a sense key of **Unit Attention** on the next command following the condition. It is not an error to issue a **Reserve Unit** command to a DX-Series system that is currently reserved to the requesting initiator.

- The target returns a **Reservation Conflict** status if a **Unit Reserve** command is:
  - Attempted on a unit that has been reserved by another initiator
  - Contains any element previously reserved by another initiator
- The target returns a **Reservation Conflict** status if an **Element Reserve** command is:
  - Issued to an element previously reserved by another initiator
  - Contained in a unit that was reserved by any initiator
  - Issued to an element reserved using a different **Reservation ID**

If, after honoring a **Unit Reservation**, any other initiator attempts to perform any command except **Inquiry**, **Request Sense**, or **Release**, the command is rejected with a **Reservation Conflict** status. A **Release** command issued by another initiator is ignored by that reserved logical

unit. If, after honoring an **Element Reservation**, any other initiator issues a command other than **Release** to that element, the command is rejected with a **Reservation Conflict** status. A **Release** command issued by another initiator is ignored by the reserved element.

Table 62 Reserve Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (16h)							
1	Logical Unit Number			3rdPty	3rd Party ID			Element
2	Reservation ID							
3	(MSB) Element List Length							
4								(LSB)
5	Unused			Reserved (00h)			Flag (0)	Link (0)

- **Logical Unit Number**

  The **Logical Unit Number** must always be 0. This field indicates the logical unit to which the command is sent.

- **3rdPty and 3rd Party ID**

  Tech Tip: The DX-Series system does not support 3rd part reservation or 3rd party ID.

  The 3rd party reservation option for **Reserve Unit** allows an initiator to reserve a logical unit for another SCSI device. This option is for systems that use **Copy** and is implemented by the DX-Series system.

  - If the 3rd party **(3rdPty)** bit is 0, the option is not requested
  - If the 3rdPty bit is 1, **Reserve Unit** reserves the logical unit for the SCSI device specified in the 3rd party device ID field
  - The DX-Series system preserves the reservation until any 1 of the 4 conditions mentioned occurs
  - The DX-Series system ignores any attempt made by any other initiator to release the reservation and returns a **Good** status

- An initiator that holds a current reservation may modify that reservation (for example, to switch third-parties) by issuing another **Reserve Unit** to the DX-Series system

- **Element and Reservation ID**

  The field specifies if this command is a **Unit Release**.

  - If the value is zero, the command releases a reservation placed on this unit by the requesting initiator that meets 3rd party release requirements, if applicable

- **Element List Length**

  Only valid if **Element** is 1, otherwise this field is reserved and must contain 0s. This field specifies **Length of Element List Descriptors** (see table 63) that follow. This value must be a whole multiple of the length of a single **Element List Descriptor** (6).

Table 63 Element List Descriptor

Bit/Byte	7	6	5	4	3	2	1	0
0	Reserved (0000h)							
1								
2	(MSB) Number of Elements							
3								(LSB)
4	(MSB) Starting Element Address							
5								(LSB)

- **Flag Bit**

  The Flag bit is used in conjunction with the Link bit to notify the initiator in an expedient manner that a command has been completed.

  Flag bits are not supported by the DX-Series system.

- **Link Bit**

  A Link bit set to 1 indicates that the initiator requests continuation of a task (an I/O process) across two or more SCSI commands.

If the Link bit is 1 and the Flag bit is 0, and the task completes successfully, the drive continues the task and returns a status of **INTERMEDIATE** and a **LINKED COMMAND COMPLETE** message.

If the Link bit and the Flag bit within a Control word are both set to 1, and the drive completes a command with a status of **INTERMEDIATE**, the drive returns a **LINKED COMMAND COMPLETE** message (with Flag).

Link bits are not supported by the DX-Series system

- **Starting Element Address and Number of Elements**
  - These fields select the range of elements to be reserved
  - The reservation begins with the first element with an address greater than or equal to the **Starting Element Address**, and includes all defined elements until the indicated number of elements have been reserved or the last element is reached
  - All the specified elements must be able to be reserved or no reservations take place at all

Rezero Unit (01h)

The **Rezero Unit** command allows the host to home all DX-Series system mechanisms.

The format of the **Rezero Unit** command is shown in table 64.

Table 64 Rezero Unit Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (01h)							
1	Logical Unit Number			Reserved (00h)				
2	Reserved (000000h)							
3								
4								
5	Reserved (00h)							

- **Logical Unit Number**

  The **Logical Unit Number** is 0. This field indicates the logical unit to which the command is sent.

Send Diagnostic (1Dh)

The DX-Series system includes a built-in self-test. This test is automatically performed when the DX-Series system is turned on. It can also be performed by issuing the **Send Diagnostic** command to the DX-Series system.

- If the self-test passes, a **Good** status is returned
- If the self-test fails, a check condition status is returned and the sense key is set to **Hardware Error**. The **Additional Sense** fields identify the type of failure

The description of the **Request Sense** command tells how to get the **Sense** data from the DX-Series system and how to interpret the **Sense** data fields. The format of the **Send Diagnostic** command is shown in table 65.

Table 65 Send Diagnostic Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (h)							
1	Logical Unit Number			PF (1)	Reserved (0)	Self Test	Dev-OfL	Unit-OfL
2	Reserved (00h)							
3	(MSB) Parameter List Length							
4								(LSB)
5	Reserved (00h)							

- **Logical Unit Number**

  The **Logical Unit Number** must always be set to 0. This field indicates the logical unit to which the command is sent.

- **PF**

  A page format bit of one specifies that the **Send Diagnostic** parameters conform to the page structure as specified in the SCSI-2 specification. This bit must be set to 1.

- **Self Test**, **DevOfL** and **UnitOfL**

  Table 66 illustrates how the "**Seltst**," "**DevOfl**," and "**UnitOfl**" bits determine which test to be performed.

Table 66 Selftest Bit Definition

Selftst	DevOfl	UnitOfl	Selftest Action
0	0	0	Illegal Combination
0	0	1	No-Op
0	1	0	Illegal Combination
0	1	1	No-Op
1	0	0	Selftest 1
1	0	1	Selftest 2
1	1	0	No-Op
1	1	1	Selftest 2

These tests verify that all major DX-Series system subsystems are working as follows:

> **Tech Tip:** The following tests are not supported by DX-Series system. A good status will always be returned when queried.

- Electronics Self-Test (Selftest 1)

  Performs tests such as CPU Functionality, Buffer RAM Integrity and ROM Checksum. This test does not move any mechanical components.

- Functionality Test (Selftest 2)

Send Volume Tag (B6h)

The **Send Volume Tag** command evaluates element descriptors found by a **Send Volume Tag** command. The type of element (medium transfer, storage, import/export or data transfer) can be specified in the command as well as the starting address for evaluation. The format of the **Send Volume Tag** command is shown in Table 67.

Table 67 Send Volume Tag Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (B6h)							
1	Logical Unit Number			Rsrvd	Element Type Code			
2	(MSB) Starting Element Address							
3	(LSB)							
4	Reserved (00h)							
5	Reserved (0h)			Send Action Code (05h)				
6	Reserved (0000h)							
7								
8	(MSB) Parameter List Length (0028h)							
9	(LSB)							
10	Reserved (00h)							
11	Reserved (00h)							

- **Logical Unit Number**

  The **Logical Unit Number** is 0.

- **Element Type Code**

  This field is used to indicate which type of element (medium transport, storage, data transfer, or all) is to be acted on by this command.

- 0 indicates all element types reported
- 1 indicates medium transport element
- 2 indicates storage element
- 3 indicates import/export element
- 4 indicates data transfer elements

- **Starting Element Address**

  The **Starting Element Address** field specifies the starting point of the **Volume Tag** evaluation. Beginning with the first defined element with an address greater than or equal to the **Starting Element Address**, all defined, type-matching elements are tagged until the last element of the specified type.

- **Send Action Code**

  The **Send Action Code** field specifies the test to be evaluated. The DX-Series system only implements the "Translate - search primary tags - ignore sequence numbers" (05h) action.

- **Parameter List Length**

  This field specifies the number of bytes in the **Send Volume Tag Parameters**. This value should always be 28h.

The format of the **Send Volume Tag Parameters** is shown in Table 68.

Table 68 Send Volume Tag Parameters

Bit/Byte	7	6	5	4	3	2	1	0
0- 31	(MSB) Volume Identification Template Field (LSB)							
32	Reserved (0000h)							
33								
34	(MSB) Minimum Volume Sequence Number (0000h) (LSB)							
35								

Bit/Byte	7	6	5	4	3	2	1	0
36	Reserved (0000h)							
37								
38	(MSB) Maximum Volume Sequence Number (0000h)							
39								(LSB)

- **Volume ID Template Field**

  The search template to be evaluated by the translate function. This may contain the '?' and '*' wildcards, where '?' match any single character and '*' match any number of characters. Any characters that follow the '*' wildcard are ignored.

- **Min Vol Sequence Number**

  Sequence numbers are not supported. This must be set to 0.

- **Max Vol Sequence Number**

  Sequence numbers are not supported. This must be set to 0.

Test Unit Ready (00h)

The host uses the **Test Unit Ready** command to determine if a DX-Series system is ready.

The DX-Series system responds in one of these ways, depending upon the state of the DX-Series system:

- Returns a **Good s**tatus - whenever the DX-Series system is ready to accept a medium access command without returning a check condition status it returns this status in response to a **Test Unit Ready** command
- Returns a check condition status - when the DX-Series system receives a **Test Unit Ready** command but is not ready to accept a medium access command, it sets the **Additional Sense** fields and returns this status
- The meaning of the values in the **Additional Sense** fields are described along with the **Request Sense** command

The format for the **Test Unit Ready** command Descriptor Block is shown in table 69.

Table 69 Test Unit Ready Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (00h)							
1	Logical Unit Number			Reserved (00h)				
2	Reserved (000000h)							
3								
4								
5	Reserved (00h)							

- **Logical Unit Number**

  The **Logical Unit Number** must be set to 0. This field indicates the logical unit to which the message is sent.

Chapter 3

Emulated DLT7000 SCSI Commands

This chapter describes the SCSI protocol features implemented in the DLT7000 tape system. Note that the sections included in this chapter do not fully reiterate every ANSI SCSI message, option, and/or command code specification; the sections do describe the supported commands, messages, options, and error recovery procedures.

Overview of Command and Status Processing

The Quantum DLT7000 tape system supports the SCSI commands listed in table 70. The subsection of this chapter that details each of the SCSI commands is listed in the "Section" column.

Table 70 Supported SCSI Commands

Command	Operation Code
Erase	19h
Inquiry	12h
Load Unload	1Bh
Locate	2Bh
Log Select	4Ch
Log Sense	4Dh
Mode Select (6/10)	15h/55h
Mode Sense (6/10)	1Ah/5Ah
Prevent Allow Medium Removal	1Eh
Read	08h
Read Block Limits	05h
Read Buffer	3Ch
Read Position	34h
Receive Diagnostics Results	1Ch
Release Unit	17h
Request Sense	03h
Reserve Unit	16h

Command	Operation Code
Rewind	01h
Send DiagnostiC	1Dh
Space	11H
Test Unit Ready	00h
Verify	13H
Write	0Ah
Write Buffer	3bH
Write Filemarks	10h

Note: Relative Addressing is not supported by the tape drive. Therefore, in all I/O commands, the RelAdr bit must be 0.

RESERVE UNIT and **RELEASE UNIT** by Logical Unit Number are supported, as are third-party reservations. Extent reservations are not supported.

The **RECEIVE DIAGNOSTIC RESULTS** and **SEND DIAGNOSTIC DATA** commands implement vendor-unique pages to test the drive during the manufacturing process. It is recommended that initiators specify only the non-page format variants of these commands (PF=0), except for page 0x40.

The DLT tape drive does not act as an initiator on the SCSI bus. Therefore, the drive will not 1) generate unsolicited interrupts to the host, 2) initiate its own SCSI commands, or 3) assert bus reset.

Linked commands are supported.

Untagged queuing is supported.

SCSI Pointers

SCSI architecture provides a set of three pointers (called saved pointers) for each I/O process. The three pointers are: Command, Status, and Data. When an I/O process becomes active, the three saved pointers are copied

to the initiator as current pointers. There is only one set of current pointers in the initiator at one time. The current pointers point to the next command, data, or status byte to be transferred between the initiator's memory and the drive. The saved and current pointers reside in the initiator.

The saved command pointer always points to the start of the Command Descriptor Block for the I/O process. The saved status pointer always points to the start of the status area of the I/O process. The saved data pointer always points to the start of the data area until the drive sends a **SAVE DATA POINTER** message for the I/O process back to the initiator.

In response to the **SAVE DATA POINTER** message, the initiator stores the value of the current data pointer into the saved data pointer for that I/O process. The drive can restore the current pointer from the saved pointer value for the active I/O process by sending a **RESTORE POINTERS** message to the initiator. The initiator then copies the set of saved pointers into the set of current pointers. Whenever a drive disconnects from the SCSI Bus, only the set of saved pointers is retained in the initiator. The set of current pointers is restored from the set of saved pointers when the I/O process is reconnected.

Reset Sequence

The DX-Series system supports the SCSI-2 soft reset option. When a SCSI bus reset occurs, the library clears the SCSI bus as described in the SCSI-2 Specification.

Table 71 Command Descriptor Block Fields

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (07h)							
1	Logical Unit Number			(MSB) Logical Block Address (LBA)				
2-3	Logical Block Address (LBA)(LSB)							
4	Transfer Length, Parameter List Length, or Allocation Length							
5	Control							

Note: Unless otherwise specified, all reserved bits indicated in the commands are 0.

Table 72 Command Descriptor Block - Field Descriptions

Field	Description
Operation Code	The operation code specifies the command being requested. The list of supported SCSI commands and their operation codes are contained in table 70.
Logical Unit Number	The Logical Unit Number contains the number of the device being addressed. It must be set to 0. The Logical Unit Number is ignored if the Command Descriptor Block is preceded by an IDENTIFY Message.
Logical Block Address	Commands that require additional parameter data specify the length of the Logical Block Address that is needed. See the specific command descriptions for more detailed information. The drive does not support Relative Addressing: it defaults to a value of 0 which specifies that the Logical Block Address specifies the first logical block of a range of logical blocks to be operated on by the command. Relative Addressing indicates a technique used to determine the next Logical Block Address to be operated on.
Transfer Length	The transfer length field normally specifies the number of blocks to be transferred between the initiator and the drive. For several commands, the transfer length indicates the number of bytes (not blocks) to be sent. For these commands, this field may be identified by a different name.
Parameter List Length	The Parameter List Length is used to specify the number of bytes sent during the DATA OUT phase. This field is typically used for parameters that are sent to a drive (for example, mode, diagnostic, and log parameters). A parameter list length of 0 indicates that no data is to be transferred.

Field	Description
Allocation Length	The Allocation Length field specifies the number of bytes that the initiator has allocated for returned data. The Allocation Length is used to limit the amount of data returned to the initiator. An Allocation Length of 0 indicates that no data is to be transferred from the drive to the initiator. The drive terminates the DATA IN phase when the specified number of bytes have been transferred to the initiator or when all available data has been transferred, whichever is less.
Control Field	The Control Field is the last byte of every command descriptor block. Its format is shown in table 73 and described in table 74, and it contains the Flag and Link bits. Tech Tip: Flag and Link bits are not supported by the DX-Series system. Use of these bits is initiator-dependent. Setting the Link bit = 1 provides an automatic link to the next command, bypassing the usual ARBITRATION, SELECTION, and MESSAGE OUT phases that would normally occur between commands. Other bits in the Control Field are considered to be reserved.
RelAdr	Relative Address must be 0 (not supported).

Table 73 Command Descriptor Block Control Field - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
5	Vendor Specific		Reserved				Flag (0)	Link (0)

Table 74 Command Descriptor Block Control Field - Field Descriptions

Field	Description
Vendor Specific Bits	These bits must be 0.
Flag Bit	The Flag bit is used in conjunction with the Link bit to notify the initiator in an expedient manner that a command has been completed. Tech Tip: Flag bits are not supported by the DX-Series system.
Link Bit	A Link bit set to 1 indicates that the initiator requests continuation of a task (an I/O process) across two or more SCSI commands. If the Link bit is 1 and the Flag bit is 0, and the task completes successfully, the drive continues the task and returns a status of INTERMEDIATE and a LINKED COMMAND COMPLETE message. If the Link bit and the Flag bit within a Control word are both set to 1, and the drive completes a command with a status of INTERMEDIATE, the drive returns a LINKED COMMAND COMPLETE message (with Flag). Tech Tip: Link bits are not supported by the DX-Series system.

Status/Error Reporting

SCSI message-level errors are communicated by messages that are defined specifically for that purpose (for example, MESSAGE PARITY ERROR, MESSAGE REJECT). Message-level errors are also handled by drive-managed retries. Refer to Chapter 4 for more detailed message-handling information.

SCSI command-level errors are communicated by a status code that is returned by the drive during the STATUS phase. This phase occurs at the end of each command, unless the command is terminated by one of the following events:

- ABORT message
- BUS DEVICE RESET message
- Hard reset condition

- Unexpected disconnect

The status code is contained in bits 1 through 5 of the status byte. Bits 0, 6, and 7 are reserved. Table 75 describes the status codes returned by the drive.

> **Note:** In contrast to the BUSY status condition, the DRIVE NOT READY Sense Key is returned as part of the Sense data following a REQUEST SENSE command and indicates that a media access command has been issued and the medium is not ready to be accessed. For example, the medium is not installed, the medium has been unloaded, and the drive is currently initializing the medium to prepare it for access).

Table 75 Status Codes

Status Code	Definition	Meaning
00h	GOOD	The drive successfully completed the command.
02h	CHECK CONDITION	A Contingent Allegiance condition occurred.
08h	BUSY	The drive cannot service the command at the moment, and its Command Descriptor Block has been discarded. The initiator can retry the command at a later time.
10h	INTERMEDIATE GOOD	This status is returned instead of a GOOD status for commands issued with the LINK bit set. Following the return of this status, the drive proceeds to the COMMAND phase for the transfer of the next linked command.

Status Code	Definition	Meaning
18h	RESERVATION CONFLICT	Another initiator has reserved the drive when it has been reserved for another initiator with a RESERVE UNIT command (this status is never returned for INQUIRY or REQUEST SENSE commands).
28h	QUEUE FULL	The drive cannot service the command at the moment, and its Command Descriptor Block has been discarded. (Returned for a tagged command when all of the drive's internal command buffers are in use, for instance.)

DATA-Phase Command Components

Many of the SCSI commands cause data to be transferred between the initiator and the drive. The content and characteristics of this data are command-dependent. Table 5–5 lists the information transmitted for all of the commands.

The "Length in CDB" column of Table 5–5 identifies the Command Descriptor Block field used by the drive to determine how much command-related data are to be transferred. The units (bytes or logical blocks) for the different Length fields are implied by the Length Field Name as follows:

Field Name	Units Implied
Allocation Length	Bytes of data the drive is allowed to send to the initiator
Parameter List Length	Bytes of data the initiator has available for the drive
Transfer Length	Logical number of data blocks or data bytes the initiator wants transferred or verified
Byte Transfer Length	Bytes of data the initiator wants transferred

The DATA OUT column in table 76 lists the information passed to the drive by the initiator as part of the command. The DATA IN column lists the information sent to the initiator by the drive. Numbers in parentheses

after an item indicate the item's length in bytes. In some cases, additional length information is communicated during the DATA phase.

Table 76 DATA-Phase Command Contents

Command	Length in CDB	Data Out (To Drive)	Data In (To Initiator)
Erase	0		
Inquiry	Allocation		Standard inquiry or a vital product data page
Load Unload	0		
Locate	0		
Log Select	Parameter List (must be 0)		
Log Sense	Allocation		Log Page
Mode Select (6)/ (10)	Parameter List	Mode Parameter Header (4) Block Descriptor (8) Page(s)	
Mode Sense (6)/ (10)	Allocation		Mode Parameter Header (4) Block Descriptor (8) Page(s)
Prevent Allow	0		
Medium Removal			
Read	Transfer		Data
Read Block Limits	Allocation		Block Length Limits
Read Buffer	Allocation		Buffer Offset and Allocation Length

Command	Length in CDB	Data Out (To Drive)	Data In (To Initiator)
Read Position	Allocation		Position Identifier or SCSI Logical Address
Receive Diagnostic Results	Allocation		Diagnostic Page
Release Unit	0		
Request Sense	Allocation		Sense Data (18)
Reserve Unit	0 (Extent list option not supported)		
Rewind	0		
Send Diagnostic	Parameter List	Diagnostic Page	
Space	0		
Test Unit Ready	0		
Verify	Transfer	Data	
Write	Transfer	Data	
Write Buffer	Parameter List	Microcode Image Data	
Write Filemarks			

Unit Attention Condition

Queued Unit Attentions are implemented on the Quantum DLT7000 tape drive and are maintained separately for each valid LUN for each initiator. Unit Attentions are created in each of the following circumstances:

- At Power On
- At Bus Reset
- At Bus Device Reset message
- When the medium may have changed asynchronously
- When another initiator changes the Mode Parameters
- When a firmware (microcode) update has completed

Two queued Unit Attentions are not unusual. For example, if a unit is powered up and a tape cartridge is loaded, Power Up and Not-Ready to Ready Transition Unit Attentions are created. Due to the limited number of Unit Attention buffers, if an initiator does not clear Unit Attentions queued for it, at some point the tape drive stops generating new Unit Attentions for that initiator-logical unit combination (existing ones will be left queued, however).

A LOAD command does not generate a Unit Attention for the initiator that issued the command since the transition to Ready is synchronous.

Behavior at Power-On and SCSI Bus Reset

The following apply to the DLT7000 system tape drive's behavior at power-on and/or SCSI bus reset:

- When the Quantum DLT7000 system is powered up, all device SCSI lines are set to high impedance.
- The design of the DLT7000 system tape drive does not allow it to generate any spurious signals on the SCSI bus at power-on.
- Within five seconds of power-on, and within 250 milliseconds (typically under 4 milliseconds) after a SCSI bus reset, the DLT7000 system tape drive responds to SCSI bus selections and returns appropriate, normal responses. Tape motion commands will be returned with Check Condition status, Sense Key Not Ready, until the tape medium has been made ready.
- The tape drive implements the hard bus reset option.
- The tape medium is rewound to Beginning of Tape (BOT).

The DLT7000 system tape drive recognizes multiple, successive SCSI bus resets and SCSI bus resets of arbitrarily long duration. The tape drive recovers within the time limits specified above following the last SCSI bus reset.

The tape drive goes through a calibration process at power up and loading of medium.

Data Cache and Tape Write Interaction

The Quantum DLT7000 system tape drive contains a data cache that buffers blocks (records) until they are written to tape. This section describes when those blocks are written, or "flushed" to tape. A Mode Select parameter allows the data cache to be disabled (unbuffered mode). In this mode, every WRITE command causes data to be written to the tape medium before the STATUS byte and the COMMAND COMPLETE message are returned to the host.

Note: Unbuffered mode is NOT recommended due to the poor performance that may result.

The contents of the write data cache are written to the tape medium under the following circumstances:

- When two or more WRITE FILEMARKS commands are issued without intervening tape motion commands.

SCSI Command Descriptions

The SCSI commands are presented in alphabetical order. Each command starts on a new, odd-numbered page. Because information about a particular command may span multiple pages, the command name is repeated, in italics, at the top of every page that concerns that command. Blank pages in the chapter can be used for note-taking.

The SCSI command descriptions that make up the rest of this chapter contain detailed information about each command supported by the Quantum DLT7000 system tape drive. Fields common to many of the SCSI commands are supported as follows:

Name of Field	How Field is Supported in SCSI Commands
Logical Unit Number	LUN for tape drive is 0
Reserved	Reserved bits, fields, bytes, and code values are set aside for future standardization and must be set to 0. If the drive receives a command that contains non-zero bits in a reserved field or a reserved code value, the command is terminated with a CHECK CONDITION status and the sense key is set to ILLEGAL REQUEST.
RelAdr	Relative Address. Unused; contents should be 0.

Explanations for those common fields are not repeated for every command in which they appear.

Throughout this manual, multiple bytes that contain information about specific command parameters are portrayed as shown in the example of

the Parameter List Length field (bytes 7 and 8) of the Log Select command shown below:

Bit/Byte	7	6	5	4	3	2	1	0
	(Bytes 0-6)							
7-8	(MSB) Parameter List Length (LSB)							

As shown, this sample indicates that the most significant bit (MSB) of the field is bit 7 of byte 7; the least significant bit is bit 0 of byte 8.

This is an alternate, "shorthand" presentation for:

Bit/Byte	7	6	5	4	3	2	1	0
	(Bytes 0-6)							
7	(MSB) Parameter List Length							
8	(LSB)							

The shorthand version of presentation is used in this manual due to space constraints.

Erase (19h)

The **ERASE** command causes data on the tape medium to be erased. Any **WRITE** data currently held in buffer memory and not yet written to tape is written to tape before the **ERASE** command is executed. **ERASE** command must be issued while at BOT.

Note that the time for a complete erase of a DLTtape IV tape cartridge can be well over one hour.

