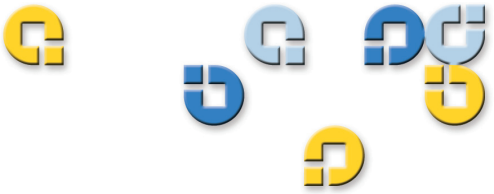
Quantum



Interface Reference Guide Interface Reference Guide Interface Reference Guide

DLT-S4 Tape Drive

DLT-S4

81-81281-04 A01

DLT-S4 Interface Reference Guide, 81-81281-04 A01, January 2008, Made in USA.

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Preface

This document describes the Parallel SCSI, Fibre Channel, and Serial Attached SCSI (SAS) interfaces for the DLT-S4 tape drive.

Audience

This document was written for software engineers developing application software and hierarchical mass storage software for DLT-S4 tape drives.

It has been designed for use by software engineers who have a basic understanding of SCSI principles and technology.

Purpose

This document provides information about:

- Parallel SCSI, Fibre Channel, and SAS transport layer information
- Task Management by Transport Layer
- All supported SCSI commands

Document Organization

This document is organized as follows:

- Chapter 1, Introduction, provides an overview of Parallel SCSI, Fibre Channel, and SAS.
- Chapter 2, Task Management, introduces task management by function
- Chapter 3, Transport Layer Implementation Details, explains the details of the transport layer as it relates to the functioning of the DLT-S4 tape drive.
- Chapter 4, SCSI Commands, provides Parallel SCSI, Fibre Channel, and SAS interface information as it relates to the DLT-S4 tape drive.

Notational Conventions

This document uses the following conventions:

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

Tech Tip: Tech Tips provide technical information which may be helpful in performing the procedure.

Caution: Cautions indicate potential hazards to equipment and are included to prevent damage to equipment.

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

This manual uses the following:

- Right side of the tape drive— Refers to the right side as you face the component being described.
- Left side of the tape drive — Refers to the left side as you face the component being described.
- *b* — All binary numbers are succeeded by “b.”
- *h* — 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

The following documents are related to the DLT-S4 tape drive:

Document No.	Document Title	Document Description
81-81278-xx	DLT-S4 Product Manual	Provides specification and usage instructions for the tape drive
81-81279-xx	DLT-S4 Product Specification	Provides hardware, performance, environment, shock and vibration, and regulatory specifications for the tape drive
81-81283-xx	DLT-S4 Quick Start Guide	Provides "quick" instructions on how to install and run the tape drive

Current SCSI standards documents available from www.t10.org

- SCSI Architecture Model (SAM-3)
- SCSI Primary Commands (SPC-3)
- SCSI Parallel Interface (SPI-5)
- SCSI Stream Commands (SSC-3)
- Serial Attached SCSI (SAS-1.1)
- Fibre Channel Protocol (FCP)
- Fibre Channel Framing and Signaling (FC-FS-2)
- Fibre Channel Arbitrated Loop (FC-AL-2)
- Fibre Channel General Services (FC-GS-5)

See the appropriate product manuals for information about the tape drive and cartridges.

SCSI Standards

Copies of the approved version of the SCSI standards may be obtained from:

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

Contacts

Quantum company contacts are listed below.

Quantum Corporate Headquarters

To order documentation on this or other Quantum products, contact:

Quantum Corporation
141 Innovation Drive
Irvine, CA 92617
(949) 856-7800
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Technical Publications

To comment on existing documentation send e-mail to:

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Getting More Information or Help

More information about this product is available on the Service and Support website at www.quantum.com/support. The Service and Support Website contains a collection of information, including answers to frequently asked questions (FAQs). You can also access software, firmware, and drivers through this site.

For further assistance, or if training is desired, contact Quantum:

QuantumTechnical Assistance Center in the USA: 800-284-5101

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Chapter 1

Introduction

This chapter covers basic SCSI background information as it relates to DLT-S4 drive characteristics and interfaces.

Background Information About SCSI

SCSI is one of the industry's most widely adopted I/O interfaces; it is widely used in computing platforms from personal computers to mainframes to peripheral devices of all types. DLT-S4 tape drives conform to the SCSI-3 standard. You should familiarize yourself with the standards as previously mentioned in **Related Documents** on page xxxi before using the remaining portions of this document.

> **Note:** Final drafts of the SCSI standards documents are available at www.t10.org.

The DLT-S4 is capable of supporting these separate transport layers:

- Parallel SCSI
- Fibre Channel
- Serial Attached SCSI (SAS)

Format of data written to tape:

- Logical addressing (rather than physical addressing) is used for all data blocks.
- Tape drives support block sizes from 4 bytes to 16,777,212 bytes.
- Fixed block sizes must be in multiple of 4 bytes.
- The DLT-S4 can read DLT-S4, SDLT 600, and SDLT 320 formatted tapes and can write to DLT-S4 formatted tapes.

Parallel SCSI Characteristics

The features of the DLT-S4 Parallel SCSI implementation include:

- The DLT-S4 tape drive is capable of negotiating and running at any of the following protocols:
  - Single Transition
  - Dual Transition
  - Information Units (Ultra 320 speeds)
- DLT-S4 tape drives support wide asynchronous and synchronous data transfers.
- SPI-4 compliant
- Odd parity is generated and checked during all single edge information transfer phases.
- CRC is generated and checked during all dual edge information transfer phases.
- The DLT-S4 drive disconnects from the SCSI bus at regular intervals during information transfer phases to allow other devices to access the bus. These disconnects are user-configurable using the Disconnect-Reconnect page of the **MODE SELECT** command.
- The DLT-S4 tape drive does not act as an initiator on the SCSI bus. Therefore, the drive does not:
  1. Generate unsolicited traffic on the network
  2. Initiate its own SCSI commands
  3. Assert bus reset.

Fibre Channel Characteristics

The features of the DLT-S4 Fibre Channel implementation include:

- Automatic speed negotiation, with transfer rates of:
  - 100 megabytes per second (1 Gb/second)
  - 200 megabytes per second (2 Gb/second)
  - 400 megabytes per second (4 Gb/second)
- Automatic topology negotiation (the tape drive operates as an NL_Port or N_Port):
  - Arbitrated Loop: private loop, NL_Port to NL_Port(s)
  - Arbitrated Loop: public loop, NL_Port to NL_Port(s) and one FL_Port
  - Fabric attachment: N_Port to F_Port
  - Point-to-Point attachment: N_Port to N_Port
- FCP-2 compliant
- Class 3 level of service
- Basic and extended link services
- Task retry identification
- Hard assigned port addresses, when attached to a library. The library can assign a hard address to the tape drive. If the library does not assign a hard address, the tape drive takes a soft address initially.
- The DLT-S4 tape drive does not act as an initiator on the SCSI bus. Therefore, the drive does not:
  1. Generate unsolicited traffic on the bus
  2. Initiate its own SCSI commands
  3. Assert bus reset.

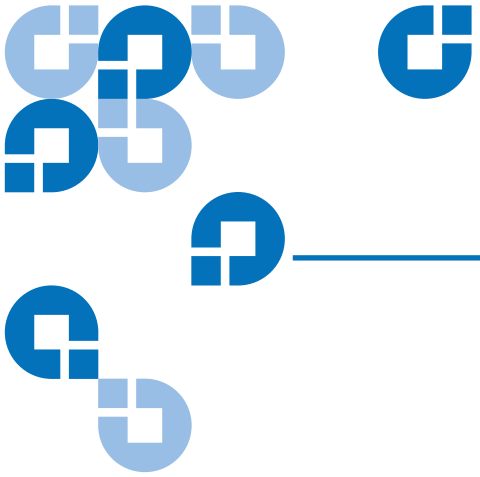
World-wide Names

Although, the DLT-S4 tape drive contains one 64-bit world-wide name for the port and one for the SSC logical unit (LUN-0), the FCP-2 standard allows for the use of the same world-wide name for the node as is used in LUN-0. The drive reports the world-wide names to the host through the **INQUIRY Command (12h)** on page 34.

Serial Attached SCSI Characteristics

The important features of the DLT-S4 SAS implementation include the following:

- Automatic speed negotiations, with transfer rates of:
  - 150 megabytes per second (1.5 Gb/second)
  - 300 megabytes per second (3.0 Gb/second).
- SAS-1.1 compliant
- Transport Layer Retries are supported
- The DLT-S4 tape drive is an SSP Target Port
- The DLT-S4 tape drive does not act as an SSP Initiator Port.



Chapter 2

Task Management

This chapter provides a detailed description of task management by transport layer. Specifically, it covers the following topics:

- Task Management by Transport Layer Overview, provides a list of task management functions by interface.
- Task Management Function, describes the tape drive response for each function.

Task Management by Transport Layer Overview

Table 1 shows the task management function and its specific characteristics by transport layer.

Table 1 Task Management by Transport Layer

Task Management Function	Fibre Channel	Serial Attached SCSI	Parallel SCSI Information Units	Parallel SCSI Non-Information Units
ABORT TASK	Basic Link Service BLS ABTS (81h)	Task Mgmt Flag=01h	Task Mgmt Flag=01h or Message Out=0Dh	Message Out=0Dh
ABORT TASK SET	Task Mgmt Flag=02h	Task Mgmt Flag=02h	Task Mgmt Flag=02h	Message Out=06h
CLEAR TASK SET	Task Mgmt Flag=04h	Task Mgmt Flag=04h	Task Mgmt Out=04h	Message Out=0Eh
LOGICAL UNIT RESET	Task Mgmt Flag=10h	Task Mgmt Flag=08h	Task Mgmt Out=08h	Message Out=17h
TARGET RESET	Task Mgmt Flag=20h	N/A	Task Mgmt Flag=20h or Message Out=0Ch	Message Out=0Ch
QUERY TASK	N/A	Task Mgmt Flag=80h	N/A	N/A

Task Management Function

There are three types of Task Management:

- Reset
  - **TARGET RESET**
  - **LOGICAL UNIT RESET**
- Abort
  - **ABORT TASK SET**
  - **ABORT TASK**
  - **CLEAR TASK SET**
- Query
  - **QUERY TASK**

TARGET RESET

An initiator sends the **TARGET RESET** request to direct the tape drive to clear all I/O processes. This task management function causes the drive to:

1. Abort all the commands in the task set without sending status and flush all of the complete blocks in the cache to tape.
2. Execute a soft reset.

The drive creates a Unit Attention condition for all initiators after accepting and processing a **TARGET RESET** request. The additional sense code is set to TARGET RESET OCCURRED.

If a **WRITE** command is in progress and **STATUS** has not been sent to the initiator when the drive receives this message, the drive may write some or all of the data for the **WRITE** command to the medium.

LOGICAL UNIT RESET

This task management function causes the drive to reset the selected unit.

When the LUN is set to 0 and the drive receives the **LOGICAL UNIT RESET** task management function, the drive is reset as described in **TARGET RESET** above.

CLEAR TASK SET

CLEAR TASK SET clears all commands for requesting initiator. **CLEAR TASK SET** can clear multiple commands, when command queuing is in effect.

ABORT TASK

This task management function causes the drive to clear the current I/O process on the selected unit. Buffered (cached) write operations are completed if possible. The current settings of **MODE SELECT** parameters and reservations are not affected. Commands, data, and status for other initiators are not affected.

This task management function can be sent to a logical unit that is not currently performing an operation for the initiator.

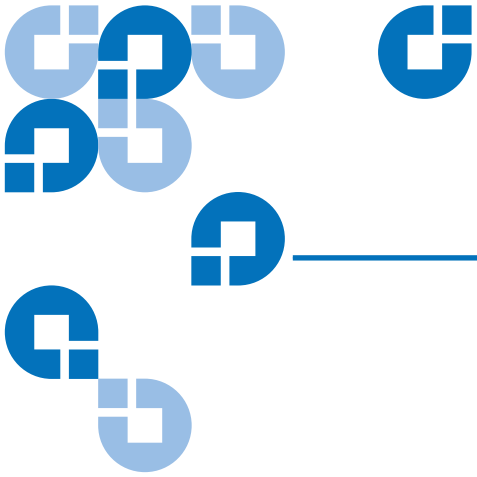
If a **WRITE** command is in progress and **STATUS** has not been sent to the initiator when the drive receives this task management function, some or all of the data for this command may be written to the medium.

ABORT TASK SET

ABORT TASK SET aborts all commands for the requesting initiator. **ABORT TASK SET** can clear multiple commands, when command queuing is in effect.

QUERY TASK

Supported in the SAS protocol only. It is used as part of the protocol error recovery process to determine if a command was received by the drive or was discarded due to an error detected at the protocol layer.



Chapter 3

Transport Layer Implementation Details

This chapter explains information specific to the Parallel SCSI, Fibre Channel, and SAS interfaces for the DLT-S4 tape drive on the transport layer.

Parallel SCSI

This section contains descriptions of each of the messages the drive supports.

Parallel SCSI message-level errors are communicated by messages that are defined specifically for that purpose (for example, **MESSAGE PARITY ERROR** or **MESSAGE REJECT**). Message-level errors are also handled by drive-managed retries (see Supported Messages on page 11 for more detailed message-handling information).

SCSI Bus Reset Condition

The DLT-S4 tape drive responds to bus reset conditions as follows:

- Within 250 milliseconds—and typically under 4 milliseconds—after a bus reset, the drive responds to SCSI bus selections and returns the appropriate normal responses. Tape motion commands are returned with CHECK CONDITION status, Sense Key of Not Ready, until the drive makes the medium ready.
- The drive rewinds the tape to Beginning of Partition 0.

> **Note:** The DLT-S4 tape drive does not implement the hard reset alternative for bus RESET processing.

The DLT-S4 tape drive recognizes multiple bus resets in succession as well as bus resets of arbitrarily long duration (power-on conditions). It recovers within the time limits specified above following the last bus reset.

Supported Messages

The tape drive supports the messages and the direction of the message flow as listed in table 2 and table 3.

Table 2 Supported Message In List

Message In	Non-Information Units	Information Units
Disconnect (04h)	✔	
Identify (80h+)	✔	
Ignore Wide Residue (23h)	✔	
Message Reject (07h)	✔	✔
Modify Data Pointers (1,5,0)	✔	
Parallel Protocol Request (1,6,4)	✔	
QAS Request (55h)		✔
Restore Pointers (03h)	✔	
Save Pointers (02h)	✔	
Simple Queue (20h,Tag)	✔	
Synchronous Transfer Req (1,3,1)	✔	✔
Task Complete (00h)	✔	
Wide Transfer Request (1,2,3)	✔	✔

Table 3 Supported Message Out List

Message Out	Non-Information Units	Information Units
Abort Task (0Dh) see ABORT TASK on page 8	✔	✔
Abort Task Set (06h) see ABORT TASK SET on page 8	✔	
Clear Task Set (0Eh) see CLEAR TASK SET on page 8	✔	
Logical Unit Reset (17h) see LOGICAL UNIT RESET on page 7	✔	
Target Reset (0Ch) see TARGET RESET on page 7	✔	✔
Identify (80h+)	✔	
Initiator Detected Error (05h)	✔	✔
Message Parity Error (09h)	✔	✔
Message Reject (07h)	✔	✔
No Operation (08h)	✔	✔
Parallel Protocol Request (1,6,4)	✔	✔
Synchronous Transfer Req (1,3,1)	✔	✔
Simple Queue (20h,Tag)	✔	
Wide Transfer Request (1,2,3)	✔	✔

Supported Task Management for Information Units

For more in information about supported task management for information units (see chapter 2, Task Management).

Synchronous Data Transfer Request

This extended message allows the tape drive and initiator to agree on the values of the parameters relevant to synchronous transfers. The SYNCHRONOUS DATA TRANSFER REQUEST message has the format shown in figure 1.

> **Note:** The ANSI SPI-4 standard prohibits target devices from initiating negotiations using the PARALLEL PROTOCOL REQUEST message. Instead, targets are required to negotiate using the WIDE DATA TRANSFER REQUEST and SYNCHRONOUS DATA TRANSFER REQUEST messages. The DLT-S4 tape drive initiates negotiations starting with a WIDE DATA TRANSFER REQUEST message before transferring any data if transfer parameters have not been established or have been lost (see *SPI-4*.

Figure 1 Synchronous Data Transfer Request Message — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Extended Message Identifier (01h)							
1	Length (03h)							
2	SYNCHRONOUS DATA TRANSFER REQUEST (01h)							
3	Transfer Period							
4	Transfer REQ/ACK Offset							

A SCSI device initiates a SYNCHRONOUS DATA TRANSFER REQUEST message exchange whenever a previously arranged transfer agreement may have become invalid. The agreement becomes invalid after any condition that may leave the data transfer agreement in an indeterminate state, such as:

- After any SCSI reset condition
- After a TARGET RESET message
- After a power cycle
- After a WIDE DATA TRANSFER REQUEST message exchange.

The SYNCHRONOUS DATA TRANSFER REQUEST message exchange establishes an agreement between two SCSI devices on the clocking of the data used for DATA phase transfer between them. This agreement applies to the DATA IN and DATA OUT phases only. All other information transfer phases must use asynchronous transfers.

The tape drive implements both the wide data transfer and synchronous data transfer options. If both wide and synchronous data transfers are used, the wide data transfer agreement must be negotiated first. If a synchronous data transfer agreement is in effect, the drive resets the synchronous agreement to asynchronous mode after accepting a WIDE DATA TRANSFER REQUEST message.

If the Transfer Period requested is less than the minimum value the drive supports, the drive adjusts the return value up to the minimum supported value.

Not all possible transfer periods between the minimum and maximum values are supported. If the Transfer Period requested is between the minimum and maximum supported values, but not exactly achievable by the drive, the drive returns the request value and the drive transmits data at the next lower speed it is capable of. The initiator may send data at the request speed. The maximum supported synchronous period is 5Dh (372 nsec). A request with a Transfer Period less than this returns a request for asynchronous mode (see table 4).

Table 4 Transfer Periods and Transfer Rates

Transfer Period	Transfer Rate
0Ah	40 MHz, 25 nsec Transfer Period
0Bh	33 MHz, 30.3 nsec Transfer Period; Ultra 2 Super DLTtape uses 37.5 nsec period
0Ch	20 MHz, 50 nsec Transfer Period
0Dh – 5Dh	(4 * Transfer Period) nsec

The drive's minimum supported value for Transfer Period is 0Ah when the bus is operating in LVD mode. When operating in SE (Single-Ended) mode, the minimum Transfer Period value is 0Ch.

When the Transfer REQ/ACK value is non-zero, the drive will transfer data using synchronous transfers; a Transfer REQ/ACK offset value of zero indicates asynchronous transfers. If the host requests a Transfer REQ/ACK offset value greater than the maximum value that the drive supports, the drive responds with the maximum value that it supports.

Parallel Protocol Request

Parallel Protocol Request (PPR) messages (as shown in figure 2) are used to negotiate synchronous transfer agreements and wide data transfer agreements, and to set the protocol options between two SCSI devices.

Figure 2 Parallel Protocol Request Message — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Extended Message Identifier (01h)							
1	Extended Message Length (06h)							
2	Parallel Protocol Request (04h)							
3	Transfer Period Factor							
4	Reserved							
5	REQ/ACK Offset							
6	Transfer Width Exponent							
7	Reserved						DT_REQ	Reserved

The PPR message is required to configure an DLT-S4 tape drive. This command sets the transfer period, offset, transfer width, and clocking all in one message.

Support for the PPR message is indicated by the Clocking field in the Standard Inquiry page. The PPR message can also be used to set the transfer period, offset, and transfer width on an DLT-S4 tape drive with

an Ultra 2 interface card. To enable it, set the **MODE SELECT** Vendor Specific EEPROM parameter EnablePPRMsg to 1.

The PPR message allows the host and target devices to negotiate operating conditions of the SCSI bus. An DLT-S4 tape drive responds to a PPR message with a reciprocal PPR message containing acceptable parameters for the interface. An DLT-S4 tape drive never initiates a PPR negotiation.

Details about how to configure the PPR message are shown in figure 3.

Figure 3 Features of the Parallel Protocol Request Message

Field	Description
DT_REQ	Double Transition Clocking Request. This bit indicates a request for Double Transition Clocking, which means that two units of data are transferred for each clock cycle. Support for the PPR message is indicated by the Clocking field in the Standard Inquiry page.
Transfer Width Exponent	Valid transfer widths for the tape drive are 8 bits (transfer width = 00h) and 16 bits (transfer width = 01h). Other transfer widths are reserved.
Transfer Period Factor	09h = 12.5 nsec transfer period, 40 MHz DT (Ultra160)
	08h = 6.25 nsec transfer period, 80 MHz DT (Ultra320)
	0Ah = 25 nsec Transfer Period, 40 MHz
	0Ch = 50 nsec Transfer Period, 20 MHz
	19h = 100 nsec Transfer Period, 10 MHz
	32h = 200 nsec Transfer Period, 5 MHz

Wide Data Transfer Request

Figure 4 illustrates the message formats.

Figure 4 Wide Data Transfer Request Message — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Extended Message Identifier (01h)							
1	Length (02h)							
2	WIDE DATA TRANSFER REQUEST (03h)							
3	Transfer Width Exponent							

The DLT-S4 tape drive initiates a WIDE DATA TRANSFER REQUEST message exchange whenever a previously arranged transfer width agreement may have become invalid. The agreement becomes invalid after any condition that may leave the data transfer agreement in an indeterminate state, such as:

- After a hard reset condition
- After a TARGET RESET message
- After a power cycle.

The WIDE DATA TRANSFER REQUEST message exchange establishes an agreement between two SCSI devices on the width of the data path to be used for DATA phase transfer between them. This agreement applies to DATA IN and DATA OUT phases only. All other information transfer phases must use an eight-bit data path.