Table 77 ERASE COMMAND Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (19h)							
1	Logical Unit Number			Reserved			Immed	Long (1)
2-4	Reserved							
5	Unused		Reserved				Flag (0)	Link (0)

Field	Description
Immed	Immediate. If the Immediate bit = 0, the target does not return status until the selected operation has completed. If set to 1, status is returned as soon as the operation has been initiated. *Tech Tip: The immed bit is accepted, but ignored in processing. The erase will take place immediately.*
Long	Must be set to 1. The Long bit controls the distance of tape to be erased. Filler and End of Data (EOD) blocks are written if needed, then the entire rest of the tape is erased. NOTE: The **ERASE** command results in no operation for the tape drive unless the Long bit is set to 1. Issuing the **ERASE** command away from Beginning of Tape (BOT) is an **ILLEGAL REQUEST**.
RelAdr	Relative Address. Unused; contents should be 0.

Inquiry (12h)

The **INQUIRY** command allows the initiator to determine the kind of SCSI devices attached to its SCSI Bus. It causes a device that is attached to a SCSI Bus to return information about itself. The drive identifies itself as a Direct Access Storage Device that implements the SCSI-2 protocol. The drive does not need to access its tape medium to respond to the inquiry.

The drive can provide two categories of data in response to an **INQUIRY** command: Standard Inquiry Data and Vital Product Data. Standard Inquiry Data contains basic data about the drive, and Vital Product Data comprises several pages of additional data. Each Vital Product Data page requires a separate **INQUIRY** command from the initiator.

An **INQUIRY** command is not affected by, nor does it clear, a Unit Attention condition.

Table 78 INQUIRY Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (12h)							
1	Logical Unit Number			Reserved				EVPD
2	Page Code							
3	Reserved							
4	Allocation Length							
5	Unused		Reserved				Flag (0)	Link (0)

Table 79 INQUIRY Command Descriptor Block - Field Descriptions

Field	Description
EVPD	Enable Vital Product Data. If 0, the drive returns the Standard Inquiry Data page. If 1, the drive returns the Vital Product Data page specified in Page Code.
Page Code	Specifies which Vital Product Data page is to be returned by the drive. This field must be 0 if EVPD is 0. A **CHECK CONDITION** with **ILLEGAL REQUEST** status is returned if this field specifies an unsupported page code. Table 80 lists the page codes for the Vital Product Pages supported by the drive.
Allocation Length	Specifies the number of bytes of inquiry information the drive is allowed to return to the initiator during the command's DATA IN phase. Error status is not returned if the value in this field truncates the requested information.
Flag Bit	The Flag bit is used in conjunction with the Link bit to notify the initiator in an expedient manner that a command has been completed. Flag bits are not supported by the DX-Series system.
Link Bit	A Link bit set to 1 indicates that the initiator requests continuation of a task (an I/O process) across two or more SCSI commands. If the Link bit is 1 and the Flag bit is 0, and the task completes successfully, the drive continues the task and returns a status of **INTERMEDIATE** and a **LINKED COMMAND COMPLETE** message. If the Link bit and the Flag bit within a Control word are both set to 1, and the drive completes a command with a status of **INTERMEDIATE**, the drive returns a **LINKED COMMAND COMPLETE** message (with Flag). Link bits are not supported by the DX-Series system.

Table 80 Vital Product Data - Page Codes

Page Code	Description
00h	Supported Vital Product Pages Page
80h	Unit Serial Number Page
83h	Device Identification Page
C0h	Code Build Information
C1h	Subsystem Components Revision Page

Standard Inquiry Data Page

Table 81 shows the format of the Standard Inquiry Data page returned by the drive.

Table 81 Inquiry Command (12h)

Bit/Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	RMB	Device Type Modifier						
2	ISO Version		ECMA Version			ANSI Version		
3	AENC	TrmIOP	Reserved		Response Data Format			
4	Additional Length = 33h							
5	Reserved							
6	Rsv'd	MChngr (0)	Reserved					
7	RelAdr (0)	Wbus32 (0)	Wbus16 (1)	Sync (1)	Linked (0)	Rsv'd (0)	CmdQue (0)	SftRe (0)
8-15	Vendor Identification (QUANTUM)							

Bit/Byte	7	6	5	4	3	2	1	0
16-31	Product Identification (DLT7000)							
32-35	Product Revision Level (hhss)							
35-55	Vendor Unique Bytes							

Table 82 contains field descriptions for the data returned by the drive.

Table 82 Standard Inquiry Data Page - Field Descriptions

Field Name	Value	Description
Peripheral Qualifier	0	Non-zero if initiator selects an invalid logical unit (see below)
Peripheral Device Type	1	1 indicates that this is a sequential access device (see below). Note that the Peripheral Device Type entry for a medium changer is 8.
RMB	1	Removable Medium Bit. Set to 1.
Device Type Modifier	0	Set to 0 to specify a sequential access device.
ISO Version	0	International Standardization Organization Version level. Set to 0.
ECMA Version	0	European Computer Manufacturers Organization Version level. Set to 0.
ANSI Version	2	ANSI SCSI Level 2 (SCSI-2) is supported.
AENC	0	Asynchronous Event Notification is not supported.
TrmlOp	0	Terminate I/O Process. The tape drive does not support the TERMINATE I/O PROCESS message.

Field Name	Value	Description
Response Data Format	2	This Standard Inquiry Data is in SCSI-2 format.
Additional Length	33h	Tape drive uses this field to indicate the number of additional bytes of INQUIRY Response Data available.
Mchnger	0	Set to 1 if a Media Changer (Loader) is present and EEPROM parameter EnbIngMedChgr is set to 1. This SCSI-3 bit indicates that the Read Element Status and Move Medium commands can be issued to the drive (LUN0). By default, this bit is set to 0 on the DLT7000.
RelAdr	0	Relative Addressing is not supported.
WBus 32	0	Set to 0 since the drive does not support 32-bit transfer.
WBus 16	0	The WBus bit is 0 since the drive supports 16-bit data transfer.
Sync	0	The drive supports Synchronous Data Transfers.
Linked	0	Linked Commands are supported.
CmdQue	0	The drive does not support Tagged Command Queuing.
SftRe	0	The drive implements the hard reset option in response to assertion of the SCSI Bus reset line.
Vendor Identification		The value in this field is QUANTUM (there is one space after the word Quantum)
Product Identification		The value in this field is DLT7000 (there is spaces after the word DLT7000)

Field Name	Value	Description
Product Revision Level		This field contains 4 bytes of ASCII data that provides the drive's software revision levels. The first two bytes are the version number of servo code. The second two bytes are the version number of the SCSI/read/write code. When a firmware update is performed on the DLT drive, this part of the revision level will change to reflect that update (quotation marks will not appear). *Tech Tip: The product revision number for the DX-Series system is Revision Level= 2769.*
Vendor Specific		

Vendor Unique Inquiry Data

The following information can be used to precisely identify the revision of subsystem components.

Table 83 INQUIRY Vendor Unique Bytes Definitions

Bit/Byte	7	6	5	4	3	2	1	0
36	Product Family (7)				Released Firmware			
37	Firmware Major Version #							
38	Firmware Minor Version #							
39	EEPROM Format Major Version #							
40	EEPROM Format Minor Version #							
41	Firmware Personality							
42	Firmware Sub-Personality							
43	Firmware Subtype							
44	Controller Hardware Version #							
45	Drive EEPROM Version #							
46	Drive Hardware Version #							

Bit/Byte	7	6	5	4	3	2	1	0
47	Media Loader Firmware Version #							
48	Media Loader Hardware Version #							
49	Media Loader Mechanical Version #							
50	Media Loader Present Flag							
51	Library Present Flag							
52-55	Module Revision							

Table 84 Vendor Unique Inquiry Data Page - Field Descriptions

Field Name	Description
Product Family	This field indicates the data density of each of the DLT tape drives as follows:
Bit	Drive Density
0	Not Specified
1	2.6 GB
2	6.0 GB
3	10.0 / 20.0 GB
5	20.0 / 40.0 GB
6	15.0 / 30.0 GB
7	35.0 / 70.0 GB Tech Tip: Only 35.0/70.0 GB is supported in the DX-Series system.
Released Firmware	This flag differentiates between released and test versions of firmware. When set to 1, indicates released code (Vxxx); 0 indicates field test code (Txxx). Released code has no minor firmware version number (byte 38 = 0). Field test and engineering versions of code have non-zero minor firmware version numbers for tracking purposes.
… Version #	These fields display the various version numbers in binary, not ASCII
Firmware Personality	Numeric indicator of firmware personality. For example, firmware personality of 12 indicates DX-Series system family.
Firmware Subpersonality	Set to 69, indicating standard SCSI device firmware.
Loader Present	Set to 0 indicates no loader present. Non-zero indicates loader is present.

Field Name	Description
Library Present	Set to 0 indicates no library present. Non-zero indicates library is present.
Module Revision	A four byte ASCII string representing the revision level of the tape drive's module (the controller PCBA attached to the tape drive).

Supported Vital Product Data Page

The Supported Vital Product Data Pages page (see table 85) provides a directory of the Vital Product Data Pages that are supported by the drive. The pages that are supported are:

- The Unit Serial Number Page (80h)
- The Device Identification Page (83h)
- The Firmware Build Information Page (C0h)
- The Subsystem Components Revision Page (C1h)

Table 85 Supported Vital Product Data Pages Page - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (00h)							
2	Reserved							
3	Page Length (5)							
4	00h - (this page)							
5	80h - Unit Serial Number Page							
6	83h - Device Identification Page							
7	C0h - Firmware Build Information Page							
8	C1h - Subsystem Components Revision Page							

Table 86 Unit Serial Number Page (80h) - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (80h)							
2	Reserved							
3	Page Length (0Ah)							
4	Serial Number							

Table 87 Unit Serial Number Page - Field Descriptions

Field Name	Description
Serial Number	The serial number given is the serial number of the module or the drive typically starting with "CX" indicating the site of manufacture. If the drive serial number is valid, then it is reported; otherwise, the module serial number is reported. The serial number can be found on the bar code label. The serial number is returned in ASCII.

Table 88 Device Identification VPD Page 83h

Bit/Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type (1)				
1	Page Code (83h)							
2	Reserved (00h)							
3	Page Length (n-3)							
	Identification Descriptor list							
4	Identification descriptor (first)							
	. . .							
	Identification descriptor (last)							
n								

- Identification Descriptor

Each identification descriptor (see table 89) contains information identifying the logical unit, physical device, or access path used by the command and returned parameter data. The association field indicates the entity that the identification descriptor describes. If a physical or logical device returns the identification descriptor with the association field set to 0h, it shall return the same descriptor when it is accessed through any other path.

Table 89 Identification Descriptor

Bit/Byte	7	6	5	4	3	2	1	0
0	Reserved				Code Set			
1	Reserved		Association		Identifier Type			
2	Reserved							
3	Identifier length (n-3)							
4	(MSB)							
	Identifier							
n								(LSB)

- Code set

  The code set field specifies the code set used for the identifier field, as described in table 90. This field is intended to be an aid to software that displays the identifier field.

Table 90 Code Set

Value	Description
0h	Reserved
1h	The identifier field shall contain binary values
2h	The identifier field shall contain ASCII graphic codes (e.g. code values 20h through 7Eh)
3h-Fh	Reserved

- Association

The association field specifies the entity with which the identifier field is associated, as described in table 91.

Table 91 Association

Value	Description
0h	The identifier field is associated with the addressed physical or logical device
1h	The identifier field is associated with the port that received the request
2h - 3h	Reserved

- Identifier Type.

  The identifier type is described in table 92

Table 92 Identifier Type

Value	Description
00h	Reserved
1h	Vendor ID followed by the product identification field from the standard inquiry data and the serial number field from the Serial Number Inquiry Page.
2h	Canonical form of the IEEE Extended Unique Identifier, 64 bit (EIU-64)
3h	FC-PH Name_Identifier
4h to fh	Reserved

Table 93 Device Identification VPD Logical Unit

Bit/Byte	7	6	5	4	3	2	1	0
0	Protocol Identifier (0)			Code Set (2)				
1	Rsvd (0)		Association (0)		Identifier Type (1)			
2	Reserved (0)							
3	Identifier Length (n-3)							
4-n	MSB — Vendor and Product ID Serial Number — LSB							

Table 94 Device Identification VPD World Wide Name

Bit/Byte	7	6	5	4	3	2	1	0
0	Protocol Identifier (0)			Code Set (1)				
1	Rsvd (0)		Association (0)		Identifier Type (2)			
2	Reserved (0)							
3	Identifier Length (8)							
4-11	MSB — IEEE Extended Unique Identifier — LSB							

Table 95 Firmware Build Information Page (C0h) - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (C0h)							
2	Reserved (00h)							
3	Page Length (20h)							
4-5	Servo Firmware Checksum							
6-7	Servo EEPROM Checksum							
8-11	Read/Write Firmware Checksum							
12-35	Read/Write Firmware Build Data							

Table 96 Firmware Build Information Page (C0h) - Field Descriptions

Field Name	Description
… Checksum	Servo Firmware, Servo EEPROM, and READ/WRITE Firmware checksums are given as binary numbers and are for positive firmware and EEPROM identification.
Firmware Build Date	Firmware Build Date is an ASCII string in the DD-MMM-YYYY HH:MM:SS format.

Table 97 Subsystem Components Revision Page (C1h) - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (C1h)							
2	Reserved							
3	Page Length (14h)							

Bit/Byte	7	6	5	4	3	2	1	0
4	Product Family (7)				Released Firmware			
5	Firmware Major Version #							
6	Firmware Minor Version #							
7	EEPROM Format Major Version #							
8	EEPROM Format Minor Version #							
9	Firmware Personality							
10	Firmware Sub-Personality							
11	Vendor Unique Subtype							
12	Controller Hardware Version #							
13	Drive EEPROM Version #							
14	Drive Hardware Version #							
15	Media Loader Firmware Version #							
16	Media Loader Hardware Version #							
17	Media Loader Mechanical Version #							
18	Media Loader Present Flag							
19	Library Present Flag							
20-23	Module Revision							

Table 98 Subsystem Components Revision Page - Field Descriptions

Field Name	Description
Product Family	This field indicates the data density of each of the DLT tape drives as follows: Bit — Drive Density 0 — Not Specified 1 — 2.6 GB 2 — 6.0 GB 3 — 10.0 / 20.0 GB 5 — 20.0 / 40.0 GB 6 — 15.0 / 30.0 GB 7 — 35.0 / 70.0 GB Tech Tip: Only 35.0 / 70.0 GB is supported in the DX-Series system.
Released Firmware	This flag differentiates between released and test versions of firmware. When set to 1, indicates released code (Vxxx); 0 indicates field test code (Txxx). Released code has no minor firmware version number (byte 38 = 0). Field test and engineering versions of code have non-zero minor firmware version numbers for tracking purposes.
… Version #	These fields display the various version numbers in binary, not ASCII
Vendor Unique Subtype	Identification of product.
Firmware Personality	Numeric indicator of firmware personality. For example, firmware personality of 4 indicates OEM family, 15 indicates OML family, and 18 indicates OMX family.
Firmware Subpersonality	Set to 1, indicating standard SCSI device firmware.

Field Name	Description
Loader Present	Set to 0 indicates no loader present. Non-zero indicates loader is present.
Library Present	Set to 0 indicates no library present. Non-zero indicates library is present.
Module Revision	A four byte ASCII string representing the revision level of the tape drive's module (the controller PCBA attached to the tape drive).

Load Unload (1Bh)

The LOAD UNLOAD command tells the target to load or unload the tape media in the tape cartridge. If no cartridge is in the tape drive, both LOAD and UNLOAD return a CHECK CONDITION status with a NOT READY sense key set. Likewise, if the drive has received an UNLOAD command with the Immediate bit set and then it receives another command that would require tape motion or if it receives a TEST UNIT

READY command, the drive returns a CHECK CONDITION STATUS with a NOT READY sense key set.

Note: Operation of the UNLOAD version of this command is different if a media loader is present.

Two modes of operation are possible if a media loader is configured. If none of the media loader-specific commands have been issued, the device operates in the sequential mode of operation described below. Once a media loader-specific command has been issued, however, the sequential mode of operation is disabled and the UNLOAD command becomes a NO OPERATION.

If the tape drive is in the default sequential mode of operation and an UNLOAD command is received by the subsystem, the current cartridge is unloaded and automatically moved to the magazine slot from which it was received. The cartridge from the next magazine slot (if the slot is not empty) automatically moves from the magazine into the drive, is loaded, and made ready. If the next magazine slot is empty, no CHECK CONDITION status is created.

When the cartridge is unloaded into the last magazine slot, the subsystem does not cycle back to slot 0. This prevents accidental overwriting of data when using a media loader subsystem in sequential auto-loading mode. The next cartridge in the cycle must be selected and loaded manually, or with a SCSI MOVE MEDIUM command.

The sequential loading feature of the loader can be enabled/disabled by modifying the ENALDRAUTOLD and DISLDRAUTOLDMC parameters of EEPROM (mode page 3Eh of the MODE SELECT command).

A media loader does not affect the tape drive's processing of the LOAD portion of the LOAD UNLOAD command.

Table 99 LOAD UNLOAD Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Bh)							
1	Logical Unit Number			Reserved				Immed (1)
2-3	Reserved							
4	Reserved					EOT (0)	Re-Ten	Load
5	Servo Firmware Checksum							
6	Unused		Reserved				Flag (0)	Link (0)

Table 100 LOAD UNLOAD Command Descriptor Block - Field Descriptions

Field Name	Description
Immed	Immediate. If this bit is set to 1, status is returned as soon as the operation is started. If set to 0, status is returned after the operation has completed. *Tech Tip: The immed bit is accepted, but ignored in processing.*
Re-Ten	Re-tension. Re-tension operations are not needed on the tape drive. This bit is ignored (i.e., "good" status, if bit is set to 1).

Field Name	Description
Load	Load. When a cartridge is inserted, the tape medium is automatically loaded and positioned by the drive at Beginning of Medium (BOM). Logically, the drive is positioned at the beginning of Partition 0. If the Load bit is set to 1, and the medium is already loaded, no action is taken. A "good" status is returned. If the medium was unloaded but the cartridge was not removed, a Load command causes the tape to be loaded to Beginning of Partition (BOP) again and made ready. If the Load bit is set to 0, and the medium is loaded, the drive writes any buffered data and filemarks to the tape and then rewinds the tape to BOM and unloads the medium back into the cartridge. The green Operate Handle indicator on the tape drive's faceplate illuminates and the cartridge can be removed from the tape drive. If the medium is already unloaded, no action is taken. A "good" status is returned.
EOT	End of Tape. This bit is ignored by the tape drive unless both the EOT and Load bits are set to 1, then the drive returns CHECK CONDITION, ILLEGAL REQUEST data.
Servo Firmware Checksum	Servo Firmware checksums are given as binary numbers and are for positive firmware and EEPROM identification.

Field Name	Description
Flag Bit	The Flag bit is used in conjunction with the Link bit to notify the initiator in an expedient manner that a command has been completed. Flag bits are not supported by the DX-Series system.
Link Bit	A Link bit set to 1 indicates that the initiator requests continuation of a task (an I/O process) across two or more SCSI commands. If the Link bit is 1 and the Flag bit is 0, and the task completes successfully, the drive continues the task and returns a status of INTERMEDIATE and a LINKED COMMAND COMPLETE message. If the Link bit and the Flag bit within a Control word are both set to 1, and the drive completes a command with a status of INTERMEDIATE, the drive returns a LINKED COMMAND COMPLETE message (with Flag). Link bits are not supported by the DX-Series system.

Locate (2Bh)

The LOCATE command is used to do high-speed positioning to the specified block address.

The READ POSITION command can be used to obtain the block address, when writing, when particular blocks of data (a data file, for example) are about to be written. The LOCATE command can then be used to position the tape back at the same logical position for high performance restore operations of particular blocks of data.

Table 101 LOCATE Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (2Bh)							
1	Logical Unit Number			Reserved		BT (0)	CP (0)	Immed
2	Reserved							
3-6	(MSB) Block Address (LSB)							
7	Reserved							
8	Partition							
9	Unused		Reserved				Flag (0)	Link (0)

Table 102 LOCATE Command Descriptor Block - Field Descriptions

Field Name	Description
BT	Block Type. The Block Type bit indicates how the Block Address field is interpreted. The first recorded object (block or filemark) is at address 0, and Block Addresses count both data blocks and filemarks.
CP	Change Partition. Since multiple partitions are not supported, this bit must be set to 0.
Immed	Immediate. If this bit is set to 1, status is returned as soon as the operation is started. If set to 0, status is returned after the operation has completed. *Tech Tip: The immed bit is accepted, but ignored in processing.*
Block Address	The Block Address field defines the SCSI Logical Block Address to which the media will be positioned. These addresses start at address 0 and include data blocks and filemarks. They could also be considered an object address.
Partition	Not applicable (see Change Partition field above).

Log Select (4Ch)

The LOG SELECT command allows the host to manage statistical information maintained by the tape drive about its own hardware parameters or about the installed tape medium. The description should be read in conjunction with the description of the LOG SENSE command that follows it and provides the user with information about log page format, parameters, and supported pages.

Table 103 LOG SELECT Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (4Ch)							
1	Logical Unit Number			Reserved			PCR	SP (0)
2	PC		Reserved					
3-6	Reserved							
7-8	(MSB) Parameter List Length (LSB)							
8	Partition							
9	Unused		Reserved				Flag (0)	Link (0)

Table 104 LOG SELECT Command Descriptor Block - Field Descriptions

Field Name	Description
PCR	Parameter Code Reset. If this bit is set to 1 and the parameter list length is set to 0, all accumulated values of page codes 2, 3, and 32 are set to 0 and all threshold values are set to default. If PCR is set to 1 and the parameter list length is set to a non-zero value, the command terminates with a CHECK CONDITION status with sense key of ILLEGAL REQUEST and an Additional Sense Code (ASC) of INVALID FIELD IN CDB.
SP	Save Page. Not supported, must be set to 0. If for some reason the Save Page bit is set, the command terminates with a CHECK CONDITION status with a sense key of ILLEGAL REQUEST and an ASC of INVALID FIELD IN CDB.

Field Name	Description
PC	Page Control. This field defines the type of parameter values to be selected: PC Type of Parameter Values 00b - Current Threshold Values 01b - Current Cumulative Values 10b - Default Threshold Values 11b - Default Cumulative Values All of these types of values are changeable using LOG SELECT. When the PC field is set to 00b or 01b and the Parameter List Length is set to 0, the command terminates with a CHECK CONDITION status, Sense Key of ILLEGAL REQUEST, and ASC of INVALID FIELD IN CDB. This occurs because modification of Current Threshold Values and Current Cumulative Values is not supported. When the PC field is set to 10b and the Parameter List Length field is set to 10b, then all Current Threshold Values are reset to the Default Threshold Values. This is equivalent to no change, since ***Threshold Values cannot be modified.*** When the PC field is set to 11b and the Parameter List Length field is set to 0, then all Current Cumulative Values are reset to the Default Cumulative Values. This is equivalent to clearing all log pages that can be cleared.

Field Name	Description
Parameter List Length	This field specifies the length, in bytes, of the LOG SELECT parameter list to be transferred from the initiator to the target during the DATA OUT phase. A parameter list length of 0 indicates that no data is to be transferred. This condition is not considered an error.
Partition	Not applicable (see Change Partition field above).

Log Detection Summary in LOG SELECT Command Descriptor Block

The following conditions constitute errors that are detected by the drive in relation to the CDB. The request sense data is set to ILLEGAL REQUEST, INVALID FIELD IN CDB.

The conditions that constitute errors are:

- PCR bit is set to 1 and parameter list is not set to 0.
- SP bit is set to 1
- A parameter list length that would cause a parameter within a valid page to be truncated or otherwise incompletely initialized.

Operation of LOG SELECT

The LOG SELECT command allows the initiator to modify and initialize parameters within the logs supported by the tape drive.

There are two ways to initialize the log parameters.

1. Set the PCR bit in the LOG SELECT CDB; this clears all parameters.
2. Specify the log page and parameter values as the log parameters to clear individual pages. The following pages can be cleared using this method:

Page Code	Page Description
02h	Writer Error Count Page
03h	Read Error Count Page
32h	Compression Ratio Page

If multiple pages are sent during the DATA OUT phase, they must be sent in ascending order according to page code. Otherwise, the command terminates with a CHECK CONDITION status, sense key set to ILLEGAL REQUEST, and additional sense code set to INVALID FIELD IN PARAMETER LIST. The same status is returned if an unsupported Page Code appears in any header or if the specified page cannot be cleared.

Log Select Page Format

Each log page begins with a 4-byte header followed by *n* number of log parameter blocks (one block for each parameter code). Each block, except for parameter code 05h is comprised of 8 bytes. The parameter block for code 05h is 12 bytes.

Table 105 LOG SELECT Log Page Header Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code					
1	Reserved							
2-3	(MSB) Page Length (LSB)							

Table 106 LOG SELECT Log Page Header Field Descriptions

Field Name	Description
Page Code	The Page Code specifies for which Log Page this LOG SELECT command is directed.
Page Length	The Page Length field specifies the total number of bytes contained in this log page, not including the four bytes that make up the header.

Table 107 LOG SELECT Log Parameters Format

Bit/Byte	7	6	5	4	3	2	1	0
0-1	(MSB) Parameter Code (LSB)							
2	DU	DS	TSD	ETC	TMC		Rsv'd	LP
3	Parameter Length							
4-7	(MSB) Parameter Code (LSB)							

Note: Byte 2 is also referred to the Parameter Control Byte.

Table 108 LOG SELECT Log Parameters Field Descriptions

Field Name	Description
Parameter Code	Parameter Codes supported for the READ/ WRITE error counter pages are as follows: Parameter Code - Descriptions 00h - Errors corrected with substantial delays 01h - Errors corrected with possible delays 02h - 0 03h - 0 04h - Total times correction algorithm processed 05h - Total bytes processed 06h - 0 8000h - Vendor Unique
	Note: Parameter codes 00h, 01h, and 04h always have a value of 0. Parameter value for 05h is 8 bytes; the parameter length is set to 8.

Field Name	Description
DU	Disable Update. This bit is not defined for LOG SELECT; the target ignores any value in DU.
DS	Disable Save. Not supported. Must be set to 1.
TSD	Target Save Disable. Not supported. Must be set to 1.
ETC	Enable Threshold Comparison. When set to 1, drive performs a comparison with threshold values once the cumulative value is updated. Comparison criteria are defined in Threshold Met Criteria (TMC). If the comparison is met and the RLEC bit of MODE SELECT / SENSE Control Page 0Ah is set to 1, then a UNIT ATTENTION is generated for all initiators. The additional sense code is set to THRESHOLD CONDITION MET. If the RLEC bit is 0 and the comparison is met, then UNIT ATTENTION is not generated.

Field Name	Description
TMC	Threshold Met Criteria. Once the criteria specified in this field is met and the ETC bit is 1 and the RLEC bit in MODE SENSE / SELECT Control Page is set to 1, then UNIT ATTENTION is generated for all initiators. The criteria for comparison are: Code - Basis of Comparison 00b - Every update of the cumulative value 01b - Cumulative value equal to threshold value 10b - Cumulative value not equal to threshold value 11b - Cumulative value greater than threshold value The Default Threshold Values are the maximum values that each parameter can attain. The Current Cumulative Values are the values computed since the last reset of the device (either via power-cycle, BUS DEVICE RESET, or SCSI RESET). The Default Cumulative Values are the values to which each parameter is initialized at a reset condition. Default values are zero. By default, Current Threshold Values = Default Threshold Values. Note that all types of parameter values are changeable via LOG SELECT.
LP	List Parameter. This bit should always be set to 0 to indicate parameter codes are treated as data counters.

Field Name	Description
Parameter Length	This field specifies the number of bytes of the parameter value.
Parameter Value	This field indicates the actual value of this log parameter.

Error Detection Summary in LOG SELECT Pages

The host issues a LOG SENSE command to initialize host-resident software that allows determination of:

- The log pages used by the drive
- The parameter codes and length of each parameter

The following conditions constitute errors in the parameter block that cause the drive to return CHECK CONDITION with sense data set to ILLEGAL REQUEST and additional send code INVALID FIELD IN PARAMETER LIST:

- A page header is received with unsupported page codes
- An incorrect log page length is specified in the page header
- An illegal parameter code is contained in a valid page code
- Parameter codes for a supported page are not sent in ascending order
- The LP bit (see table 108) is set to 1 in the parameter control byte
- The DS bit (see table 108) is set to 0 in the parameter control byte
- The TSD bit (see table 108) is set to 0 in the parameter control byte

Log Sense (4Dh)

The LOG SENSE command allows the host to retrieve statistical information maintained by the tape drive about its own hardware parameters or about the installed tape medium. It is a complementary command to LOG SELECT.

> Tech Tip: Log pages 2 and 3 are cleared when the unload command is received by a virtual drive in the DX-Series system.

Table 109 LOG SENSE Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (4Dh)							
1	Logical Unit Number (0)			Reserved			PPC	SP(0)
2	PC		Page Code					
3-4	Reserved							
5-6	(MSB) Parameter Pointer (LSB)							
7-8	(MSB) Allocation Length (LSB)							
9	Unused		Reserved				Flag (0)	Link (0)

Table 110 LOG SENSE Command Descriptor Block - Field Descriptions

Field Name	Description
PPC	Parameter Pointer Control. This bit must be set to 0. A PPC of 0 indicates that the parameter data requested from the device starts with the parameter code specified in the Parameter Pointer field (Bytes 5 - 6) and return the number of bytes specified in the Allocation Length field (Bytes 7 - 8) in ascending order of parameter codes from the specified log page. Note that the current implementation of the READ/WRITE COMPRESSION page does not support a PPC other than 0. If PPC bit is set, then the target terminates the command with CHECK CONDITION status, sense key set to ILLEGAL REQUEST, and additional sense code set to INVALID FIELD IN CDB.
SP	Save Parameters. Not supported, must be set to 0. If for some reason the Save Parameters bit is set, the command terminates with a CHECK CONDITION status with a sense key of ILLEGAL REQUEST and an ASC of INVALID FIELD IN CDB.
PC	Page Control. This field defines the type of parameter values to be returned: PC - Type of Parameter Values 00b - Threshold Values 01b - Cumulative Values 10b - Default Threshold Values 11b - Default Cumulative Values The Default Threshold Values are the maximum values that each parameter can attain. The Current Cumulative Values are the values computed since the last reset of the device (either via power-cycle, BUS DEVICE RESET, or SCSI RESET. The Default Cumulative Values are the values to which each parameter is initialized at a reset condition. Default values are zero. By default, Current Threshold Values = Default Threshold Values. Note that all types of parameter values are changeable via LOG SELECT.

Table 111 LOG SENSE Command Descriptor Block

Field Name	Description
Page Code	The Page Code field identifies which log page is being requested by the initiator. If the page is not supported, then the command terminates with a CHECK CONDITION status, sense key set to ILLEGAL REQUEST, and additional sense code of INVALID FIELD IN CDB. Supported pages are: Page Code Page Definition 00h Supported Pages Log Page (Page 00h) 02h Write Error Counter Page - not supported. 03h Read Error Counter Page (Page 03h) - not supported. 07h Last n Error Events Page (07h) - not supported. 2Eh TapeAlert Page (2Eh) 32h Read / Write Compression Page (32h) 33h Device Wellness Page (33h) - not supported. 3Eh Device Status Page (3Eh) - not supported.

Field Name	Description
Parameter Pointer	The Parameter Pointer field allows the host to specify at which parameter within a log page the requested data should begin. For example, if a page supports parameters 0 through 5, and the Parameter Pointer contains 3, then only parameters 3, 4, and 5 are returned to the initiator. Similarly, if a page supports parameters 1, 3, and 6, and the Parameter Pointer contains 2, then only parameters 3 and 6 are returned to the initiator. If the Parameter Pointer is larger than the highest numbered parameter on the page, then the target terminates the command with CHECK CONDITION status, sense key set to ILLEGAL REQUEST, and additional sense code set to INVALID FIELD IN CDB. Note that parameters within a page are always returned in ascending order according to parameter code. If the target does not support a parameter code within this page then it does not return any data associated with this parameter.
Allocation Length	The Allocation Length field is used to inform the target how much space the initiator has allocated for data. The host uses this field to limit the size of data transfers to its own internal buffer size.

Error Detection Summary in LOG SENSE Command Descriptor Block

The following conditions constitute errors detected by the drive relating to the LOG SENSE command descriptor block. The request sense data is set to ILLEGAL REQUEST, INVALID FIELD IN CDB.

Error conditions occur when:

- A page is not supported
- The parameter pointer is larger than the highest numbered parameter on the page
- The SP bit is set to 1
- The Allocation Length is smaller than the data being returned by the target.
- PPC bit set to 1

Supported Pages Log Page (Page 00h)

When page 00h is requested, the 4-byte page header is returned, followed by the pages supported in ascending order, one byte for each.

Table 112 Supported Pages Page - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code (00h)					
1	Reserved							
2-3	(MSB) Page Length (08h) (LSB)							
4	00h							
5	2Eh							
6	32h							

Read Error Counter Page (Page 03h)

The Read Error Counter Page (03h) is not supported.

Last n Error Events Page (07h)

The Last n Error Events page (07h) is not supported.

TapeAlert Page (2Eh)

This page returns results of the tape drive's on-going self diagnosis, so that the tape drive's behavior can be monitored and high reliability ensured. The TapeAlert page is read from the tape drive at the beginning of each READ/WRITE activity, after any fatal errors occur during a READ/WRITE, at the end of any tape cartridge when the READ/WRITE activity continues onto another tape cartridge, and at the end of each

READ/WRITE activity. The flags, of which there are 16, are set or cleared by the tape drive when the failure or corrective action occurs.

> Tech Tip: The tape alert page returns cleared error information in the DX-Series system.

Table 113 TapeAlert LOG SENSE Header Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Page Code (2Eh)							
1	Reserved							
2-3	Parameter Length							
4-n	(MSB) Page Length (LSB)							

Table 114 TapeAlert LOG SENSE Header Field Descriptions

Field Name	Description
Page Code	The Page Code echoes the page code that was specified in the LOG SENSE command descriptor block.
Page Length	The Page Length field specifies the total number of bytes contained in this log page, not including the four bytes that make up the header.

Table 115 TapeAlert Page Log Parameters Format

Bit/Byte	7	6	5	4	3	2	1	0
5n-1 to 5n	(MSB) Parameter Code (n) (LSB)							
5n +1	DU	DS	TSD	ETC	TMC		Rsv'd	LP
5n +2	Parameter Length (1)							
5n +3	Value of TapeAlert Flag (Flag is set when Bit 0-1; Bits 1-7 are Reserved							

Table 116 TapeAlert Page Log Parameter Field Descriptions

Field Name	Description
Page Code	This field contains the Flag code.
Page Length	This field is set to 1.
Value of Tape Alert Flag	If Bit 0 is set to 1, this indicates that TapeAlert has sensed a problem. See Table 5-26 for the supported Flags and their definitions. If Bit 0 is 0, the Flag is not set and no problem has been sensed.

For definitions of bits that make up the Control Byte (the byte "5n + 1" above), refer to Read Error Counter Page (Page 03h) on page 162.

Table 117 TapeAlert Flags, Severity Levels, and Meanings

Flag	Severity Level*	Meaning
1 Read Warning	Warning	Problems reading data. There is no loss of data, but the tape drive's performance is reduced.
2 Write Warning	Warning	Problems writing data. There is no loss of data, but the capacity of the tape is reduced.
3 Hard Error	Warning	An error has occurred during a read or write operation that the tape drive cannot correct: operation has stopped.
5 Read Failure	Critical	The tape medium or the tape drive is damaged. Contact a service representative.
6 Write Failure	Critical	The tape medium is faulty or the tape drive is damaged. Test the tape drive using a known-good tape cartridge. If the problem persists, contact a service representative.
9 Write Protect	Critical	The tape cartridge is write protected. Set the write protection switch to enable writing, or use a different tape cartridge.
10 No Removal	Informational	The tape drive is busy and the tape cartridge cannot be ejected. Wait for the operation to complete before attempting to eject the tape cartridge.
11 Cleaning Media	Informational	The tape cartridge in the tape drive is a cleaning cartridge. For normal tape drive data-related operations, replace the cleaning cartridge with a data tape cartridge.
20 Clean Now	Critical	The tape drive needs to be cleaned. Make sure that all tape operations have completed, eject the data tape cartridge and follow the appropriate steps to use a cleaning cartridge.
22 Expired Cleaning Media	Critical	The cleaning cartridge that was used has expired. Wait for all tape drive operations to complete, then use a valid cleaning cartridge for cleaning.

Flag	Severity Level*	Meaning
31 Hardware B	Critical	The tape drive may have a hardware fault. Contact a service representative.
32 Interface	Warning	The tape drive may have a hardware fault. Contact a service representative.
34 Download Fail	Warning	The attempted firmware download has failed.
40 Loader Hardware A	Critical	The mechanism that loads media to the tape drive is experiencing problems communicating with the tape drive.

* Severity levels are *Informational*, *Warning,* and *Critical*. Informational flags provide a status-type message, Warning flags indicate that there is the possibility of loss of data, and Critical flags indicate the possibility of loss of data and that user intervention is urgently required.

Read / Write Compression Page (32h)

This page begins with a 4-byte header followed by the log parameter blocks of 6 or 8 bytes, depending on the Parameter Code selected.

> Tech Tip: Read/write compression page updates only the bytes read/write from and to the host in the DX-Series system.

Table 118 Read / Write Compression Ratio LOG SENSE Header Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code (32h)					
1	Reserved							
2-3	(MSB) Additional Length (LSB)							

Table 119 Read / Write Compression Ratio LOG SENSE Header Field Descriptions

Field Name	Description
Page Code	The Page Code echoes the page code that was specified in the LOG SENSE command descriptor block.
Additional Length	The Additional Length field specifies the number of bytes available and depends on the parameters requested.

Table 120 Log Parameters Format for Read / Write Compression Ratio LOG SENSE Page (Parameter Codes 00h and 01h)

Bit/Byte	7	6	5	4	3	2	1	0
0-1	(MSB) Parameter Code (LSB)							
2	DU	DS(1)	TSD(1)	ETC	TMC		Rsv'd	LP
3	02h							
4-n	(MSB) Compression Ratio x 100 (LSB)							

Table 121 Log Parameters for Read / Write Compression Ratio LOG SENSE Page Field Descriptions (Parameter Codes 00h and 01h)

Field Name	Description
Page Code	Parameter Codes supported for the READ / WRITE COMPRESSION RATIO page are as follows (for codes 00h and 01h only; codes 02h through 09h are detailed separately): Parameter Code - Description 00h - READ Compression Ratio x 100 01h - WRITE Compression Ration x 100
DU	Disable Update. Always 0.
DS	Disable Save. Not supported. This bit always set to 1.
TSD	Target Save Disable. Not supported. This bit always set to 1.
ETC	Enable Threshold Comparison. Threshold checking is not supported on this page. Always set to 0.
TMC	Threshold Met Criteria. Always 0.
LP	List Parameter. Always set to 0 (parameter codes treated as data counter).

Table 122 Log Parameters Format for Read / Write Compression Ratio LOG SENSE Page (Parameter Codes 02h through 09h)

Bit/Byte	7	6	5	4	3	2	1	0
0-1	(MSB) Parameter Code (LSB)							
2	DU(0)	DS(1)	TSD(1)	ETC(0)	TMC(0)		Rsv'd	LP(0)
3	04h							
4	(MSB) Counter Value (LSB)							

Table 123 Log Parameters for Read / Write Compression Ratio LOG SENSE Page Field Descriptions (Parameter Codes 02h through 09h)

Field Name	Description
Parameter Code	Parameter Codes supported for the READ / WRITE COMPRESSION RATIO page (codes 02h through 09h) are as follows: Parameter – Code Descriptions 02h - Mbytes Transferred to Host 03h - Bytes Transferred to Host 04h - Mbytes Read from Tape 05h - Bytes Read from Tape 06h - Mbytes Transferred from Host 07h - Bytes Transferred from Host 08h - Mbytes Written to Tape 09h - Bytes Written to Tape
DU	Disable Update. Always 0.
DS	Disable Save. Not supported. This bit always set to 1.
TSD	Target Save Disable. Not supported. This bit always set to 1.
ETC	Enable Threshold Comparison. Threshold checking is not supported on this page. Always set to 0.
TMC	Threshold Met Criteria. Always 0.

Field Name	Description
LP	List Parameter. Always set to 0 (parameter codes treated as data counter).
Counter Value	**Parameter Codes 06h and 07h** -- Report the count of bytes transferred from the initiator to the buffer. Parameter Code 06h reports the number of full megabytes transferred; Parameter Code 07h reports the number of bytes less than a full megabyte that have been transferred. Multiplying the counter returned for Parameter Code 06h by 1,048,576 and then adding the value of the counter returned by Parameter Code 07h results in the actual total bytes transferred from the initiator to the buffer. **Parameter Codes 08h and 09h** -- Report the count of bytes written to the tape drive. Parameter Code 08h reports the number of full megabytes transferred; Parameter Code 09h reports the number of bytes less than a full megabyte that have been transferred. Multiplying the counter returned for Parameter Code 08h by 1,048,576 and then adding the value of the counter returned by Parameter Code 09h results in the actual total bytes written to the tape drive.

Device Wellness Page (33h)

The Device Wellness Page is not supported.

Device Status Page (3Eh)

The Device Status Page is not supported.

Mode Select (6 /10) (15h / 55h)

The MODE SELECT command (available in either 6- or 10-byte format) enables the host to configure the tape drive. Implementing MODE SELECT and MODE SENSE requires “handshaking” between the host and the drive. Before configuring the drive, the host should issue a MODE SENSE command to the drive to obtain a report of the current configuration and determine what parameters are configurable. The host interprets this information and then may issue MODE SELECT to set the drive to the host’s preferred configuration. The Mode Parameter List is passed from the initiator to the drive during the command’s DATA OUT phase.

Information for the drive is carried on a number of pages, each of which serves to set the tape drive’s operating parameters. The MODE SELECT pages supported, and the sections of this manual that details each page, are:

Page Code	Description
01h	READ/WRITE Error Recovery Page
02h	Disconnect / Reconnect Page
0Ah	Control Mode Page
0Fh	Data Compression Page
10h	Device Configuration Page
11h	Medium Partition Page
1Ch	Tape Alert Page
3Eh	EEPROM Vendor Unique Page

Tech Tip: All page information is accepted, but not acted on with the exception of the RLEC bit and block length in the DX-Series system.

(Continued on next page)

The tape drive always powers up with its default configurations set. This is also true if the drive receives a BUS DEVICE RESET message or a hard reset via the RST line on the SCSI bus.

The Command Descriptor Block is illustrated in table 124.

Note: For a list of changeable parameters within MODE SELECT, refer to EEPROM Vendor Unique Page 3Eh and Changeable Parameters within MODE SELECT.

Table 124 Mode Select (6) Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (15h)							
1	Logical Unit Number			PF	Reserved			SP (0)
2-3	Reserved							
4	Parameter List Length							
5	Unused (00)		Reserved				Flag (0)	Link (0)

Table 125 Mode Select (10) Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (55h)							
1	Logical Unit Number			PF	Reserved			SP (0)
2-6	Reserved							
7-8	Parameter List Length							
9	Unused (00)		Reserved				Flag (0)	Link (0)

Table 126 MODE SELECT (6)/(10) Command Descriptor Block - Field Descriptions

Field Name	Description
PF	Page Format. The Page Format bit indicates that the data sent by the host after the MODE SELECT header and block descriptors complies with the definition of pages in the SCSI-2 specification. The SCSI-1 format will not be implemented so this bit must be set to 1. It is an ILLEGAL REQUEST to have page parameters while the PF bit is 0.
SP	Save Parameters. Must be 0. If set, this bit instructs the drive to save all savable pages, and this is not supported on the tape drive.

Mode Parameter List

The figure shows the format of the Mode Parameter List that is passed by the initiator to the tape drive during the command's DATA OUT phase.

Table 127 MODE SELECT (6) Mode Parameter List - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0-3	Mode Parameter Header							
4-11	Mode Parameter Block Descriptor (Optional)							
4-11 or 12 - n	Page(s) (Optional)							

Table 128 MODE SELECT (10) Mode Parameter List - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0-7	Mode Parameter Header							
8-15	Mode Parameter Block Descriptor (Optional)							
8-n or 16 - n	Page(s) (Optional)							

Table 129 MODE SELECT Mode Parameter List - Field Descriptions

Field Name	Description
Mode Parameter Header	Page Format. The Page Format bit indicates that the data sent by the host after the MODE SELECT header and block descriptors complies with the definition of pages in the SCSI-2 specification. The SCSI-1 format will not be implemented so this bit must be set to 1. It is an ILLEGAL REQUEST to have page parameters while the PF bit is 0.
Mode Parameter Block Descriptor	8 bytes in length, allows the initiator to set the drive's Logical Block Size and number of Descriptor Logical Block Addresses.
Page(s)	The Page Code(s) of the pages that are a part of this MODE SELECT command.

Mode Parameter Header

The figure and table that follow provide an illustration and description of the fields that make up the MODE SELECT command's Mode Parameter header.

Table 130 MODE SELECT (6) Mode Parameter Header - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Reserved							
1	Media Type							
2	Ignored	Buffered Mode			Speed			
3	Block Descriptor Length (08h)							

Table 131 MODE SELECT (10) Mode Parameter Header - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0-1	Reserved							
2	Media Type							
3	Ignored	Buffered Mode			Speed			
4-5	Reserved							
6-7	Block Descriptor Length							

Table 132 MODE SELECT Mode Parameter Header - Field Descriptions

Field Name	Description
Media Type	This field is ignored by the MODE SELECT command.
Buffered Mode	Default = 1. The drive implements immediate reporting on WRITE commands through its buffered mode. With Buffered Mode set to 1, the drive reports GOOD status on WRITE commands as soon as the data block has been transferred to the buffer. If this field = 0, then the drive does not report GOOD status on WRITE commands until the data blocks have been written to tape. When Buffered Mode is not used, the tape drive suffers significant performance degradation, and possible capacity, depending on tape format, block size, and compression. When writing 2.6 or 6.0 GB formats and block size that is a multiple of 4 Kbytes, there is no capacity loss. Likewise, when using the 10 or 20 GB format with compression disabled and block size a multiple of 8 Kbytes, there is no capacity loss. When writing 10 or 20 GB format with compression enabled and Buffered Mode disabled, some capacity loss can occur. The block packing feature is essentially disabled by turning off Buffered Mode. If Buffered Mode is set to a number greater than 1, the command is rejected with CHECK CONDITION, sense key of ILLEGAL REQUEST.
Speed	The tape drive supports only its default speed.
Block Descriptor Length	This field specifies the length in bytes of all the block descriptors. Since the drive only allows one block description, the value must be either 0 or 8. A value of 0 indicates no block description is included; a value of 8 indicates a block descriptor is present and precedes the mode page data. Any other value other than 0 or 8 causes a CHECK CONDITION status with sense key of ILLEGAL REQUEST to be returned.

Mode Parameter Block Descriptor

The figure and table that follow provide an illustration and description of the fields that make up the MODE SELECT command's Mode Parameter Block Descriptor.

Table 133 MODE SELECT Mode Parameter Block Descriptor - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Density Code							
1-3	(MSB) Number of Blocks (LSB)							
4	Reserved							
5	(MSB) Block Length (LSB)							

Table 134 MODE SELECT Mode Parameter Block Descriptor - Field Descriptions

Field Name	Description
Density Code	This field should match the current tape medium density; it is set to 0 if the density is unknown.
00h	Use default density.
0Ah	6667 bpi MFM serial cartridge tape X3B5/86-199 (read only).
16h	10000 bpi MFM serial cartridge tape X3.193-1990 (read only).
17h	42500 bpi MFM serial cartridge tape X3B5/91- 2.6 GB (DLTtape III only).
18h	Same as 17h, but with 56 track pairs vs. 24 - 6.0 GB (DLTtape III only).

Field Name	Description
19h	62500 bpi, 64 track pairs, serial cartridge tape - 10.0 GB (DLTtape III only) /15.0 GB (DLTtape IIIxt only)
1Ah	81633 bpi, 64 track pairs, serial cartridge tape - 20.0 GB (DLTtape IV only)
1Bh	85937 bpi, 52 quad pairs, serial cartridge tape - 35.0 GB
	The density codes above are the **preferred** codes used to define density. Additionally, the following codes may be used, though use of the Data Compression Page is preferred:
7Fh	No change from previous density (No Operation)
80h	62500 bpi, 64 track pairs, serial cartridge tape - 10.0 GB (DLTtape III) /15.0 GB (DLTtape IIIxt) without compression
81h	62500 bpi, 64 track pairs, serial cartridge tape - 20.0 GB (DLTtape III) /30.0 GB (DLTtape IIIxt) with compression
82h	81633 bpi, 64 track pairs, serial cartridge tape - 20.0 GB (DLTtape IV) without compression
83h	81633 bpi, 64 track pairs, serial cartridge tape - 40 GB (DLTtape IV) with compression
84h	85937 bpi, 52 quad tracks, serial cartridge tape - 35 GB (without compression)
85h	85937 bpi, 52 quad tracks, serial cartridge tape - 70 GB (with compression)

Field Name	Description
Number of Blocks	This MODE SENSE field is sent = 0, indicating that all of the remaining logical blocks on the tape will have the medium characteristics specified by the block descriptor.
Block Length	This field specifies the length, in bytes, of each logical block transferred over the SCSI bus. A block length of 0 indicates that the length is variable (specified in the I/O command). Any value other than 0 indicates the number of bytes per block to use for READ, WRITE, and VERIFY commands that specify a "fixed" bit of 1 (i.e., fixed block mode) which also causes the transfer length in the command descriptor block to be defined as a block count. If fixed bit is not equal to 1, this field is ignored.