The drive implements both the wide data transfer option and synchronous data transfer option. If both wide and synchronous data transfers are used, the wide data transfer agreement must be negotiated first. If a synchronous data transfer agreement is in effect, the drive resets the synchronous agreement to asynchronous mode after accepting a WIDE DATA TRANSFER REQUEST message.

The transfer width established applies to all logical units. Valid transfer widths for the tape drive are 8 bits (transfer width = 00h) and 16 bits (transfer width = 01h). Other transfer widths are reserved.

Fibre Channel

For more in information about fibre channel task management, (see chapter 2, Task Management).

Link Service and Unsolicited Control Support

DLT-S4 tape drives provide Link Service and Unsolicited Control support as described in this section.

Basic Link Service

Table 5 lists the Basic Link Service requests the drive supports (see the *FC-FS-2* specification for details).

Table 5 Supported Basic Link Service Commands

R_CTL	Abbreviation	Description
80h	NOP	No Operation
81h	ABTS	Abort Sequence
84h	BA_ACC	Basic Accept
85h	BA_RJT	Basic Reject

Extended Link Service Commands

Table 6 lists the Extended Link Service (ELS) commands the drive supports (see the *FC-FS-2* specification for details).

Table 6 Supported Extended Link Service Commands

ELS Command	Abbreviation	Description
01h	LS_RJT	Link Service Reject
02h	LS_ACC	Link Service Accept
03h	PLOGI	N_Port Login
04h	FLOGI	F_Port Login
05h	LOGO	Logout
0Eh	RTV	Read Timeout Value
11h	TEST	Test (Loop Initialization)
12h	RRQ	Reinstate Recovery Qualifier
13h	REC	Read Exchange Concise
20h	PRLI	Process Login
21h	PRLO	Process Logout
50h	PDISC	Discover N_Port Service Parameters
52h	ADISC	Discover Address
56h	RPS	Read Port Status Block
57h	RPL	Read Port List
60h	FAN	Fabric Address Notification
78h	RNID	Request Node Identification Data

Extended Link Service Loop Initialization

Table 7 lists the ELS Loop Initialization commands the drive supports. The drive is capable of being a loop initialization master (see the *FC-AL-2* specification).

Table 7 Supported Extended Link Service Loop Initialization Commands

Loop Initialization Identifier	Abbreviation	Description
1101h	LISM	Select Loop Master Based on 8-Byte Port Name
1102h	LIFA	Fabric Assigned AL_PA Bit Map
1103h	LIPA	Previously Acquired AL_PA Bit Map
1104h	LIHA	Hard Assigned AL_PA Bit Map
1105h	LISA	Soft Assigned AL_PA Bit Map
1106h	LIRP	Report AL_PA Position Map
1107h	LILP	Loop AL_PA Position Map

FC-4 Link Service Commands

Table 8 lists the FC-4 Link Service commands the drive supports (see the *FC-FS* and *FCP-2* specifications).

Table 8 Supported FC-4 Link Service Commands

FC-4 Command	Abbreviation	Description
13h	REC	Read Exchange Concise
14h	SRR	Sequence Retransmission Request

Unsolicited Control / Name Server Requests

Table 9 lists the Name Server Requests the drive supports (see the *FC-GS*).

Table 9 Supported Name Server Requests

Name Server Request	Abbreviation	Description
0217h	RFT_ID	Register FC-4 Types
021Fh	RFF_ID	Register FC-4 Features – Port Identifier

Serial Attached SCSI (SAS)

For more in information about SAS task management, (see chapter 2, Task Management).

Transport Layer Retries

DLT-S4 tape drives support Transport Layer Retries as indicated in the **MODE SENSE** Logical Unit Control Page. It is not possible to turn off support of Transport Layer Retries.

This section describes implementation specific details of the Transport Layer retires for DLT-S4 tape drive.

Data In Information Unit Retries

When the SDLT-S4 detects that the host did not successfully receive the Data In IU, it will resend the Data In IU. The retransmitted Data In IU will have the following new information in the SSP Frame Header:

- The Changing Data Pointer bit is set to 1
- The Target Port Transfer Tag is set to a new value

The SDLT-S4 will attempt to retransmit the Data In IU up to two times.

Transfer Ready Information Unit Retries

When the SDLT-S4 detects that the host did not successfully receive the Transfer Ready IU, it will resend the Transfer Ready IU. The retransmitted Transfer Ready IU will have the following new information in the SSP Frame Header:

- The Retransmit Bit is set to 1
- The Target Port Transfer Tag is set to a new value

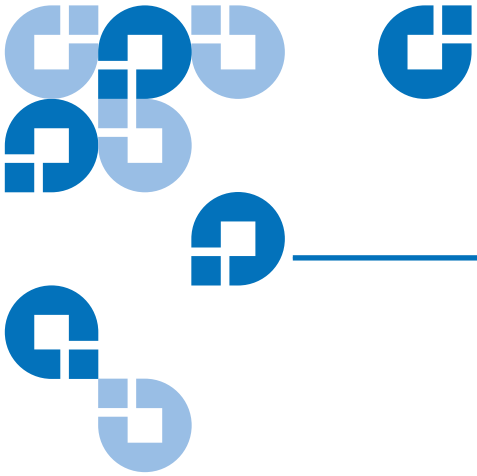
The SDLT-S4 will attempt to retransmit the Transfer Ready IU up to two times.

Response Information Unit Retries

When the SDLT-S4 detects that the host did not successfully receive the Response IU, it will resend the Response IU. The retransmitted Response IU will have the following new information in the SSP Frame Header:

- The Retransmit Bit is set to 1

The SDLT-S4 will attempt to retransmit the Response IU up to two times.



Chapter 4

SCSI Commands

This chapter describes the supported SCSI commands, options, and error recovery procedures implemented in the DLT-S4 tape drive. This chapter *does not* fully reiterate the entire ANSI SCSI standards; for information of this nature, refer to the SCSI standards itself.

The Web sites www.scsita.org and www.t10.org are also helpful sources of information.

Overview of SCSI Command and Status Processing

The DLT-S4 tape drive supports the SCSI-3 command set and the SCSI commands listed in table 10.

Table 10 SCSI Commands Supported by DLT-S4 Tape Drives

Command	Operation Code	See
ERASE	19h	page 33
INQUIRY	12h	page 34
LOAD UNLOAD	1Bh	page 54
LOCATE	2Bh	page 56
LOG SELECT	4Ch	page 57
LOG SENSE	4Dh	page 66
MODE SELECT (6) / (10)	15h / 55h	page 98
MODE SENSE (6) / (10)	1Ah / 5Ah	page 157
PERSISTENT RESERVE IN	5Eh	page 209
PERSISTENT RESERVE OUT	5Fh	page 219
PREVENT / ALLOW MEDIUM REMOVAL	1Eh	page 231
READ	08h	page 232
READ ATTRIBUTE	8Ch	page 235
READ BLOCK LIMITS	05h	page 261
READ BUFFER	3Ch	page 263
READ POSITION	34h	page 269
RECEIVE DIAGNOSTIC RESULTS	1Ch	page 275
RELEASE (10)	57h	page 277
RELEASE UNIT	17h	page 279
REPORT DENSITY SUPPORT	44h	page 281
REPORT DEVICE IDENTIFIER	A3h, SA= 05h[1]	page 288
REPORT LUNS	A0h	page 291
REPORT SUPPORTED OPERATION CODES	A3h, SA= 0Ch[1]	page 294

Command	Operation Code	See
REPORT SUPPORTED TASK MANAGEMENT OPERATIONS	A3h, SA= 0Dh[1]	page 300
REPORT TIMESTAMP	A3h, SA= 0Fh[1]	page 302
REQUEST SENSE	03h	page 304
RESERVE (10)	56h	page 317
RESERVE UNIT	16h	page 319
REWIND	01h	page 321
SEND DIAGNOSTIC	1Dh	page 322
SET DEVICE IDENTIFIER	A4h, SA= 06h[1]	page 326
SET TIMESTAMP	A4h, SA= 0Fh[1]	page 328
SPACE	11h	page 330
TEST UNIT READY	00h	page 332
VERIFY	13h	page 333
WRITE	0Ah	page 334
WRITE ATTRIBUTE	8Dh	page 336
WRITE BUFFER	3Bh	page 340
WRITE FILEMARKS	10h	page 343

1. SA = Service Action

Status and Error Reporting

SCSI command-level errors are communicated by a status code that the drive returns during **STATUS**. This occurs at the end of each command unless one of the following events terminates the command:

- **ABORT TASK**, **ABORT TASK SET**, or **CLEAR TASK SET** task management function is processed so that it affects the command.
- **TARGET RESET** or **LOGICAL UNIT RESET** task management function is processed.
- Reset condition
- Unexpected disconnect (Parallel SCSI only).

Table 11 describes the status codes the drive returns.

Table 11 Status Codes

Status Code	Definition	Meaning
00h	**GOOD**	The drive successfully completed the command.
02h	**CHECK CONDITION**	An exception condition occurred.
08h	**BUSY**	The drive cannot currently service the command and has discarded the CDB. The initiator may retry the command later.
18h	**RESERVATION CONFLICT**	The drive cannot process the command because another initiator has established a reservation and the command is subject to reservations.
28h	**TASK SET FULL**	The drive does not have the resources to presently accept the command. The initiator should retry the command at another time, preferably after status is received for a currently outstanding command to the drive.

Autosense

Autosense is the automatic return of sense data to the application client coincident with the completion of a SCSI command ending in **CHECK CONDITION**.

> **Note:** While Fibre Channel and Serial Attached SCSI always support Autosense, Parallel SCSI only supports Autosense when running in Information Unit Mode.

When a command ends with a **CHECK CONDITION**, sense data (that describes the reason for the **CHECK CONDITION**) is generated. If the interface supports autosense, then the drive automatically returns the sense data with the status for the command that ended with a **CHECK CONDITION**. If the interface does not support autosense, then the host issues a **REQUEST SENSE** command to find out what the sense data is.

The sense data that is returned automatically, would still have the same format as the sense data that is returned by the **REQUEST SENSE** command.

Unit Attention Condition

Queued Unit Attentions are implemented on the DLT-S4 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.
- When the medium may have changed asynchronously.
- When another initiator changes the Mode parameters.
- When a firmware (microcode) update has completed.
- Following a **TARGET RESET** or **LOGICAL UNIT RESET** task management function.
- *For Parallel SCSI Only* — Change of SCSI bus transceivers (SE or LVD).
- *For Parallel SCSI Only* — SCSI Bus Reset
- *For Fibre Channel Only* — Port logout or implicit logout.
- *For Serial Attached SCSI only* — Link reset sequence with hard reset.

Up to three Unit Attentions may be queued for each initiator. If an initiator does not clear its queued Unit Attentions, any additional Unit Attention conditions are not reported.

Data In/Out Command Components

Many of the SCSI commands cause data to be transferred between the initiator and the tape drive. The content and characteristics of this data are command-dependent. Table 13 lists the information transmitted with each of the commands.

The drive uses the "Length in CDB" column of table 13 to determine how much command-related data are to be transferred. Table 12 lists how the units (bytes or logical blocks) for the different Length fields are implied by the Length field name as follows:

Table 12 Units for Lengths Fields

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 13 lists the information the initiator passes to the drive as part of the command. The Data In column lists the information the drive sends to the initiator. Numbers in parentheses after an item indicate the item's length in bytes. In some cases, additional length information is communicated during DATA.

Table 13 Command Contents

Command	Length in CDB	Data Out (to drive)	Data In (from drive)
ERASE	0	---	---
INQUIRY	Allocation	---	Standard Inquiry or a Vital Product Data page
LOAD UNLOAD	0	---	---
LOCATE	0	---	---
LOG SELECT	Parameter List	Write Error Count Page, Read Error Count Page, and Compression Ratio Page	---
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)
PERSISTENT RESERVE IN	Allocation	---	Parameter Data
PERSISTENT RESERVE OUT	Parameter Length	Parameter List	---
PREVENT ALLOW MEDIUM REMOVAL	0	---	---
READ	Transfer	---	Data
READ BLOCK LIMITS	0	---	Block Length Limits
READ BUFFER	Allocation	---	Buffer Offset and Allocation Length and/ or Test Data
READ POSITION	Determined by Long Bit	---	Position Identifier or SCSI Logical Address

Command	Length in CDB	Data Out (to drive)	Data In (from drive)
RECEIVE DIAGNOSTIC RESULTS	Allocation	---	Diagnostic Page
REPORT DENSITY SUPPORT	Allocation	---	Density Support Header (4), Density Support Descriptors
REPORT DEVICE IDENTIFIER	Allocation	---	Device Identification Information
REPORT LUNS	Allocation	---	Supported LUNs List
REPORT SUPPORTED OPERATION CODES	Allocation	---	Depends on Parameter Value
REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS	Allocation	---	List of the Various Task Management Functions (Supported, Unsupported)
REPORT TIMESTAMP	Allocation	---	---
REQUEST SENSE	Allocation	---	Sense Data
REWIND	0	---	---
SEND DIAGNOSTIC	Parameter List	Diagnostic Page	---
SET DEVICE IDENTIFIER	Parameter List	Device ID	---
SET TIMESTAMP	Parameter List	Timestamp	---
SPACE	0	---	---
TEST UNIT READY	0	---	---
VERIFY	0	---	---
WRITE	Transfer	Data	---
WRITE BUFFER	Parameter List	Microcode Image Data or Test Data	---
WRITE FILEMARKS	---	---	---

Behavior at Power-On

Depending on the interface, the DLT-S4 tape drive's behavior at power-on consists of the following:

- Parallel SCSI
  - The drive's SCSI lines are set to high impedance.
  - The design of the drive prevents it from generating any spurious signals on the SCSI bus during power-on.
  - Following power-on self test (POST) and self initialization, the tape drive responds to SCSI bus selections and returns appropriate, normal responses. The drive responds to tape motion commands with **CHECK CONDITION** status, Sense Key set to **NOT READY**, until the tape medium is ready.
  - The drive rewinds the tape to Beginning of Tape (BOT).
  - The drive goes through a calibration process at power-on and loading of media.
- Fibre Channel
  - Transceivers are turned on and auto speed negotiation occurs unless a speed jumper on the rear panel of the drive is set, in which case the drive operates at the selected speed.
  - Topology is initialized (loop, point-to-point, or fabric).
  - In point-to-point mode, the drive is ready to send a FLOGI to determine if there is a fabric present.
  - In public loop mode, the drive is ready to log into the fabric.
  - In private loop mode, the drive is ready to accept a login request from a host.
  - The drive rewinds the tape to Beginning of Tape (BOT).
  - The drive goes through a calibration process at power-on and loading of media.
  - Following power-on self test (POST) and self initialization, the tape drive is ready to respond to interface traffic. The drive responds to tape motion commands with **CHECK CONDITION** status, Sense Key set to **NOT READY**, until the tape medium is ready.

- Serial Attached SCSI
  - Transceivers are turned on, auto speed negotiation occurs, and the link reset sequence is initiated.
  - The drive rewinds the tape to Beginning of Tape (BOT).
  - The drives goes through a calibration process at power-on and loading of media.
  - Following power-on self test (POST) and self initialization, the tape drive is ready to respond to interface traffic. The drive responds to tape motion commands with **CHECK CONDITION** status, Sense Key set to **NOT READY**, until the tape medium is ready.

Data Cache and Tape Write Interaction

The DLT-S4 tape drive contains a data cache that buffers blocks and filemarks until it writes them to tape. This section describes what happens when the drive writes, or "flushes," those blocks 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 drive returns the message to the host.

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

The DLT-S4 tape drive writes the contents of the write data cache to the tape medium under the following circumstances:

- When the initiator issues a **WRITE FILEMARKS** command with the Immediate bit set to 0.
- When data has been in the cache longer than the maximum time specified by the value of the **MODE SELECT** command Write Delay Time parameter (the default is 10 seconds).
- When the drive receives a non-write-type media access command.
- When a **RESET** condition occurs.

SCSI Command Descriptions

The SCSI command descriptions that make up the rest of this chapter contain detailed information about each command the DLT-S4 tape drive supports. The SCSI commands are presented in alphabetical order. Fields common to many of the SCSI commands are not repeated for every command; instead they are supported as shown in table 14.

Table 14 Fields Common to Many SCSI Commands

Field Name	How the Field is Supported in SCSI Commands
Control	All SCSI commands must have a Control byte, which is implemented as described in *SCSI Architecture Model – 3* (*SAM–3*).
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 drive terminates the command with a **CHECK CONDITION** status and the Sense Key is set to **ILLEGAL REQUEST**.

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 to 8) of the **LOG SELECT** command, shown as follows:

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

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

This is an alternate, "shorthand" presentation for:

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

ERASE Command (19h)

The **ERASE** command erases the data on the tape medium. The tape drive erases the data only if the Long bit is set to 1 and the drive receives the **ERASE** command while it is at Beginning of Tape (BOT). If the Long bit is set to 0, this command has no effect on the tape medium.

> Note: The time required to completely erase a tape cartridge is more than 3 hours.

Figure 5 **ERASE** Command Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (19h)							
1	Reserved						Immed	Long
2 — 4	Reserved							
5	Control							

Table 15 **ERASE** Command Descriptor Block — Field Descriptions

Field	Description
Immed	Immediate. If set to 0, the drive does not return status until the selected operation has completed. If set to 1, the drive returns status as soon as it initiates the operation.
Long	Must be set to 1 to perform an erase operation. Issuing an **ERASE** command when the tape is not at BOT is an **ILLEGAL REQUEST**. If set to 0, the drive performs no operation—the **ERASE** command does not affect the tape.

INQUIRY Command (12h)

The **INQUIRY** command allows the initiator to direct all attached devices to return information about themselves. DLT-S4 devices respond by providing a variety of information, including their World Wide Name and other important characteristics. The DLT-S4 tape drive identifies itself as a Sequential Access Storage Device.

> Note: The tape drive does not need to access its tape medium to respond to the **INQUIRY** command.

The drive can provide different categories of data in response to an **INQUIRY** command:

- **Standard Inquiry Data** — contains basic data about the drive, including vendor-specific inquiry data that precisely identifies the revision of tape drive subsystem components.
- **Vital Product Data** — comprises several pages of additional data. Each Vital Product Data page requires a separate **INQUIRY** command from the initiator. To see a list of supported Vital Product Data pages (see Supported Vital Product Data Page (00h) on page 41).

An **INQUIRY** command is neither affected by—nor does it clear—any Unit Attention condition.

Figure 6 **INQUIRY** Command Descriptor Block — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (12h)							
1	Reserved						Obsolete	EVPD
2	Page Code							
3 — 4	(MSB) Allocation Length (LSB)							
5	Control							

Table 16 **INQUIRY** Command Descriptor Block — Field Descriptions

Field	Description
EVPD	Enable Vital Product Data. If set to 0, the drive returns the Standard Inquiry Data. If EVPD is set to 1, the drive returns the Vital Product Data Page specified by Page Code.
Page Code	Specifies the Vital Product Data Page that the drive is to return when EVPD is set to 1. Figure 9 shows the Page Codes for the Vital Product Data pages the drive supports.
Allocation Length	Specifies the number of bytes of inquiry information the drive is allowed to return to the initiator. The drive does not return Error status if the value in this field truncates the requested information.

Standard Inquiry Data Page

Figure 7 shows the Standard Inquiry Data page format.

Figure 7 Standard Inquiry Data Page —Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	RMB	Reserved						
2	Version							
3	Obsolete		NormACA	HiSup	Response Data Format			
4	Additional Length							
5	SCCS	ACC	ALUA		3PC	Reserved		
6	BQue	EncServ	VS	MultiP	MChngr	Obsolete		Addr16
7	RelAdr	Obsolete	Wbus16	Sync	Linked	Obsolete	CmdQue	VS
8 — 15	(MSB) Vendor Identification (QUANTUM) (LSB)							

Bit / Byte	7	6	5	4	3	2	1	0
16 — 31	(MSB) Product Identification (LSB)							
32 — 35	(MSB) Product Revision Level (hhss) (LSB)							
36 — 55	(MSB) Vendor-Specific Bytes (LSB)							
56	Reserved				Clocking		QAS	IUS
57	Reserved							
58 — 59	(MSB) Version Descriptor (first version descriptor) (LSB)							
(*n* — 1) — *n*	Version Descriptor (last version descriptor, if more than one)							

Table 17 contains field descriptions for the data the DLT-S4 tape drive returns.

Table 17 Standard **INQUIRY** Data Page — Field Descriptions

Field	Value	Description
Peripheral Qualifier	000b or 011b	This field contains 000b if the command is directed to a valid device. The field contains 011b if there is no device at the selected LUN.
Peripheral Device Type	01 or 1Fh	This field contains 01h if the LUN is 0h or 1Fh if no device is attached to the selected LUN.
RMB	1	Removable Medium Bit.
Version	04h	The drive supports ANSI SCSI-3 per *SPC-2*.
NormACA	0	Normal ACA.
HiSup	1	Hierarchical Support.

Field	Value	Description
Response Data Format	2	This Standard Inquiry Data is in the format described in the Version field.
Additional Length	---	The drive uses this field to indicate the number of additional bytes of **INQUIRY** Response Data available. The value depends on the number of version descriptors returned in the **INQUIRY** Response Data.
SCCS	0	SCC Supported.
ACC	0	Access Controls Coordinator.
ALUA	00b	Asymmetric Logical Unit Access.
3PC	0	Third-party Copy.
BQue	0	Basic Tagged Command Queuing.
EncServ	0	Enclosure Services.
VS	0	Vendor-Specific.
MultiP	0	Multi Port.
Addr16	See table 18.	16-Bit Addressing.
MChnger	0	Medium Changer.
RelAdr	0	Relative Addressing.
WBus16	See table 18.	Wide Bus 16.
Sync	See table 18.	Synchronous Data Transfer.
Linked	0	Linked Command Support.
CmdQue	See table 18.	Tagged Command Queuing.
Vendor Identification	QUANTUM	The value in this field is left-aligned and set to “QUANTUM”. The remainder of the field is filled with space characters.
Product Identification	DLT-S4	For the DLT-S4 tape drive, this field is set to “DLT-S4”, left-aligned, filled with spaces to the end of the field.
Product Revision	---	Contains 4 bytes of ASCII data that provide the drive’s firmware revision levels. The first 2 bytes are the version number for servo code. The second 2 bytes are the version number of the SCSI/ read/write code. When a firmware update is performed on the tape drive, the second two bytes of the revision level change to reflect that update.