Mode Page Descriptors

Following the MODE SELECT command's Mode Parameter Block Descriptor are the MODE SELECT pages, each of which sets a different device parameter. Each mode page has a 2-byte header that identifies the page code and indicates the number of bytes in that page.

Table 135 MODE SELECT Page Descriptor - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	PS(0)	0	Page Code					
1	Additional Page Length							
2-n	Page-Defined or Vendor Unique Parameter List							

Table 136 MODE SELECT Page Descriptor - Field Descriptions

Field Name	Description
PS	Parameters Savable. For the MODE SELECT (6) (10) commands, this field is reserved (0).
Additional Page Length	Indicates number of bytes in that page (not including bytes 0 and 1).
Page-Defined or Vendor Unique Parameter List	Information in this field depends on the mode page.

READ / WRITE Error Recovery Page (01h)

The READ / WRITE Error Recovery Page controls the drive's response to error conditions that arise during the course of READ and WRITE command processing.

Table 137 Error Recovery Page - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	PS(0)	0	Page Code (01h)					
1	Additional Page Length (0Ah)							
2	Rsv'd	Rsv'd	TB	Rsb'd	EER(1)	PER	DTE(0)	DCR(0)
3	Read Retry Count							
4-7	Reserved							
8	Write Retry Count							
9-11	Reserved							

Table 138 Error Recovery Page - Field Descriptions

Field Name	Description
PS	Parameters Savable. For MODE SELECT, this bit must be 0.
Additional Page Length	This field indicates the number bytes in the page. However, the value does not include bytes 0 and 1. The length is returned in MODE SENSE commands and must subsequently be set to the same value when performing MODE SELECT. If the page length does not match that expected by the drive, a CHECK CONDITION status is returned, sense key set to ILLEGAL REQUEST. The drive returns a CHECK CONDITION status with sense key set to ILLEGAL REQUEST if it receives an unsupported Page Code or a Page field with values not supported or changeable. In such cases, no parameters are changed as a result of the command.
TB	Transfer Block. Not supported.
EER	Enable Early Recovery. Set to 1 (always enabled).
PER	Post Error. Default is 0. When set to 1, this bit enables reporting of Check Condition for recovered READ / WRITE errors.
DTE	Disable Transfer on Error. Must be 0. Not supported.
DCR	Disable ECC Correction. Must be 0. Not supported.
Read Retry Count	This field reports the maximum number or rereads that are attempted before declaring an unrecoverable error.
Write Retry Count	This field reports the maximum number of overwrite retries that will be attempted before declaring an unrecoverable error.

Tech Tip: Parameters are accepted, but not acted on.

Disconnect/ Reconnect Page (02h)

The Disconnect / Reconnect Page controls the drive's behavior on the SCSI bus and allows an initiator to tune bus performance.

Table 139 Disconnect / Reconnect Page - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	PS(0)	0	Page Code (02h)					
1	Additional Page Length (0Eh)							
2	Buffer Full Ratio							
3	Buffer Empty Ratio							
4-5	(MSB) Bus Inactivity Limit (LSB)							
6-7	(MSB) Disconnect Time Limit (LSB)							
8-9	(MSB) Connect Time Limit (LSB)							
10-11	(MSB) Maximum Burst Time (LSB)							
12	Reserved							DTDC
13-15	Reserved							

Table 140 Disconnect / Reconnect Page - Field Descriptions

Field Name	Description
PS	Parameters Savable. For MODE SELECT, this bit must be 0.
Additional Page Length	This field indicates the number bytes in the page. However, the value does not include bytes 0 and 1. The length is returned in MODE SENSE commands and must subsequently be set to the same value when performing MODE SELECT. If the page length does not match that expected by the drive, a CHECK CONDITION status is returned, sense key set to ILLEGAL REQUEST. The drive returns a CHECK CONDITION status with sense key set to ILLEGAL REQUEST if it receives an unsupported Page Code or a Page field with values not supported or changeable. In such cases, no parameters are changed as a result of the command.
Buffer Full Ratio	Not supported. Any value is ignored.
Buffer Empty Ratio	Not supported. Any value is ignored.
Bus Inactivity Limit	Not supported. Any value is ignored.
Disconnect Time Limit	Not supported. Any value is ignored.
Connect Time Limit	Not supported. Any value is ignored.
Maximum Burst Size	This value specifies the maximum amount of data that will be transferred without disconnecting. A value of 0 sets no limit. Any value is in units of 512 bytes. For example, a value of 8 represents 4 Kbytes. Values that are not multiples of 8 are rounded up to the closest multiple of 8.

Field Name	Description
DTDC	Data Transfer Disconnect Control. This field defines further restrictions for when disconnect is permitted.
	00b - Data transfer disconnect control is not used. Disconnect is controlled by the other fields in this page.
	01b - Once the data transfer of a command has been started, a target does not attempt to disconnect until all the data to be transferred has been transferred.
	10b - Reserved
	11b - Once the data transfer of a command has started, a target does not attempt to disconnect until the command is complete.
	If DTDC is a non-zero value and the maximum burst size is non-zero, the tape drive returns CHECK CONDITION status, sense key set to ILLEGAL REQUEST and additional sense code set to ILLEGAL FIELD IN PARAMETER LIST.

Tech Tip: Parameter values and flags are accepted but not acted on.

Control Mode Page (0Ah)

The Control Mode Page provides control over several features such as tagged queuing, extended contingent allegiance, asynchronous event notification, and error logging.

Table 141 Control Mode Page Format Descriptor - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	PS(0)	0	Page Code (0Ah)					
1	Page Length (06)							
2	Reserved							RLEC
3	Queue Algorithm Modifier (0)				Reserved		Qerr (0)	DQue (0)
4	EECA (0)	Reserved				RAENP (0)	UAAENP (0)	EAENP (0)
5	Reserved							
6-7	(MSB) Ready AEN Hold off Period (0) (LSB)							

Table 142 Control Mode Page Descriptor - Field Descriptions

Field Name	Description
PS	Parameters Savable. For MODE SELECT, this bit must be 0.
Page Length	The Page Length field indicates the number of bytes in the Control Mode Page that follow this byte. The valid value for this byte is 06h.

Field Name	Description
RLEC	Report Log Exception Condition. When set to 1, specifies that the target will report log exception conditions. When 0, specifies that the target will not report log exception conditions. The RLEC bit works in conjunction with the READ / WRITE Error Log Sense Page, specifically, the TMC bit of the READ / WRITE Error Log SENSE Page (Page 2 and 3), described earlier in this manual. The RLEC bit indicates whether the drive should return CHECK CONDITION status with sense key set to UNIT ATTENTION when one of the READ and WRITE error counters of the log pages reach a specified threshold. Thresholds can be modified using LOG SELECT.
Queue Algorithm Modifier	Must be 0.
Qerr	Queue Error. Must be 0.
DQue	Disable Queuing. Must be 0.
EECA	Enable Extended Contingent Allegiance. Not supported; must be 0.
RAENP	Ready Asynchronous Event Notification. Not supported; must be 0.
UAAENP	Unit Attention Asynchronous Event Notification. Not supported; must be 0.
EAENP	Enable AEN Permission. Asynchronous event notification is not supported; must be 0.
Ready AEN Hold off Period	Not supported; must be 0.

Data Compression Page (0Fh)

The Data Compression Page specifies parameters for the control of data compression. This page allows the user to turn the tape drive's compressed format on and off independently of the tape medium's position. Additionally, it allows the user to enable or disable decompression of the tape drive compressed data during WRITE operations.

Table 143 Data Compression Page Format Descriptor - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code (0Fh)					
1	Page Length (0Eh)							
2	DCE	DCC (1)	Reserved					
3	DDE (1)	RED (00)		Reserved				
4-7	(MSB) Compression Algorithm (10) (LSB)							
8-11	(MSB) Decompression Algorithm (10) (LSB)							
12-15	Reserved							

Table 144 Data Compression Page Descriptor - Field Descriptions

Field Name	Description
PS	The Page Code identifies the type of MODE SELECT page being transferred. A value of 0Fh identifies this as the Data Compression page.
Page Length	The Page Length field indicates the number of bytes in the Data Compression page that follow this byte. The valid value for this byte is 0Eh.
DCE	Data Compression Enable. This bit specifies whether the tape drive should enable or disable data compression. When set to 1, the drive starts in compressed format.
DDE	Data Decompression Enable. Must be set to 1. When the tape drive reads compressed data from tape, it automatically decompresses the data before sending it to the initiator. Data compression must always be enabled.
RED	Report Exception on Decompression. The tape drive does not report exceptions on decompression (boundaries between compressed and uncompressed data). The RED field must be 00h.

Field Name	Description
Compression Algorithm	The Compression Algorithm field indicates which compression algorithm the tape drive will use to process data from the initiator when the DCE bit (byte 02, bit 7) is set to 1. The only value currently supported for this field is 10h. **NOTE:** Specifying a value other than 10h for this field causes the tape drive to return CHECK CONDITION status, sense key set to ILLEGAL REQUEST. However, if EEPROM parameter EnaRepDecomp is set, the parameter in this field is ignored and no CHECK CONDITION status is returned.
Decompression Algorithm	The Decompression Algorithm field indicates which decompression algorithm the tape drive will use when decompressing data on the tape. The only value currently supported is 10h. **NOTE:** Specifying a value other than 10h for this field causes the tape drive to return CHECK CONDITION status, sense key set to ILLEGAL REQUEST.

Tech Tip: RLEC is honored.

Device Configuration Page (10h)

The Device Configuration Page controls the drive's behavior on the SCSI bus and allows an initiator to tune bus performance.

Table 145 Device Configuration Page - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code (10h)					
1	Additional Page Length (0Eh)							
2	Res'd	CAP (0)	CAF (0)	Active Format (0)				
3	Active Partition (0)							

Bit/Byte	7	6	5	4	3	2	1	0
4	Write Buffer Full Ratio							
5	Read Buffer Empty Ratio							
6-7	(MSB) Write Delay Time (LSB)							
8	DBR (0)	BIS	RSmk (0)	AVC (0)	SOCF (0)		RBO (0)	REW (0)
9	Gap Size (0)							
10	EOD Defined (0)			EEG	SEW (1)	Reserved		
11-13	(MSB) Buffer Size at Early Warning (0) (LSB)							
14	Select Data Compression Algorithm							
15	Reserved							

Table 146 Device Configuration Page - Field Descriptions

Field Name	Description
PS	Parameters Savable. For MODE SELECT, this bit must be 0.
Additional Page Length	This field indicates the number bytes in the page. However, the value does not include bytes 0 and 1. The length is returned in MODE SENSE commands and must subsequently be set to the same value when performing MODE SELECT. If the page length does not match that expected by the drive, a CHECK CONDITION status is returned, sense key set to ILLEGAL REQUEST. The drive returns a CHECK CONDITION status with sense key set to ILLEGAL REQUEST if it receives an unsupported Page Code or a Page field with values not supported or changeable. In such cases, no parameters are changed as a result of the command.
CAP	Change Active Partition. Not supported; must be 0.
CAF	Change Active Format. Not supported; must be 0.
Active Format	Not supported. Must be 0.
Active Partition	Only partition 0 is supported. Setting this field to any other value causes rejection by the drive with a CHECK CONDITION status, sense key ILLEGAL REQUEST set.
Write Buffer Full Ratio	The drive sets this field to 0. The drive uses an automatic adaptive mechanism to adjust its Full Ratio according to the average data rates over the SCSI bus.
Read Buffer Empty Ratio	The drive sets this field to 0. The drive uses an automatic adaptive mechanism to adjust its Empty Ratio according to the average data rates over the SCSI bus.

Field Name	Description
Write Delay Time	This field indicates the maximum time that the drive will wait with a partially full buffer before forcing the data to tape (100 ms increments). The buffer Full/Empty ratio, which is dynamic, can cause data to be written sooner than the Write Delay Time would indicate. The Write Delay Time defaults to 200 (C8h). This causes the buffer to be flushed in 20 seconds. Maximum value is 6500 (1964h) and the minimum is 15 (0Fh). This represents a range from 11 minutes down to 1.5 seconds. Values between 0 and 15 on a MODE SELECT, are rounded down to 0. This causes the data to go straight to the medium without delay.
DBR	Data Buffer Recovery. Not supported, must be 0.
BIS	Block Identifiers Supported. This field is supported. Set to 1.
RSmk	Report Setmark. Not supported, must be 0.
AVC	Automatic Velocity Control. Not supported; must be 0.
SOCF	Stop on Consecutive Filemarks. Not supported; must be 0.
RBO	Recover Buffer Order. Not supported; must be 0.
REW	Report Early Warning. Not supported; must be 0 (do not report Early Warning EOM on READ).
Gap Size	Not used; must be 0.
EOD Defined	End-of-Data Defined. This field must be set to 00h.

Field Name	Description
EEG	Enable End-of-Data Generation. Set to 1. This field indicates that the drive will generate an EOD. The drive generates an EOD mark before any change of direction following a WRITE-type operation. This bit is ignored, however, on MODE SELECT.
SEW	Synchronize at Early Warning. Must be set to 1.
Buffer Size at Early Warning	Not supported; must be 0.
SEW	Synchronize at Early Warning. Must be set to 1.
Select Data Compression Algorithm	When set to 1, enables data compression. When 0, data compression is disabled.

Tech Tip: Cell parameter values and flags are accepted, but not acted on.

Medium Partition Page (11h)

The drive supports the Medium Partitions Parameters Page that is used to specify the medium partitions.

Table 147 Medium Partition Page Format Descriptor - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code (11h)					
1	Additional Page Length (06)							
2	Maximum Additional Partitions (0)							
3	Additional Partitions Defined (0)							
4	FDP (0)	SDP (0)	IDP (0)	PSUM (0)	Reserved			
5	Medium Format Recognition (01)							
6-7	Reserved							

Table 148 Medium Partition Page Descriptor - Field Descriptions

Field Name	Description
PS	Parameters Savable. For MODE SELECT, this bit must be 0.
Additional Page Length	This field indicates the number bytes in the page. However, the value does not include bytes 0 and 1. The length is returned in MODE SENSE commands and must subsequently be set to the same value when performing MODE SELECT. If the page length does not match that expected by the drive, a CHECK CONDITION status is returned, sense key set to ILLEGAL REQUEST. The drive returns a CHECK CONDITION status with sense key set to ILLEGAL REQUEST if it receives an unsupported Page Code or a Page field with values not supported or changeable. In such cases, no parameters are changed as a result of the command.
Maximum Additional Partitions	Not supported. Must be 0.

Field Name	Description
Additional Partitions Defined	Must be 0. This field specifies the number of additional partitions to be defined for the tape based on the settings of the SDP and IDP bits. The maximum allowed is the value returned in the Maximum Additional Partitions field. Only one partition is supported, therefore the value of the field must be 0.
FDP	Fixed Data Partitions. Must be 0.
SDP	Select Data Partitions. Must be 0.
IDP	Initiator Defined Partitions. Must be 0.
PSUM	Partition Size Unit of Measure. Must be 0.
Medium Format Recognition	This field is valid for MODE SENSE only, and is set to 01h, indicating that Medium Format Recognition is supported.

TapeAlert Page (1Ch)

The drive supports the TapeAlert Page that is used to set/change the supported TapeAlert configuration options (use the MODE SENSE command to read the settings of the TapeAlert page).

Table 149 TapeAlert Page Format Descriptor - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code (1Ch)					
1	Additional Page Length (0A)							
2	Perf	Reserved			DExcpt	Test	Rsvd	LogErr

Bit/Byte	7	6	5	4	3	2	1	0
3	Reserved				MRIE			
4-7	(MSB) Interval Timer (LSB)							
8-11	(MSB) Report Count / Test Flag Number (LSB)							

Table 150 TapeAlert Page Format Descriptor - Field Descriptions

Field Name	Description
PS	Parameters Savable. For MODE SELECT, this bit must be 0.
Additional Page Length	This field indicates the number bytes in the page. However, the value does not include bytes 0 and 1. The length is returned in MODE SENSE commands and must subsequently be set to the same value when performing MODE SELECT. If the page length does not match that expected by the drive, a CHECK CONDITION status is returned, sense key set to ILLEGAL REQUEST. The drive returns a CHECK CONDITION status with sense key set to ILLEGAL REQUEST if it receives an unsupported Page Code or a Page field with values not supported or changeable. In such cases, no parameters are changed as a result of the command.
Perf	Performance bit. Not supported, always = 0.

Field Name	Description
DExcpt	Disable Information Exception Operations. When this bit = 0, the reporting method specified by the contents of MRIE is selected. When this bit = 1 (its default setting), all information exception operations are disabled and the contents of the MRIE field are ignored. When in this mode, the TapeAlert Log page is polled by the software. To enable CHECK CONDITION mode, DExcpt should = 0.
Test	Test Bit. Not supported.
LogErr	Error Log. Not supported

Field Name	Description
MRIE	Method for Reporting Informational Exceptions. The tape drive uses the contents of this field to report information about exception conditions. Three methods are available: Value - Method 00h - No reporting of Informational Exception Conditions. The device server does not report information exception conditions. 03h - Conditionally Generate Recovered Error. The device server reports informational exception conditions, if such reports of recovered errors is allowed, by returning CHECK CONDITION status on the next SCSI command (except INQUIRY and REQUEST SENSE commands) following detection of the condition. The Sense Key is set to RECOVERED ERROR with an additional sense code of 5D 00 (TapeAlert Event). The SCSI command with CHECK CONDITION completes without error prior to the report of any exception condition, and does not need to be repeated. 06h - Only Report Informational Exception Condition on Request. The device server preserves information exception data. To access the data, a poll can be taken by issuing an unsolicited REQUEST SENSE command. The Sense Key is set to NO SENSE with an additional sense code of 5D 00 (TapeAlert Event).
	The additional sense code of 5D 00 for values 03h and 06h signals that a TapeAlert event has occurred. Information about the event is stored in the TapeAlert Log Page. The setting of MRIE does not impact logging of events in the TapeAlert Log Page.

Field Name	Description
Interval Timer	Not supported.
Report Count / Test Flag Number	Not supported.

Tech Tip: All parameter values and flags are accepted, but not acted on.

EEPROM Vendor Unique Page (3Eh)

EEPROM Vendor Unique Page (3Eh) is not supported.

Changeable Parameters within MODE SELECT

The table below lists the MODE SELECT command's changeable parameters and their default, minimum, and maximum values. Descriptions of the various parameters are provided in the discussions of the different mode pages within MODE SELECT. Note that parameter rounding is supported for all parameters except for the block descriptor length.

Table 151 Changeable Parameters within MODE SELECT

Parameter	Default	Minimum	Maximum
Header: Buffered Mode, Device Specific Byte	1	0	1
Block Descriptor Length	08h	00h	08h

Parameter	Default	Minimum	Maximum
Block Descriptor: Block Length			
2.0 GB and 6.0 GB Mode	0	0	40000h
10.0 GB and 20.0 GB Mode	0	0	FFFFFEh
35.0 GB and 70 GB Mode	0	0	FFFFFEh
READ / WRITE Error Recovery (01h): PER bit	0	0	1
Control Mode (0Ah): RLEC	0	0	1
Disconnect / Reconnect (02h): Maximum Burst Size	0080h	0000h	FFFFh
Disconnect / Reconnect (02h): DTDC	0	0	3
Device Configuration (10h): WRITE Delay Time	C8h	Fh	1964h
Device Configuration (10h): SEW	1	0	1
Device Configuration (10h): Select Data Compression Algorithm	1	0	1
Data Compression (0Fh): DCE	0	0	1
TapeAlert (1Ch): Perf	0	0	1
TapeAlert (1Ch): DExcpt	1	0	1
TapeAlert (1Ch): Test	0	0	1
TapeAlert (1Ch): MRIE	3	0	6

Mode Sense (6/10) (1Ah / 5Ah)

The MODE SENSE command allows the drive to report its media type, and current, or changeable configuration parameters to the host. It is a complementary command to MODE SELECT.

> Tech Tip: The specific page information is accepted and retained, but not acted on during processing. The EEPROM vendor unique page will always return:
>
> VENDORID QUANTUM
>
> PRODUCTID DLT7000

The command descriptor block for the 6-byte MODE SENSE (1Ah) is shown below. An illustration of the command descriptor block for the 10-byte MODE SENSE (5Ah) follows on the next page.

Table 152 MODE SENSE (6) Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Ah)							
1	Logical Unit Number			Rsv'd	DBD	Reserved		
2	PC		Page Code					
3	Reserved							
4	Allocation Length							
5	Unused		Reserved				Flag (0)	Link (0)

The 10-byte MODE SENSE command is required to request the Vendor-Unique EEPROM parameter page due to the large amount of data that parameter page contains. MODE SENSE (10) can be used to retrieve the other pages as well. Note that MODE SENSE (10) returns descriptor data in a different format than MODE SENSE (6).

Table 153 MODE SENSE (10) Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (5Ah)							
1	Logical Unit Number			Rsv'd	DBD	Reserved		
2	PC		Page Code					
3-6	Reserved							
7-8	(MSB) Allocation Length (LSB)							
9	Unused		Reserved				Flag (0)	Link (0)

Table 154 MODE SENSE Control Descriptor Block - Field Descriptions

Field Name	Description
DBD	Disable Block Descriptors. If 0, device returns the block descriptor data. If set to 1, block descriptor information is not returned.
PC	Page Control. The Page Control field indicates the type of page parameter values to be returned to the host. PCDescription 00 - Report Current Values 01 - Report Changeable Values 10 - Report Default Values 11 - Not supported

Field Name	Description
Page Code	This field allows the host to select any specific page or all of the pages supported by the drive.
Allocation Length	This field specifies the number of bytes that the host has allocated for returned MODE SENSE data. An allocation length of zero indicates that the drive will return no MODE SENSE data. This is not considered an error, and GOOD status is returned.

MODE SENSE may be either MODE SENSE (6) or MODE SENSE (10). MODE SENSE (6) data contains a 4-byte header followed by one 8-byte block descriptor, followed by zero or more variable length pages, depending on the Page Code and Allocation Length.

MODE SENSE Data Headers

The MODE SENSE (6) and MODE SENSE (10) headers are illustrated in the following figures.

Table 155 MODE SENSE (6) Data Header - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Mode Sense Data Length							
1	Media Type							
2	WC	Buffered Mode			Speed (0)			
3	Block Descriptor Length (08h)							

Table 156 MODE SENSE (10) Data Header - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0-1	(MSB) Mode Sense Data Length (LSB)							
2	Media Type							
3	WP	Buffered Mode			Speed (0)			
4-5	Reserved							
6-7	(MSB) Block Descriptor Length (08h) (LSB)							

Table 157 MODE SENSE Data Header - Field Descriptions

Field Name	Description
Mode Sense Data Length	This field specifies the length (in bytes) of the MODE SENSE data that is available to be transferred during the DATA IN phase. Note that the Mode Sense Data Length does not include itself.
Media Type	The media type is determined by the drive and can be one of the following: Media Type - Description 00h - Unknown or not present 81h - Cleaning tape 82h - DLTtape I or DLTtape II 83h - DLTtape III 84h - DLTtape IIIxt 85h - DLTtape IV
WP	Write Protect. If 0, this field indicates that the tape is write-enabled. If set to 1, it indicates that the tape is write-protected.

Field Name	Description
Buffered Mode	This mode implements Immediate Reporting on WRITE commands via the Buffered Mode. If the field is 0, then the drive does not report a GOOD status on WRITE commands until the data blocks are actually written to tape. If the field is 1, then the drive reports GOOD status on WRITE commands as soon as the data block has been transferred to the buffer. This is the default configuration of the drive. Note that if Buffered Mode is not used, the tape drive will suffer a degradation in performance, but not in capacity.
Speed	The tape drive supports only one speed. This is the default speed (0).
Block Descriptor Length	This field specifies the length (in bytes) of all of the block descriptors. Since the drive only supports one block descriptor, this value is 08h.

MODE SENSE Block Descriptor

The following figure describes the MODE SENSE block descriptor that follows the MODE SENSE header. Descriptions of the MODE SENSE blocks are provided in Table 5-51.

Table 158 MODE SENSE Block Descriptor - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Density Code							

Bit/Byte	7	6	5	4	3	2	1	0
1-3	(MSB) Number of Blocks (000000h) (LSB)							
4	Reserved							
5-7	(MSB) Block Length (LSB)							

Table 159 MODE SENSE Block Descriptor - Field Descriptions

Field Name	Description
Density Code	The contents of this field match the density of the media, or 0 if the density is unknown:
Density Code 00h 0Ah 16h 17h 18h 19h 1Ah 1Bh	Description Use default density. 6667 bpi MFM serial cartridge tape X3B5/86-199 (read only). 10000 bpi MFM serial cartridge tape X3.193-1990 (read only). 42500 bpi MFM serial cartridge tape X3B5/91- 2.6 GB (DLTtape III only). Same as 17h, but with 56 track pairs vs. 24 - 6.0 GB (DLTtape III only). 62500 bpi, 64 track pairs, serial cartridge tape - 10.0 GB (DLTtape III only) /15.0 GB (DLTtape IIIxt only) 81633 bpi, 64 track pairs, serial cartridge tape - 20.0 GB (DLTtape IV only) 85937 bpi, 52 quad pairs, serial cartridge tape - 35.0 GB

Field Name	Description
	The density codes above are the **preferred** codes used to define density. Additionally, the codes listed below may be used, though use of the Data Compression Page is preferred (these codes are only returned if they were set using the MODE SELECT command; note that the codes may be different than the code set using MODE SELECT if the selection was made while the tape was not at BOT):
80h	62500 bpi, 64 track pairs, serial cartridge tape - 10.0 GB (DLTtape III) /15.0 GB (DLTtape IIIxt) without compression
81h	62500 bpi, 64 track pairs, serial cartridge tape - 20.0 GB (DLTtape III) /30.0 GB (DLTtape IIIxt) with compression
82h	81633 bpi, 64 track pairs, serial cartridge tape - 20.0 GB (DLTtape IV) without compression
83h	81633 bpi, 64 track pairs, serial cartridge tape - 40 GB (DLTtape IV) with compression
84h	85937 bpi, 52 quad tracks, serial cartridge tape - 35 GB without compression
85h	85937 bpi, 52 quad tracks, serial cartridge tape - 70 GB with compression

Field Name	Description
Number of Blocks	This field is sent as 0, indicating that all of the remaining logical blocks on the tape have the medium characteristics specified by the block descriptor.
Block Length	This field specifies the length (in bytes) of each logical block transferred over the SCSI bus. A block length of 0 indicates that the length is variable (as specified in the I/O command). Any other value indicates the number of bytes per block that are used for READ, WRITE, and VERIFY type commands that specify a fixed bit of 1 (fixed block mode).

MODE SENSE Mode Pages

The following figure depicts the variable length page descriptor.

Table 160 MODE SENSE Page Descriptor - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	PS	0	Page Code					
1	Additional Page Length							
2	Page Defined or Vendor-Unique Parameter Bytes							

Descriptions of the MODE SENSE page descriptor fields are provided in the following table. Detailed descriptions of each of the MODE SENSE Pages follow.

Table 161 MODE SENSE Page Descriptor - Field Descriptions

Field Name	Description
PS	Parameters Savable. When 0, the supported parameters cannot be saved (savable pages are not supported). When set to 1, it indicates that the page can be saved in nonvolatile memory by the drive.
Additional Page Length	This field indicates the number of bytes in the page. Note that this value does not include bytes 0 and 1. The length is returned on MODE SENSE and must subsequently be set to the same value when performing MODE SELECT.

Page codes and pages that are supported are:

Page Code	Description	Sense/Select
00h	No Requested Page	SENSE
01h	READ / WRITE Error Recovery Page	BOTH
02h	Disconnect / Reconnect Page	BOTH
0Ah	Control Mode Page	BOTH
0Fh	Data Compression Page	BOTH
10h	Device Configuration Page	BOTH
11h	Medium Partition Page	BOTH
1Ch	TapeAlert Page	BOTH
3Eh	EEPROM Vendor Unique Page	BOTH
3Fh	All Pages (Except EEPROM)	BOTH

READ / WRITE Error Recovery Page (01h)

The tape drive supports the Error Recovery Page for READ and WRITE operations. The format for the page is illustrated in the following figure.

Table 162 Read / Write Error Recovery Page - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code (01h)					
1	Additional Page Length (01h)							
2	Rsv'd	Rsv'd	TB	Rsv'd	EER	PER	DTE (0)	DCR (0)
3	READ Retry Count							
4-7	Reserved							
8	WRITE Retry Count							
9-11	Reserved							

Table 163 Read / Write Error Recovery Page - Field Descriptions

Field Name	Description
PS	Parameters Savable. Must be 0, the supported parameters cannot be saved (savable pages are not supported).
Additional Page Length	This field indicates the number of bytes in the page. Note that this value does not include bytes 0 and 1. The length is returned on MODE SENSE and must subsequently be set to the same value when performing MODE SELECT.
TB	Transfer Block. The Transfer Block (when not fully recovered) function is not supported.
EER	Enable Early Recovery. This function is always enabled (must be = 1).
PER	Parity Error. This bit enables reporting of CHECK CONDITION for recovered READ / WRITE errors. Default is 0.
DTE	Disable Transfer on Error. Set to 0. This feature is not supported.
DCR	Disable ECC Correction Bit. Set to 0. This feature is not supported.
READ Retry Count	This field reports the maximum number of re-reads that are attempted before declaring an unrecoverable error.
WRITE Retry Count	This field reports the maximum number of overwrite retries that are attempted before declaring an unrecoverable error.

(Continued on next page)

DISCONNECT / RECONNECT Page (02h)

The tape drive supports the DISCONNECT / RECONNECT Page. The format for the page is illustrated in the following figure.

Table 164 Disconnect / Reconnect Page - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	PS	0	Page Code (02h)					
1	Additional Page Length (0Eh)							
2	Buffer Full Ratio (0)							
3	Buffer Empty Ratio (0)							
4-5	(MSB) Bus Inactivity Limit (0) (LSB)							
6-7	(MSB) Disconnect Time Limit (0) (LSB)							
8-9	(MSB) Connect Time Limit (0) (LSB)							
10-11	(MSB) Maximum Burst Size (LSB)							
12	Reserved						DTDC	
13-15	Reserved							

Table 165 Disconnect / Reconnect Page - Field Descriptions

Field Name	Description
PS	Parameters Savable. When 0, the supported parameters cannot be saved (savable pages are not supported). When set to 1, it indicates that the page can be saved in nonvolatile memory by the drive.
Additional Page Length	This field indicates the number of bytes in the page. Note that this value does not include bytes 0 and 1. The length is returned on MODE SENSE and must subsequently be set to the same value when performing MODE SELECT.
Buffer Full Ratio	Not supported.
Buffer Empty Ratio	Not supported.
Bus Inactivity Limit	Not supported.
Disconnect Time Limit	Not supported.
Connect Time Limit	Not supported.
Maximum Burst Size	The value in this field specifies the maximum amount of data to be transferred without disconnecting. A value of 0 sets no limit. This value is given in 512 byte increments. For example, a value of 8 indicates 4K bytes. Values that are not multiples of 8 are rounded up to the nearest multiple of 8.
DTDC	Data Transfer Disconnect Control. The value in this field specifies the restriction when a disconnect is permitted.

Control Mode Page (0Ah)

The Control Mode Page allows the user to determine whether the tape drive returns a CHECK CONDITION status when one of the WRITE and READ counters has reached a specified threshold.

Table 166 Control Mode Page - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code (0Ah)					
1	Page Length (06)							
2	Reserved							RLEC
3	Queue Algorithm Modifier (0)				Reserved		Qerr (0)	DQue (0)
4	EECA (0)	Reserved				RAENP (0)	UAAENP (0)	EAENP (0)
5	Reserved							
6-7	(MSB) Ready AEN Hold off Period (0) (LSB)							

Table 167 Control Mode Page - Field Descriptions

Field Name	Description
Page Length	The value in this field indicates the number of bytes in the Control Mode Page being transferred. The value for this byte is 06h.
RLEC	Report Log Exception Condition. This bit indicates whether the tape drive returns CHECK CONDITION status with sense key set to UNIT ATTENTION (06h) when one of its WRITE and READ error counters reaches a specified threshold, as follows: 0 = Do not return UNIT ATTENTION when a threshold has been met. 1 = Return UNIT ATTENTION when a threshold is met.
Queue Algorithm Modifier	Must be 0.
Qerr	Queue Error. Must be 0.
Dque	Disable Queuing. Must be 0.
EECA	Enable Extended Contingent Allegiance. Not supported; must be 0.
Ready AEN Hold off Period	Not supported; must be 0.
RAENP	Ready AEN Permission. Asynchronous event notification is not supported; must be 0.
UAAENP	Unit Attention AEN Permission. Not supported; must be 0.
EAENP	Enable AEN Permission. Asynchronous event notification is not supported; must be 0.

Data Compression Page (0Fh)

The Data Compression page specifies parameters for the control of data compression.

Table 168 Data Compression Page - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	PS (0)	Rsv'd	Page Code (0Fh)					
1	Page Length (0E)							
2	DCE	DCC	Reserved					
3	DDE (0)	RED (0)	Reserved					
4-7	(MSB) Compression Algorithm (LSB)							
8-11	(MSB) Decompression Algorithm (LSB)							
12-15	Reserved							

Table 169 Data Compression Page - Field Descriptions

Field Name	Description
Page Length	The value in this field indicates the number of bytes in the Control Mode Page being transferred. The value for this byte is 0Eh.
DCE	Data Compression Enable. The value returned for this bit depends on the current WRITE density of the tape drive: 0 = Write compression is Disabled 1 = Write compression is Enabled

Field Name	Description
DCC	Data Compression Capable. The value returned for this bit indicates whether this tape drive supports data compression: 0 = Data Compression is disabled 1 = Data Compression is enabled
DDE	Data Decompression Enable. The value returned for this bit indicates whether data decompression is enabled or not. 0 = Data Decompression is Disabled 1 = Data Decompression is Enabled Note that when the tape drive reads compressed data from tape, it automatically decompresses the data before sending it to the initiator. The value for this bit, therefore, is always 1.
RED	Report Exception on Decompression. The tape drive does not report exceptions on decompression (boundaries between compressed and decompressed data). The value returned for RED is 00h.
Compression Algorithm	The value for this field is 10h. This indicates the Lempel-Ziv high efficiency data compression algorithm.
Decompression Algorithm	The value for this field is 10h. This indicates the Lempel-Ziv high efficiency data decompression algorithm. If EEPROM parameter EnaRepDCcomp is set, a value of 0 is reported if the last block read is not decompressed.

Device Configuration Page (10h)

The tape drive supports the Device Configuration Page. The format for the page is illustrated in the following figure.

Table 170 Device Configuration Page - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	PS (0)	Rsv'd	Page Code (10h)					
1	Additional Page Length (0Eh)							
2	Rsv'd	CAP (0)	CAF (0)	Active Format (0)				
3	Active Partition (0)							
4	WRITE Buffer Full Ratio (0)							
5	READ Buffer Empty Ratio (0)							
6-7	(MSB) WRITE Delay Time (LSB)							
8	DBR (0)	BIS (0)	RSmk	AVC (0)	SOCF (0)		RBO (0)	REW (0)
9	Gap Size (0)							
10	EOD Defined (0)			EEG (1)	SEW (1)	Reserved		
11-13	(MSB) Buffer Size at Early Warning (0) (LSB)							
14	Select Data Compression Algorithm							
15	Reserved							

Table 171 Device Configuration Page - Field Descriptions

Field Name	Description
PS	Parameters Savable. Not supported; must be 0.
Additional Page Length	This field indicates the number of bytes in the page. Note that this value does not include bytes 0 and 1. The length is returned on MODE SENSE and must subsequently be set to the same value when performing MODE SELECT.
CAP	Change Active Partition. Not supported.
CAF	Change Active Format. Not supported.
Active Format	Not supported.
Active Partition	This field indicates the current logical partition number in use. Only partition 0 is supported.
WRITE Buffer Full Ratio	Indicates how full the buffer should be before restarting writing to the medium. The tape drive sets this to 0 (unused) since it uses an automatic adaptive mechanism to dynamically adjust its ratio according to the average data rates over the SCSI bus.
READ Buffer Empty Ratio	Indicates how empty the buffer should be before restarting reading from the medium. The tape drive sets this to 0 (unused) since it uses an automatic adaptive mechanism to dynamically adjust its ratio according to the average data rates over the SCSI bus.

Field Name	Description
WRITE Delay Time	Indicates the maximum time (in 100 ms increments) the drive waits with a partially fully buffer before forcing the data to tape. Note that the buffer full/ empty ratio, which is dynamic, can cause data to be written sooner than the WRITE delay time value indicates. The WRITE delay time defaults to 200 ms (C8h). This causes the buffer to be flushed in 20 seconds. Minimum value is 15 (Fh); maximum value is 6500 (1964h). This represents a range in delay from 1.5 seconds to 11 minutes. Tech Tip: Accepted, but not acted on.
DBR	Data Buffer Recovery. Not supported, must be 0.
BIS	Block Identifiers Supported. Set to 1.
RSmk	Report Setmarks. Not supported, must be 0.
AVC	Automatic Velocity Control. Not supported; must be 0.
SOCF	Stop on Consecutive Filemarks. Set to 0.
RBO	Recover Buffer Order. Set to 0.
REW	Report Early Warning. Set to 0 (do not report early warning EOM on reads).
Gap Size	Not supported. Set to 0.
EOD Defined	End of Data. Set to 00h.
EEG	Enable EOD Generation Bit. Set to 1 to indicate that the drive generates an EOD. The drive generates an EOD mark before any change of direction following a WRITE-type operation.
SEW	Synchronize at Early Warning. Set to 1.

Field Name	Description
Buffer Size at Early Warning	Not supported; must be 0.
Select Data Compression Algorithm	If set to 1, data compression is enabled. If 0, data compression is disabled.

Medium Partition Page (11h)

The tape drive supports the Medium Partition Page. The format for the page is illustrated in the following figure.

Table 172 Medium Partition Page - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code (11h)					
1	Additional Page Length (06h)							
2	Maximum Additional Partitions (0)							
3	Additional Partitions Defined (0)							
4	FDP (0)	SDP (0)	IDP (0)	PSUM (0)	Reserved			
5	Medium Format Recognition (01h)							
6-7	Reserved							

Table 173 Medium Partition Page - Field Descriptions

Field Name	Description
PS	Parameters Savable. Not supported; must be 0.
Additional Page Length	This field indicates the number of bytes in the page. Note that this value does not include bytes 0 and 1. The length is returned on MODE SENSE and must subsequently be set to the same value when performing MODE SELECT.
Maximum Additional Partitions	Not supported. Must be 0.
Additional Partitions Defined	This field specifies the number of additional partitions to be defined for the tape based on the settings of the SDP and IDP bits. The maximum allowed is the value returned in the Maximum Additional Partitions field. Since only one partition is supported, this field must be 0.
FDP	Fixed Data Partitions. Must be 0.
SDP	Select Data Partitions. Must be 0.
IDP	Initiator Defined Patrons. Must be 0.
PSUM	Partition Size Unit of Measure. Must be 0.
Medium Format Recognition	Set to 01h, indicating that automatic format recognition is supported.

TapeAlert Page (1Ch)

The TapeAlert configuration settings can be read via the MODE SENSE command's TapeAlert Page.

Table 174 TapeAlert Page Format Descriptor - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code (1Ch)					
1	Additional Page Length (0A)							
2	Perf	Reserved			DExcpt	Test	Rsvd	LogErr
3	Reserved				MRIE			
4-7	(MSB) Interval Timer (LSB)							
8-11	(MSB) Report Count / Test Flag Number (LSB)							

Table 175 TapeAlert Page Format Descriptor - Field Descriptions

Field Name	Description
PS	Parameters Savable. For MODE SELECT, this bit must be 0.
Additional Page Length	This field indicates the number bytes in the page. However, the value does not include bytes 0 and 1. The length is returned in MODE SENSE commands and must subsequently be set to the same value when performing MODE SELECT. If the page length does not match that expected by the drive, a CHECK CONDITION status is returned, sense key set to ILLEGAL REQUEST. The drive returns a CHECK CONDITION status with sense key set to ILLEGAL REQUEST if it receives an unsupported Page Code or a Page field with values not supported or changeable. In such cases, no parameters are changed as a result of the command.

Field Name	Description
Perf	Performance bit. Not supported.
DExcpt	Disable Information Exception Operations. When this bit = 0, the reporting method specified by the contents of MRIE is selected. When this bit = 1, all information exception operations are disabled and the contents of the MRIE field are ignored. When in this mode, the TapeAlert Log page is polled by the software. To enable CHECK CONDITION mode, DExcpt should = 0.
Test	Not Supported.
LogErr	Error Log. Not supported
MRIE	Method for Reporting Informational Exceptions. The tape drive uses the contents of this field to report information about exception conditions. Three methods are available:
Value	Method
00h	No reporting of Informational Exception Conditions. The device server does not report information exception conditions.
03h	Conditionally Generate Recovered Error. The device server reports informational exception conditions, if such reports of recovered errors is allowed, by returning CHECK CONDITION status on the next SCSI command (except INQUIRY and REQUEST SENSE commands) following detection of the condition. The Sense Key is set to RECOVERED ERROR with an additional sense code of 5D 00 (TapeAlert Event). The SCSI command with CHECK CONDITION completes without error prior to the report of any exception condition, and does not need to be repeated.

Field Name	Description
06h	Only Report Informational Exception Condition on Request. The device server preserves information exception data. To access the data, a poll can be taken by issuing an unsolicited REQUEST SENSE command. The Sense Key is set to NO SENSE with an additional sense code of 5D 00 (TapeAlert Event). The additional sense code of 5D 00 for values 03h and 06h signals that a TapeAlert has occurred. Information about the event is stored in the TapeAlert Log Page. The setting of MRIE does not impact logging of events in the TapeAlert Log Page.
Interval Timer	Not Supported.
Report Count / Test Flag Number	Not Supported.

EEPROM Vendor Unique Page (3Eh)

EEPROM Vendor Unique Page (3Eh) is not supported.

Prevent / Allow Medium Removal (1Eh)

This command enables or disables the unloading of the tape cartridge.

Table 176 PREVENT / ALLOW MEDIUM REMOVAL Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Eh)							
1	Logical Unit Number			Reserved				
2-3	Reserved							
4	Reserved							Prevent
5	Unused		Reserved				Flag (0)	Link (0)

Table 177 PREVENT / ALLOW MEDIUM REMOVAL Command Descriptor Block - Field Descriptions

Field Name	Description
Prevent	The PREVENT / ALLOW status in the device is maintained separately by each initiator. When set to 0, the prevent state corresponding to that initiator is cleared. When all initiators have cleared their prevent states, the UNLOAD button and UNLOAD commands are enabled. By default, after power up, a hard reset, or Bus Device Reset message, the prevent medium removal function is cleared. If a Media Loader device is present, its MOVE MEDIUM command is prevented from removing a cartridge if PREVENT has been enabled.
Flag Bit	The Flag bit is used in conjunction with the Link bit to notify the initiator in an expedient manner that a command has been completed. Flag bits are not supported by the DX-Series system.
Link Bit	A Link bit set to 1 indicates that the initiator requests continuation of a task (an I/O process) across two or more SCSI commands. If the Link bit is 1 and the Flag bit is 0, and the task completes successfully, the drive continues the task and returns a status of INTERMEDIATE and a LINKED COMMAND COMPLETE message. If the Link bit and the Flag bit within a Control word are both set to 1, and the drive completes a command with a status of INTERMEDIATE, the drive returns a LINKED COMMAND COMPLETE message (with Flag). Link bits are not supported by the DX-Series system.

Read (08h)

This command transfers one or more data blocks or bytes to the initiator starting with the next block on the tape.

Table 178 READ Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (08h)							
1	Logical Unit Number			Reserved			SILI	Fixed
2-4	(MSB) Transfer Length (LSB)							
5	Unused		Reserved				Flag (0)	Link (0)

Table 179 READ Command Descriptor Block - Field Descriptions

Field Name	Description
SILI	Suppress Incorrect Length Indicator. If the SILI bit is set to 1 and the Fixed bit is set to 1, the target terminates the command with CHECK CONDITION status, sense key set to ILLEGAL REQUEST, and additional sense code of INVALID FIELD IN CDB. If the SILI bit is 0 and the actual block length is different than the specified transfer length, a CHECK CONDITION status is returned. Within the sense data, the Incorrect Length Indicator (ILI) bit and Valid bit will be set to 1. The sense key field specifies NO SENSE. The information bytes are set to the difference (residue) between the requested transfer length and the actual block length., or, in Fixed Block mode, the difference (residue) between the requested number of blocks and the actual number of blocks read. No more than transfer length blocks are transferred to the initiator and the tape is logically positioned after the block (EOM side).
Fixed	This bit specifies whether fixed-length or variable-length blocks are to be transferred, and gives meaning to the Transfer Length field of the READ command. When set to 0, variable-block mode is requested. A single block is transferred with the Transfer Length specifying the maximum number of bytes the initiator has allocated for the returned data. When the Fixed bit is set to 1, the Transfer Length specifies the number of blocks to be transferred to the initiator. This is valid only if the logical unit is currently operating in Fixed Block mode. When the Transfer Length is 0, no data is transferred and the current position on the logical unit does not change. This is not an error condition. A successful READ with Fixed bit set to 1 transfers (current block length) x (# of blocks x block size) bytes of data to the host. Upon termination of READ, the medium is logically positioned after the last block of data transferred (EOM). Note that a READ command in fixed mode with an odd number of blocks returns a CHECK CONDITION: the DLT7000 tape drive does not support odd block number transfers.

Filemark, End-of-Data, and End-of-Medium/Partition Handling

If the tape drive reads a Filemark, it returns a CHECK CONDITION status. Within the sense data, the Filemark and Valid bits are set and the Sense Key field is set to NO SENSE. The information fields contain the residue count. The Additional Sense Code and Additional Sense Code Qualifier fields are set to FILEMARK DETECTED. Upon termination, the medium is logically positioned after the Filemark.

If the drive detects End-of-Data (EOD) during a READ, the drive returns a CHECK CONDITION status. Within the sense data, the Valid bit is set and the Sense Key field is set to BLANK CHECK. The End-of-Medium (EOM) bit may be set if the drive determines that the tape is positioned past the PSEN marker. The information fields contain the residue count. The Additional Sense Code Qualifier fields are set. Upon termination, the medium is physically positioned before EOD and after the last block on tape.

The meaning of EOD is different for a READ command than for a WRITE-related command. EOM is reported only when the physical EOM or End-of-Partition (EOP) is encountered. The drive returns a CHECK CONDITION status. The EOM and Valid bits are set and the Sense Key is set to MEDIUM ERROR. The information fields contain the residue count and the Additional Sense Code and Additional Sense Code Qualifier fields are set to EOM/P DETECTED. The tape is physically positioned at EOM/P.

If any READ command cannot be successfully completed, the drive returns a CHECK CONDITION status. Further commands should attempt to move past the anomaly and to complete successfully.

Read Block Limits (05h)

The READ BLOCK LIMITS command directs the tape drive to report it's block length limits.

Table 180 READ BLOCK LIMITS Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (05h)							
1	Logical Unit Number			Reserved				
2-4	Reserved							
5	Unused		Reserved				Flag (0)	Link (0)

The READ BLOCK LIMITS data shown below is sent during the DATA IN phase of the command. The command does not reflect the currently selected block size, only the available limits. MODE SENSE is the command that returns the current block size.

Table 181 READ BLOCK LIMITS Data - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Reserved							
1-3	(MSB) Maximum Block Length (LSB)							
4-5	(MSB) Minimum Block Length (0002h) (LSB)							

In SCSI-3 configurations, Byte 0 appears as shown below:

0	Reserved	Granularity

The Granularity field is described in the table below.

Table 182 READ BLOCK LIMITS Data - Field Descriptions

Field Name	Description
Granularity **(SCSI-3 Only)**	This field indicates the supported block size granularity. The DLT7000 tape drive supports all block sizes *n* such that *n* minus the minimum block length limit is a multiple of 2^x (where ^{x} is the value in the Granularity bits), and *n* is greater than or equal to the Minimum Block Length Limit and less than or equal to the Maximum Block Size Limit. For the DLT7000 system, the content of the Granularity field is 1 (since block sizes must be a multiple of 2; $2^1 = 2$). For backward compatibility, the DLT7000 will process requests that do not meet Granularity criteria, except for Odd-byte Multiple Block Fixed Block WRITE commands when connected to a Wide (16-bit) SCSI bus.
Maximum Block Length	The value in this field indicates the maximum block size. The tape drive supports a maximum block length of 16,777,214 (16 MB-2) for 10, 20, or 35 GB format. A maximum block length of 256 K bytes is supported for 2.6 GB or 6.0 GB formats.
Minimum Block Length	The value in this field indicates the minimum block size. The tape drive supports a minimum block length of 2 bytes.

Read Buffer (3Ch)

The READ BUFFER command is used in conjunction with WRITE BUFFER as a diagnostic function for testing the drive's data buffer for possible diagnostic data and for checking the integrity of the SCSI bus. In addition, by using buffers 1 and 2, the READ BUFFER command allows the contents of the tape system's local RAM/EEPROM, and DRAM to be transferred over the SCSI bus. Buffers 1 and 2 provide a diagnostic capability for the system's firmware.