Field	Value	Description
Clocking	See table 18.	Clocking.
QAS	See table 18.	Quick Arbitrate Supported.
IUS	See table 18.	Information Units Supported.
Version Descriptors	Version descriptors my vary by protocol (Parallel SCSI, Fibre Channel, and SAS)	Identifies the industry standards to which the drive conforms. **Note:** As many version descriptors as apply for the drive are returned.

Table 18 **INQUIRY** Command Variance by Protocol

Field	Parallel SCSI	Fibre Channel	SAS
Addr16	1	0	0
Wbus16	1	0	0
Sync	1	0	0
CmdQue	1	0	1
Clocking	11b	00b	00b
QAS	1	0	0
IUS	1	0	0

Vendor-Specific Inquiry Data Field

Figure 8 identifies the revision of tape drive subsystem components.

Figure 8 Vendor-Specific Inquiry Data Field — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
36	Product Family				Released Firmware			
37	Firmware Major Version Number							
38	Firmware Minor Version Number							
39	EEPROM Format Major Version Number							
40	EEPROM Format Minor Version Number							
41	Firmware Personality							
42	Firmware Subpersonality							
43	Vendor-Specific Subtype							
44	Controller Hardware Version Number							
45	Tape Drive EEPROM Version Number							
46	Tape Drive Hardware Version Number							
47	Media Loader Firmware Version Number							
48	Media Loader Hardware Version Number							
49	Media Loader Mechanical Version Number							
50	Media Loader Present Flag							
51	Library Present Flag							
52 — 55	Module Revision							

Note: See Subsystem Components Revision Page (C1h) on page 52 for information about an alternate method for accessing these same drive subsystem components.

Table 19 Vendor-Specific Inquiry Data Page — Field Descriptions

<table>
<tr><th>Field</th><th colspan="3">Description</th></tr>
<tr><td>Product Family</td><td colspan="3">Indicates the data density of the tape drive. This field is set to a value of Dh for the DLT-S4.</td></tr>
<tr><td>Released Firmware</td><td colspan="3">Differentiates between released and test versions of firmware. The Released Firmware field combined with the Minor Version field, can be used to determine the Code Version. Released customer code has no minor firmware version number (byte 38 is set to 0). The following shows how to determine the Code Version based on the Minor Version and the Released Firmware Fields:
<table>
<tr><th>Code Version</th><th>Released Firmware</th><th>Minor Version</th></tr>
<tr><td>V code</td><td>1</td><td>0</td></tr>
<tr><td>T code</td><td>1</td><td>Non-zero</td></tr>
<tr><td>X code</td><td>0</td><td>any</td></tr>
</table></td></tr>
<tr><td>Version Number Fields</td><td colspan="3">These fields display the various version numbers in binary format, instead of ASCII.</td></tr>
<tr><td>Firmware Personality</td><td colspan="3">Numeric indicator of firmware personality. Note that when set to 4, indicates OEM family.</td></tr>
<tr><td>Firmware Subpersonality</td><td colspan="3">Indicates the variant of the firmware personality. Always set to 1, indicating the primary firmware personality variant.</td></tr>
<tr><td>Vendor-Specific Subtype</td><td colspan="3">Product identification.</td></tr>
<tr><td>Media Loader Present Flag</td><td colspan="3">Set to zero to indicate there is no attached medium changer present.</td></tr>
<tr><td>Library Present Flag</td><td colspan="3">Set to 0 to indicate the drive has not detected the presence of a library controller. Set to a non-zero value when communications has been established with a tape automation system.</td></tr>
<tr><td>Module Revision</td><td colspan="3">A 4-byte ASCII string representing the revision level of the tape drive’s module (the controller PCBA attached to the drive).</td></tr>
</table>

Vital Product Data Pages

The following subsections describe the Vital Product Data Pages for the DLT-S4 tape drive.

Supported Vital Product Data Page (00h)

The Supported Vital Product Data Page provides a directory of the Vital Product Data pages that the drive supports. The supported pages are:

- Supported Vital Product Data Page (00h)
- Unit Serial Number Page (80h)
- Device Identification Page (83h)
- Sequential-Access Device Capabilities Page (B0h)
- Manufacturer-assigned Serial Number Page (B1h)
- Firmware Build Information Page (C0h)
- Subsystem Components Revision Page (C1h).

Figure 9 Supported Vital Product Data Pages — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (00h)							
2	Reserved							
3	Page Length (07h)							
4	Supported Vital Product Data Page (00h)							
5	Unit Serial Number Page (80h)							
6	Device Identification Page (83h)							
7	Sequential-Access Device Capabilities Page (B0h)							
8	Manufacturer-assigned Serial Number Page (B1h)							
9	Firmware Build Information Page (C0h – Vendor Specific)							
10	Subsystem Components Revision Page (C1h – Vendor Specific)							

Unit Serial Number Page (80h)

Figure 10 shows the format of the Unit Serial Number Page the drive returns.

Figure 10 Unit Serial Number Page — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type (01h)				
1	Page Code (80h)							
2	Reserved							
3	Page Length (10h)							
4 — 19	Serial Number							

Table 20 Unit Serial Number Page — Field Descriptions

Field	Description
Serial Number	The serial number given is the serial number of the module or the drive, typically beginning with "MX", indicating the site of manufacture. If the drive serial number is valid, it is reported; otherwise, the module serial number is reported. The serial number appears on the bar code label. The drive returns the serial number in ASCII format.

Device Identification Page (83h)

Figure 11 shows the format of the Device Identification Page the drive returns.

Figure 11 Device Identification Page — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type (01h)				
1	Page Code (83h)							
2	Reserved							
3	Page Length							
4 — *n*	Identification Descriptors							

Table 21 Device Identification Page — Field Descriptions

Field	Description
Peripheral Qualifier	Contains 000b.
Peripheral Device Type	Contains 01h.
Page Code	A value of 83h identifies this as the Device Identification page.
Page Length	Indicates the size of the returned Device Identification page.
Identification Descriptors	The drive always returns the Vendor-Unique Logical Unit Identifier and the Logical Unit NAA Identifier. It may also return other identifiers. The following identifiers are described in this section: • Vendor-Unique Logical Unit Identifier • Logical Unit NAA Identifier • Port NAA Identifier • Relative Target Port Identifier

Vendor-Unique Logical Unit Identifier

Figure 12 shows the format of the Vendor-Unique Logical Unit Identifier.

Figure 12 Vendor-Unique Logical Unit Identifier — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Protocol Identifier (0)				Code Set (2h)			
1	PIV (0)	Reserved	Association (0)		Identifier Type (1)			
2	Reserved							WORM
3	Identifier Length (40)							
4 — 11	(MSB) Vendor Identification (LSB)							
12 — 27	(MSB) Product Identification (LSB)							
28 — 43	(MSB) Serial Number (LSB)							

Table 22 Vendor-Unique Logical Unit Identifier — Field Descriptions

Field	Description
Protocol Identifier	Set to 0.
Code Set	Set to 2h indicating the descriptor consists of ASCII printable characters.
PIV	Protocol Identifier Valid. Set to 0, indicating that the value returned in the Protocol Identifier field should be ignored.
Association	Set to 0, indicating that the Identifier is associated with the logical unit.
Identifier Type	Set to 1h indicating this identifier is of the T10 Vendor-Specific type.
WORM	This would indicate that the drive can read and write WORM tapes.
Identifier Length	Set to 40, indicating the remainder of the descriptor is 40 byte long.
Vendor Identification	The value in this field is left-aligned and set to “QUANTUM”. The remainder of the field is filled with space characters.
Product Identification	This field is set to “DLT-S4”, left-aligned, and filled with space characters to the end of the field.
Serial Number	The serial number given is the serial number of the module or the drive, typically beginning with “MX”, indicating the site of manufacture. If the drive serial number is valid, it is reported; otherwise, the module serial number is reported. The serial number appears on the bar code label. The drive returns the serial number in ASCII format.

Logical Unit NAA Identifier

Figure 13 shows the format of the Logical Unit NAA Identifier.

Figure 13 Logical Unit NAA Identifier — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Protocol Identifier (0)				Code Set (1)			
1	PIV (0)	Reserved	Association (0)		Identifier Type (3h)			
2	Reserved							
3	Identifier Length (08h)							
4 — 11	(MSB) NAA Identifier (binary) (LSB)							

Table 23 Logical Unit NAA Identifier — Field Descriptions

Field	Description
Protocol Identifier	Set to 0.
Code Set	Set to 1h, indicating binary data.
PIV	Set to 0, indicating that the value returned in the Protocol Identifier field should be ignored.
Association	Set to 0, indicating that the Identifier is associated with the logical unit.
Identifier Type	Set to 3h indicating this identifier is of the NAA type.
Identifier Length	Specifies the length in bytes of the Identifier field. If the Allocation Length field of the CDB is too small to transfer the entire identifier, the Identifier Length value is not adjusted to reflect the truncation.
NAA Identifier	Contains the Name Address Authority (NAA) identifier for the logical unit.

Port NAA Identifier

Figure 14 shows the format of the Port NAA Identifier.

Figure 14 Port NAA Identifier — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Protocol Identifier				Code Set (1)			
1	PIV (1)	Reserved	Association (1)		Identifier Type (3)			
2	Reserved							
3	Identifier Length (08h)							
4 — 11	(MSB) NAA Identifier (binary) (LSB)							

Table 24 Port NAA Identifier — Field Descriptions

Field	Description
Protocol Identifier	The drive returns 0 if the protocol is Fibre Channel, and 6h if the protocol is SAS. This identifier type is not returned by devices using a parallel SCSI interface.
Code Set	Set to 1h, indicating binary data.
PIV	Set to 1, indicating that the value returned in the Protocol Identifier field is valid.
Association	Set to 1h, indicating that the Identifier is associated with the port.
Identifier Type	Set to 3h indicating this identifier is of the NAA type.
Identifier Length	Specifies the length in bytes of the Identifier field. If the Allocation Length field of the CDB is too small to transfer the entire identifier, the Identifier Length value is not adjusted to reflect the truncation.
NAA Identifier	Contains the Name Address Authority (NAA) identifier for the port.

Relative Target Port Identifier

Figure 15 shows the format of the Relative Target Port Identifier.

Figure 15 Relative Target Port Identifier — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Protocol Identifier				Code Set (1)			
1	PIV (1)	Reserved	Association (1)		Identifier Type (4)			
2	Reserved							
3	Identifier Length (04h)							
4 — 5	Obsolete							
6 — 7	Relative Target Port Identifier							

Table 25 Relative Target Port Identifier — Field Descriptions

Field	Description
Protocol Identifier	The drive returns 0h if the protocol is Fibre Channel, 1h if the protocol is Parallel SCSI, and 6h if the protocol is SAS.
Code Set	Set to 1h, indicating binary data.
PIV	Set to 1h, indicating that the value returned in the Protocol Identifier field is valid.
Association	Set to 1h, indicating that the Identifier is associated with the port.
Identifier Type	Set to 4h indicating this identifier is of type Relative Target Port.
Identifier Length	Specifies the length in bytes of the Identifier field. If the Allocation Length field of the CDB is too small to transfer the entire identifier, the Identifier Length value is not adjusted to reflect the truncation.
Relative Target Port Identifier	Value = 1 device has single port.

Sequential-Access Device Capabilities VPD Page (B0h)

Figure 16 and table 26 specify and describe the sequential-access device capabilities VPD page. This page provides the application client with the means to determine if the features specified in this page are supported by the device server.

Figure 16 Sequential-Access Device Capabilities VPD Page — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (B0h)							
2 — 3	(MSB) Page Length (4) (LSB)							
4	Reserved							WORM (1)
5 — 7	Reserved							

Table 26 Sequential-Access Device Capabilities VPD Page — Field Descriptions

Field	Description
Peripheral Qualifier	Contains 000b.
Peripheral Device Type	Contains 01h.
Page Length	The PAGE LENGTH field specifies the length of the following VPD page data. If the allocation length value in the **INQUIRY** command descriptor block is too small to transfer all of the VPD page data, the page length is not adjusted to reflect the truncation.
WORM	The Write Once, Read Many (WORM) bit indicates if the device is capable of supporting this mode. This bit is always set to 1.

Manufacturer-Assigned Serial Number Page (B1h)

Figure 17 and table 27 specify and describe the Manufacturer-Assigned Serial Number Page.

Figure 17 Manufacturer-Assigned Serial Number Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (B1h)							
2	Reserved							
3	Page Length (10h)							
4 — 19	Manufacturer Serial Number							

Table 27 Manufacturer-Assigned Serial Number Page — Field Descriptions

Field	Description
Peripheral Qualifier	Contains 000b.
Peripheral Device Type	Contains 01h.
Page Code	A value of B1h identifies this as the Manufacturer-Assigned Serial Number page.
Page Length	Contains 10h that indicates the size of the returned Manufacturer-Assigned Serial Number page.
Manufacturer Serial Number	The Manufacturer Serial Number field contains right-aligned ASCII data that is the manufacturer assigned serial number.

Firmware Build Information Page (C0h)

Figure 18 shows the format of the Firmware Build Information page the drive returns.

Figure 18 Firmware Build Information Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (C0h)							
2	Reserved							WORM
3	Page Length (28h)							
4 — 7	Servo Firmware Revision							
8 — 11	Servo Firmware Checksum							
12 — 15	Servo EEPROM Checksum							
16 — 19	Controller Firmware Checksum							
20 — 43	Controller Firmware Build Date							

Table 28 Firmware Build Information Page — Field Descriptions

Field	Description
WORM	The Write Once, Read Many (WORM) bit indicates if the device is capable of supporting this mode. This bit is always set to 1.
Servo Firmware Revision	Contains the revision number of the servo firmware.
Checksum	The Servo Firmware, Servo EEPROM, and **READ** / **WRITE** Firmware checksums are binary numbers used for positive firmware and EEPROM identification.
Controller Firmware Build Date	Firmware Build Date. An ASCII string in DD-MM-YYYY HH:MM:SS format.

Subsystem Components Revision Page (C1h)

Figure 19 identifies the revision of tape drive subsystem components.

Figure 19 Subsystem Components Revision Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (C1h)							
2	Reserved							
3	Page Length (39h)							
4	Product Family				Released Firmware			
5	Firmware Major Version Number							
6	Firmware Minor Version Number							
7	EEPROM Format Major Version Number							
8	EEPROM Format Minor Version Number							
9	Firmware Personality							
10	Firmware Subpersonality							
11	Vendor-Specific Subtype							
12	Controller Hardware Version Number							
13	Tape Drive EEPROM Version Number							
14	Tape Drive Hardware Version Number							
15	Media Loader Firmware Version Number							
16	Media Loader Hardware Version Number							
17	Media Loader Mechanical Version Number							
18	Media Loader Present Flag							
19	Library Present Flag							
20 — 23	Module Revision							
24 — 43	Unit Serial Number							

Table 29 Subsystem Components Revision Page — Field Descriptions

Field	Description
Product Family	Indicates the data density of the tape drive. This field is set to a value of Dh.
Released Firmware	Differentiates between released and test versions of firmware. When set to 1, indicates released code (Vxxx); when set to 0, indicates field test code (Txxx). Released code has no minor firmware version number (byte 38 is set to 0). For tracking purposes, field test and engineering versions of code have non-zero minor firmware version numbers.
Version Number Fields	These fields display the various version numbers in binary format, instead of ASCII.
Firmware Personality	Numeric indicator of firmware personality. Note that when set to 4, indicates OEM family.
Firmware Subpersonality	Indicates the variant of the firmware personality. Always set to 1, indicating the primary firmware personality variant.
Vendor-Specific Subtype	Product identification.
Media Loader Present Flag	When set to 0, indicates no loader present. Non-zero indicates loader is present.
Library Present Flag	When set to 0, indicates no library present. Non-zero indicates library is present.
Module Revision	A 4-byte ASCII string representing the revision level of the tape drive's module (the controller PCBA attached to the drive).
Unit Serial Number	Drive's serial number; matches what is shown on the exterior of the drive chassis.

LOAD UNLOAD Command (1Bh)

The **LOAD UNLOAD** command instructs the DLT-S4 tape drive to load or unload the tape inside the data cartridge. If no data cartridge is in the drive, the **LOAD UNLOAD** command returns a CHECK CONDITION status with the Sense Key set to NOT READY. Likewise, if the drive receives a **LOAD UNLOAD** command with the Immediate bit set and then it receives another command that requires tape motion or if it receives a **TEST UNIT READY** command, the drive returns a CHECK CONDITION status with the Sense Key set to NOT READY.

Before executing the **LOAD UNLOAD** command, the drive writes any cached write data to the tape.

Figure 20 **LOAD UNLOAD** Command Descriptor Block — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Bh)							
1	Reserved							Immed
2 — 3	Reserved							
4	Reserved				Hold	EOT	ReTen	Load
5	Control							

Table 30 **LOAD UNLOAD** Command Descriptor Block — Field Descriptions

Field	Description
Immed	Immediate. When set to 1, the drive returns status as soon as the operation starts. When set to 0, the drive returns status after the operation has completed.
Hold	See table 31.
EOT	End of Tape. The drive ignores this bit unless both the EOT and Load bits are set to 1, then the drive returns CHECK CONDITION status with Sense Key set to ILLEGAL REQUEST.
ReTen	Retension. Ignored. Retension operations are not needed.
Load	See table 31.

Table 31 **HOLD** and LOAD — Field Descriptions

HOLD	LOAD	Description
0	0	The tape is unloaded and the cartridge is ejected. When the HOLD bit is set to 0 and the LOAD bit is set to 0, the tape is unloaded and the cartridge is ejected.
0	1	The tape is and positioned for access. When set to 0 and the LOAD bit is set to one, the tape is loaded for medium access.
1	0	The tape is unloaded, but not ejected. When the HOLD bit is set to 1 and the LOAD bit is set to 0, the tape is unloaded from the device but not ejected to allow the operator access to the cartridge.
1	1	The tape is seated, but not loaded. When the HOLD bit set to 1 and the LOAD bit is also set to 1, the tape is loaded to the point where the MAM is accessible but the medium is not positioned for access.

LOCATE Command (2Bh)

The **LOCATE** command performs high-speed positioning to a specified block address. Use the **READ POSITION** command to obtain the block address associated with the current position on tape. Then use the **LOCATE** command to position the tape at the same logical position for high-performance restore operations of particular blocks of data.

Figure 21 **LOCATE** Command Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (2Bh)							
1	Reserved					BT	CP	Immed
2	Reserved							
3 — 6	(MSB) Logical Object Identifier (LSB)							
7	Reserved							
8	Partition							
9	Control							

Table 32 **LOCATE** Command Descriptor Block — Field Descriptions

Field	Description
BT	Block Type. The drive ignores this bit.
CP	Change Partition. Must set to 0.
Immed	Immediate. When set to 1, the drive returns status as soon as the operation starts. When set to 0, the drive returns status after the operation has completed.
Logical Object Identifier	Specifies the Logical Object Identifier to which the drive positions the medium.
Partition	Not applicable; the drive ignores this bit (see CP field).

LOG SELECT Command (4Ch)

The **LOG SELECT** command allows the host to manage statistical information the DLT-S4 tape drive maintains about its own hardware parameters and about the installed tape medium. Read the description of the LOG SENSE Command (4Dh) on page 66; it provides information about log page format, parameters, and supported pages.

Figure 22 **LOG SELECT** Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (4Ch)							
1	Reserved						PCR	SP
2	PC		Reserved					
3 — 6	Reserved							
7 — 8	(MSB) Parameter List Length (LSB)							
9	Control							

Table 33 **LOG SELECT** Command Descriptor Block — Field Descriptions

<table>
<tr><th>Field</th><th colspan="2">Description</th></tr>
<tr><td>PCR</td><td colspan="2">Parameter Code Reset. If this bit is set to 1 and the Parameter List Length field is set to 0, all accumulated values of page codes 2, 3, and 0C are set to 0 and all threshold values are set to default. If PCR is set to 1 and the Parameter List Length field is set to a non-zero value, the drive terminates the command with CHECK CONDITION status, Sense Key set to ILLEGAL REQUEST, and Additional Sense Code (ASC) set to INVALID FIELD IN CDB.</td></tr>
<tr><td>SP</td><td colspan="2">Save Parameters. Must be set to 0.</td></tr>
<tr><td>PC</td><td colspan="2">Page Control. Defines the type of parameter values to be selected:
Code — Types of Parameter Value
00b — Current Threshold Values
01b — Current Threshold Values
10b — Default Threshold Values
11b — Default Threshold Values
When the PC field is set to 10b and the Parameter List Length field is set to 0, all Current Threshold Values are reset to the Default Threshold Values. When the PC field is set to 11b and the Parameter List Length field is set to 0, all Current Cumulative Values are reset to the Default Cumulative Values. This is equivalent to clearing all log pages that can be cleared.
Note: The drive ignores the PC field value if the PCR bit is set to 1.</td></tr>
<tr><td>Parameter List Length</td><td colspan="2">Specifies the length, in bytes, of the LOG SELECT parameter list to be transferred from the initiator to the drive during DATA OUT.
A Parameter List Length of 0 indicates that no data is to be transferred. This condition is not considered an error.</td></tr>
</table>

Overview—LOG SELECT Command Descriptor Block Errors

The following conditions constitute errors that the drive detects in relation to the CDB. If the drive detects one of the conditions listed, it will return CHECK CONDITION with the Sense Key set to ILLEGAL REQUEST and the Additional Sense Code set to INVALID FIELD IN CDB.