Table 183 READ BUFFER Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (3Ch)							
1	Logical Unit Number			Reserved			Mode	
2	Buffer ID							
3-5	(MSB) Buffer Offset (LSB)							
6-8	(MSB) Allocation Length (LSB)							
9	Unused		Reserved				Flag (0)	Link (0)

Table 184 READ BUFFER Command Descriptor Block - Field Descriptions

Field Name	Description
Mode	The tape drive supports the following values within this field. If any non-supported value is set, the drive terminates the command with a CHECK CONDITION status, ILLEGAL REQUEST sense key set. ModeDescription 000b Combined Header and Data 010b Data 011b Descriptor
Buffer ID	Must be 0, 1, or 2. Buffer 0: This buffer is intended to be used in conjunction with the WRITE BUFFER command to provide a diagnostic capability for testing the SCSI bus and/or hardware integrity. Buffer 1: Choosing Buffer 1 results in the tape system transferring the contents of SCSI RAM and EEPROM over the SCSI bus. For DLT7000 tape systems, a total of 264K is transferred (4K for RAM). Buffer 2: Choosing Buffer 2 results in the tape system transferring the contents of cache RAM over the SCSI bus. For DLT7000 tape systems, a total of either 4 or 8 MB is transferred.
Buffer Offset	Supported if Buffer ID is 2. The Buffer Offset field allows the host to specify where the start of the data is within the buffer.
Allocation Length	This field specifies the maximum number of bytes that the initiator has allocated for returning data. The host uses this field to limit the size of data transfers to its own internal buffer size.

The host should first send a READ BUFFER command, in Descriptor mode, to determine the size of the buffer being returned. In response to the READ BUFFER command, the tape system returns four bytes of data, three of which contain the size of the buffer. The host can then use this data to establish the Buffer Offset/Allocation Length fields of the CDB.

Once the size of the buffer is known, Mode 2 (Data Only, see Section 5.14.2) can be used to transfer the data across the SCSI Bus.

Combined Header and Data Mode

In this mode, the tape drive returns a 4-byte header followed by data bytes. The drive terminates the DATA IN phase when the Allocation Length bytes of header and data have been transferred or when all available data has been transferred to the initiator, whichever is less. The 4-byte READ BUFFER header is followed by data bytes from the target data buffer. The figure below illustrates the format of the header.

Table 185 READ BUFFER Header - Data Format.

Bit/Byte	7	6	5	4	3	2	1	0
0	Reserved							
1-3	(MSB) Available Length (LSB)							
2	Buffer ID							
3-5	(MSB) Buffer Offset (LSB)							
6-8	(MSB) Allocation Length (LSB)							
9	Unused		Reserved				Flag (0)	Link (0)

Table 186 READ BUFFER Header - Field Descriptions

Field Name	Description
Available Length	This field specifies the total number of data bytes available in the target's buffer. This number is not reduced to reflect the allocation length, nor is it reduced to reflect the actual number bytes written using the WRITE BUFFER command. Following the READ BUFFER header, the target transfers data from its data buffer.

Data Mode

In this mode, the DATA IN phase contains only buffer data.

Descriptor Mode

In this mode, a maximum of four bytes of READ BUFFER descriptor information is returned. The tape drive returns the descriptor information for the buffer specified by the Buffer ID. In this mode, the drive does not reject the valid Buffer IDs with a CHECK CONDITION status, but returns all zeros in the READ BUFFER descriptor.

The Offset Boundary is 12 (0Ch), indicating that buffer offsets should be integral multiples of 4 K.

Table 187 READ BUFFER Descriptor - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Offset Boundaries (0Ch)							
1-3	(MSB) Buffer Capacity (LSB)							

Tech Tip: Read and Write buffer is currently not implemented.

Read Position (34h)

The READ POSITION command is used to read a position identifier or SCSI Logical Block Address (LBA). The LOCATE command uses this identifier to position back to this same logical position in a high-performance fashion.

Table 188 READ POSITION Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Offset Boundaries (34h)							
1	Logical Unit Number				Reserved			BT
2-8	Reserved							
9	Unused		Reserved				Flag (0)	Link (0)

Table 189 READ POSITION Command Descriptor Block - Field Descriptions

Field Name	Description
BT	Block Type. This bit indicates how the position is to be interpreted. Since the tape drive uses the same logical block regardless of the setting of this bit, the setting is ignored. The logical block address values include all recorded objects: blocks and filemarks.

Note: The drive returns CHECK CONDITION with UNIT NOT READY sense key with the READ POSITION command if the media is not ready to be accessed.

Data from READ POSITION takes the following format:

Table 190 READ POSITION - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	BOP	EOP	Reserved			BPU (0)	Reserved	
1	Partition Number							
2-3	Reserved							
4-7	(MSB) First Block Location (LSB)							
8-11	(MSB) Last Block Location (LSB)							
12	Reserved							
13-15	(MSB) Number of Blocks in Buffer (LSB)							
15-19	(MSB) Number of Bytes in Buffer (LSB)							

Table 191 READ POSITION Data - Field Descriptions

Field Name	Description
BOP	Beginning of Partition. When set to 1, indicates that the logical unit is at the beginning of partition in the current partition. When 0, indicates that the current logical position is not at the beginning of partition. Since the tape drive does not support more than one partition, the value of this field will be 1 when at BOT.
EOP	End of Partition. When set to 1, indicates that the logical unit is positioned between early warning and the end of partition in the current partition. When 0, it indicates that the current logical position is not between early warning and end of partition.
BPU	Block Partition Unknown. This bit is never set: the setting of the Block Type (BT) bit of READ POSITION CDB does not affect the block address values returned.
First Block Location	The block address associated with the current logical position: the next block to be transferred between the target and initiator if a READ or WRITE command is issued.
Last Block Location	The block address associated with the current physical position: the next block to be transferred to tape medium and from the target's buffer. If the buffer is empty, or has only a partial block, the same value as First Block Location is reported. The first block or filemark written onto the tape medium is at address 0.
Number of Bytes in Buffer	The number of data blocks in the target's buffer.
Number of Bytes in Buffer	The number of data bytes in the buffer that have not been written to the tape medium.

Receive Diagnostic Results (1Ch)

The **RECEIVE DIAGNOSTIC RESULTS** command fetches the results of the last **SEND DIAGNOSTIC** command sent to the tape drive.

Table 192 RECEIVE DIAGNOSTIC RESULTS Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Ch)							
1	Logical Unit Number			Reserved				
2	Reserved							
3-4	(MSB) Allocation Length (LSB)							
5	Unused		Reserved				Flag (0)	Link (0)

Table 193 RECEIVE DIAGNOSTIC RESULTS Command Data - Field Descriptions

Field Name	Description
Allocation Length	Specifies the number of bytes of diagnostic page results the drive is allowed to send to the initiator.

The following data is returned by the drive as a result of the **RECEIVE DIAGNOSTIC** command. Note that a **REQUEST SENSE** command should be used to obtain more detailed information following a **CHECK CONDITION** on a **SEND DIAGNOSTIC** command.

Table 194 RECEIVE DIAGNOSTIC RESULTS - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Controller Present Flag							
1	Controller Error Flag							
2	Drive Present Flag							
3	Drive Error Flag							
4	Media Loader Present Flag							
5	Media Loader Error Flag							

Note: Flag set = 1 = failure

Flag not set = 0 = not present or no error

This information indicates which of the main components of the tape drive subsystem may have failed diagnostic testing.

Release Unit (17h)

The RELEASE UNIT command releases the drive if it is currently reserved by the requesting initiator. It is not an error to release the tape drive if it is not currently reserved by the requesting initiator. If the tape drive is reserved by another initiator, however, it is not released; the tape drive is only released from the initiator that issued the RELEASE command.

Table 195 RELEASE UNIT Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (17h)							
1	Logical Unit Number			3rd Pty	Third Party Device ID			Rsv'd
2-4	Reserved							
5	Unused		Reserved				Flag (0)	Link (0)

Table 196 RELEASE UNIT Command Data - Field Descriptions

Field Name	Description
3rdPty	The third party release option for RELEASE UNIT allows an initiator to release a logical unit that was previously reserved using the third-party reservation option. If this bit is 0, then the third-party release option is not requested. If this bit is set to 1, the drive is released if it was originally reserved by the same initiator using the third-party reservation option and if the tape drive is the same SCSI device specified in the Third Party Device ID field.
Third Party Device ID	Required if the 3rdPty bit is 1. This field specifies the SCSI ID of the initiator whose third party reservation is being released. This field must be set if the initiator of the original third party RESERVE is the source of the RELEASE.

Field Name	Description
Reservation ID	If the value is 1, the command releases all elements reserved by the requesting initiator that were reserved with the same **Reservation ID** value as this release attempt and that meet 3rd party release requirements, if applicable.
Flag Bit	The Flag bit is used in conjunction with the Link bit to notify the initiator in an expedient manner that a command has been completed. Flag bits are not supported by the DX-Series system.
Link Bit	A Link bit set to 1 indicates that the initiator requests continuation of a task (an I/O process) across two or more SCSI commands. If the Link bit is 1 and the Flag bit is 0, and the task completes successfully, the drive continues the task and returns a status of INTERMEDIATE and a LINKED COMMAND COMPLETE message. If the Link bit and the Flag bit within a Control word are both set to 1, and the drive completes a command with a status of INTERMEDIATE, the drive returns a LINKED COMMAND COMPLETE message (with Flag). Link bits are not supported by the DX-Series system.

Media Changer Considerations

The optional Element reservation feature defined for Medium Changer devices in the SCSI-2 ANSI specification is not supported. The RELEASE command is defined the same as for the tape drive. The whole loader unit can be released. RESERVE / RELEASE of the Loader and Drive LUNs are handled independently.

Report LUNS (A0h)

The REPORT LUNS command requests that the peripheral device logical unit numbers of known logical units in the target be sent to the applications client. The command only returns information about the logical units to which commands may be sent.

Table 197 Report Luns Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (A0h)							
1	Reserved							
2	Select Report							
3-5	Reserved							
6-9	(MSB) Allocation Length (LSB)							
10	Reserved							
11	Control							

- Allocation Length

  If the Allocation Length is not sufficient to contain the logical unit number values for all configured logical units, the device server still reports as many logical number values as will fit in the Allocation Length.

  The format of the report of configured logical units is shown in

Table 198 LUN Reporting Parameter List

Bit/Byte	7	6	5	4	3	2	1	0
0-3	(MSB) LUN List Length (n-7) (LSB)							
4-7	Reserved							
8-15	(MSB) LUN (first LUN) (LSB)							
n-7 - n	LUN (last LUN, if more than one)							

The LUN List Length field contains the length in bytes of the LUN list that can be transferred. THe LUN list length equals the number of logical unit numbers reported multiplied by eight. If the allocation length in the CDB is too small to allow transfer of information about all of the logical units configured, the LUN list length value is not adjusted to reflect the truncation.

Request Sense (03h)

The REQUEST SENSE command causes the tape drive to transfer detailed sense data to the initiator.

Table 199 REQUEST SENSE Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (03h)							
1	Logical Unit Number			Reserved				
2-3	Reserved							
4	Allocation Length							
5	Unused		Reserved				Flag (0)	Link (0)

Table 200 REQUEST SENSE Command Data - Field Descriptions

Field Name	Description
Allocation Length	This field specifies the maximum number of sense bytes to be returned. The tape drive terminates the transfer when this number of bytes has been transferred or when all available sense data has been transferred to the host, whichever is less.

The REQUEST SENSE command causes the tape drive to transfer detailed sense data to the initiator.

The sense data is valid for a CHECK CONDITION or RESERVATION CONFLICT status returned on the previous command. The sense data bytes are preserved by the tape drive until retrieved by a REQUEST SENSE command, or until the receipt of any other command from the same initiator, though some commands, such as INQUIRY, do not change sense data.

If the tape drive receives an unsolicited REQUEST SENSE, it returns sense data with the appropriate values in the End of Media (EOM), Sense Key, Additional Sense Code, and Additional Sense Code Qualifier. The positional information provided reflects the logical position of the tape

drive. The tape drive returns information based on the non-diagnostic data in its buffer as well as the data on tape medium. Additionally, bytes 25 through 28 contain the amount of tape to be written in 4 KB blocks.

REQUEST SENSE does not cause the drive to flush its buffered data to tape. Therefore, if the host requires the exact physical positioning of the tape medium, it should precede the REQUEST SENSE command with a WRITE FILEMARKS command with length 0 (Immed=0) specified. This forces the tape drive to flush any currently-buffered data to tape. A subsequent REQUEST SENSE command returns the actual physical (and logical) position of the tape drive to the initiator.

The following illustration portrays the format of REQUEST SENSE DATA.

Table 201 REQUEST SENSE - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Valid	Error Code						
1	Segment Number (0)							
2	Filemark	EOM	ILI	Reserved	Sense Key			
3-6	(MSB) Information Bytes (LSB)							
7	Additional Sense Length							
8-11	(MSB) Command-Specific Information Bytes (LSB)							
12	Additional Sense Code (ASC)							
13	Additional Sense Code Qualifier (ASCQ)							
14	Sub-Assembly Code (0)							
15	SKSV	C/D	Reserved		BPV	Bit Counter		

Bit/Byte	7	6	5	4	3	2	1	0
16-17	(MSB) Field Pointer (LSB)							
18	Internal Status Code (VU)							
19-20	Tape Motion Hours							
21-24	Power On Hours							
25-28	Tape Remaining							
29	Reserved							

Table 202 REQUEST SENSE Data - Field Descriptions

Field Name	Description
Valid	When set to 1, this field indicates that the information bytes contain valid information as defined in the ANSI SCSI-2 specification.
Error Code	A value of 70h indicates a current error – the report is associated with the most recently received command. A value of 71h indicates a deferred error – the report is associated with a previous command and not as a result of the current command. No other values are returned in this field.
Segment Number	This value of this byte is always 0.
Filemark	This bit indicates that the current command has read a Filemark.

Field Name	Description
EOM	End of Medium. This bit indicates that an End of Medium condition (End of Partition or Beginning of Partition) exists. The warning is also given by setting the Sense Key to NO SENSE and the Additional Sense Qualifier to End of Partition or Beginning of Partition.
ILI	Incorrect Length Indicator. This bit indicates that the requested logical block length did not match the logical block length of the data on the tape medium. Only READ or VERIFY may cause this bit to be set.
Sense Key	In most cases, Additional Sense Code and/or Qualifier information is available. The codes and qualifiers are covered in detail in Table 5-72.
Information Bytes	These bytes contain the differences (residue) of the requested length minus the actual length in bytes, blocks, or Filemarks, as determined by the command. Negative values are indicated by two's complement notation. The bytes are valid for all READ, WRITE, SPACE, and VERIFY tape commands for which a CHECK CONDITION status has been generated. The information bytes are 0 for MODE SELECT / SENSE, INQUIRY, READ BLOCK LIMITS, and TEST UNIT READY.
Additional Sense Length	This field specifies the number of additional sense bytes to follow. If the Allocation Length of the Command Descriptor Block is too small to transfer all of the Additional Sense bytes, the Additional Sense Length is not adjusted to reflect the truncation.
Command Specific Information Bytes	Command Specific Information Bytes can be logged by the operating system on error conditions. On tape medium errors, such an entry usually contains the current SCSI Logical Block Address.

Field Name	Description
Additional Sense Code	This field (and the field for Additional Sense Code Qualifier) provide additional information about the Sense Key and cause of a CHECK CONDITION status. Additional Sense Codes are discussed in detail later in this chapter.
Additional Sense Code Qualifier	This field (and the field for Additional Sense Code) provides additional information about the Sense Key and cause of a CHECK CONDITION status. Additional Sense Code Qualifiers are discussed in detail later in this chapter.
Sub-Assembly Code	Not used. Returned as 0.
SKSV	Sense-Key Specific Valid. When = 1, indicates that the Sense Key specific field is as defined by the International Standard.
C/D	Command / Data. When set to 1, this field indicates that the illegal parameter is contained in the Command Descriptor Block. A C/D set to 0 indicates that the illegal parameter is in the Parameter List from the initiator.
BPV	Bit Pointer Valid. When set to 1, this field indicates that the Bit Pointer field is valid and designates which bit of the byte designated by the field pointer is in error. For a multi-bit field, it points to the most significant bit of the field.
Field Pointer	This field indicates which byte of the Command Descriptor Block or Parameter List is in error. For a multi-byte field, the most significant byte is indicated.
Internal Status Code (VU)	Internal Status Codes (Vendor Unique) are explained in detail in Appendix A.

Field Name	Description
Tape Motion Hours	This field reports the number of tape motion (i.e., head wear) hours. Format is given as a hexadecimal word (2 bytes).
Power On Hours	This field reports the total number of hours that drive power has been applied since its last power on cycle (not total power on hours over the device's lifetime). Format is given as a hexadecimal longword (4 bytes).
Tape Remaining	This field reports the amount of tape remaining in 4 KB (4096 bytes) blocks.

Table 203 Supported Sense Keys

Field Name	Description
0h	NO SENSE. Check the Filemark/EOM/ILI bits and the Additional Sense Code/Additional Sense Code Qualifier bytes.
1h	RECOVERED ERROR. This can be caused by rounding of Mode Parameters on a MODE SELECT, or may report that READ/WRITE error rates are reaching subsystem specification limits for optimal operation. The device may still be able to continue to function without any unrecovered errors for a long period of time, however. No CHECK CONDITION is generated unless the PER bit of Mode Page 01h is set.
2h	NOT READY. The tape medium is not ready for tape operation commands. Tape medium might not be present in the drive or may be in the process of loading or calibrating.
3h	MEDIUM ERROR. An unrecoverable WRITE, READ, or positioning error has occurred. Detailed device-specific information may be available.

Field Name	Description
4h	HARDWARE ERROR. The Additional Sense Code / Additional Sense Code Qualifier fields may present more specific information.
5h	ILLEGAL REQUEST. The Command Descriptor Block or supplied parameter data had an unsupported or illegal operation specified. Check bytes 15, 16, and 17.
6h	UNIT ATTENTION. Unit Attentions are created after a device reset, if the medium asynchronously becomes ready to the initiator, if another initiator changes Mode Parameters, and/or if the firmware is updated.
7h	DATA PROTECTED. The current tape medium is write-protected. This can be because the Write Protect switch on the cartridge is in its enabled position or if the tape medium is not the appropriate type (DLTtape I or DLTtape II), or if a software write protect is issued.
8h	BLANK CHECK. An End of Data or LongGap has been encountered.
Bh	COMMAND ABORTED. This key is generated when a command has been aborted by the tape drive for some reason. Check the Additional Sense Code / Additional Sense Code Qualifier bytes.
Dh	VOLUME OVERFLOW. This key indicates that the physical end of tape medium has been reached during writing. The initiator ignored the End of Medium condition and continued to write to tape.
Eh	MISCOMPARE. A compare error has occurred during READ by the self-tests invoked during execution of a SEND DIAGNOSTIC command.

Reserve Unit (16h)

The RESERVE UNIT command reserves the specified tape drive for exclusive use by the requesting initiator or for another specified SCSI device.

Table 204 RESERVE UNIT Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (16h)							
1	Logical Unit Number			3rdPty	Third Party Device ID			Rsv'd
2-4	Reserved							
5	Unused		Reserved				Flag (0)	Link (0)

Table 205 RESERVE UNIT Command Data - Field Descriptions

Field Name	Description
3rdPty	The third party reservation option for RESERVE UNIT allows an initiator to reserve a logical unit for another SCSI device. This option is intended for systems that use COPY, and is implemented by the tape drive. If set to 1, logical unit is reserved for the SCSI device whose ID appears in the Third Party Device ID field. The tape drive ignores any attempt made by any other initiator to release the reservation and returns a GOOD status. If set to 0, no third party reservation is requested and device is reserved for the initiator that issued the CDB.
Third Party Device ID	If 3rdPty is set to 1 (indicating that an initiator has reserved the logical unit for another SCSI device), this field contains the ID number of that SCSI device for which the reservation was made.

Field Name	Description
Flag Bit	The Flag bit is used in conjunction with the Link bit to notify the initiator in an expedient manner that a command has been completed. Flag bits are not supported by the DX-Series system.
Link Bit	A Link bit set to 1 indicates that the initiator requests continuation of a task (an I/O process) across two or more SCSI commands. If the Link bit is 1 and the Flag bit is 0, and the task completes successfully, the drive continues the task and returns a status of INTERMEDIATE and a LINKED COMMAND COMPLETE message. If the Link bit and the Flag bit within a Control word are both set to 1, and the drive completes a command with a status of INTERMEDIATE, the drive returns a LINKED COMMAND COMPLETE message (with Flag). Link bits are not supported by the DX-Series system.

A reservation via the RESERVE UNIT command remains in effect until one of the following conditions is met:

The initiator that made the reservation sends another RESERVE UNIT command.

The tape drive is released via a RELEASE UNIT command from the same initiator.

A BUS DEVICE RESET message is received from any initiator.

A hard reset occurs.

The occurrence of the last two conditions is indicated by the drive returning a CHECK CONDITION status, sense key of UNIT ATTENTION on the next command following the condition. It is not an error to issue a RESERVE UNIT command to a drive that is currently reserved by the requesting initiator.

If another initiator has previously reserved the logical unit, the target returns a RESERVATION CONFLICT status.

If, after honoring the reservation, any other initiator attempts to perform any command except **INQUIRY**, **REQUEST SENSE**, or **RELEASE UNIT**, the command is rejected with a **RESERVATION CONFLICT** status. That logical unit ignores a **RELEASE UNIT** command issued by another initiator.

An initiator that holds a current reservation may modify that reservation (for example, to switch third parties) by issuing another **RESERVE UNIT** command to the tape drive.

Medium Changer Considerations for **RESERVE UNIT** Command

The optional Element Reservation feature defined for Medium Change devices as described in the ANSI SCSI-2 specification is not supported. The **RESERVE** command is defined the same as for the tape drive. The whole loader unit may be reserved. This is separate from a reservation of the tape drive.

The **RESERVE / RELEASE** commands operate on a LUN basis. The Medium Changer and the tape drive are generally handled as different devices. In the case of a reserved drive LUN, a **MOVE MEDIUM** command issued to the Medium Changer LUN cannot insert or remove a tape cartridge to or from a tape drive unless the tape drive is reserved by the same initiator.

Rewind (01h)

The REWIND command directs the tape drive to position the tape at the beginning of the currently active partition (for DLT drives, this is BOM). Before rewinding, the tape drive writes any write data that is in the buffer to the tape medium and appends an End of Data marker.

Table 206 REWIND Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (01h)							
1	Logical Unit Number			Reserved				Immed
2-4	Reserved							
5	Unused		Reserved				Flag (0)	Link (0)

Table 207 REWIND Command Data - Field Descriptions

Field Name	Description
Immed	Immediate. If this bit is set to 1, the tape drive first writes any remaining buffered data to tape medium and adds an EOD marker. It then returns status to the host **before** beginning the actual rewind operation. If this bit is 0, status will be sent **after** the rewind has completed. *Tech Tip: The immed bit is accepted, but ignored in processing.*

Tech Tip: The immed bit is accepted, but ignored in processing.

Send Diagnostic (1Dh)

The SEND DIAGNOSTIC command directs the tape drive to perform its self-diagnostic tests.

Table 208 SEND DIAGNOSTIC Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Dh)							
1	Logical Unit Number			PF (0)	Rsv'd	Selftst	DevOfl	UnitOfl
2	Reserved							
3-4	MSB Parameter list LSB							
5	Unused		Reserved				Flag (0)	Link (0)

Table 209 SEND DIAGNOSTIC Command Data - Field Descriptions

Field Name	Description
PF	Page Format. Not supported; must be 0.
Selftst	Self Test. This bit is used in conjunction with DevOfl and UnitOfl to specify the type of testing to be done. An explanation is provided in the following paragraphs.
DevOfl	Device Offline. This bit is used in conjunction with Selftst and UnitOfl to specify the type of testing to be done. An explanation is provided in the following paragraphs.
UnitOfl	Unit Offline. This bit is used in conjunction with Selftst and DevOfl to specify the type of testing to be done. An explanation is provided in the following paragraphs.

Tech Tip:	This command will accept any correctly formatted command and return a good status.

Two levels of unit-resident diagnostic tests can be accessed:

Electronics Self-Test (Level 1 Test)

To invoke this level of diagnostic test, a major portion of the controller hardware and software must be functioning properly. The test is based on the premise that full power-up testing is not necessary, therefore, it is an extension of the power-up self tests that are run. The code ROM EDC is verified, two queues used by much of the controller software are checked by dequeuing and enqueuing items.

If a loader (Medium Changer) is configured, the test attempts a software reset on the loader. This test does not attempt a WRITE or READ to or from the tape medium. When complete, any errors that occur are reported in the extended Sense Data bytes. This Level 1 test has an execution time of approximately five (5) seconds.

- Specify the Electronics Self-Test by setting the Selftst bit to 1, and both the DevOfl and UnitOfl bits to 0.
- Read / Write Functionality Test (Level 2 Test)
- The default version of this test does the following:
- Writes 500 32 KB records on track 0 (forward motion)
- Rewinds the tape.
- Reads the records.
- Positions to the beginning of track 1 (backward motion)
- Writes 500 32 KB records on track 1.
- Repositions to the beginning of track 1.
- Reads the records.
- Rewinds the tape.

The execution time for this Level 2 test is approximately 6 minutes, if calibration is not required. Specify the Read/Write test by setting both the Selftst bit and the UnitOfl bit to 1 and ensuring that the DevOfl bit to 0.

A level III (or test type III) is available with user defined parameters.