The conditions that constitute errors are:

- PCR bit is set to 1; Parameter List Length field is not set to 0.
- Both the PCR and SP bits are 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 the drive supports.

The two ways to initialize the log parameters are:

1. Set the PCR bit to 1 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:

Table 34 **LOG SELECT** Page-clearing Codes

Page Code	Page Description
02h	Write Error Count Page
03h	Read Error Count Page
0Ch	Sequential Access Device Page
38h	General Purpose Non-Volatile Log Page

Note: If an initiator sends multiple pages, it must send them in ascending order according to page code. Otherwise, the drive terminates the command with a CHECK CONDITION status, Sense Key set to ILLEGAL REQUEST, and Additional Sense Code set to INVALID FIELD IN PARAMETER LIST. The drive returns the same status if an unsupported page code appears in any header or if the specified page cannot be cleared.

LOG SELECT Log 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, comprises 8 bytes. The parameter block for page code 05h is 12 bytes.

Figure 23 **LOG SELECT** Log Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Page Code							
1	Reserved							
2 – 3	(MSB) Page Length (*n* – 3) (LSB)							
	Log Parameters							
4	Log Parameter (First)							
x + 3	Length (*x*)							
	. .							
n — *y* + 1	Log Parameter (Last)							
n	Length (*y*)							

Table 35 **LOG SELECT** Log Page Header — Field Descriptions

Field	Description
Page Code	Specifies the log page to which this **LOG SELECT** command is directed.
Page Length	Specifies the total number of bytes contained in this log page, not including the 4 bytes that make up the header.
Log Parameters	Use one block for each parameter code.

Figure 24 **LOG SELECT** Log Page — Parameters Format

Bit / Byte	7	6	5	4	3	2	1	0
0 — 1	(MSB) Parameter Code (LSB)							
2	DU	DS	TSD	ETC	TMC		LBIN	LP
3	Parameter Length (*n* – 3)							
4 — *n*	(MSB) Parameter Value (LSB)							

Table 36 **LOG SELECT** Log Parameters — Field Descriptions

Field	Description	
Parameter Code	Parameter codes supported for the **READ** / **WRITE** error counter pages:	
	Code	**Description**
	0000h	Errors corrected without substantial delays
	0001h	Errors corrected with possible delays
	0002h	Total read / write errors
	0003h	Total read / write errors
	0004h	Total times correction algorithm processed. Always 0 for write errors only.
	0005h	Total bytes processed
	0006h	Total uncorrected errors
	8000h	**WRITE** errors since last **READ** (page 02) *or* **READ** errors since last **WRITE** (page 03)

<table>
<tr><th>Field</th><th colspan="2">Description</th></tr>
<tr><td rowspan="6">Parameter Code
(continued)</td><td>8001h</td><td>Total raw write error flags</td></tr>
<tr><td>8002h</td><td>Total dropout error count</td></tr>
<tr><td>8003h</td><td>Total servo tracking errors</td></tr>
<tr><td>9000h-900Fh</td><td>Without substantial delay errors by channel</td></tr>
<tr><td>9080h-908Fh</td><td>Write only: Possible delay errors assignable to specific channels
Read only: Raw sub-block read errors by channel
Note: Many of these errors are write, not read, errors and are not to be included in read error-rate calculations. If these errors are used to try to identify bad channels, the bad channel may be on either the writing or reading drive.</td></tr>
<tr><td colspan="2">Note: Parameter codes 00h, 01h, and 04h always have a value of 0. Parameter value for 05h is eight bytes; the Parameter Length field is set to 8.</td></tr>
<tr><td>DU</td><td colspan="2">Disable Update. This bit is not defined for LOG SELECT; the drive ignores any value in DU.</td></tr>
<tr><td>DS</td><td colspan="2">Disable Save. DS and Target Save Disable (TSD) must be set to 1.</td></tr>
<tr><td>TSD</td><td colspan="2">Target Save Disable. TSD and DS must be set to 1.</td></tr>
<tr><td>ETC</td><td colspan="2">Enable Threshold Comparison. When set to 1, the 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, the drive generates a UNIT ATTENTION for all initiators. The drive sets the Additional Sense Code to THRESHOLD CONDITION MET. If the RLEC bit is 0 and the comparison is met, the drive does not generate a UNIT ATTENTION.</td></tr>
<tr><td rowspan="6">TMC</td><td colspan="2">Threshold Met Criteria. Once the criteria specified in this field are met, the ETC bit is 1, and the RLEC bit in the MODE SENSE / SELECT Control Page is set to 1, the drive generates a UNIT ATTENTION for all initiators.
The criteria for comparison are:</td></tr>
<tr><td>Code</td><td>Basis of Comparison</td></tr>
<tr><td>00b</td><td>Every update of the cumulative value</td></tr>
<tr><td>01b</td><td>Cumulative value equal to threshold value</td></tr>
<tr><td>10b</td><td>Cumulative value not equal to threshold value</td></tr>
<tr><td>11b</td><td>Cumulative value greater than threshold value</td></tr>
</table>

Field	Description
TMC (continued)	• 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 tape drive by power-cycle, **TARGET RESET**, **SCSI RESET**, or **FCP TARGET RESET**. • The Default Cumulative Values are the values to which each parameter is initialized at a reset condition. Default value is 0. • By default, Current Threshold Values are set to Default Threshold Values. • Note that all types of parameter values are changeable using **LOG SELECT**.
LBIN	List Binary. Must be set to 0.
LP	List Parameter. Always set this bit to 0 to indicate that parameter codes are treated as data counters.
Parameter Length	Specifies the number of bytes in the parameter value.
Parameter Value	Indicates the actual value of this log parameter.

General Purpose Non-Volatile Log Page (38h)

Log page 38h provides access to a 64 byte non-volatile buffer in the tape drive for general purpose use. The log page contains one 64 byte parameter with a Parameter Code setting of 0. The 64 bytes in the Parameter Value field are stored in device non-volatile memory and are returned when a **LOG SENSE** command requests log page 38h.

Figure 25 General Purpose Non-Volatile **LOG SELECT** Page — Header Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Page Code (38h)							
1	Reserved							
2 – 3	(MSB) Page Length (LSB)							

Table 37 General Purpose Non-Volatile **LOG SELECT** Header — Field Descriptions

Field	Description
Page Code	Echoes the page code specified in the **LOG SELECT CDB**.
Page Length	Specifies the total number of bytes contained in this log page, not including the 4 bytes that make up the header.

Figure 26 General Purpose Non-Volatile **LOG SELECT** Page — Parameter Format

Bit / Byte	7	6	5	4	3	2	1	0
0 — 1	(MSB) Parameter Code (LSB)							
2	DU	DS	TSD	ETC	TMC		LBIN	LP
3	Parameter Length (40h)							
4 — 67	(MSB) Parameter Value (LSB)							

Table 38 General Purpose Non-Volatile **LOG SELECT** Page — Field Descriptions

Field	Description		
Parameter Code	Parameter code supported for this page. Must be 0.		
Parameter Control Byte	**Bit**	**Value**	**Description**
	DU	1	Disable Update.
	DS	0	Disable Save.
	TSD	0	Target Save Disable.
	ETC	0	Enable Threshold Comparison.
	TMC	0	Threshold Met Criteria.
	LBIN	0	List Binary.
	LP	1	List Parameter.
Parameter Length	Specifies the number of bytes in the parameter value. Must be 40h.		
Parameter Value	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 the drive uses.
- 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 status with Sense Data set to ILLEGAL REQUEST and Additional Sense Code set to INVALID FIELD IN PARAMETER LIST:

- The drive receives a page header 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 parameter control byte is set to an invalid value for the parameter code.

LOG SENSE Command (4Dh)

The **LOG SENSE** command allows the host to retrieve statistical information the tape drive maintains about its own hardware parameters or about the installed tape medium. This command complements the **LOG SELECT** command.

Figure 27 **LOG SENSE** Command Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (4Dh)							
1	Reserved						PPC	SP (0)
2	PC		Page Code					
3 — 4	Reserved							
5 — 6	(MSB) Parameter Pointer (LSB)							
7 — 8	(MSB) Allocation Length (LSB)							
9	Control							

Table 39 **LOG SENSE** Command Descriptor Block — Field Descriptions

<table>
<tr><th>Field</th><th colspan="3">Description</th></tr>
<tr><td>PPC</td><td colspan="3">Parameter Pointer Control. When set to 0, indicates that the parameter data requested from the drive starts with the parameter code specified in the Parameter Pointer field (bytes 5 – 6) and returns the number of bytes specified in the Allocation Length field (bytes 7 – 8) in ascending order of parameter codes from the specified log page. When set to 1, the drive returns only the parameters that have changed since the last time the page was read.</td></tr>
<tr><td>SP</td><td colspan="3">Save Parameters. Must be set to 0.</td></tr>
<tr><td>PC</td><td colspan="3">Page Control. This field defines the type of parameter values to be returned:
<table>
<tr><th>Code</th><th>Type of Parameter Values</th></tr>
<tr><td>00b</td><td>Threshold Values</td></tr>
<tr><td>01b</td><td>Cumulative Values</td></tr>
<tr><td>10b</td><td>Default Threshold Values</td></tr>
<tr><td>11b</td><td>Default Cumulative Values</td></tr>
</table>

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 drive by power-cycle, TARGET RESET, SCSI RESET, or FCP TARGET RESET.
Some parameters reset to their default value due to other events, such as loading a new medium.
The Default Cumulative values are the values to which each parameter is initialized at a reset condition. Default values are 0.
By default, Current Threshold Values are set to Default Threshold Values.
</td></tr>
<tr><td>Page Code</td><td colspan="3">The Page Code field identifies the log page the initiator requested. The drive supports the following pages:
<table>
<tr><th>Page Code</th><th>Page Definition</th><th>Refer to</th></tr>
<tr><td>00h</td><td>Supported Pages Log Page (Page 00h)</td><td>page 69</td></tr>
<tr><td>03h/02h</td><td>Read (Page 03h) / Write (Page 02h) Error Log Pages</td><td>page 69</td></tr>
</table></td></tr>
</table>

Field	Description		
	07h	LAST n ERROR EVENTS Log Page (07h)	page 73
	0Ch	Sequential Access Device Log Page (0Ch)	page 75
	0Dh	Temperature Log Page (0Dh)	page 77
	18h	SAS Phy Control and Discover Log Page (18h)	page 79
	2Eh	TapeAlert Log Page (2Eh)	page 83
	33h	Device Wellness Log Page (33h)	page 88
	38h	General Purpose Non-Volatile Log Page (38h)	page 91
	3Eh	Device Status Log Page (3Eh)	page 93
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, the drive returns only parameters 3, 4, and 5. Similarly, if a page supports parameters 1, 3, and 6, and the Parameter Pointer contains 2, the drive returns only parameters 3 and 6. If the Parameter Pointer is larger than the highest numbered parameter on the page, the drive terminates the command with CHECK CONDITION status, Sense Key set to ILLEGAL REQUEST, and Additional Sense Code set to INVALID FIELD IN CDB. **Note:** The drive always returns parameters within a page in ascending order according to the parameter code.		
Allocation Length	Specifies the maximum number of bytes that the host allocated for returning data. The host uses this field to limit the size of data transfers to its own internal buffer size.		

Error Summary in LOG SENSE Command Descriptor Block

The following conditions constitute errors the drive detects relating to the **LOG SENSE CDB**. The drive terminates the command with CHECK CONDITION status, Sense Key set to ILLEGAL REQUEST, and Additional Sense Code set to INVALID FIELD IN CDB.

Error conditions occur when:

- The drive does not support the requested page.
- The parameter pointer is larger than the highest numbered parameter on the page.
- The SP bit is set to 1.

Supported Pages Log Page (Page 00h)

When the host requests Page 00h, the drive returns the 4-byte page header followed by the pages supported in ascending order, one byte for each.

Figure 28 Supported Pages **LOG SENSE** Page — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Page Code (00h)							
1	Reserved							
2 — 3	(MSB) Page Length (LSB)							
4 — *n*	Supported Page List							

Table 40 Supported Pages **LOG SENSE** Page — Field Descriptions

Field	Description
Page Code	Echoes the page code specified in the **LOG SENSE CDB**.
Page Length	Specifies the total number of bytes contained in this log page, excluding the 4 bytes that make up the header.
Supported Page List	Contains a list of all log page codes in ascending order beginning with Page Code 00h, one byte for each.

Read (Page 03h) / Write (Page 02h) Error Log Pages

Each log page begins with a 4-byte header followed by a number of log parameters.

Figure 29 Read / Write Error **LOG SENSE** Pages — Header Format

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

Table 41 Read / Write Error **LOG SENSE** Header — Field Descriptions

Field	Description
Page Code	Echoes the page code specified in the **LOG SENSE CDB**.
Page Length	Specifies the total number of bytes contained in this log page, excluding the 4 bytes that make up the header.

Figure 30 Log Parameters Format for Read / Write Error **LOG SENSE** Page

Byte \ Bit	7	6	5	4	3	2	1	0
0 — 1	(MSB) Parameter Code (LSB)							
2	DU	DS	TSD	ETC	TMC		LBIN	LP
3	Parameter Length							
4 — *n*	(MSB) Parameter Value (LSB)							

Table 42 Log Parameters for Read / Write Error **LOG SENSE** Page— Field Descriptions

Field	Description	
Parameter Code	The parameter codes supported for the **READ** / **WRITE** error counter pages are:	
	Code	**Descriptions**
	0000h	Errors corrected without substantial delays
	0001h	Errors corrected with possible delays
	0002h	Total read/write errors
	0003h	Total read/write errors
	0004h	Total times correction algorithm processed. Always 0 for write errors only.
	0005h	Total bytes to/from tape (including ECC and Overhead)
	0006h	Total uncorrected errors
	8000h	WRITE errors since last READ (page 02h) *or* READ errors since last WRITE (page 03h)
	8001h	Total raw write/read errors
	8002h	Total dropout error count
	8003h	Total servo tracking errors
	9000h-900Fh	Write only: Without substantial delay errors by channel Read only: Raw sub-block read errors by channel
	9080h-908Fh	Write only: Possible delay errors assignable to specific channels **Note:** Many of these errors are write, not read, errors and are not to be included in read error-rate calculations. If these errors are used to try to identify bad channels, the bad channel may be on either the writing or reading drive.
	Note: Parameter codes 00h, 01h, and 04h always return a value of 0.	
DU	Disable Update. When set to 0, indicates that the drive updates all log parameter values. When set to 1, indicates that the drive does not update the log parameter values except in response to a **LOG SELECT** command. The drive sets this bit to 1 when accumulated values reach maximum. The drive also returns this bit set to 1 if the host set the bit in the last **LOG SELECT** command. Default is 0. Note that for parameter types other than threshold and cumulative values, this bit is always set to 0.	

<table>
<tr><th>Field</th><th colspan="2">Description</th></tr>
<tr><td>DS</td><td colspan="2">Disable Save. Always set to 1.</td></tr>
<tr><td>TSD</td><td colspan="2">Target Save Disable. Always set to 1.</td></tr>
<tr><td>ETC</td><td colspan="2">Enable Threshold Comparison. When set to 1, indicates that the drive performs comparison to threshold. When set to 0, indicates that the drive does not perform the comparison. The Control Mode Page of the MODE SELECT command sets this bit set to 1. Default is 0.</td></tr>
<tr><td rowspan="5">TMC</td><td colspan="2">Threshold Met Criteria. This field is valid only if the host sets the ETC bit to 1. This field determines the basis for comparison. The host specifies this field using the LOG SELECT command. If the result of comparison is true (cumulative = threshold) and the MODE SELECT / SENSE Control Mode Page RLEC bit is set to 1, the drive generates a UNIT ATTENTION for all initiators. In that case, the drive sets the Sense Key to UNIT ATTENTION, the Additional Sense Code to LOG EXCEPTION, and the Additional Sense Code Qualifier to THRESHOLD CONDITION MET. If the RLEC bit in Control Mode Page is 0, the drive does not generate a UNIT ATTENTION.</td></tr>
<tr><td colspan="2">Note that comparison is performed in real time. A LOG SENSE command need not be issued to get the CHECK CONDITION status. Once ETC is selected and the RLEC bit in Control Mode Page is set to 1, the drive issues a CHECK CONDITION status based on the criteria defined in the TMC bits if the criteria is met in real time. The CHECK CONDITION status does not identify for which parameter code the criterion is met. The host must issue a LOG SENSE command to read the counters to determine for which parameter code the criterion has been met.</td></tr>
<tr><td colspan="2">The criteria for comparison are:</td></tr>
<tr><td>Code</td><td>Description</td></tr>
<tr><td>00b</td><td>Every update of the cumulative value</td></tr>
<tr><td>01b</td><td>Cumulative value equal to the threshold value</td></tr>
<tr><td>10b</td><td>Cumulative value not equal to the threshold value</td></tr>
<tr><td>11b</td><td>Cumulative value greater than the threshold value</td></tr>
<tr><td>LBIN</td><td colspan="2">List Binary. Always set to 0.</td></tr>
<tr><td>LP</td><td colspan="2">List Parameter. Always set to 0.</td></tr>
<tr><td>Parameter Length</td><td colspan="2">Specifies the number of bytes in the parameter value. All parameters are 4 bytes in length except parameter 0005h, which is 8 bytes in length.</td></tr>
<tr><td>Parameter Value</td><td colspan="2">Indicates the actual value of this log parameter.</td></tr>
</table>

LAST *n* ERROR EVENTS Log Page (07h)

This page returns event logs stored in the device's non-volatile memory. The event logs are ASCII text. Each event log may take between 1 and 16 parameters, depending on the amount of ASCII text contained within the log entry. Event log entries begin at parameters that have parameter codes that are even multiple of 10h and may span between multiple parameters with increasing parameter code values. Parameter codes that are not needed are to complete an event log are not returned. The page will contain a variable number of parameters depending on the number and type of events in the log.

Figure 31 Last *n* Error Events **LOG SENSE** Page Command Descriptor Block — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Page Code (07h)							
1	Reserved							
2 — 3	(MSB) Page Length (LSB)							

Table 43 Last *n* Error Events **LOG SENSE** Header — Field Descriptions

Field	Description
Page Code	Echoes the page code specified in the **LOG SENSE CDB**.
Page Length	Specifies the total number of bytes contained in this log page, excluding the 4 bytes that make up the header.

Figure 32 Log Parameters Format for Last *n* Error Events **LOG SENSE** Page

Byte \ Bit	7	6	5	4	3	2	1	0
0 — 1	(MSB) Parameter Code (LSB)							
2	DU	DS	TSD	ETC	TMC		LBIN	LP
3	Parameter Length							
4 — *n*	(MSB) ASCII String for Event *n* (LSB)							

Table 44 Log Parameters for Last *n* Error Events **LOG SENSE** Page — Field Descriptions

Field	Description		
Parameter Code	Event logs start in parameters with Parameter Code values that are even multiple of 10h. The event logs in parameter 0h is the oldest event in the log, the event log in parameter 10h is the next oldest, and so on. Event log may span between multiple parameters up to 16.		
Parameter Control Byte	**Bit**	**Value**	**Description**
	DU	0	Disable Update.
	DS	1	Disable Save.
	TSD	0	Target Save Disable.
	ETC	0	Enable Threshold Comparison.
	TMC	0	Threshold Met Criteria.
	LBIN	0	List Binary.
	LP	1	List Parameter.
Parameter Length	Specifies the total number of bytes contained in this log page, excluding the 4 bytes that make up the header.		

Field	Description
ASCII String for Event *n*	The text of the parameters with Parameter Code values that are an even multiple of 10h include a "Packet #" that is a value from 0 to 255. The drive assigns this internal number when the packet is written to EEPROM. A value of 0 is normally the oldest packet, but packet numbers wrap back to 0 after reaching 255.

Sequential Access Device Log Page (0Ch)

This page provides a standardized way to report the amount of data transferred between the tape drive and the host.

Figure 33 Sequential Access Device **LOG SENSE** Page Block — Header Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Page Code (0Ch)							
1	Reserved							
2 — 3	(MSB) Page Length (LSB)							

Table 45 Sequential Access Device **LOG SENSE** Header — Field Descriptions

Field	Description
Page Code	Echoes the page code specified in the **LOG SENSE CDB**.
Page Length	Specifies the total number of bytes contained in this log page, excluding the 4 bytes that make up the header.

Figure 34 Log Parameters Format for Sequential Access Device **LOG SENSE** Page

Bit / Byte	7	6	5	4	3	2	1	0
0 — 1	(MSB) Parameter Code (LSB)							
2	DU	DS	TSD	ETC	TMC		LBIN	LP
3	Parameter Length							
4 — *n*	Parameter Value							

Table 46 Sequential Access Device **LOG SENSE** Page Parameters — Field Descriptions

Field	**Description**		
Parameter Code	Parameter codes supported for the Sequential Access Device Page:		
	Code	**Description**	
	0000h	Host Write Byte Count. This is the number of data bytes received from application clients during **WRITE** command operations.	
	0001h	Tape Write Byte Count. The number of data bytes written to the media during **WRITE** command operations, not counting ECC and formatting overhead.	
	0002h	Tape Read Byte Count. The number of data bytes read from the media during **READ** command operations, not counting ECC and formatting overhead.	
	0003h	Host Read Byte Count. The number of data bytes transferred to the initiator(s) during **READ** command operations.	
Parameter Control Byte	**Bit**	**Value**	**Description**
	DU	0	Disable Update.
	DS	1	Disable Save.

Field	Description		
Parameter Control Byte (Continued	TSD	1	Target Save Disable.
	ETC	0	Enable Threshold Comparison.
	TMC	0	Threshold Met Criteria.
	LBIN	0	List Binary.
	LP	0	List Parameter.
Parameter Length	Specifies the number of bytes in the parameter value. All parameters are 8 bytes in length.		
Parameter Value	Indicates the actual value of this log parameter.		