The following table illustrates the possible settings of the Selftst, DevOfl, and UnitOfl bits and the effects of each setting on the resulting self-test:

Table 210 SEND DIAGNOSTIC CDB Bits Selftst, DevOfl, and UnitOfl

Selftst	DevOfl	UnitOfl	Self-Test Effect
0	0	0	Illegal Combination
0	0	1	Self-Test Level 3 with User Parameters
0	1	0	Illegal Combination
0	1	1	Self-Test Level 2 with Default Parameters
1	0	0	Self-Test Level 1 with Default Parameters
1	0	1	Self-Test Level 2 with Default Parameters
1	1	0	Self-Test Level 1 with Default Parameters
1	1	1	Self-Test Level 2 with Default Parameters

Table 211 SEND DIAGNOSTIC Parameter List - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0-1	(MSB) Pattern Number (See Table 5-77) (LSB)							
2-3	(MSB) Maximum Number of Test Passes (LSB)							
4-7	(MSB) Block Size (LSB)							
8-11	(MSB) Block Count (LSB)							

Table 212 SEND DIAGNOSTIC Parameter List - Field Descriptions

Field Name	Description		
Pattern Number	Indicates the type of data pattern to be used during the diagnostic tests.		
	Pattern	Name	Data in Hex
	0	Rotate	Rotate through the other 9 patterns; change for each tape file.
	1	All 0s	
	2	2F	
	3	Alternating 1s and 0s	0000000000
	4		FF FF FF FF FF
	5	Marching 1	55 5A AA A5 55 5A AA A5
	6	Marching 0	
	7	MW	01 02 03 04 08 10 20 40 80
	8	MFM	
	9 (default)	IF	FE FD FB F7 EF DF BF 7F
		Random Data	0E 0E 0E 0E 0E 0E 0E 0E
			DE AD DE AD DE AD DE AD
			AA AA AA AA AA AA AA AA
Maximum Number of Test Passes	This field specifies the number of test passes of the diagnostic to be run. If Maximum Number of Test Passes = 0, the test will loop continuously. A BUS RESET or a selection from the host sending an ABORT or BUS DEVICE RESET message terminates testing. Default = 1		

Field Name	Description
Block Size	This field specifies the size of the blocks to be used. If this field is 0, random block sizes are used. Default = 8400 bytes (DLTtape III media); 64 K (DLTtape IV media).
Block Count	This field specifies how many blocks to **WRITE** / **READ** to and from starting on track 0, then moving to track 1. Default = 500. For example, if the Block Size and Block Count fields result in three (3) tracks worth of data, the test will: Write tracks 0, 1, 2 **REWIND**, **READ**, and **VERIFY** tracks 0, 1, 2 **WRITE** three tracks starting with 1: 1, 2, 3 and then **REWIND** to the beginning of track 1 and perform the **READ** and **VERIFY** pass. If Block Count is = 0, data is written until EOT is reached each time, so almost four (4) complete passes over the tape would result.

Note: Because of data generation and verification, this test only streams the tape for short periods of time. If Block Count is set very high, the test can take many minutes or even many hours to complete.

If the specified diagnostic test passes, a **GOOD** status is returned. Otherwise, a **CHECK CONDITION** is generated and the Sense Data contains information about the failure.

Table 213 Sense Keys Used for SEND DIAGNOSTIC

Sense Key	Description
3h	Medium Error. A positioning error has occurred in which the returned position does not match the expected position. Additional Sense Code for possible additional information.
4h	Hardware Error. The Additional Sense Code and any Additional Sense Code Qualifier provide more specific information.
5h	**ILLEGAL REQUEST**. Illegal bit settings in the **SEND DIAGOSTIC** command.
Eh	Miscompare. A compare error occurred during a **READ** operation.

Additional Sense Codes and Additional Sense Code Qualifiers that apply to **SEND DIAGNOSTIC** self-test results are described in the table below.

Table 214 ASC / ASCQ for SEND DIAGNOSTIC

ASC	ASCQ	Description
15h	2h	A positioning error has occurred in which the returned position does not match the expected position.
40h	80h	Level 1 ROM Test Failed.
40h	81h	Level 1 RAM Test Failed.
40h	82h	Level 1 Test Failed. Bad Drive Status.
40h	83h	Level 1 Test Failed. Loader Reset Failed.

Space (11h)

The SPACE command provides a variety of positioning functions that are determined by Code and Count fields in the Command Descriptor Block. Both forward (toward End of Medium/End of Partition) and reverse (toward Beginning of Medium/Beginning of Partition) positioning are provided.

Table 215 SPACE Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (11h)							
1	Logical Unit Number			Reserved		Code		
2-4	(MSB) Count (LSB)							
5	Unused		Reserved				Flag (0)	Link (0)

Table 216 SPACE Command Data - Field Descriptions

Field Name	Description
Code	The code can be one of the following: Space CodeSpace by: 000b Blocks 001b Filemarks 010b Sequential Filemarks 011b End of Data For 2.6 GB and 6.0 GB format, the tape drive supports count values 0, 1, and 2 only. For 10.0 GB and newer formats, compressed or noncompressed, the count value can be from 0 to FFFFFFh.
Count	When spacing over blocks or marks, the Count field is interpreted as follows: A positive value N causes forward motion over N blocks or marks. The tape is logically positioned after the Nth block or mark on the EOM or EOP side. A value of 0 causes no change in logical position. A negative value -N (two's complement notation) causes reverse movement over N blocks or marks. The tape is logically positioned on the BOM or BOP side of the Nth block or mark. When spacing to EOD, the Count field is ignored. Forward movement occurs until the drive encounters EOD. The position is such that a subsequent WRITE command would append data after the last object that has been written to tape before EOD.

When executing SPACE, the tape drive implements the following hierarchy:

Highest	BOM/P or EOM/P EOD Filemarks
Lowest	Blocks

Note that a “space sequential filemarks” is a space to the first occurrence of *n* filemarks written sequentially.

A SPACE command in the form “SPACE N blocks” will halt with GOOD status after the Nth block, or with CHECK CONDITION status on any occurrence of Filemark, EOD, BOM/P, or EOM/P. A command “SPACE N Filemarks” will halt on the Nth Filemark with GOOD status on any occurrence of EOD, BOM/P, or EOM/P.

Depending on the size of blocks, read ahead data in the buffer allows some spacing requests to be satisfied without actual tape movement.

Test Unit Ready (00h)

The TEST UNIT READY command checks the tape drive to ensure that the unit is ready for commands involving tape movement. If the drive has a tape loaded, the command returns a GOOD status. Otherwise, CHECK CONDITION is reported.

Due to power cycle, code update, and tape loaded conditions, it is possible to get multiple check conditions on a TEST UNIT READY command.

Table 217 TEST UNIT READY Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (00h)							
1	Logical Unit Number			Reserved				
2-4	Reserved							
5	Unused		Reserved				Flag (0)	Link (0)

Verify (13h)

The VERIFY command directs the tape drive to verify one or more blocks beginning with the next block on the tape. Both CRC and EDCs are validated.

Table 218 VERIFY Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (13h)							
1	Logical Unit Number			Reserved		Immed	BC	Fixed
2-4	(MSB) Verification Length (LSB)							
5	Unused		Reserved				Flag (0)	Link (0)

Table 219 VERIFY Command Data - Field Descriptions

Field Name	Description
Immed	Immediate. When set to 1, the VERIFY command completes before any tape medium movement is done (that is, when the processing has been initiated. *Tech Tip: The immed bit is accepted, but ignored in processing.*
BC	Byte Check. When set to 0, the tape drive performs an internal CRC/ECC check of data. No data is transferred to the initiator. When set to 1, the command is rejected.

Field Name	Description
Fixed	This bit specifies whether fixed-length or variable-length blocks are to be verified. When set to 0, variable-block mode is requested. A single block is transferred with the Verification Length specifying the maximum number of bytes the initiator has allocated for verification. When the Fixed bit is set to 1, the Verification Length specifies the number of blocks to be verified. This is valid only if the logical unit is currently operating in Fixed Block mode.
Verification Length	This field specifies the amount of data to verify, in blocks or bytes as indicated by the Fixed bit.

Write (0Ah)

The WRITE command transfers one or more blocks from the host to the current logical position. When in Buffered Mode (the DLT tape drive default mode), the tape drive reports GOOD status on WRITE commands as soon as this data block has been transferred to the data buffer. Any check conditions will be experienced as deferred errors. Refer to the MODE SELECT command subsection for more information on Buffered Mode.

Table 220 WRITE Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (0Ah)							
1	Logical Unit Number			Reserved				Fixed
2-4	(MSB) Transfer Length (LSB)							
5	Unused		Reserved				Flag (0)	Link (0)

Table 221 WRITE Command Data - Field Descriptions

Field Name	Description
Fixed	The fixed bit specifies both the meaning of the Transfer Length field and whether fixed-length or variable-length blocks are to be transferred. When the Fixed bit is 0, Variable-length block mode is selected. A single block is transferred from the initiator and is written to the logical unit beginning at the current logical tape position. Upon successful termination, the tape is logically positioned after this block (on the EOM/P side). The Transfer Length specifies the number of bytes that the drive handshakes out from the initiator as one block. When the Fixed bit is 1, the Transfer Length field specifies the number of blocks to be transferred to the host beginning at the current tape position. This form of WRITE is valid only if the logical unit is currently operating in the Fixed Block mode – when it has been instructed to use fixed-length blocks with MODE SELECT. The current block length is the block length defined in the MODE SELECT command. Upon termination, the tape is logically positioned after these blocks.
Transfer Length	This field contains the length of the data transfer in bytes or blocks depending on whether Fixed or Variable block mode is selected. When the Transfer Length is 0, no data is transferred and the current position on the logical unit is not changed.

Exception Conditions

If End of Tape (EOT) is detected while writing, the tape drive finishes writing any buffered data. The command terminates with CHECK CONDITION status. Within the sense data, the EOM bit is set, the Sense Key is set to NO SENSE, and the Additional Sense code and Additional Sense Code Qualifier fields are set to EOM/P detected. The drive attempts to complete any subsequent writes, returning a CHECK CONDITION status in each case.

If the tape drive encounters the physical End of Medium (EOM) when attempting WRITE, a CHECK CONDITION status is returned. Within the sense data, the EOM and Valid bits are set, and the Sense Key field is set to Volume Overflow. The Information fields contain the residue count and the Additional Sense code and Additional Sense Code Qualifier fields are set to EOM/P Detected. The tape is physically positioned at EOM/P.

Write Buffer (3Bh)

The WRITE BUFFER command is used with READ BUFFER as a diagnostic function for testing the device data buffer, DMA engine, SCSI bus interface hardware, and SCSI bus integrity. It is also used for downloading and updating DLT microcode (firmware).

Table 222 WRITE BUFFER Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (3Bh)							
1	Logical Unit Number			Reserved		Mode		
2	Buffer ID (00h)							
3-5	(MSB) Buffer Offset (LSB)							
6-8	(MSB) Parameter List / Data Length (LSB)							
9	Unused		Reserved				Flag (0)	Link (0)

Tech Tip: Read and Write buffer is correctly implemented to the SCSI protocol, but the information is not usable.

Table 223 WRITE BUFFER Command Data - Field Descriptions

Field Name	Description
Mode	The tape drive supports the following values within the field. If any other value is set, the drive terminates the command with CHECK CONDITION status and an ILLEGAL REQUEST sense key set. ModeDescription 000b WRITE combined header and data 010b WRITE data (4k buffer) 100b Download Microcode (4k buffer) 101b Download Microcode and Save (4k buffer)
Buffer ID	For all of the modes described for the Mode field, only a Buffer ID of 0 is supported. If the Buffer ID field is a value other than 0, the command is rejected. The target detects and rejects commands that would overrun the buffer.
Buffer Offset	

Write Combined Header and Data Mode (000b)

The data to be transferred is preceded by a 4-byte header consisting entirely of reserved bytes. This header is discarded (not stored within the buffer).

The buffer offset field must be 0 for this mode.

Write Data Mode (010b)

Similar to Header and Data Mode, except there is no header in the data passed to the target. Any potential buffer overruns are detected and the command is rejected.

Caution: During the actual reprogramming of the FLASH EEPROM, if any type of power-fail occurs, or if the reprogramming fails before completion, the tape drive subsystem becomes unusable and the tape drive must be replaced.

Download Microcode Mode (100b)

Using buffer offsets, the host can download the firmware image into the target's buffer in pieces. These commands do not cause the new image to become active. A Download and Save Mode WRITE BUFFER command must be issued for the image to become active.

The tape drive must be empty of tape medium to allow downloading of an image. This is a safeguard against accidentally starting a firmware update. If a tape cartridge is loaded when all or part of a firmware image has been downloaded, another WRITE BUFFER with Download Microcode mode will be rejected. The firmware image must be downloaded in integral multiples of 8K bytes.

Any error on a WRITE BUFFER command causes any downloaded image data to be discarded and the download must be restarted from the beginning.

Caution: During the actual reprogramming of the FLASH EEPROM, if any type of power-fail occurs, or if the reprogramming fails before completion, the tape drive subsystem becomes unusable and the tape drive must be replaced.

Download Microcode and Save Mode (101b)

This mode is used to download and save the entire image at once, or to download the image and save it, or to cause a save operation after the image data has been downloaded using the Download Microcode mode (without the Save). This mode of the WRITE BUFFER command causes the image data to be verified and the Flash EEPROM firmware area to be updated. Also, when it is updating the EEPROM, it disconnects from the SCSI bus and will not respond until the update is complete.

When the Save operation is successfully completed, the firmware restarts itself, causing the Power On Self Test (POST) to be run, and two UNIT ATTENTION conditions are generated: POWER UP RESET and OPERATING CODE HAS CHANGED.

Write Filemarks (10h)

The WRITE FILEMARKS command directs the tape drive to write the specified number of Filemarks beginning at the current logical position on tape. If the Immediate bit is not set, any data or Filemarks in the WRITE cache buffer are written to tape.

Table 224 WRITE FILEMARKS Command Descriptor Block - Data Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (10h)							
1	Logical Unit Number			Reserved			WSMk (0)	Immed
2-4	(MSB) Number of Filemarks (LSB)							
5	Unused		Reserved				Flag (0)	Link (0)

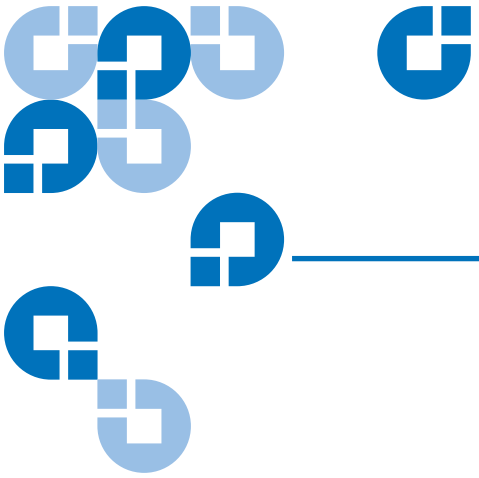
Table 225 WRITE FILEMARKS Command Data - Field Descriptions

Field Name	Description
WSmk	Write Setmark. Must be 0. This tape drive does not support Setmarks.

Field Name	Description
Immed	Immediate. When this bit is set to 1, the tape drive returns status as soon as the Command Descriptor Block (CDB) has been validated, unless the Filemark count is 0, or greater than 1 (since either condition causes the WRITE buffer to be flushed to tape medium). When set to 0, this bit indicates the status will not be returned until the operation is complete. *Tech Tip: The immed bit is accepted, but ignored in processing.*
Number of Filemarks	This field contains the number of consecutive Filemarks to be written to tape medium. A value of 0 is not considered to be an error; GOOD status is returned.

The WRITE FILEMARKS command may be used to force the tape drive to write any buffered WRITE data to the tape medium. If the tape drive is in buffered mode, and WRITE FILEMARKS is received, the requested filemarks are appended to the data and the WRITE buffer contents are flushed to tape medium. A value of 0 in the Number of Filemarks field indicates that no filemarks are to be written to the tape medium, but still flushes any WRITE data to the tape medium.

If End of Tape (EOT) is detected while writing filemarks, the tape drive finishes writing any buffered data and terminates with CHECK CONDITION status. Within the Sense data, the End of Medium (EOM) bit is set, the Sense Key field is set to NO SENSE and the Additional Sense Code and Additional Sense Code Qualifier fields are set to EOM/P DETECTED. The tape drive attempts to complete any subsequent WRITE FILEMARKS, returning a CHECK CONDITION status in each case. If the tape drive encounters the physical EOM when attempting a WRITE FILEMARKS, it returns CHECK CONDITION status.



Appendix A

Sense Key Values

The following table lists sense key information that can be sent from the media changer or tape drive to the host computer.

Table 226 Sense Data Values (Hexadecimal)

Sense Key	Message Name/Description
0h	NO SENSE. Check the Filemark/EOM/ILI bits and the Additional Sense Code/ Additional Sense Code Qualifier bytes.
1h	RECOVERED ERROR. This can be caused by rounding of Mode Parameters on a MODE SELECT, or may report that READ/WRITE error rates are reaching subsystem specification limits for optimal operation. The device may still be able to continue to function without any unrecovered errors for a long period of time, however. No CHECKCONDITION is generated unless the PER bit of Mode Page 01h is set.
2h	NOT READY. The tape medium is not ready for tape operation commands. Tape medium might not be present in the drive or may be in the process of loading or calibrating.

Sense Key	Message Name/Description
3h	MEDIUM ERROR. An unrecoverable AWRITE, READ, or positioning error has occurred. Detailed device-specific information may be available.
4h	HARDWARE ERROR. The Additional Sense Code/Additional Sense Code Qualifier fields may present more specific information.
5h	ILLEGAL REQUEST. The Command Descriptor Block or supplied parameter data had an unsupported or illegal operation specified. Check bytes 15, 16, and 17.
6h	UNIT ATTENTION. Unit Attentions are created after a device reset, if the medium asynchronously becomes ready to the initiator, if another initiator changes Mode Parameters, and/or if the firmware is updated.
7h	DATA PROTECTED. The current tape medium is write-protected. This can be because the Write Protect switch on the cartridge is in its enabled position or if the tape medium is not the appropriate type, or if a software write protect is issued.
8h	BLANK CHECK. An End of Data or LongGap has been encountered.
Bh	COMMAND ABORTED. This key is generated when a command has been aborted by the tape drive for some reason. Check the Additional Sense Code/Additional Sense Code Qualifier bytes.
Dh	VOLUME OVERFLOW. This key indicates that the physical end of tape medium has been reached during writing. The initiator ignored the End of Medium condition and continued to write to tape.

Appendix B

Media Changer Sense Code Values

The following table lists message information that can be sent from the media changer to the host computer. The sense data table is sorted by the data in the ASC column (second column from left) and lists the following information:

- Additional Sense Code (ASC)
- Additional Sense Code Qualifier (ASCQ)
- Message name, description and (potential) recovery action
- Valid Interfaces

  SCSI (host computer)
  DIAG (diagnostic port/computer)
  Both = SCSI and DIAG port

Message name and description may contain abbreviations as follows:

- LU = Logical Unit
- REQ'D = Required
- DEV = Device
- DIAG = Diagnostics
- NVRAM = Nonvolatile RAM
- A/D = Analog-to-Digital

Table 227 Sense Data Values (Hexadecimal

ASC	ASCQ	Message Name/Description
00	00	**NO ADDITIONAL SENSE INFORMATION** No recovery necessary.
04	00	**LU IS NOT READY, CAUSE NOT REPORTABLE** Check DX-Series system unit power. Retry command.
04	01	**LOGICAL UNIT IN PROCESS OF BECOMING READY** Wait for DX-Series system unit to complete initialization.
04	02	**LOGICAL UNIT INIT REQUIRED** Element status or calibration unknown. Perform **"Initialize Element Status"** command (SCSI) or **"Initialize Inventory"** command (DIAG).
04	03	**LU IS NOT READY, MANUAL INTERVENTION REQ'D** Initialization failed. Determine failure type by checking any previous error code returned to host. Correct the cause of the failure and toggle **STANDBY** button.
08	00	**LOGICAL UNIT COMMUNICATION FAILURE** Check cables. Ensure DX-Series system unit is turned on. Retry command.
08	01	DX-Series system **COMMUNICATION TIME-OUT** ER_LU_COM_TO QSPI communications not responding. Retry command.
1A	00	**PARAMETER LIST LENGTH ERROR** Invalid parameter list length field specified by command.

ASC	ASCQ	Message Name/Description
20	00	**INVALID COMMAND OPERATION CODE** Verify the host command format.
21	01	**INVALID ELEMENT ADDRESS** Check Mode Sense data for correct element addresses.
24	00	**INVALID FIELD IN COMMAND DATA BLOCK** Ensure all reserve fields are set to zero.
25	00	**LOGICAL UNIT IS NOT SUPPORTED** Verify the logical unit field specified in the command contains a legitimate logical unit number. Check cabling to logical unit.
26	00	**INVALID FIELD IN PARAMETER LIST** Verify **Mode Select** page fields. Verify that fields comply with command format described in this guide.
26	02	**PARAMETER VALUE INVALID** Verify **Mode Select** page fields. Verify that fields comply with command format described in this guide. This response is also returned for commands issued to the diagnostic interface of the DX-Series system if an invalid parameter is sent.
29	00	**POWER-ON, RESET OR BUS DEVICE RESET OCCURRED** Informational message. If power on occurs, the host user should assume the inventory may have been corrupted, and should ask the DX-Series system for that information again.
29	01	**POWER-ON RESET OCCURRED.**
29	02	**BUS RESET OCCURRED.**

ASC	ASCQ	Message Name/Description
29	03	**BUS DEVICE RESET OCCURRED**
29	04	**INTERNAL DEVICE RESET OCCURRED**
2A	01	**MODE PARAMETERS CHANGED** Mode parameters may have changed due to another host issuing a **Mode Select** command.
39	00	**SAVING PARAMETERS NOT SUPPORTED** Verify **Save Parameter** field in the **Mode Sense** command complies with the command format described in this guide.
3A	00	**MEDIUM NOT PRESENT** The inventory indicated that a cartridge was in this bin but no cartridge was sensed by the gripper when it attempted to pick it. Retry the command. Check for proper seating of the cartridge. It may also indicate that the tape is not ready to be picked from the drive because the tape is not fully unloaded. Retry the command. If the problem persists, check the function of the tape drive handle assembly. Manually unload the tape.
3B	0D	**MEDIUM DESTINATION ELEMENT FULL** Destination element address already contains a cartridge. Issue a **Read Element Status** command and retry move command. If the problem recurs, issue an **Initialize Element Status** command followed by a **Read Element Status** command and retry move command.

ASC	ASCQ	Message Name/Description
3B	0E	**MEDIUM SOURCE ELEMENT EMPTY** Source element address does not contain a cartridge. Issue a **Read Element Status** command and retry move command. If the problem recurs, issue an **Initialize Element Status** command followed by a **Read Element Status** command and retry the move command.
3F	0E	**REPORTED LUNS DATA HAS CHANGED**
45	00	**SELECT OR RE-SELECT FAILUR**E DX-Series system timed out trying to reselect host. Make sure host is running.
47	00	**SCSI PARITY ERROR** SCSI Parity Error detected. Check cable connections and cable length.
48	00	**INITIATOR DETECTED ERROR** Initiator Detected Error Message was received from the host.
4E	00	**OVERLAPPED COMMANDS ATTEMPTED** Due to a second command being sent from the same host before a previous command has completed, the previous command has been aborted. This may also occur when executing off-line commands via the control panel and DIAG port simultaneously.
53	02	**MEDIUM REMOVAL PREVENTED** **Prevent Medium Removal** command was executed and command was received to export cartridge. **Execute Allow Medium Removal** command and retry move medium command.

ASC	ASCQ	Message Name/Description
54	00	**SCSI TO HOST SYSTEM INTERFACE FAILURE** Possible SCSI bus time-out or premature disconnect. Check cable connections and cable length.
80	00	**DOOR WAS OPENED INVENTORY MAY HAVE BEEN CORRUPTED** Close door and retry command.
80	01	**TRANSFER FULL - COMMAND CAN NOT BE EXECUTED** Gripper has cartridge in it. Move cartridge to empty storage element using **Move Medium** command. Retry command.
80	06	**TRANSFER EMPTY - COMMAND ABORTED** Gripper does not contain cartridge at end of pick portion of **Move Medium** command.
80	08	**LOGICAL UNIT TURNED ON-LINE** The DX-Series system is ready to communicate with the host computer.
80	09	**LOGICAL UNIT IS TURNED OFF-LINE** The DX-Series system is ready to communicate with the diagnostic PC. Set the DX-Series system offline from the GUI.
80	0B	**COMMAND ABORTED BY USER** Informational message. No action is necessary.
80	0E	**DATA TRANSFER CHANGED** A drive has been inserted into the system. Use "Read Element Status" to determine status of drives.
80	0F	**LOW POWER ERROR** Check power connections.