Temperature Log Page (0Dh)

This page provides a standardized way to report the device temperature.

Figure 35 Temperature **LOG SENSE** Page — Header Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Page Code (0Dh)							
1	Reserved							
2 — 3	(MSB) Page Length (LSB)							

Table 47 Temperature **LOG SENSE** Header — Field Descriptions

Field	Description
Page Code	Echoes the page code specified in the **LOG SENSE CDB**.
Page Length	Specifies the total number of bytes contained in this log page, excluding the 4 bytes that make up the header.

Figure 36 Log Parameters Format for Temperature Page

Byte \ Bit	7	6	5	4	3	2	1	0
0 — 1	(MSB) Parameter Code (Temperature) (LSB)							
2	DU	DS	TSD	ETC	TMC		LBIN	LP
3	Parameter Length (02h)							
4 — 5	(MSB) Parameter Value (LSB)							

Table 48 Temperature **LOG SENSE** Parameters

Field	Description		
Parameter Code	Parameter codes supported for the Temperature page are as follows:		
	Code	**Description**	
	0000h	Current operating temperature (degrees Celsius).	
	0001h	Reference temperature (degrees Celsius). This is the maximum reported sensor temperature at which the tape drive is capable of operating continuously without experiencing degradation beyond the limits, specified in the *DLT-S4 Product Manual* for this product.	
Parameter Control Byte	**Bit**	**Value**	**Description**
	DU	0	Disable Update.
	DS	1	Disable Save.
	TSD	0	Target Save Disable.
	ETC	0	Enable Threshold Comparison.
	TMC	0	Threshold Met Criteria. Ignored.

Field	Description		
Parameter Control Byte (continued)	LBIN	1	List Binary.
	LP	1	List Parameter.
Parameter Length	Specifies the number of bytes in the parameter value. All parameters are 2 bytes in length.		
Parameter Value	Indicates the actual value of this log parameter.		

SAS Phy Control and Discover Log Page (18h)

The SAS Phy Control and Discover Log Page defined in figure 37 is used to report errors that have occurred on the SAS target device's phy.

Figure 37 ***SAS*** Phy Control and Discover Log Page

Byte \ Bit	7	6	5	4	3	2	1	0
0	Page Code (18h)							
1	Reserved							
2 — 3	(MSB) Page Length (38h) (LSB)							

Table 49 ***SAS*** Phy Control and Discover **LOG SENSE** Header — Field Descriptions

Field	Description
Page Code	Echoes the Page Code specified in the **LOG SENSE CDB**.
Page Length	Specifies the number of bytes contained in this log page, excluding the 4 bytes that make up the header.

Figure 38 shows the format for a SAS log parameter.

Figure 38 ***SAS*** Phy Control and Discover Log Page — Parameter Format

Bit / Byte	7	6	5	4	3	2	1	0
0 — 1	(MSB) Parameter Code (Relative Target Port Identifier) (LSB)							
2	DU	DS	TSD	ETC	TMC		LBIN	LP
3	Page Length (34h)							
4	Reserved				Protocol Identifier (6h)			
5	Reserved							
6	Reserved							
7	Number of Phys							
8 — 55	SAS Phy Log Descriptor (see figure 39)							

Table 50 ***SAS*** Phy Control and Discover Log Page Subpage — Field Descriptions

Field	Description		
Parameter Code	The parameter code field contains the relative target port identifier (see *SPC-3*) for the SSP target port that this log parameter describes.		
Parameter Control Byte	**Bit**	**Value**	**Description**
	DU	0	Disable Update.
	DS	0	Disable Save.
	TSD	0	Target Save Disable.
	ETC	0	Enable Threshold Comparison.
	TMC	any	Threshold Criteria Met.

Field	Description		
Parameter Control Byte (continued)	LBIN	1	List Binary.
	LP	1	List Parameter.
Parameter Length	The Parameter Length field is set to the length of the log parameter minus three.		
Protocol Identifier	A value of 6h indicates that this log page applies to an SAS-1.1 port (see the *Serial Attached SCSI -1.1 (SAS -1.1)* standard for specific SAS information).		
Number of Phys	The Number of Phys is set to 1h.		
SAS Phy Log Descriptor	See figure 39.		

Figure 39 shows the SAS phy log descriptor.

Figure 39 ***SAS*** Phy Log Descriptor

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved							
1	Phy Indentifier							
2	Reserved							
3	Reserved							
4	Reserved	Attached Device Type			Reserved			
5	Reserved				Negotiated Physical Link Rate			
6	Reserved				Attached SSP Initiator Port	Attached STP Initiator Port	Attached SMP Initiator Port	Reserved
7	Reserved				Attached SSP Target Port	Attached STP Target Port	Attached SMP Target Port	Reserved
8 — 15	SAS Address							
16 — 23	Attached SAS Address							

Byte \ Bit	7	6	5	4	3	2	1	0
24	Attached Phy Identifier							
25 — 31	Reserved							
32 — 35	(MSB) Invalid Dword Count (LSB)							
36 — 39	(MSB) Running Disparity Error Count (LSB)							
40 — 43	(MSB) Loss of Dword Synchronization (LSB)							
44 — 47	(MSB) Phy Reset Problem (LSB)							

Table 51 ***SAS*** Phy Log Descriptor — Field Descriptions

Field	Descriptor
Phy Identifier	Phy Identifier Always set to 0.
Attached Device Type	Reflects the Device Type reported in the Identify Address frame received by the drive.
Negotiated Physical Link Rate	The value for this field is either 8h or 9h, indicating a Physical Link Rate of 1.5 Gbps or 3.0 Gbps.
Attached SSP Initiator Port	Reflects the SSP Initiator Port Bit reported in the Identify Address frame received by the drive.
Attached STP Initiator Port	Reflects the STP Initiator Port Bit reported in the Identify Address frame received by the drive.
Attached SMP Initiator Port	Reflects the SMP Initiator Port Bit reported in the Identify Address frame received by the drive.
Attached SSP Target Port	Reflects the SSP Target Port Bit reported in the Identify Address frame received by the drive.
Attached STP Target Port	Reflects the STP Target Port Bit reported in the Identify Address frame received by the drive.
Attached SMP Target Port	Reflects the SMP Target Port Bit reported in the Identify Address frame received by the drive.

Field	Descriptor
SAS Address	Indicates the SAS Address of the drive.
Attached SAS Address	Reflects the SAS Address reported in the Identify Address frame received by the drive.
Attached Phy Identifier	Reflects the Phy Identifier reported in the Identify Address frame received by the drive.
Invalid Dword Count	Indicates the number of invalid dwords that have been received by the phy, not including those received during reset sequences.
Running Disparity Error Count	Indicates the number of dwords containing running disparity errors that have been received by the phy, not including those received during reset sequences.
Loss of Dword Synchronization	Indicates the number of times the phy has lost dword synchronization and restarted the reset sequence.
Phy Reset Problem	Indicates the number of times the phy reset sequence has failed.

TapeAlert Log Page (2Eh)

This page returns results of the tape drive's ongoing self-diagnosis, so that the drive's behavior can be monitored and high reliability assured. The host typically reads the TapeAlert page from the drive at the beginning of each **READ** or **WRITE** activity, after any fatal errors occur during a **READ** or **WRITE**, at the end of any data cartridge when the **READ** or **WRITE** activity continues onto another data cartridge, and at the end of each **READ** or **WRITE** activity. The drive sets or clears the flags when the failure or corrective action occurs.

Figure 40 TapeAlert **LOG SENSE** Page — Header Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Page Code (2Eh)							
1	Reserved							
2 — 3	(MSB) Page Length (LSB)							

Table 52 TapeAlert Page **LOG SENSE** Header — Field Descriptions

Field	Description
Page Code	Echoes the page code specified in the **LOG SENSE CDB**.
Page Length	Specifies the total number of bytes contained in this log page, excluding the 4 bytes that make up the header.

Figure 41 TapeAlert **LOG SENSE** Page — Parameters Format

Byte \ Bit	7	6	5	4	3	2	1	0
0 — 1	(MSB) Parameter Code (LSB)							
2	DU	DS	TSD	ETC	TMC		LBIN	LP
3	Parameter Length (1)							
4 — *n*	Value of TapeAlert Flag (Flag is set when bit 0 is set to 1; bits 1–7 are reserved)							

Table 53 TapeAlert Page **LOG SENSE** Parameters — Field Descriptions

Field	Description
Parameter Code	Contains the Flag code (see table 54 for the supported flags, level of severity, and the flag definitions).
Parameter Length	Always set to 1.
Value of TapeAlert Flag	If bit 0 is set to 1, indicates that TapeAlert has sensed a problem (see table 54 for the supported flags and their definitions). If bit 0 is set to 0, indicates that TapeAlert did not sense a problem and therefore did not set the flag.

Table 54 TapeAlert Flags, Severity Levels, and Meanings — Field Descriptions

	Flag	Security Level	Description
1	Read Warning	W	The tape drive is having problems reading data. No data has been lost, but there has been a reduction in the performance of the tape.
2	Write Warning	W	The tape drive is having problems writing data. No data has been lost, but there has been a reduction in the capacity of the tape.
3	Hard Error	W	The operation has stopped because an error has occurred while reading or writing data which the drive cannot correct.
4	Media	C	Your data is at risk: 1. Copy any data you require from this tape. 2. Do not use this tape again. 3. Restart the operation with a different tape.
5	Read Failure	C	The tape is damaged or the drive is faulty. Call the tape drive supplier helpline.
6	Write Failure	C	The tape is from a faulty batch or the tape drive is faulty: 1. Use a good tape to test the drive. 2. If the problem persists, call the tape drive supplier helpline.

	Flag	Security Level	Description
7	Media Life	W	The tape cartridge has reached the end of its calculated useful life: 1. Copy any data you need to another tape 2. Discard the old tape.
9	Write Protect	C	You are trying to write to a write-protected cartridge. Remove the write-protection or use another tape.
10	No Removal	I	You cannot eject the cartridge because the tape drive is in use. Wait until the operation is complete before ejecting the cartridge.
11	Cleaning Media	I	The tape in the drive is a cleaning cartridge.
17	Read Only Format	W	You have loaded a cartridge of a type that is read-only in this drive. The cartridge will appear as write-protected.
19	Nearing Media Life	I	The tape cartridge is nearing the end of its calculated life. It is recommended that you: 1. Use another tape cartridge for your next backup. 2. Store this tape cartridge in a safe place in case you need to restore data from it.
20	Clean Now	C	The tape drive needs cleaning: 1. If the operation has stopped, eject the tape and clean the drive 2. If the operation has not stopped, wait for it to finish and then clean the drive. Check the tape drive users manual for device specific cleaning instructions.
21	Clean Periodic	W	The tape drive is due for routine cleaning: 1. Wait for the current operation to finish. 2. Then use a cleaning cartridge. Check the tape drive users manual for device specific cleaning instructions.
22	Expired Cleaning Media	C	The last cleaning cartridge used in the tape drive has worn out: 1. Discard the worn out cleaning cartridge. 2. Wait for the current operation to finish. 3. Then use a new cleaning cartridge.

	Flag	Security Level	Description
31	Hardware B	C	The tape drive has a hardware fault: 1. Turn the tape drive off and then on again. 2. Restart the operation. 3. If the problem persists, call the tape drive supplier helpline. Check the tape drive users manual for device specific instructions on turning the device power on and off.
32	Interface	W	The tape drive has a problem with the host interface: 1. Check the cables and cable connections. 2. Restart the operation.
34	Download Fail	W	The firmware download has failed because you have tried to use the incorrect firmware for this tape drive. Obtain the correct firmware and try again.
36	Drive Temperature	W	Environmental conditions inside the tape drive are outside the specified temperature range.
38	Predictive Failure	C	A hardware failure of the tape drive is predicted. Call the tape drive supplier helpline.
40	Loader Hardware A	C	The changer mechanism is having difficulty communicating with the tape drive: 1. Turn the autoloader off then on. 2. Restart the operation. 3. If problem persists, call the tape drive supplier helpline.
42	Loader Hardware B	W	There is a problem with the autoloader mechanism.
51	Tape directory invalid at unload	W	The tape directory on the tape cartridge just unloaded has been corrupted. File search performance will be degraded. The tape directory can be rebuilt by reading all the data.
55	Loading Failure	C	The operation has failed because the media cannot be loaded and threaded. 1. Remove the cartridge, inspect it as specified in the product manual, and retry the operation. 2. If the problem persists, call the tape drive supplier help line.

	Flag	Security Level	Description
59	WORM Medium Integrity Check Failed	W	The tape drive has detected an inconsistency during WORM medium integrity checks. Someone may have tampered with the cartridge.
60	WORM Medium Overwrite Attempted	W	An attempt has been made to overwrite user data on a WORM medium: 1. If a WORM medium was used inadvertently, replace it with a normal data medium. 2. If a WORM medium was used intentionally, check that the software application is compatible with the WORM medium format you are using.

Note: W = Warning
C = Critical
X = Informational

Device Wellness Log Page (33h)

The Device Wellness Page returns information about any CHECK CONDITION status related to Sense Keys 03h, 04h, 09h, and 0Bh that the tape drive has logged. This page can contain up to 16 entries (parameter code 0000h to 000Fh). Note that parameter code 0000h contains the oldest log information while parameter code 000Fh contains the most recent log information.

This page begins with a 4-byte header followed by the log parameter blocks, as shown in figure 42.

Figure 42 Device Wellness **LOG SENSE** Page — Header Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Page Code (33h)							
1	Reserved							
2 — 3	(MSB) Page Length (LSB)							

Table 55 Device Wellness **LOG SENSE** Header — Field Descriptions

Field	Description
Page Code	Echoes the page code specified in the **LOG SENSE CDB**.
Page Length	Specifies the total number of bytes contained in this log page, excluding the 4 bytes that make up the header.

Figure 43 Log Parameters Format for Device Wellness LOG SENSE Page (Parameter Codes 0000h – 000Fh)

Byte \ Bit	7	6	5	4	3	2	1	0
0 — 1	Parameter Code							
2	DU	DS	TSD	ETC	TMC		LBIN	LP
3	Parameter Length (0Ch)							
4 — 7	(MSB) Time Stamp (LSB)							

Byte \ Bit	7	6	5	4	3	2	1	0
8 — 11	(MSB) Media ID (LSB)							
12	Sense Key							
13	Additional Sense Code							
14	Additional Sense Code Qualifier							
15	Additional Error Information							

Table 56 Log Parameters for Device Wellness **LOG SENSE** Page — Field Descriptions

Field	Description		
Parameter Code	Parameter codes 0000h through 000Fh are supported, providing 16 log entries for error information capture.		
Parameter Control Byte	**Bit**	**Value**	**Description**
	DU	0	Disable Update.
	DS	1	Disable Save.
	TSD	0	Target Save Disable.
	ETC	0	Enable Threshold Comparison.
	TMC	0	Threshold Met Criteria.
	LBIN	0	List Binary.
	LP	1	List Parameter.

Field	Description
Time Stamp	Power-on hours when CHECK CONDITION status occurred. This is the number of power-on hours since the last time the drive was powered on, not total number of hours during the lifetime of the drive. The time stamp counter is updated once per hour. If the drive is powered down before the hourly update occurs, the update does not occur until a full hour after power is re-applied.
Media ID	Internal media identifier being used when CHECK CONDITION status occurred. A value of 0 indicates no media or unknown media when the event occurred. Note that this is not a legitimate method of tracing media.
Sense Key	The Sense Keys are described table 173 on page 308.
Additional Sense Code	The Additional Sense Codes are described in table 174 on page 309.
Additional Sense Code Qualifier	The Additional Sense Code Qualifiers are described in table 173 on page 308.
Additional Error Information	Not used.

General Purpose Non-Volatile Log Page (38h)

Log page 38h provides access to a 64 byte non-volatile buffer in the tape drive for general purpose use. The log page contains one 64 byte parameter with a Parameter Code setting of 0. The 64 bytes in the Parameter Value field contain the data from the Parameter Value field the last time a **LOG SELECT** command was processed that contained page 38h.

Figure 44 General Purpose Non-Volatile **LOG SENSE** Page — Header Format

Bit Byte	7	6	5	4	3	2	1	0
0	Page Code (38h)							
1	Reserved							
2 – 3	(MSB) Page Length (LSB)							

Table 57 General Purpose Non-Volatile **LOG SENSE** Header — Field Descriptions

Field	Description
Page Code	Echoes the page code specified in the **LOG SENSE CDB**.
Page Length	Specifies the total number of bytes contained in this log page, not including the 4 bytes that make up the header.

Figure 45 General Purpose Non-Volatile **LOG SENSE** Page — Parameter Format

Bit Byte	7	6	5	4	3	2	1	0
0 — 1	(MSB) Parameter Code (LSB)							
2	DU	DS	TSD	ETC	TMC		LBIN	LP
3	Parameter Length (40h)							
4 — 67	(MSB) Parameter Value (LSB)							

Table 58 General Purpose Non-Volatile **LOG SENSE** Page — Field Descriptions

Field	Description		
Parameter Code	Parameter code supported for this page. Always 0.		
Parameter Control Byte	**Bit**	**Value**	**Description**
	DU	1	Disable Update.
	DS	0	Disable Save.
	TSD	0	Target Save Disable.
	ETC	0	Enable Threshold Comparison.
	TMC	0	Threshold Met Criteria.
	LBIN	0	List Binary.
	LP	1	List Parameter.
Parameter Length	Specifies the number of bytes in the parameter value. Always set to 40h.		
Parameter Value	Indicates the actual value of this log parameter.		

Device Status Log Page (3Eh)

This page describes the current status of the drive.

Figure 46 Device Status **LOG SENSE** Page — Header Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Page Code (3Eh)							
1	Reserved							
2 — 3	(MSB) Page Length (LSB)							

Table 59 Device Status **LOG SENSE** Header — Field Descriptions

Field	Description
Page Code	Echoes the page code specified in the **LOG SENSE CDB**.
Page Length	Specifies the total number of bytes contained in this log page, excluding the 4 bytes that make up the header.

Figure 47 Log Parameters Format for Device Status **LOG SENSE** Page

Byte \ Bit	7	6	5	4	3	2	1	0
0 — 1	Parameter Code							
2	DU	DS	TSD	ETC	TMC		LBIN	LP
3	Parameter Length							
4 — *n*	(MSB) Parameter Value (LSB)							

Table 60 Log Parameters for Device Status **LOG SENSE** Page — Field Descriptions

Field	Description	
Parameter Code	Parameter codes 0000h through 0011h, 7000h, 8000h through 8005h, and 9000h through 9005h are supported:	
	Code	**Description**
	0000h	Specifies the device type. For sequential-type devices such as tape drives, the value is always 00010000h.
	0001h	Specifies device cleaning-related status (see figure 48).
	0002h	Specifies the number of loads over the lifetime of the drive.
	0003h	Specifies the remaining number of cleans on the last cleaning cartridge mounted in the drive.
	0004h	Vendor specific.

Field	Description		
Parameter Code (continued)	0005h		Drive temperature in degrees C.
	0006h		Media ID of the most recently loaded cartridge.
	0007h		Controller serial number (least significant 16 bits). The drive uses this value to generate the Media ID for blank tape cartridges.
	0008h		Drive cleaning cycle count.
	0009h		Serial number of the first drive to write the current tape.
	000Ah		Serial number of the last drive to write the current tape.
	000Bh		Total number of event log entries that are available through log page 07h.
	000Ch		Maximum number of parameter codes per event log entry in log page 07h.
	000Dh		Maximum number of cleans on a cleaning cartridge.
	000Eh		Number of drive power cycles.
	000Fh		Power on time for this power cycle, in milliseconds.
	0010h		Total drive power on time, in milliseconds.
	0011h		Current Track Number.
	7000h		TapeAlert flags bit map — See ADC specification INCITS 403-2005, Table 17 - bytes 4-15.
	8000h		Drive Lifetime media loads
	8001h		Drive Lifetime media motion hours
	8002h		Drive media motion hours since last clean
	8003h		Periodic Cleaning Interval in media motion hours
	8004h		Drive Lifetime GBs written to tape
	8005h		Drive Lifetime GBs read from tape
	9000h		Media Lifetime load count
	9001h		Media Lifetime load count threshold
	9002h		Media Lifetime wear passes
	9003h		Media Lifetime wear passes threshold
	9004h		Media Lifetime motion hours
	9005h		Media Lifetime motion hours threshold
Parameter Control Byte	**Bit**	**Value**	**Description**
	DU	0	Disable Update.

Field	Description		
	DS	1	Disable Save.
	TSD	any	Target Save Disable. When set to zero indicates the parameter is saved periodically. When set to one the parameter is not saved.
	ETC	0	Enable Threshold Comparison.
	TMC	0	Threshold Met Criteria.
	LBIN	any	List Binary. When set to zero indicates the parameter value is in ASCII. When set to one, indicates the parameter value is a binary number.
	LP	any	List Parameter. When set o zero indicates the parameter value is a counter. When set to one, indicates the parameter value is not a counter.
Parameter Length	Specifies the number of bytes in the parameter value.		
Parameter Value	Indicates the actual value of this log parameter.		

Figure 48 Cleaning-Related Log Parameters Format for Device Status **LOG SENSE** Page

Bit / Byte	7	6	5	4	3	2	1	0
4	Reserved					ClnQ	ClnR	ClnEx
5 — 7	(MSB) Reserved (LSB)							

Table 61 Log Parameters for Device Status **LOG SENSE** Parameter 0001h (Cleaning-Related) — Field Descriptions

Field	Description
ClnQ	Set to 1 if a cleaning-required condition exists. When the condition clears, the drive also clears this bit.
ClnR	Set to 1 if a cleaning-request condition exists. When the condition clears, the drive also clears this bit.
ClnEx	Set to 1 if the cleaning tape has expired. If no cleaning tape is installed, the drive clears this bit.

MODE SELECT (6) / (10) Command (15h / 55h)

The **MODE SELECT** commands enable the host to configure the tape drive. Before configuring the drive, the host should issue **MODE SENSE** commands to the drive to obtain a report of the current configuration and determine which parameters are configurable. The host interprets this information and then may issue **MODE SELECT** to set the drive to the host's preferred configuration.

Operating parameters for the drive are contained in several pages. Table 62 lists the **MODE SELECT** pages supported and the location of the sections in this document detailing each page:

Table 62 **MODE SELECT** Operating Parameters Reference

Page Code	Description	Refer to
01h	Read / Write Error Recovery Page (01h)	page 105
02h	Disconnect / Reconnect Page (02h)	page 106
0Ah	Control Mode Page (0Ah)	page 113
0Fh	Data Compression Page (0Fh)	page 116
10h	Device Configuration Page (10h)	page 118
11h	Medium Partition Page (11h)	page 122
18h	Logical Unit Control Page (18h)	page 123
19h	Port Control Page (19h)	page 127
19h/01h	SAS Phy Control and Discover Mode Subpage (19h/01h)	page 130
19h/03h	SPI Negotiated Settings Mode Subpage (19h/03h)	page 134
19h/04h	SPI Report Transfer Capabilities Mode Subpage (19h/04h)	page 137
1Ch	TapeAlert Page (1Ch)	page 139
1Dh	Medium Configuration Mode Page (1Dh)	page 142
27h	Data Security Mode Page (27h)	page 144
3Eh	EEPROM Mode Page (3Eh)	page 150

Except for the EEPROM Vendor-Specific Page (page 3Eh), the drive always powers on with its default configurations set. The drive sets the mode parameters to their default setting following the processing of a **TARGET RESET** or **LOGICAL UNIT RESET** task management function (see TARGET RESET on page 7 or LOGICAL UNIT RESET on page 7).

> Note: See Changeable Parameters Within MODE SELECT on page 156 for a list of changeable parameters within **MODE SELECT** (see EEPROM Mode Page (3Eh) on page 207 for additional information about how to use these changeable parameters).

Figure 49 **MODE SELECT** (6) Command Descriptor Block — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (15h)							
1	Reserved			PF	Reserved			SP (0)
2 — 3	Reserved							
4	Parameter List Length							
5	Control							

Figure 50 **MODE SELECT** (10) Command Descriptor Block — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (55h)							
1	Reserved			PF	Reserved			SP (0)
2 — 6	Reserved							
7 — 8	(MSB) Parameter List Length (LSB)							
9	Control							

Note: 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 not changeable. In such cases, the drive does not change any parameters as a result of a command.

Table 63 **MODE SELECT** (6)/ (10) Command Descriptor Block — Field Descriptions

Field	Description
PF	Page Format. Indicates that the data the host sent after the **MODE SELECT** header and block descriptors complies with the definition of pages in the SCSI-3 specification. If the Page Format bit is set to 0, only a Mode Parameter Header and Mode Parameter Block Descriptor may be included in the mode parameter data.
SP	Save Parameters. Must be set to 0.

Figure 51 shows the format of the Mode Parameter List that the host passes to the drive.

Figure 51 **MODE SELECT** (6) Mode Parameter List — Data Format

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

Figure 52 **MODE SELECT** (10) Mode Parameter List — Data Format

Byte \ Bit	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)							

Figure 53 **MODE SELECT** Mode Parameter List — Field Descriptions

Field	Description
Mode Parameter Header	Four bytes in length for **MODE SELECT** (6) or 8 bytes in length for **MODE SELECT** (10). Contains information about the remainder of the Parameter List and is always present.
Mode Parameter Block Descriptor	Eight bytes in length. Allows the host to set the drive's Logical Block Size and Density Code to be written from BOT.
Page(s)	Any mode pages that are a part of this **MODE SELECT** command.

Mode Parameter Header

Figure 54, figure 55, and table 64 illustrate and describe the fields that make up the **MODE SELECT** command's Mode Parameter header.

Figure 54 **MODE SELECT** (6) Mode Parameter Header — Data Format

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

Figure 55 **MODE SELECT** (10) Mode Parameter Header — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0 — 1	Reserved							
2	Medium Type							
3	Ignored	Buffered Mode			Speed (0h)			
4 — 5	Reserved							
6 — 7	(MSB) Block Descriptor Length (LSB)							

Table 64 **MODE SELECT** Mode Parameter Header — Field Descriptions

Field	Description
Medium Type	The drive ignores this field.
Buffered Mode	Set to 1 by default. 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 is set to 0, the drive does not report GOOD status on **WRITE** commands until it writes the data blocks to tape. When Buffered Mode is not used, the drive suffers significant performance and capacity degradation.
Speed	The drive supports a single speed of operation per format. This field must be set to 0h.
Block Descriptor Length	Specifies the length in bytes of all the block descriptors. Since the drive only allows one block descriptor, the value must be either 0 or 8. A value of 0 indicates no block descriptor is included; a value of 8 indicates a block descriptor is present and precedes the mode page data.

Mode Parameter Block Descriptor

Figure 56 and table 65 illustrate and describe the fields that make up the **MODE SELECT** command's Mode Parameter Block Descriptor.

Figure 56 **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 — 7	(MSB) Block Length (LSB)							

Table 65 **MODE SELECT** Mode Parameter Block Descriptor — Field Descriptions

Field	Description	
Density Code	This field must contain one of the Density Code values listed below:	
	Density Code	**Description**
	00h	Use default density
	49h	190,000 bpi, 56 logical tracks, serial cartridge tape 160 GB / 320 GB (Super DLTtape I)[1]
	4Ah	233,000 bpi, 40 logical tracks, serial cartridge tape, 300 GB / 600 GB (Super DLTtape II)
	4Bh	256,000 bpi, 80 logical tracks, serial cartridge tape, 800 GB / 1600 GB (DLTtape S4)

Field	Description	
	7Fh	No change from previous density (no Operation)
Number of Blocks	Must be set to 0, indicating that all of the remaining logical blocks on the tape have the medium characteristics specified by this block descriptor.	
Block Length	Specifies the length, in bytes, of each logical block transferred. 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 CDB to be defined as a block count. If the Fixed bit is not set to 1, the drive ignores this field. The value in this field must be a multiple of 4.	

1. The Density Code must match a supported density of the tape cartridge currently mounted in the DLT-S4 tape drive.

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.

Figure 57 Read / Write Error Recovery **MODE SELECT** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (01h)					
1	Page Length (0Ah)							
2	Reserved		TB (0)	Reserved	EER (1)	PER	DTE (0)	DCR (0)
3	Read Retry Count							
4 — 7	Reserved							
8	Write Retry Count							
9 — 11	Reserved							

Table 66 Read / Write Error Recovery **MODE SELECT** Page — Field Descriptions

Field	Description
PS	Parameters Savable. For **MODE SELECT**, must be set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 01h identifies this as the Read / Write Error Recovery Page.
Page Length	Indicates the number bytes in the page, excluding 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**.
TB	Transfer Block. Must be set to 1.
EER	Enable Early Recovery. Must be set to 1.
PER	Post Error. Default is 0. When set to 1, enables reporting of CHECK CONDITION to report recovered **READ** / **WRITE** errors.
DTE	Disable Transfer on Error. Must be set to 0.
DCR	Disable ECC Correction. Must be set to 0.
Read Retry Count	This field reports the maximum number of read retries the drive attempts before reporting an unrecoverable error.
Write Retry Count	This field reports the maximum number of write retries the drive attempts before reporting an unrecoverable error.

Disconnect / Reconnect Page (02h)

The Disconnect/Reconnect Page controls the drive's behavior on the SCSI bus or network and allows the host to tune bus or network performance (for Parallel SCSI, see figure 58; for Fibre Channel, see figure 59; and for SAS, see figure 60).

Figure 58 ***Parallel SCSI*** — Disconnect / Reconnect **MODE SELECT** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (02h)					
1	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	EMDP	Fair Arbitration			DIMM	DTDC		
13	Reserved							
14 — 15	(MSB) Reserved (LSB)							

Table 67 ***Parallel SCSI*** — Disconnect / Reconnect **MODE SELECT** Page — Field Descriptions

Field	Description
PS	Parameters Savable. For **MODE SELECT**, must be set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 02h identifies this as the Disconnect / Reconnect Page.
Page Length	Indicates the number of bytes in the page, excluding 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**.
Buffer Full Ratio	Must be set to 0.
Buffer Empty Ratio	Must be set to 0.
Bus Inactivity Limit	Must be set to 0.
Disconnect Time Limit	Must be set to 0.
Connect Time Limit	Must be set to 0.
Maximum Burst Size	Indicates the maximum amount of data that will be transferred without disconnecting, in units of 512 bytes. The default value is 80h for 64 KBytes. A value of 0 indicates there is no limit to the amount of data that may be transferred without disconnecting.
EMDP	Enable Modify Data Pointers. Must be set to 0.
Fair Arbitration	Must be set to 0.
DIMM	Disconnect Immediate. Must be set to 0.
DTDC	Data Transfer Disconnect Control. Must be set to 0.

Figure 59 ***Fibre Channel*** — Disconnect / Reconnect **MODE SELECT** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (02h)					
1	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	EMDP	FAA	FAB	FAC	Restricted			
13	Reserved							
14 — 15	(MSB) First Burst Size (0) (LSB)							

Table 68 ***Fibre Channel*** — Disconnect / Reconnect **MODE SELECT** Page — Field Descriptions

Field	Description
PS	Parameters Savable. For **MODE SELECT**, must be set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 02h identifies this as the Disconnect / Reconnect Page.
Page Length	Indicates the number of bytes in the page, excluding 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**.
Buffer Full Ratio	Must be set to 0.
Buffer Empty Ratio	Must be set to 0.
Bus Inactivity Limit	Must be set to 0.
Disconnect Time Limit	Must be set to 0.
Connect Time Limit	Must be set to 0.
Maximum Burst Size	Indicates the maximum amount of data that will be transferred without disconnecting, in units of 512 bytes. The default value is 80h for 64 KBytes.
EMDP	Enable Modify Data Pointers. Must be set to 0. The drive does not support reordering FCP_Data IU frames for a single SCSI command.
FAA	Fair Arbitration: Fair Access Read. Must be set to 0. The drive always uses the access fairness algorithm when it sends FCP_Data IU frames to the host.
FAB	Fair Arbitration: Fair Access Write. Must be set to 0. The drive always uses the access fairness algorithm when it sends FCP_Xfer_Rdy frames to the host.
FAC	Fair Arbitration: Fair Access Status. Must be set to 0. The drive always uses the access fairness algorithm when it sends FCP_Rsp frames to the host.
First Burst Size	Must be set to 0.

Figure 60 ***SAS*** — Disconnect / Reconnect **MODE SELECT** Page — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (02h)					
1	Page Length (0Eh)							
2	Reserved							
3	Reserved							
4 — 5	(MSB) Bus Inactivity Time Limit (LSB)							
6 — 7	(MSB) Reserved (LSB)							
8 — 9	(MSB) Maximum Connect Time Limit (LSB)							
10 — 11	(MSB) Maximum Burst Size (LSB)							
12	Reserved							
13	Reserved							
14 — 15	(MSB) First Burst Size (0) (LSB)							

Table 69 ***SAS*** — Disconnect / Reconnect **MODE SELECT** Page — Field Descriptions

Field	Description
PS	Parameters Savable. For **MODE SELECT**, must be set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 02h identifies this as the Disconnect / Reconnect Page.
Page Length	Indicates the number of bytes in the page, excluding 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**.
Bus Inactivity Time Limit	Indicates the maximum period the tape drive is permitted to maintain a connection without transferring a frame. This value is specified in 100us increments. Must be set to 1.
Maximum Connect Time Limit	Indicates the maximum duration of a connection. This value is specified in 100us increments. Must be set to A0h.
Maximum Burst Size	Indicates the maximum amount of data that will be transferred without disconnecting, in units of 512 bytes. The default value is 80h for 64 KBytes.
First Burst Size	Must be set to 0.

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.

Figure 61 Control Mode **MODE SELECT** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (0Ah)					
1	Page Length (0Ah)							
2	TST (1)			Reserved		D_Sense (0)	GLTSD (0)	RLEC
3	Queue Algorithm Modifier (0)				Reserved	QErr (0)		DQue (0)
4	TAS (0)	RAC (0)	UA_Intlck_Ctrl (0)		SWP (0)	Obsolete		
5	Reserved					Autoload Mode		
6 — 7	Obsolete							
8 — 9	(MSB) Busy Timeout Period (FFFFh) (LSB)							
10 — 11	(MSB) Extended Self-test Completion Time (030Ch) (LSB)							

Table 70 Control Mode **MODE SELECT** Page — Field Descriptions

Field	Description
PS	Parameters Savable. For **MODE SELECT**, must be set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 0Ah identifies this as the Control Mode Page.
Page Length	Indicates the number of bytes in the page, excluding 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**.
TST	Task Set Type. The drive maintains separate task sets for each initiator. Must be set to 1h.
D_Sense	Descriptor Format Sense Data. Must be set to 0.
GLTSD	Global Logging Target Save Disable. Must be set to 0.
RLEC	Report Log Exception Condition. When set to 1, specifies that the drive reports log exception conditions. When set to 0, specifies that the drive does not report log exception conditions. The RLEC bit works with the Read / Write Error **LOG SENSE** page, specifically, the TMC bit of the Read / Write Error LOG SENSE page (page 02h and 03h), described in table 42 on page 71. RLEC 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. Modify the thresholds using the **LOG SELECT** command.
Queue Algorithm Modifier	Must be set to 0.
QErr	Queue Error. Must be set to 0.
DQue	Disable Queuing. Must be set to 0.
TAS	Task Aborted Status. Must be set to 0, indicating that tasks aborted by other initiators do not return a status.
RAC	Report a Check. Must be set to 0, indicating that the drive may return BUSY status.

<table>
<tr><th>Field</th><th colspan="2">Description</th></tr>
<tr><td>UA_Intlck_Ctrl</td><td colspan="2">Unit Attention Interlocks Control. Must be set to 0, indicating that the drive clears UNIT ATTENTION conditions when they are reported.</td></tr>
<tr><td>SWP</td><td colspan="2">Software Write Protect. Must be set to 0.</td></tr>
<tr><td>Autoload Mode</td><td colspan="2">Indicates the action the drive is to take when tape medium is loaded. All values not listed below are reserved.</td></tr>
<tr><td></td><td>Value</td><td>Description</td></tr>
<tr><td></td><td>000b</td><td>The medium is loaded for full access.</td></tr>
<tr><td></td><td>001b</td><td>The medium is loaded for Enhanced Medium Auxiliary Memory (EMAM) access only.</td></tr>
<tr><td></td><td>010b</td><td>The medium is not loaded.</td></tr>
<tr><td>Busy Timeout Period</td><td colspan="2">Specifies the maximum time, in 100 ms increments, that the initiator allows the drive to remain busy for unanticipated conditions that are not a routine part of commands from the initiator. A value of 0000h is undefined. A value of FFFFh specifies an unlimited busy timeout period.</td></tr>
<tr><td>Extended Self-test Completion Time</td><td colspan="2">Contains advisory data that an application client uses to determine the time (in seconds) that the drive requires to complete an extended self-test when the drive is not interrupted by additional commands and no errors occur during execution of the self-test. The application client should expect this time to increase significantly if it sends other commands to the drive while a self-test is in progress or if errors occur during execution of the self-test.</td></tr>
</table>

Data Compression Page (0Fh)

The Data Compression Page specifies parameters for the control of data compression. This page allows an initiator to turn the DLT-S4 tape drive's compressed format on and off independently of the position of the tape medium.

Figure 62 Data Compression **MODE SELECT** Page — Data Format

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

Table 71 Data Compression **MODE SELECT** Page — Field Descriptions

Field	Description
PS	Parameters Savable. For **MODE SELECT**, must be set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 0Fh identifies this as the Data Compression Page.
Page Length	Indicates the number of bytes in the page, excluding 0 and 1. The length is returned in **MODE SENSE** commands and must subsequently be set to the same value when performing **MODE SELECT**.
DCE	Data Compression Enable. Specifies whether the drive enables or disables data compression. When set to 1, the drive compresses all data before writing it to tape. When set to 0, the drive does not compress data before writing it to tape.
DCC	Data Compression Capable. The **MODE SENSE** command uses this bit to indicate that the drive supports data compression.
DDE	Data Decompression Enable. Must be set to 1. When the drive reads compressed data from tape, it automatically decompresses the data before sending it to the host. Data decompression must always be enabled.
RED	Report Exception on Decompression. The drive does not report exceptions on decompression (boundaries between compressed and uncompressed data). Must be set to 00h.
Compression Algorithm	Indicates which compression algorithm the drive uses to process data from the host when the DCE bit (byte 02, bit 7) is set to 1. The only value currently supported for this field is 10h.
Decompression Algorithm	Indicates which decompression algorithm the drive uses when decompressing data on the tape. The only value currently supported is 10h.

Device Configuration Page (10h)

The drive supports the Device Configuration Page. The format for the page is shown in figure 63.

Figure 63 Device Configuration **MODE SELECT** Page — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (10h)					
1	Page Length (0Eh)							
2	Reserved	Obsolete	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 (1)	RSmk (0)	AVC (0)	SOCF (0)		RBO (0)	REW (0)
9	Gap Size (0)							
10	EOD Defined (0)			EEG (1)	SEW	SWP (0)	Reserved	
11 — 13	(MSB) Buffer Size at Early Warning (0) (LSB)							
14	Select Data Compression Algorithm							
15	Reserved		OIR	Rewind on Reset (1)		AsocWP (0)	PersWP (0)	PrmWP (0)

Table 72 Device Configuration **MODE SELECT** Page — Field Descriptions

Field	Description
PS	Parameters Savable. For **MODE SELECT**, must be set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 10h identifies this as the Device Configuration Page.
Page Length	Indicates the number bytes in the page, excluding 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**.
CAF	Change Active Format. Must be set to 0.
Active Format	Must be set to 0.
Active Partition	The drive only supports partition 0.
Write Buffer Full Ratio	The drive sets this field to 0. The drive uses an automatic adaptive mechanism to adjust its Write Buffer 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 Read Buffer Empty Ratio according to the average data rates over the SCSI bus.
Write Delay Time	Indicates the maximum time, in 100 ms increments, that the drive waits with a partially full buffer before forcing the data to tape. 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 100 (64h). This causes the drive to flush the buffer in 10 seconds. The maximum value is 6500 (1964h); the minimum value is 15 (0Fh), representing a range from 11 minutes to 1.5 seconds. A value of 0 disables forcing data to tape based on time in the buffer. The drive rounds values greater than 6500 down to 6500.
DBR	Data Buffer Recovery. Must be set to 0.
BIS	Block Identifiers Supported. This bit is supported and must be set to 1.
RSmk	Report Setmark. Must be set to 0.
AVC	Automatic Velocity Control. Must be set to 0.

Field	Description
SOCF	Stop on Consecutive Filemarks. Must be set to 0.
RBO	Recover Buffer Order. Must be set to 0.
REW	Report Early Warning. Must be set to 0 (do not report Early Warning EOM on READ).
Gap Size	Must be set to 0.
EOD Defined	End-of-Data Defined. Must be set to 0h.
EEG	Enable End-of-Data Generation. Indicates that the drive generates an EOD mark before any change of direction following a **WRITE**-type operation. Must be set to 1.
SEW	Synchronize at Early Warning. When set to 1, the drive writes any unwritten data or tape marks to the tape medium before each command completes once the End of Medium early warning point is reached, effectively operating as if in unbuffered mode. When set to 0, the drive continues to operate in buffered mode, if enabled, past the End of Medium early warning point. The default value is 1.
SWP	Software Write Protection. Must be set to 0.
Buffer Size at Early Warning	Must be set to 0.
Select Data Compression Algorithm	When set to 1, enables data compression. When set to 0, disables data compression.

Field	Description
OIR	If the only if reserved (OIR) bit is set to one, the device server will process a command only if a reservation (see *SPC-2*) or persistent reservation (see *SPC-3*) exists that allows access via the I_T nexus from which the command was received. If the OIR bit is set to one and a command is received from an I_T nexus for which no reservation exists, the device server will not process the command. If the OIR bit is set to one and a command is received from an I_T nexus for a logical unit upon which no reservation or persistent reservation exists, the device servers terminates the command with CHECK CONDITION status. The sense key is set to ILLEGAL REQUEST and the additional sense code is set to NOT RESERVED. Commands that are not be effected by the OIR bit set to one are defined as Allowed in the presence of persistent reservations in *SPC-3*, or are defined in *SPC-2* as Allowed in the presence of reservations. Commands that are effected by the OIR bit set to one are defined as Conflict in the presence of persistent reservations in *SPC-3*, except for the **RESERVE**, **RELEASE**, **PERSISTENT RESERVATION IN**, and **PERSISTENT RESERVATION OUT** commands, or are defined in SPC-2 as Conflict in the presence of reservations. An OIR bit set to zero specifies the device server will process commands as specified in SPC-3.
Rewind on Reset	Rewind the tape on a logical unit reset operation. Must be set to 1.
AsocWP	Associated Write Protection. Must be set to 0.
PersWP	Persistent Write Protection. Must be set to 0.
PrmWP	Permanent Write Protection. Must be set to 0.

Medium Partition Page (11h)

The drive supports the Medium Partition Parameters Page, which specifies the medium partitions.