ASC	ASCQ	Message Name/Description
80	22	**ELEMENT CONTENTS UNKNOWN** The contents of an element address are unknown. Issue a Read Element Status for the element address. If contents are still unknown issue an Initialize Element Status command.
88	00	**WARNING SAFE TEMPERATURE EXCEEDED** This is only a warning that the temperature in the DX-Series system exceeds the normal operational temperature (96.8ºF).
88	01	**MAXIMUM TEMPERATURE EXCEEDED** DX-Series system turns off and remains off until the temperature returns to an acceptable level (59-90ºF).
8F	00	**DX-SERIES UNIT COMMAND TIMED OUT** Verify that communications to DX-Series system still exists by issuing another command
F0	01	**RESERVATION CONFLICT** Internal firmware error. Report this occurrence and previous command (if known) to Technical Support.
F1	00	**COMMAND UNSPECIFIED** Internal firmware error. Report this occurrence and previous command (if known) to Technical Support.
F1	01	**COMMAND HEAP OVERFLOW** Internal firmware error. Report this occurrence and previous command (if known) to Technical Support.

ASC	ASCQ	Message Name/Description
F1	02	**UNRECOGNIZED COMMAND** Internal firmware error. Report this occurrence and previous command (if known) to Technical Support.
F1	03	**COMMAND REGISTER ERROR** Internal firmware error. Report this occurrence and previous command (if known) to Technical Support.

Appendix C
DLT7000 Sense Code Values

Table 228 lists message information that can be sent from the DLT7000 tape drive to the host computer. Table 228 is sorted by the data in the ASC column (second column from left) and lists the following information:

- Additional Sense Code (ASC)
- Additional Sense Code Qualifier (ASCQ)
- Message name, description and (potential) recovery action

Message name and description may contain abbreviations as follows:

- LU = Logical Unit
- REQ'D = Required
- DEV = Device
- DIAG = Diagnostics
- NVRAM = Nonvolatile RAM
- A/D = Analog-to-Digital

Table 228 DLT7000 Tape Drive Sense Data Values (Hexadecimal)

ASC	ASCQ	Description
00	00	No Additional Sense Code
00	01	Unexpected FM Encountered
00	02	End of Medium (EOM) Encountered
00	03	SetMark Encountered
00	04	Beginning of Medium (BOM) Encountered
00	05	EOD Encountered
00	17	Clean Requested (Non-Vendor Unique)
0A	00	Error Log Overflow
0A	80	Error Log Generated
0C	00	WRITE Error (possible tape medium problem, cleaning tape needed)
0C	80	Write SCSI FIFO CRC Error
04	00	Unit Not Ready, Cause Nonreportable
04	02	Unit Not Ready, LOAD Command Needed
08	00	LUN Communication Failure
08	01	LUN Communication Timeout Failure
11	00	Unrecovered READ Error
11	08	Unrecovered READ Error, Incomplete Block Read
11	80	Read SCSI FIFO CRC Error
11	81	Block Port Detected EDC Error
11	82	Block Port Detected Record CRC Error

ASC	ASCQ	Description
14	00	Recorded Entity Not Found (logical DLT block not found)
15	02	Position Error Detected by Read of Medium
1A	00	Parameter List Length Error
20	00	Illegal Opcode
20	81	Illegal Command While In Recovery Mode
21	01	Invalid Element Address
24	00	Invalid CDB Field (may occur if odd block counts are attempted in fixed mode)
24	81	Invalid Mode on WRITE Buffer
24	82	Media in Drive
24	84	Insufficient Resources
24	86	Invalid Offset
24	87	Invalid Size
24	8C	Not Immediate Command
25	00	Illegal LUN
26	00	Parameter List Error, Invalid Field
26	01	Parameter List Error, Parameter Not Supported
26	02	Parameter List Error, Parameter Value Invalid
27	80	Hardware WRITE Protect
27	82	Data Safety WRITE Protect (if Use Cleaning Tape LED is lit, use a cleaning tape)
28	00	Not Ready To Ready Transition

ASC	ASCQ	Description
29	00	Reset Occurred
2A	01	Mode Parameters Changed
2A	02	Log Parameters Changed
2F	00	Commands Cleared by Another Initiator
30	00	Incompatible medium (cannot read medium)
30	02	Incompatible Format
30	03	Unit Not Ready, Incompatible Media (Cleaning Cartridge) Installed
37	00	Rounded Parameter
39	00	Saving Parameters Not Supported
3A	00	Media Not Present
3A	80	Media Not Present, VU Cartridge Missing
3B	00	Sequential Positioning Error
3B	08	Repositioning Error
3B	0D	Media Destination Element Full[1]
3B	0E	Media Source Element Empty[1]
3D	00	Invalid Bits in ID Message
3F	01	Microcode has been Changed
3F	0E	Reported Luns Data has Changed
43	00	Message Error
44	00	Internal Target Failure
44	80	Unexpected Selection Interrupt

ASC	ASCQ	Description
44	82	Command Complete Sequence Failure
44	83	SCSI Chip, Gross Error/ Illegal – Command Status
44	84	Unexpected/Unexplained Residue Count in Transfer Register
44	85	Immediate Data Transfer Timeout
44	86	Insufficient CDB Bytes
44	87	Disconnect Sequence Failed
44	88	Bus DMA Transfer Timeout
44	89	Command Cleared from Queue Without Other
44	8A	Over Temperature Condition
44	C1	EEROM Copy 1 Area Bad
44	C2	EEROM Copy 2 Area Bad
44	C3	Both EEROM Copy Areas Bad
45	00	Select/Reselect Failure
47	00	SCSI Parity Error (check SCSI bus configuration and connections)
48	00	IDE Message Received
49	00	Invalid Message Error
4B	00	Data Phase Error
4E	00	Overlapped Commands Attempted (queue tag is not unique, CDB sent with abort tag message, or untagged, or untagged CDBs are outstanding)
51	00	Erase Failure

ASC	ASCQ	Description
53	00	Media Load/Eject Failure
53	01	Unload Tape Failure
53	02	Media Removal Prevented
5A	01	Operator Media Removal Request
5B	01	Log Threshold Condition Met
5B	02	Log Counter at Maximum
5D	00	Tape Alert Failure Prediction Threshold Exceeded
5D	FF	False Exception Condition
80	00	Calibration Error (use cleaning tape)
80	01	Cleaning Required (use cleaning tape)
80	02	Cleaning Requested (use cleaning tape)
81	00	Directory Read Error (use cleaning tape)
82	00	Not Allowed if not at BOT
82	01	LUN Communications Time-out
83	00	Can not Retry Read/Write Data Transfer (a READ/WRITE Data Transfer was aborted due to a bus parity error or unexpected ATN.
XX	YY	Code Update Event (where XX = Drive revision code; YY = Controller revision code)

[1] Medium changer specific command.

[2] Contact a service representative.

[3] Bad firmware image or code download possible.

0Dh VOLUME OVERFLOW (No Additional Sense Code or Sense Code Qualifier)
0Eh MISCOMPARE (No Additional Sense Code or Sense Code Qualifier)

Filemark, End of Medium (EOM), and Incorrect Length Indicator (ILI) Bits

Filemark (byte 2, bit 7), EOM (byte 2, bit 6), and ILI (byte 2, bit 5) are names of fields in the SCSI-2 REQUEST SENSE command. Any of these bits may be set to a 1 even though the Additional Sense Code (ASC) / Additional Sense Code Qualifier (ASCQ) bits have a value of 0.

For example:

Filemark, EOM, ILI bit may be set to 1 with No Sense key (00h) and ASC / ASCQ = 00 00.

Filemark, EOM, ILI bit may be set to 1 with Recovered Error (01h) and ASC / ASCQ = 00 00.

Filemark, BOM, ILI bit may be set to 1 with Medium Error (03h) and ASC / ASCQ = 00 00.

Appendix D

Fibre Channel Topology

Fibre Channel is a serial data transfer architecture for use with computers and mass storage devices that is rapidly emerging to challenge SCSI as the interface of choice for host-to-storage applications.

Fibre Channel advantages include:

- Connection distances up to 500 meters
- 1 or 2 Gbit/S data transfer rates depending on host HBA
- Supports up to 126 devices in loop mode
- Supports 24-bit addressing for over 16 million devices in point-to-point mode or fabric, when using a Fibre Channel switch or multiple Fibre Channel switches.
- Operating system independence
- Interconnect flexibility

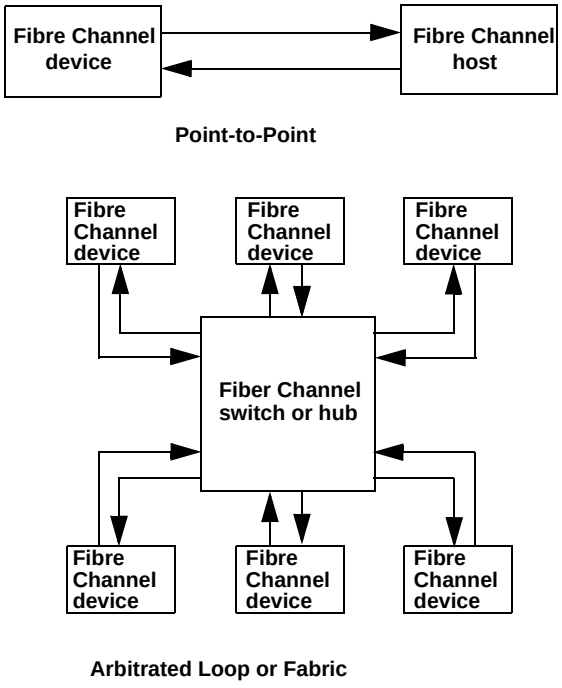
This section also includes information on:

Fibre Channel Topology

Fibre Channel topologies are divided into two types (see figure 3):

- Point-to-Point (Fibre Channel device is connected directly to the Fibre Channel host)
- Arbitrated Loop (multiple Fibre Channel devices are connected to a switch or hub in a Fibre Channel network or fabric)

Figure 3 Fibre Channel Topologies



Fibre Channel Addressing

Unlike many LAN technologies that use a fixed six-byte Media Access Control (MAC) address, Fibre Channel uses a three byte address identifier, which is dynamically assigned during Login. N_Ports transmit frames from their own Source_ID (S_ID) to a Destination_ID (D_ID). Addresses in the range of hex'FFFFF0' to hex'FFFFFE' are special, well-known addresses uses for such things as the Fabric, Alias Server, or the Multicast Server. Before Fabric Login, the N_Port's S_ID is undefined: hex'000000'. Hex'FFFFFF' is reserved for broadcast. In a point-to-point topology, Fabric Login will fail of course, and the two ports will simply chose two unique addresses.

Arbitrated Loop devices still use the three byte address identifiers, but also use an Arbitrated Loop Physical Address (AL_PA). AL_PAs are one byte values dynamically assigned each time the Loop is initialized. Once the Loop is initialized and (hopefully) each L_Port has selected an AL_PA, public NL_Ports will attempt Fabric Login. If there is an FL_Port, the Fabric will assign the upper two bytes of the NL_Port's address identifier and usually allow the low byte to be the NL_Port's AL_PA. (If not, the Loop will need to be re-initialized so the NL_Port can select the Fabric assigned AL_PA). If no Fabric exists or if an NL_Port is a private NL_Port (does not login with the Fabric), the upper two bytes of the address identifier will remain '0000', and the lower byte will simply be the NL_Port's AL_PA.

But there still needs to be a way of uniquely identifying a port - even for much of the above initialization to take place. This is accomplished using Name_Identifiers, a fixed 64-bit value. Name_Identifiers are used to uniquely identify nodes (Node_Name), a Port (Port_Name), and a Fabric (Fabric_Name). Name Identifiers are not used to route frames, but are used in mapping to upper layer protocols.

Appendix E

DX-Series Software Deviations

The DX-Series system emulates an ATL P1000 library media changer and a DLT 7000 tape drive. This section documents the software deviations in both the media changer (ATL P1000) and the DLT 7000 tape drive SCSI command sets.

Media Changer SCSI Command Deviations

This section documents where the DX-Series system deviates from a normal ATL P1000 media changer.

General Information

- Number of Elements - Import/Export Element - The DX-Series system does not have an Import/Export Element Export Element, whereas the ATL P1000 library can be configured with up to 8 Import/Export Elements.
- Storage Element - The DX-Series system supports the following maximum storage elements:
  - DX30 - 1280
  - DX100 - 5120

- DX3000 - 800
- DX5000 - 1600

The ATL P1000 library can be configured with a maximum of 40 storage elements.

- Data Transport Element - The DX-Series system supports the following maximum transport elements:
  - DX30 - 30
  - DX100 - 55
  - DX3000 - 32
  - DX5000 - 64

  The ATL P1000 library can be configured with a maximum of 4 data transport elements. Currently, all DX-Series data transport elements are of the Quantum DLT 7000 type, whereas the ATL P1000 supports a variety of different tape drive types.

Initialize Element Status

Implemented per specification.

See Initialize Element Status (07h) on page 13 for more information.

Initialize Element Status with Range

Implemented per specification. This will take less than a second to complete whereas a P1000 would take minutes.

See Initialize Element Status with Range (E7h) on page 14 for more information.

Inquiry

The DX Series supports the additional Pages 80h (Unit Serial Number Page) and 83h (Device Identification Page).

See Inquiry (12h) on page 16 for more information.

Log Sense

Log sense page 30h, parameter data is all zeroes (example: emulated library statistics are not maintained).

See Log Sense (4Dh) on page 26 for more information.

Mode Select 6/10

Implemented per specification.

See Mode Select (15h) on page 32 for more information.

Mode Sense 6/10

Element Address Page, the number of storage elements is as follows:

- DX30 - 320
- DX100 - 320
- DX3000 - 800
- DX5000 - 1600

The number of import/export field is 0, the number of data transport elements is as follows:

- DX30 - 30
- DX100 - 55
- DX3000 - 32
- DX5000 - 64

whereas the ATL P1000 library uses 40, 8, and 4 respectively.

Device Capabilities Page, the StorIE field (i.e. load port) is 0 indicating that it is not capable of storing a tape cartridge. Additional fields with IE as the source or destination are also 0 indicating the movement transfer is not allowed.

See Mode Sense (1Ah) on page 39 for more information.

Move Medium

Implemented per specification.

See Move Medium (A5h) on page 50 for more information.

Position to Element

Implemented per specification.

See Position To Element (2Bh) on page 52 for more information.

Prevent/Allow Medium Removal

The DX-Series system returns a check condition, unsupported command, whereas the ATL P1000 supports this command.

Read Element Status

Implemented per specification.

See Read Element Status (B8h) on page 54 for more information.

Read Buffer

The DX-Series system returns a check condition, unsupported command, whereas the ATL P1000 supports this command.

Ready Import

The DX-Series system returns a check condition, unsupported command, whereas the ATL P1000 supports this command.

Release

The DX-Series system only performs Unit Reservation Releases. Element reservation releases are validated but are never performed nor tracked.

See Release (17h) on page 71 for more information.

Report LUNS

Implemented per specification.

See Report LUNS (A0h) on page 73 for more information.

Request Sense

The DX-Series system sense data size is 24 bytes whereas the ATL P1000 is 21 bytes. The extra 3 bytes are located at the end and are reserved.

All Sense Codes related to mechanical failures have been removed from the list since they will never occur.

See Request Sense (03h) on page 75 for more information.

Request Volume Element Address

The DX-Series system returns a check condition, unsupported command, whereas the ATL P1000 supports this command.

See Request Volume Element Address (B5h) on page 79 for more information.

Reserve

The DX-Series system only performs Unit Reservations. Element reservations are validated but are never made nor tracked.

When a reservation is made for itself, the reservation is bound to its' World Wide Node Name and not the ReservationID value passed in the Command.

See Reserve (16h) on page 95 for more information.

Rezero Unit

Implemented per specification.

See Rezero Unit (01h) on page 99 for more information.

Send Diagnostic

The DX-Series system does not perform any actual diagnostics indicated by the command. It will always return a good status for the diagnostics requested.

See Send Diagnostic (1Dh) on page 100 for more information.

Send Volume Tag

The DX-Series system returns a check condition, unsupported command, whereas the ATL P1000 supports this command.

See Send Volume Tag (B6h) on page 102 for more information.

Test Unit Ready

Implemented per specification

See Test Unit Ready (00h) on page 105 for more information.

Write Buffer

The DX-Series system returns a check condition, unsupported command, whereas the ATL P1000 supports this command.

DLT 7000 SCSI Command Deviations

This section documents where the DX-Series system deviates from a normal DLT 7000 tape drive.

General Information

- Tape Cartridge Media Type - All DX-Series tape cartridges are created of type DLTtape IV.
- Tape Cartridge Capacity - The DX-Series tape cartridge capacity will not necessarily match an actual DLTtape IV. The user is given the option when creating cartridges to set the capacity depending on his DX system configuration.

- Tape Drive Density Setting - Block Descriptor, Density Code field, all density codes are excepted. Only density codes 80h – 85h may effect the compression setting (Data Compression Page, field DCE).

Erase

Implemented per specification.

> **Note:** The DX-Series system will perform this operation in less than 5 seconds, whereas a DLT 7000 may take upwards of over an hour to perform.

See Erase (19h) on page 122 for more information.

Inquiry

The DX Series supports the additional Page 83h (Device Identification Page).

See Inquiry (12h) on page 124 for more information.

Load-Unload

Implemented per specification.

See Load Unload (1Bh) on page 142 for more information.

Locate

Implemented per specification.

> **Note:** The DX-Series system will perform this operation in less than 5 seconds, whereas a DLT 7000 may take much longer.

See Locate (2Bh) on page 147 for more information.

Log Select

Implemented per specification.

See Log Select (4Ch) on page 149 for more information.

Log Sense

Write Error Counter Page 02h, is not supported.

Enable Threshold Comparison (ETC) not supported.

Read Error Counter Page 03h, cumulative values, parameter codes 2,3,5,6,8000h are always 0.

Enable Threshold Comparison (ETC) not supported.

Device Wellness Page 33h, parameter code data are always 0.

Device Status Page 3Eh, parameter code 0002h is always 0.

See Log Sense (4Dh) on page 158 for more information.

Mode Select 6 / 10

Block Descriptor, Density Code field, all density codes are excepted. Only density codes 80h – 85h may effect the compression setting (Data Compression Page, field DCE). It is preferred to use the Data Compression Page, field DCE to enable or disable compression. Actual compression of data is supported in some variants of DX systems.

Disconnect/Reconnect Page 02h, fields Maximum Burst Size and DTDC may be changed but have no effect on the tape drive emulation operation.

Control Mode Page 0Ah, field RLEC may be changed but has no effect on the tape drive emulation operation.

Device Configuration Page 10h, fields SEW, Write Delay Time, and Select Data Compression Algorithm may be changed but have no effect on the tape drive emulation operation

Tape Alert Page 1Ch, fields Perf, Dexter, Test, and MRIE may be changed but have no effect on tape drive emulation operation.

EEPROM Vendor Unique Page 3Eh, is not supported.

See Mode Select (6 /10) (15h / 55h) on page 172 for more information.

Mode Sense 6 / 10

EEPROM Vendor Unique Page 3Eh, is not supported.

See Mode Sense (6/10) (1Ah / 5Ah) on page 202 for more information.

Prevent/Allow Medium Removal

Implemented per specification.

See Prevent / Allow Medium Removal (1Eh) on page 227 for more information.

Read

Implemented per specification.

See Read (08h) on page 229 for more information.

Read Block Limits

Implemented per specification.

See Read Block Limits (05h) on page 232 for more information.

Read Buffer

The DX-Series system returns a check condition, unsupported command, whereas the DLT 7000 supports this command.

See Inquiry (12h) on page 124 for more information.

Read Position

Implemented per specification.

See Read Position (34h) on page 238 for more information.

Receive Diagnostics

Implemented per specification.

See Receive Diagnostic Results (1Ch) on page 241 for more information.

Release Unit

Implemented per specification.

See Release Unit (17h) on page 243 for more information.

Report LUNS

Implemented per specification.

See Report LUNS (A0h) on page 245 for more information.

Request Sense

All Sense Codes related to mechanical failures have been removed from the list since they will never occur.

See Request Sense (03h) on page 247 for more information.

Reserve Unit

When a reservation is made for itself, the reservation is bound to its' World Wide Node Name and not the ReservationID value passed in the Command.

See Reserve Unit (16h) on page 254 for more information.

Rewind

Implemented per specification.

Note:	The DX-Series system will perform this operation in less than 5 seconds, whereas a DLT 7000 may take much longer.

See Rewind (01h) on page 257 for more information.

Send Diagnostic

The DX-Series system does not perform any actual diagnostics indicated by the command. It does validate the command but does not validate any of the parameter list data. It will always return a good status for the diagnostics requested.

See Send Diagnostic (1Dh) on page 258 for more information.

Space

Implemented per specification.

> **Note:** The DX-Series system will perform this operation in less than 5 seconds, whereas a DLT 7000 may take much longer.

See Space (11h) on page 265 for more information.

Test Unit Ready

Implemented per specification.

See Test Unit Ready (00h) on page 268 for more information.

Verify

Implemented per specification

See Verify (13h) on page 269 for more information.

Write

Implemented per specification.

See Write (0Ah) on page 271 for more information.

Write Buffer

The DX-Series system returns a check condition, unsupported command, whereas the DLT 7000 supports this command.

See Write Buffer (3Bh) on page 274 for more information.

Write Filemarks

Implemented per specification.

See Write Filemarks (10h) on page 277 for more information.

Glossary

A

abort message This SCSI-2 message allows the host to abort a process and stop the DX-Series system's operation at its next "safe" position.

B

bar code label The identification label on cartridges.

bus device reset message This SCSI-2 message causes the DX-Series system to clear all I/O processes. The **Unit Attention** condition is set to indicate that the device has been reset.

C

calibration The software measurements and configuration required for successful operation of the DX-Series system.

command complete message This SCSI-2 message is sent to the host after the DX-Series system has completed the command operation and sent valid status information to the host. This message does not indicate that the operation was completed successfully.

D

disconnect (target to initiator) message This optional SCSI-2 message disconnects the DX-Series system from the host while performing an operation. This frees the SCSI bus for other uses while the operation is in progress.

DLT Digital Linear Tape. A magnetic tape technology used for backing up data on medium to large-scale Loans.

DX-Series system A backup device based on hard drives.

E

element A discrete physical entity that can hold a single tape cartridge and is represented by a unique 16-bit element address. SCSI elements include storage bins, tape drives, load port bins, and the gripper.

F

FCC Class A Standard established by the U.S. Federal Communications Commission governing electromagnetic emissions.

G

gripper assembly The assembly that grips cartridges.

H

host computer The computer that issues SCSI commands to control the DX-Series system robotics.

I

identify (initiator to target) message This SCSI-2 message is sent to establish communication with the DX-Series system.

identify (target to initiator) The host sends this SCSI-2 message to the DX-Series system to identify the DX-Series system to which the command is being sent.

inquiry command Determines devices attached to the SCSI bus and request a description from each device.

initialize element status command Allows the host to request an inventory of the tape cartridges held in a DX-Series system.

initialize element status with range command Allows the host to request an inventory of a range of elements in the DX-Series system.

initialization sequence Actions that occur when the DX-Series system is initially powered on. This includes a DX-Series system reset, initialization of all hardware and a response to the **Inquiry, Request Sense, Log Sense**, and **Mode Sense** commands.

initiator detected error message This SCSI-2 message is sent to the DX-Series system to inform it that an error has occurred that does not preclude the DX-Series system from retrying the operation.

L

log sense command Retrieves statistical information maintained by the logical unit.

M

medium changer element A member of the tape DX-Series address space. Each element is a discrete physical entity that can hold a single tape cartridge.

medium transport element Mechanism used to move media between elements within the DX-Series.

message parity error This SCSI-2 message is sent to the DX-Series to indicate that it received a message byte with a parity error.

message reject This SCSI-2 message is sent to indicate that the last message or message byte it received was inappropriate or has not been implemented.

mode sense command Provides a method for a host to obtain parameter setting of a target device

move medium command Moves a tape cartridge from one element to another within a DX-Series

N

NVRAM Nonvolatile RAM

no operation message This SCSI-2 message is sent in response to a DX-Series's request for a message when the host does not currently have any other valid message to send.

O

on-line Ready for communications with a host.

P

position to element command Allows the application to move the robotics to a more advantageous position while the tape drives are busy.

prevent/allow medium removal command Requests target to disable or enable medium removal by preventing the user from opening load port or load pack doors.

R

read element status command Determines status of any DX-Series element, including element type, starting address and number of elements for which status information is being returned.

ready import command Provided on this unit for compatibility with existing libraries and provides no function on this DX-Series.

release command Releases the DX-Series or elements that match the specified release parameters.

request sense command Allows the host to receive sense data from the DX-Series.

request volume element address command Reports the element descriptors found by a Send Volume Tag command.

reserve command Reserves the specified DX-Series or elements for exclusive use by the requesting initiator or another specified SCSI device.

rezero unit command Allows the host to home all DX-Series mechanisms.

RS-232 A serial communications cabling and protocol standard for nine-pin connectors.

S

save data pointer message When data transfers are broken into multiple connections, the DX-Series will send this SCSI-2 message before disconnecting from the host.

SCSI Small Computer System Interface. A communications standard for attaching peripheral equipment to small computers.

send diagnostic command Performs a self test on the DX-Series.

Index

I

L

M

O

P

R

S

T

U