Figure 64 Medium Partition **MODE SELECT** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (11h)					
1	Page Length (06h)							
2	Maximum Additional Partitions (0)							
3	Additional Partitions Defined (0)							
4	FDP (0)	SDP (0)	IDP (0)	PSUM (0)		POFM (0)	Clear (0)	ADDP (0)
5	Medium Format Recognition (01)							
6	Reserved					Partition Units (0)		
7	Reserved							

Table 73 Medium Partition **MODE SELECT** Page — Field Descriptions

Field	Description
PS	Parameters Savable. For **MODE SELECT**, must be set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 11h identifies this as the Medium Partition Page.

Field	Description
Page Length	Indicates the number bytes in the page, excluding 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**.
Maximum Additional Partitions	Must be set to 0.
Additional Partitions Defined	Must be set to 0. Specifies the number of additional partitions 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, this field must be set to 0.
FDP	Fixed Data Partitions. Must be set to 0.
SDP	Select Data Partitions. Must be set to 0.
IDP	Initiator Defined Partitions. Must be set to 0.
PSUM	Partition Size Unit of Measure. Must be set to 0.
POFM	Partition on Format. Must be set to 0.
Clear	Must be set to 0.
ADDP	Additional Defined Data Partitions. Must be set to 0.
Medium Format Recognition	Set to 01h, indicating that the drive supports Medium Format Recognition.
Partition Units	Must be set to 0.

Logical Unit Control Page (18h)

The Logical Unit Control Page contains the logical unit control parameters for **READ** and **WRITE** operations (For Parallel SCSI, see figure 65; for Fibre Channel, see figure 66; and for SAS, see figure 67).

Figure 65 ***Parallel SCSI*** — Logical Unit Control **MODE SELECT** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (18h)					
1	Page Length (06h)							
2	Reserved				Protocol Identifier (1h)			
3 — 7	Reserved							

Table 74 ***Parallel SCSI*** — Logical Unit Control **MODE SELECT** Page — Field Descriptions

Field	Description
PS	Parameters Savable. Must be set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 18h identifies this as the Logical Unit Control Page.
Page Length	Indicates the number of bytes in the page, excluding bytes 0 and 1. The length is returned on **MODE SENSE** and must subsequently be set to the same value when performing **MODE SELECT**.
Protocol Identifier	A value of 1h indicates that this mode page applies to an SPI-5 compliant port (see the *SCSI Parallel Interface - 5* (SPI-5) standard).

Figure 66 ***Fibre Channel*** — Logical Unit Control **MODE SELECT** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (18h)					
1	Page Length (06h)							
2	Reserved				Protocol Identifier (0h)			
3	Reserved							EPDC (0)
4 — 7	Reserved							

Table 75 ***Fibre Channel*** — Logical Unit Control **MODE SELECT** Page — Field Descriptions

Field	Description
PS	Parameters Savable. Must be set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 18h identifies this as the Logical Unit Control Page.
Page Length	Indicates the number of bytes in the page, excluding bytes 0 and 1. The length is returned on **MODE SENSE** and must subsequently be set to the same value when performing **MODE SELECT**.
Protocol Identifier	A value of 0h indicates that this mode page applies to an FCP-2 port (see the *Fibre Channel Protocol – 2* (FCP–2) standard).
EPDC	Enable Precise Delivery Checking. Indicates whether the drive uses the precise delivery function defined by the Fibre Channel standard. Must be set to 0. The drive ignores the contents of the Command Reference Number (CRN) in the FCP command IU. This value is not changeable using the **MODE SELECT** command.

Figure 67 ***SAS*** — Logical Unit Control **MODE SELECT** Page — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (18h)					
1	Page Length (06h)							
2	Reserved			Transport Layer Retries	Protocol Identifier (6h)			
3 — 7	Reserved							

Table 76 ***SAS*** — Logical Unit Control **MODE SELECT** Page — Field Descriptions

Field	Description
PS	Parameters Savable. Must be set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 18h identifies this as the Logical Unit Control Page.
Page Length	Indicates the number of bytes in the page, excluding bytes 0 and 1. The length is returned on **MODE SENSE** and must subsequently be set to the same value when performing **MODE SELECT**.
Protocol Identifier	A value of 1h indicates that this mode page applies to a SAS-1.1 compliant port (see the *Information Technology – Serial Attached SCSI – 1. 1 (SAS-1.1)*).
Transport Layer Retries	When set to 1, transport layer retries are supported by this device as defined in SAS 1.1. When this bit is set to 0 in a **MODE SELECT** command, the device will disable transport layer retries. The default and recommended value for this field is 1, transport layer retries enabled.

Port Control Page (19h)

The Port Control Page contains the parameters that affect SCSI target port or FCP_Port operations (For Parallel SCSI, see figure 68; for Fibre Channel, see figure 69; and for SAS, see figure 70).

Figure 68 ***Parallel SCSI*** — Port Control **MODE SELECT** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (19h)					
1	Page Length (06h)							
2	Reserved				Protocol Identifier (1h)			
3	Reserved							
4 — 5	(MSB) Synchronous Transfer Timeout (LSB)							
6 — 7	Reserved							

Table 77 ***Parallel SCSI*** — Port Control **MODE SELECT** Page — Field Descriptions

Field	Description
PS	Parameters Savable. Must be set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 19h identifies this as the Port Control Page.
Page Length	Indicates the number of bytes in the page, excluding 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**.
Protocol Identifier	A value of 1h indicates that this mode page applies to a SPI-5 compliant port (see the *SCSI Parallel Interface - 5* (SPI-5) standard).
Synchronous Transfer Timeout	Indicates the amount of time, in 1 msec increments, that the drive waits for an ACK during data transfers before performing an unexpected BUS FREE operation.

Figure 69 ***Fibre Channel*** — Port Control **MODE SELECT** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (19h)					
1	Page Length (06h)							
2	Reserved				Protocol Identifier (0h)			
3	DTFD (0)	PLPB (1)	DDIS (1)	DLM (0)	RHA (0)	ALWLI (0)	DTIPE (0)	DTOLI (0)
4 — 5	Reserved							
6	Reserved					RR_TOV Units (5h)		
7	Resource Recovery Time-out (RR_TOV) (1Eh)							

Table 78 ***Fibre Channel*** — Port Control **MODE SELECT** Page — Field Descriptions

Field	Description
PS	Parameters Savable. Must be set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 19h identifies this as the Port Control Page.
Page Length	Indicates the number of bytes in the page, excluding 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**.
Protocol Identifier	A value of 0h indicates that this mode page applies to an FCP-2 port (see the *Fibre Channel Protocol – 2* (FCP–2) standard).

Field	Description
DTFD	Disable Tape Drive Fabric Discovery. Must be set to 0. The drive always recognizes a fabric loop port if it is present.
PLPB	Prevent Loop Port Bypass. Must be set to 1. The loop port is always participating and ignores all LPE and LPB primitives.
DDIS	Disable Discovery. Applies only if the drive is attached to an arbitrated loop. Must be set to 1. The drive does not require receipt of an Address or Port Discovery following loop initialization.
DLM	Disable Loop Master. Must be set to 0. The drive participates in loop master arbitration in the normal manner.
RHA	Require Hard Address. Must be set to 0. The drive attempts to acquire a soft address if it cannot obtain a hard address.
ALWLI	Allow Login Without Loop Initialization. Must be set to 0. The drive only enters the monitoring mode after it has gone through loop initialization.
DTIPE	Disable Tape Initiated Port Enable. Must be set to 0. The drive performs an LIP and attempts to participate in the loop as soon as power is restored.
DTOLI	Disable Tape Originated Loop Initialization. Must be set to 0. The drive generates the initializing LIP after it successfully enables a port into a loop.
RR_TOV Units	Resource Recovery Timeout Units. Must be set to 101b. The drive uses a ten second unit of measure for RR_TOV in all cases.
RR_TOV	Resource Recovery Timeout Value. Must be set to 1Eh. The drive always uses an RR_TOV value of 300 seconds.

Figure 70 ***SAS*** — Port Control **MODE SELECT** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (19h)					
1	Page Length (06h)							
2	Reserved			Ready LED Meaning	Protocol Identifier (6h)			
3	Reserved							

Byte \ Bit	7	6	5	4	3	2	1	0
4 — 5	(MSB) I_T Nexus Loss Time (LSB)							
6 — 7	(MSB) Initiator Response Timeout (LSB)							

Table 79 ***SAS*** — Port Control **MODE SELECT** Page — Field Descriptions

Field	Description
PS	Parameters Savable. Always set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 19h identifies this as the protocol-specific Port Control page.
Page Length	Indicates the number of bytes in the page, excluding 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**.
Ready LED Meaning	Always set to 0.
Protocol Identifier	A value of 6h indicates that this mode page applies to an SAS-1.1 port, (see the *Serial Attached SCSI – 1. 1 (SAS-1.1)* standard for specific SAS information).
I_T Nexus Loss Time	Contains the time that the SSP target retries connection requests to an SSP initiator that are reject with responses indicating the SSP initiator port may no longer be present before recognizing an I_T Nexus Loss (at 2000 ms).
Initiator Response Timeout	Contains the time in milliseconds that the SSP target port waits for the receipt of a frame (e.g., a write DATA frame) before aborting the command associated with that frame.

SAS Phy Control and Discover Mode Subpage (19h/01h)

The SAS Phy Control and Discover Mode subpage contains phy-specific parameters.

Figure 71 ***SAS*** Phy Control and Discover Mode Subpage — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (1)	Page Code (19h)					
1	SubPage Code (01h)							
2 — 3	(MSB) Page Length (34h) (LSB)							
4	Reserved							
5	Reserved				Protocol Identifier (6h)			
6	Reserved							
7	Number of Phys (1)							
8 — 55	SAS Phy Mode Descriptor (see figure 72)							

Table 80 ***SAS*** Phy Control and Discover Mode Subpage — Field Descriptions

Field	Description
PS	Parameters Savable. Must be to 0.
SPF	SubPage Format. Must be to 1. Indicates that this page uses the sub_page mode page format.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 19h identifies this is as the Port Control Page.
SubPage Code	Identifies the type of **MODE SELECT** Subpage being transferred. A value of 01h identifies this is as the SAS Phy Control and Discover Mode Subpage.

Field	Description
Page Length	Indicates the number of bytes in the page, excluding the 4 bytes that make up the header.
Protocol Identifier	A value of 6h indicates that this mode page applies to an SAS SSP-specific mode page (see the *Serial Attached SCSI – 1. 1 (SAS-1.1)* for specific SAS information).
Number of Phys	Indicates the Number of Phys. Must be to 1.
SAS Phy Mode Descriptor	See figure 72.

Figure 72 shows the SAS phy mode descriptor.

Figure 72 ***SAS*** Phy Mode Descriptor

Byte \ Bit	7	6	5	4	3	2	1	0
8	Reserved							
9	Phy Indentifier							
10	Reserved							
11	Reserved							
12	Reserved	Attached Device Type			Reserved			
13	Reserved				Negotiated Physical Link Rate			
14	Reserved				Attached SSP Initiator Port	Attached STP Initiator Port	Attached SMP Initiator Port	Reserved
15	Reserved				Attached SSP Target Port	Attached STP Target Port	Attached SMP Target Port	Reserved
16 — 23	SAS Address							
24 — 31	Attached SAS Address							

Byte \ Bit	7	6	5	4	3	2	1	0
32	Attached Phy Identifier							
33 — 39	Reserved							
40	Programmed Minimum Physical Link Rate					Hardware Minimum Physical Link Rate		
41	Programmed Maximum Physical Link Rate					Hardware Maximum Physical Link Rate		
42 — 49	Reserved							
50 — 51	Vendor Specific							
52 — 55	Reserved							

Table 81 ***SAS*** Phy Mode Descriptor — Field Descriptions

Field	Descriptor
Phy Identifier	Phy Identifier Always set to 0.
Attached Device Type	Reflects the Device Type reported in the Identify Address frame received by the drive.
Attached SSP Initiator Port	Reflects the SSP Initiator Port Bit reported in the Identify Address frame received by the drive.
Attached STP Initiator Port	Reflects the STP Initiator Port Bit reported in the Identify Address frame received by the drive.
Attached SMP Initiator Port	Reflects the SMP Initiator Port Bit reported in the Identify Address frame received by the drive.
Attached SSP Target Port	Reflects the SSP Target Port Bit reported in the Identify Address frame received by the drive.
Attached STP Target Port	Reflects the STP Target Port Bit reported in the Identify Address frame received by the drive.
Attached SMP Target Port	Reflects the SMP Target Port Bit reported in the Identify Address frame received by the drive.
SAS Address	Indicates the SAS Address of the drive.

Field	Descriptor
Attached SAS Address	Reflects the SAS Address reported in the Identify Address frame received by the drive.
Negotiated Physical Link Rate	The value for this field is either 8h or 9h, indicating a Physical Link Rate of 1.5 Gbps or 3.0 Gbps.
Attached Phy Identifier	Reflects the Phy Identifier reported in the Identify Address frame received by the drive.
Programmed Minimum Physical Link Rate	Always set to 8h, indicating the 1.5 Gbps.
Hardware Minimum Physical Link Rate	Always set to 8h, indicating the 1.5 Gbps.
Programmed Maximum Physical Link Rate	Always set to 9h, indicating the 3.0 Gbps.
Hardware Maximum Physical Link Rate	Always set to 9h, indicating the 3.0 Gbps.

SPI Negotiated Settings Mode Subpage (19h/03h)

The SPI Negotiated Settings Mode Subpage, shown in figure 73, is used to report the negotiated settings of a SCSI target port for the current I_T nexus for Parallel SCSI only. For additional information see figure 68.

> Note: The values reported in this page pertain to protocol options negotiated or established on the SCSI Parallel interface (SPI) used to transfer the data. None of these parameters are changeable with a **MODE SELECT** command. For a description of the possible settings, see the *SCSI Parallel Interface - 5* (SPI-5) standard.

Figure 73 ***Parallel SCSI*** — SPI Negotiated Settings Mode Subpage — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (1)	Page Code (19h)					
1	Subpage Code (03h)							
2 — 3	(MSB) Page Length (0Ah) (LSB)							
4	Reserved							
5	Reserved				Protocol Identifier (1h)			
6	Transfer Period Factor							
7	Reserved							
8	REQ/ACK Offset							
9	Transfer Width Exponent							
10	Reserved	Protocol Options Bits						
11	Reserved				Transceiver Mode		Sent PCOMP_EN	Received PCOMP_EN
12	Reserved							
13	Reserved							

Table 82 ***Parallel SCSI*** — SPI Negotiated Settings Mode Subpage — Field Descriptions

Field	Description
PS	Parameters Savable. For **MODE SELECT**, must be set to 0.
SPF	SubPage Format. Always set to 1. Indicates that this page uses the page_1 page format.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 19h identifies this as the Port Control Page.
Subpage Code	The SUBPAGE CODE field indicates which mode subpage is being accessed. Mode subpage code values are listed in SPI-5. If the parameter data of a **MODE SELECT** command contains a mode subpage formatted mode page with the SUBPAGE CODE field is set to zero, the SCSI target device returns a CHECK CONDITION status. The sense key sets to ILLEGAL REQUEST and the additional sense code set to ILLEGAL FIELD IN PARAMETER LIST.
Page Length	Indicates the number of bytes in the page, excluding the 4 bytes that make up the header. The length is returned in **MODE SENSE** commands and must subsequently be set to the same value when performing **MODE SELECT**.
Protocol Identifier	A value of 1h indicates that this mode page applies to a SPI-5 compliant port (see the *SCSI Parallel Interface - 5* (SPI-5) standard).
Transfer Period Factor	The TRANSFER PERIOD FACTOR field indicates the negotiated transfer period factor for the current I_T nexus.
REQ/ACK Offset	The REQ/ACK Offset field indicates the negotiated REQ/ACK offset for the current I_T nexus.
Transfer Width Exponent	The TRANSFER WIDTH EXPONENT field indicates the negotiated transfer exponent for the current I_T nexus.
Protocol Options Bits	The PROTOCOL OPTIONS BITS field indicates the negotiated protocol options for the current I_T nexus.
Transceiver Mode	The TRANSCEIVER MODE field specifies the current bus mode of the SCSI target port as defined below:

Code	Bus Mode
00b	Unknown
01b	Single ended
10b	Low Voltage Differential
11b	High Voltage Differential (not supported)

Field	Description
Sent PCOMP_EN	The SENT PCOMP_EN bit contains the value on the PCOMP_EN bit sent by the SCSI target port for the current I_T nexus.
Received PCOMP_EN	The RECEIVED PCOMP_EN bit contains the value on the PCOMP_EN bit received by the SCSI target port for the current I_T nexus.

SPI Report Transfer Capabilities Mode Subpage (19h/04h)

The SPI Report Transfer Capabilities Mode Subpage, shown in figure 74, is used to report the transfer capabilities for the SCSI target port for Parallel SCSI only. The values in this mode subpage are not changeable via a **MODE SELECT** command. For additional information, see figure 68.

Figure 74 ***Parallel SCSI*** — SPI Report Transfer Capabilities Mode Subpage — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (1)	Page Code (19h)					
1	Subpage Code (04h)							
2 — 3	(MSB) Page Length (0Ah) (LSB)							
4	Reserved							
5	Reserved				Protocol Identifier (1h)			
6	Minimum Transfer Period Factor							
7	Reserved							
8	Maximum REQ/ACK Offset							
9	Maximum Transfer Width Exponent							

Byte \ Bit	7	6	5	4	3	2	1	0
10	Protocol Options Bits Supported							
11	Reserved							
12	Reserved							
13	Reserved							

Table 83 ***Parallel SCSI*** — SPI Report Transfer Capabilities Mode Subpage — Field Descriptions

Field	Description
PS	Parameters Savable. For **MODE SELECT**, must be set to 0.
SPF	SubPage Format. Always set to 1. Indicates that this page uses the page_1 page format.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 19h identifies this as the Port Control Page.
Subpage Code	The SUBPAGE CODE field indicates which mode subpage is being accessed. Mode subpage code values are listed in SPI-5. If the parameter data of a **MODE SELECT** command contains a mode subpage formatted mode page with the SUBPAGE CODE field is set to zero, the SCSI target device returns a CHECK CONDITION status. The sense key sets to ILLEGAL REQUEST and the additional sense code set to ILLEGAL FIELD IN PARAMETER LIST.
Page Length	Indicates the number of bytes in the page, excluding the 4 bytes that make up the header. The length is returned in **MODE SENSE** commands and must subsequently be set to the same value when performing **MODE SELECT**.
Protocol Identifier	A value of 1h indicates that this mode page applies to a SPI-5 compliant port (see the *SCSI Parallel Interface - 5* (SPI-5) standard).
Minimum Transfer Period Factor	The MINIMUM TRANSFER PERIOD FACTOR field is set to the smallest value of the transfer period factor (see SPI-5) supported by the SCSI target port.

Field	Description
Maximum REQ/ACK Offset	The MAXIMUM REQ/ACK Offset field indicates the REQ/ACK offset for the current I_T nexus.
Maximum Transfer Width Exponent	The MAXIMUM TRANSFER WIDTH EXPONENT field indicates the transfer exponent for the current I_T nexus.
Protocol Options Bits Supported	The PROTOCOL OPTIONS BITS SUPPORTED field indicates the protocol options for the current I_T nexus.

TapeAlert Page (1Ch)

The drive supports the TapeAlert Page, which sets or changes the supported TapeAlert configuration options. Use the **MODE SENSE** command to read the settings of the TapeAlert page.

Figure 75 TapeAlert **MODE SELECT** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (1Ch)					
1	Page Length (0Ah)							
2	Perf	Reserved	EBF (0)	EWASC (0)	DExcpt	Test	Reserved	LogErr (0)
3	Reserved				MRIE			
4 — 7	(MSB) Interval Timer (0) (LSB)							
8 — 11	(MSB) Report Count / Test Flag Number (LSB)							

Table 84 TapeAlert **MODE SELECT** Page — Field Descriptions

Field	Description
PS	Parameters Savable. For **MODE SELECT**, must be set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 1Ch identifies this as the TapeAlert Page.
Page Length	Indicates the number of bytes in the page, excluding 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**.
Perf	Performance. Performance Impacting Exceptions are acceptable. The drive ignores this bit.
EBF	Enable Background Function. Must be set to 0.
EWASC	Enable Warning. Must be set to 0.
DExcpt	Disable Information Exception Operations. When set to 0, the reporting method specified by the contents of the MRIE field is selected. When set to 1, all information exception conditions are disabled regardless of the contents of the MRIE field. When in this mode, the software polls the TapeAlert Log page. To enable CHECK CONDITION mode, set DExcpt to 0. Default setting is 1.
Test	Generates false TapeAlert conditions to test the response to failure conditions (see the Report Count / Test Flag Number description for more information). If both Test and DExcpt are set to 1, the drive returns CHECK CONDITION status, Sense Key ILLEGAL REQUEST, and Additional Sense Code set to INVALID FIELD IN PARAMETER LIST.
LogErr	Error Log. Must be set to 0.

<table>
<tr><th>Field</th><th colspan="2">Description</th></tr>
<tr><td>MRIE</td><td colspan="2">Method for Reporting Informational Exceptions. The drive uses the contents of this field to report information about exception conditions. The available methods are:</td></tr>
<tr><td></td><td>Value</td><td>Method</td></tr>
<tr><td></td><td>00h</td><td>No reporting of Informational Exception Conditions. The drive does not report information exception conditions.</td></tr>
<tr><td></td><td>03h</td><td>Conditionally Generate Recovered Error. The drive reports informational exception conditions, if such reports of recovered errors are allowed, by returning CHECK CONDITION status on the next SCSI command (except INQUIRY and REQUEST SENSE commands) following detection of the condition. The drive sets the Sense Key to RECOVERED ERROR with an Additional Sense Code of 5Dh / 00h (TapeAlert Event). The SCSI command with the CHECK CONDITION status completes without error before the report of any exception condition and does not need to be repeated.</td></tr>
<tr><td></td><td>04h</td><td>Unconditionally Generate Recovered Error. The drive reports informational exception conditions by returning CHECK CONDITION status on the next SCSI command (except INQUIRY and REQUEST SENSE commands) following detection of the condition. The drive sets the Sense Key to RECOVERED ERROR with an Additional Sense Code of 5Dh / 00h (TapeAlert Event). The SCSI command with the CHECK CONDITION status completes without error before the report of any exception condition and does not need to be repeated.</td></tr>
<tr><td></td><td>06h</td><td>Only Report Informational Exception Condition on Request. The drive preserves information exception data. To access the data, issue an unsolicited REQUEST SENSE command. The drive sets the Sense Key to NO SENSE with an Additional Sense Code of 5Dh / 00h (TapeAlert Event).</td></tr>
<tr><td></td><td colspan="2">The Additional Sense Code of 5Dh / 00h for values 03h, 04h, and 06h signals that a TapeAlert event occurred. Information about the event is stored in the TapeAlert Log page. The setting of the MRIE field does not impact logging of events in the TapeAlert Log page.</td></tr>
<tr><td>Interval Timer</td><td colspan="2">Must be set to 0.</td></tr>
</table>

Field	Description	
Report Count / Test Flag Number	Report Count or Test Flag Number. Must be set to 0 unless the Test bit is set to 1, in which case this field indicates a test condition to be generated as follows:	
	Value	**Result**
	0	Do not change the TapeAlert Flag but report an exception condition based on the value in the MRIE field.
	1 to 64	Set the TapeAlert flag indicated in the value and generate an exception condition based on the value in the MRIE field.
	-64 to -1	Clear the TapeAlert flag in an equivalent manner to taking corrective action for the flag indicated by the absolute number of the value.
	32,767	Set all TapeAlert flags and generate an exception condition based on the value in the MRIE field.

Medium Configuration Mode Page (1Dh)

The Medium Configuration Mode Page specifies any special considerations the device server uses when processing commands that access the medium.

Figure 76 Medium Configuration Mode Page

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (1Dh)					
1	Page Length (1Eh)							
2	Reserved							WORMM
3	Reserved							
4	WORM Mode Label Restrictions (00h)							
5	WORM Mode Filemark Restrictions (03h)							
6 — 31	Reserved							

Table 85 Medium Configuration Mode Page — Field Descriptions

Field	Description
PS	Parameters Savable. For **MODE SELECT**, must be set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 1Dh identifies this as the Medium Configuration Mode Page.
Page Length	Indicates the number bytes in the page, excluding 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**.
WORMM	The WORM mode (WORMM) bit is set to one when the device server is operating in WORM mode, no medium is mounted, or the current medium is not a WORM medium (see SSC-3). The WORMM bit is set to zero when the device server is not operating in WORM mode or when the current medium is a WORM medium. This bit is not changeable with a MODE SELECT command.
WORM MODE LABEL RESTRICTIONS	The field specifies the restrictions against overwriting format labels when operating in WORM mode. A series of filemarks with no interleaved logical blocks immediately preceding EOD is treated as a filemark sequence and is controlled by the WORM MODE FILEMARKS RESTRICTIONS field. The DLT-S4 supports only a setting of 00h indicating that it will not allow any logical blocks to be over-written on a WORM medium.
WORM MODE FILEMARKS RESTRICTIONS	The WORM MODE FILEMARKS RESTRICTIONS field specifies the restrictions against overwriting a series of filemarks immediately preceding EOD when operating in WORM mode. The WORM MODE FILEMARKS RESTRICTIONS field controls only the overwriting of a series of filemarks with no interleaved logical blocks immediately preceding EOD. The DLT-S4 supports only a setting of 03h indicating that it will allow any number of filemarks immediately preceding EOD to be over-written.

Data Security Mode Page (27h)

The DLT-S4 drive checks for password protection on the DLT-S4 tape during the load process and if it is enabled, verifies that the drive has the same password. If the passwords match, the user can read and write data on the tape. If they do not match, **READ** and **WRITE** commands will be rejected and sense data will be presented to the initiator.

Data Security is enabled using a **MODE SELECT** command for the Vendor-Unique Data Security Mode page. The Data Security settings can be read using a **MODE SENSE** command for the Data Security Mode page. The password will not be returned in the **MODE SENSE** data. The password is written to the tape in response to a **WRITE** command when positioned at the beginning of the tape (**WRITE** from BOT). Action code 0x08 (Set Drive Password and Write to Tape Immediately) does not require a **WRITE** command to cause the password to be written to tape, it is written automatically prior to the completion of the **MODE SELECT** command.

Figure 77 shows the page that controls uses a password verification mechanism to prevent or allow reading and writing the data to the tape. Its primary function is to provide a means of preventing unauthorized access to data on a DLT-S4 native cartridge. It has no impact on Back Read cartridges.

Figure 77 Data Security Mode Page — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code (27h)					
1	Additional Page Length (32h)							
2	Reserved	PAX	PCP	PWF	Reserved		CRA	CWA
3	Reserved							
4	Reserved		Password Selection			Scope		
5	Reserved		Action Code					
6	Reserved							
7	Reserved				Number of Passwords Supported			
8 — 9	Reserved		APB	APD	PA	TPP	DPS	PM

Byte \ Bit	7	6	5	4	3	2	1	0
10	Reserved for Password 2 Status							
11	Reserved for Password 3 Status							
12	Reserved for Password 4 Status							
13	Reserved for Password 5 Status							
14	Reserved for Password 6 Status							
15	Reserved for Password 7 Status							
16 — 19	Reserved							
20 — 51	Password Value							

Table 86 Data Security Mode Page — Field Descriptions

Field	Description
PS	Parameters Savable. Must be set to 0.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 27h identifies this as the Data Security Mode Page.
Additional Page Length	Indicates the number bytes in the page, excluding 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**.
PAX	Password Attempts Exceeded. This read only bit is set when the allowed number of attempts to unlock the cartridge with the correct password have been exceeded. The number of attempts allowed is 32 per cartridge per load. This bit is cleared when the cartridge is unloaded. When the number of password attempts has been exceeded the sense data reported when a medium access command is rejected, will change from Data Protect, Access Denied, Invalid Management ID Key (07,20,03) to Data Protect, Access Denied, Password Attempts Exceeded (07, 20, 80).

<table>
<tr><th>Field</th><th colspan="2">Description</th></tr>
<tr><td>PCP</td><td colspan="2">Password Change Pending. This read only bit indicates that the desired tape password has been sent to the drive and is stored in drive memory but has not been written to tape. This bit is set anytime a tape is intended to be password protected with action codes 02 – Set Drive Password and write it to tape; 03 - Set Drive Password and write it to all blank tapes; and 04 – Set Drive Password and write it to all unprotected formatted tapes, and cleared by successful directory write or next load of the tape.
• If the currently loaded tape is blank, a WRITE, WRITE FM, or ERASE command is required to write the password to tape.
• If the currently loaded tape has data written on it, a WRITE or WRITE FM command from BOT; REWIND, or UNLOAD command will cause the password to be written to tape.</td></tr>
<tr><td>PWF</td><td colspan="2">Password Write Failed. This read only bit indicates that the password that was pending to be written to tape was not written due to a write error. This bit is set from the time of unloading the failing cartridge until the load of the next cartridge. If this bit is 0 after unloading a tape then the password was successfully written to tape. The PCP bit is cleared when this bit is set.</td></tr>
<tr><td>CRA</td><td colspan="2">Cartridge Read Access. This read only bit indicates if the cartridge can be accessed for the following READ type commands: READ, SPACE, VERIFY and LOCATE.</td></tr>
<tr><td>CWA</td><td colspan="2">Cartridge Write Access. This read only bit indicates if the cartridge can be accesses for the following WRITE type commands: WRITE, WRITE FM, ERASE and WRITE ATTRIBUTE.</td></tr>
<tr><td rowspan="4">Password Selection</td><td colspan="2">This read/write field selects the identification of the password to modify. The values are:</td></tr>
<tr><td>0</td><td>Host Read/Write Password</td></tr>
<tr><td>1</td><td>Automation Read/Write Password</td></tr>
<tr><td colspan="2">On a MODE SENSE command this field will be set to the last password that was selected on a MODE SELECT for that port.</td></tr>
<tr><td rowspan="6">Scope</td><td colspan="2">Scope of Password Protection. This two bit read/write field determines who is allowed to access the drive in a multi-initiator environment. This field is reserved for the ADC device server. The last scope successfully selected determines the global scope for passwords. A Unit Attention (Mode Parameters Changed) will be sent to any other initiators affected by the scope change. 03h Reserved</td></tr>
<tr><td>Scope Value</td><td>Description</td></tr>
<tr><td>00h</td><td>Only allow me to access the tape</td></tr>
<tr><td>01h</td><td>Allow everyone with a reservation to access the tape. Loss of</td></tr>
<tr><td>02h</td><td>Allow everyone to access the tape.</td></tr>
<tr><td>03h</td><td>Reserved</td></tr>
<tr><td>Action Code</td><td colspan="2">This 6-bit read/write field indicates the desired password protection action. The value in this field has the following meaning:</td></tr>
</table>

Field	Description	
	Action Value	Description
	00h	No Action
	01h	Set Drive Password. This action can be done with or without a tape in the drive. If a tape is mounted and password protected, the value in the password field must match the password on the tape. The corresponding DPS bit is set and the APB, APD, PAX, PCP, and PWF bits are cleared.
	02h	Set the Drive Password and write it to tape. Tape must be mounted and either have no password or the value in the password field must match the password on the tape. The PCP bit is set until the password has been successfully written to tape. Upon successful completion of the **MODE SELECT** command, the PCP bit is set if the tape does not have a password. The APB, APD, PAX, and PWF bits are cleared.
	03h	Set Drive Password in drive memory and write it to all **blank** tapes. This action sets the APB bit. This action code can be sent with or without a tape in the drive. The currently loaded tape, if it is blank, and subsequent blank tapes that are loaded into the drive will become password protected. If a tape is mounted and password protected, the value in the password field must match the password on the tape. The password will be written to the tape in conjunction with a **WRITE**, **WRITE FM**, or **ERASE** command. If none of these commands are received prior to an **UNLOAD** command, the tape will not become formatted or Password Protected. Formatted and password protected tapes will not alter the APB state and will not be modified by this action code.
	04h	Set Drive Password in drive memory and write it to all **unprotected/ formatted** tapes. This action sets the APD bit. The currently loaded tape, if it is unprotected/formatted, and subsequent unprotected/formatted tapes loaded into the drive will become password protected. If a tape is mounted and password protected, the value in the password field must match the password on the tape. The password will be written to the tape in conjunction with a **WRITE**, **WRITE FM**, **ERASE**, or **UNLOAD** command. Blank tapes and password protected tapes will not alter the APD state and will not be modified by this action code.

Field	Description	
	05h	Set Drive Password and write it to all **unprotected** tapes. All unprotected tapes will then automatically become password protected. This action sets the APB and APD bits. The currently loaded tape, if it is unprotected, and subsequent unprotected tapes loaded into the drive will become password protected. If a tape is mounted and password protected, the value in the password field must match the password on the tape. The password will be written to the tape in conjunction with a **WRITE**, **WRITE FM**, **ERASE**, or **UNLOAD** command. Password protected tapes will not be modified by this action code.
	06h	Remove Password from the tape. Tape must be mounted and the drive password(s) must match the tape password(s). This action clears the APB, APD, and the appropriate TPP bits. The drive password is not cleared from drive memory.
	07h	Clear Drive Password. This action clears the APB, APD and corresponding DPS bits, and the password from drive memory. If a password protected tape is loaded, the appropriate PMM bit will be set. Password field is ignored.
	08	Set the Drive Password and write it to tape now. Tape must be mounted and either have no password or the value in the password field must match the password on the tape. Upon successful completion of the **MODE SELECT** command, the password is written to tape, the TPP bit is set for the interface(s) that just put a password on the tape, and the APB, APD, PAX, and PWF bits are cleared.
	09h-3Fh	Reserved
Number of Passwords Supported	This read only four bit field indicates the number of passwords supported. This field is currently set to two: one for the host interface and one for the automation interface. However, this design can handle up to 8 passwords.	
APB	Auto Password Blank Tapes. This read only bit indicates password protection mode for this password is set to auto-password protect all blank tapes.	
APD	Auto Password Unprotected Data Tapes. This read only bit indicates password protection mode for this password is set to auto-password protect all unprotected/formatted tapes.	
PA	Password Accessible on this interface. This read only status bit indicates if this password is accessible from this interface.	
TPP	Tape Password Protected. This read only bit indicates if this tape is password protected with this password.	
DPS	Drive Password Set. This read only bit indicates if the drive has a password set for this interface.	

Field	Description
PM	Password Mismatch. This read only bit indicates that this password on the tape does not match this password set in the drive.
Password	This is a 32 byte write only field used to set the drive password to the desired value for the requesting interface. The password value is secret and will not be reported in **MODE SENSE** data. Instead, the password reported by the **MODE SENSE** command is all zeroes. For actions other than 00 or 05, the password must be non-zero or the command will be rejected. The password is cleared using action code 05 – Clear Drive Password

General Operation

The password(s) are written to the drive using a **MODE SELECT** command for the Vendor-Unique Data Security Mode page. The password value will not be returned in the **MODE SENSE** data. The drive will create password protected tapes as instructed by the Action Code of the **MODE SELECT** command.

At the end of the load process there is a determination if the tape is password protected. If the tape is password protected, the password(s) on the tape will be compared to the password(s) in the drive. If the password(s) are equal, subsequent write and read operations are allowed. If the passwords do not match, the following operations will be rejected and sense data presented to the host: **WRITE**, **WRITE FMs**, **READ**, **LOCATE**, **VERIFY**, **ERASE**, **SPACE**, **WRITE ATTRIBUTES**, **SEND DIAG** and **WRITE BUFFER**. If the tape is not password protected and the action code is to password protect the tape, then the passwords are written to tape at the next possible opportunity (when the tape is positioned at BOT).

In the event of a password mismatch, the following commands are rejected:

WRITE, **WRITE FMs**, **READ**, **LOCATE**, **VERIFY**, **ERASE**, **SPACE**, **WRITE ATTRIBUTES**, **SEND DIAG**, and **WRITE BUFFER**.

The sense data returned when one of these commands is rejected is:

- Sense data (0x07, 0x20, 0x03) Data Protect, Access Denied, Invalid Management ID Key.

In the event of an attempt to disable a password protected tape or add a password to a non-protected tape **when not at BOT**, the following sense data will be available on the interface:

- Sense data (0x05, 0x82, 0x00) Illegal request, Action not allowed away from BOT.

In the event of excessive attempts to select the correct password, when the number of password attempts has been exceeded the sense data will change from:

- Data Protect, Access Denied, Invalid Management ID Key (07, 20, 03) to Data Protect, Access Denied, Password Attempts Exceeded (07, 20, 80).

Drive Password and Password Protection State Storage

The drive password and the 'Password Protection State' will be stored in the drive's volatile RAM. Passwords sent to the drive using action code 01 – Set Drive Password, will be saved in the drive's volatile RAM for automatic password validation on future tape loads. The default value of the Password bytes and Password Protection State will be 00. In a parallel SCSI drive, the drive password, Password field, and Password Protection State will be reset to default values only after a power-on reset. A device reset or bus reset will not reset the drive's passwords. For Fibre Channel and SAS drives, the drive password, Password field, and Password Protection State will be reset to default values after a power-on reset, device reset, or bus reset.

EEPROM Mode Page (3Eh)

The drive supports an EEPROM Mode Page that enables an initiator to modify savable parameters. Only one savable parameter can be changed per **MODE SELECT** command.

Figure 78 EEPROM Mode Page — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (3Eh)					
1	Page Length							
2 — *n*	ASCII String of Parameter Name and Value							

The ASCII string has a parameter name followed by one or more space characters, a parameter value, and an ASCII line feed or null character. When the string is parsed, the parameter value is interpreted as shown in

table 87. Note that the parameter name may be in upper or lower case. The drive saves the savable parameters during resets and power cycles.

Table 87 EEPROM Mode Page — Parameter Descriptions

Parameter	Data Type	Default	Length (Bytes)	Usage
VendorID	ASCII	QUANTUM	8	Vendor Identification field in **INQUIRY** data.
CacheTMs	Binary	0	1	When set, the drive always treats a **WRITE FILEMARKS** command that writes a single filemark and is not preceded by another **WRITE FILEMARKS** command as if the Immed bit was set to 1.
DefaultCompON	Binary	1	1	When set to 0, indicates that compression is defaulted OFF at power-on/reset. When set to 1, indicates that compression is defaulted ON at power-on/reset.
DefFixedBlkLen	Decimal	0	4	Default fixed block size. Minimum value of this field is 0, maximum value is 16,777,215.
DefSEW	Binary	1	1	Default Synchronize at Early Warning parameter.
DisDeferClnRpt	Binary	0	1	When set to 1, the drive sends a cleaning report over the library port as soon as the cleaning light illuminates. When set to 0, the drive sends the report only at unload.
DisUnbufMode	Binary	0	1	When set to 1, the drive completely disables unbuffered mode; it ignores the **MODE SELECT** buffered mode selection to turn off buffered mode. When set to 0, buffered mode can be enabled or disabled.
EnaCleanLib	Binary	1	1	When set to 1, the drive reports cleaning status using the library tape drive interface. When set to 0, this functionality is disabled.

Parameter	Data Type	Default	Length (Bytes)	Usage
EnaCleanLight	Binary	1	1	When set to 1, the Cleaning Required LED is turned on and off as appropriate. When set to 0, this functionality is disabled.
EnaCleanSense	Binary	1	1	When set to 1, the drive collects cleaning Sense Key data. When set to 0, this functionality is disabled.
EnaCleanTA	Binary	1	1	When set to 1, the drive returns tape cleaning flags for TapeAlert. When set to 0, this functionality is disabled.
EnaGranularity	Binary	0	1	Enables the Granularity field in the **READ BLOCK LIMITS** command.
EnaRepDecomp	Binary	0	1	If set and the drive is in Read mode, the decompression algorithm field in Data Compression mode is reset if the drive decompressed the last block the host requested; otherwise, the drive clears the Decompression Algorithm field in Data Compression mode.
EnaSCSIUnlonPMR	Binary	0	1	When set to 1, enables a **SCSI UNLOAD** when a previous **PREVENT MEDIUM REMOVAL** command is in effect.
EnaPeriodicClean	Binary	1	1	When set to 1, periodic cleaning of the read/write heads is enabled. When set to 0, this functionality is disabled.
EnaThirdPtyDens	Binary	1	1	When set to 1, makes non-DLT density codes act as the default density (same as density code 0).
ForceComp	Binary	0	1	0b = Automatic[1] 1b = Force Compression disabled 10b = Force Compression enabled
ForceEERebuild	Binary	0	1	When set to 1, forces the drive to reset all of the parameters to default values at the next power cycle.

Parameter	Data Type	Default	Length (Bytes)	Usage
MaxBurstSize	Binary	0080h	2	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 4 KB. The drive rounds values that are not multiples of 8 down to the nearest multiple of 8. Minimum value of this field is 0000h, maximum value is FFFFh.
NoDeferRcvdErr	Binary	0	1	When set to 1, the drive reports a deferred recovered error as a current recovered error.
NoSCSIEject	Binary	0	1	Disables ejection of the cartridge at the completion of an unload operation initiated by a **SCSI LOAD UNLOAD** command.
RepBusyInProg	Binary	0	1	When set to 1, the drive reports BUSY status if it is in the process of becoming ready.
RepMAMAvailUA	Binary	0	1	When set, the drive reports a UNIT ATTENTION when the EMAM data is available.
ReportRcvdPerrs	Binary	1	1	When set to 1, the drive reports a recovered error if parity error retried successfully (Parallel SCSI only).
ReportRcvrdErr	Binary	0	1	Sets the default value of the PER bit of the Read / Write Error Recovery Mode Page (01h).
RewindOnReset	Binary	1	1	When set to 1, the drive rewinds the tape medium to BOT on reset. When set to 0, the drive does *not* rewind on BUS RESET or BDR message. Caution: Partial block data may be written to tape if reset occurs during **WRITE**.
SCSIBusDMATimer	Decimal	2	1	The number of seconds before the drive times out waiting for ACK once DMA transfer started. When set to 0, the timer is set to infinite (Parallel SCSI only). Minimum value of this field is 0, maximum value is 255.

Parameter	Data Type	Default	Length (Bytes)	Usage
SCSIReselRetries	Decimal	10	1	The number of reselection retries the drive makes before giving up. A reselection retry occurs once each second. When set to 0, the drive never gives up; it preforms infinite reselection retries (Parallel SCSI only). Minimum value of this field is 0, maximum value is 255.
SCSIResRelNOP	Binary	0	1	When set to 1, **SCSI RESERVE / RELEASE UNIT** commands are no operation (NOP).
SCSIXferMax	Decimal	0	1	0 = Best possible speed 5 = Limit to 5 MB/sec 10 = Limit to 10 MB/sec 20 = Limit to 20 MB/sec 40 = Limit to 40 MB/sec (Parallel SCSI only)
SetEOMatEW	Binary	0	1	When set to 1, sets EOM field in byte 2 of **REQUEST SENSE** data when encountering Early Warning End of Media for all operations.
SPC3Reserve	Binary	1	1	Controls if the device complies with SPC-3 with respect to **RESERVE** commands and **TEST UNIT READY** being subject to reservations.
TaMrieDefault	Decimal	3	1	Default setting for the MRIE field in the Tape Alert Mode Page. Minimum value of this field is 0, maximum value is 6.
ThirdPartyDen	Decimal	0	1	Value of default third party density. Minimum value of this field is 0, maximum value is 255.

Figure 79 is a sample of an EEPROM Mode Page that modifies the VendorID parameter to "XXXYY."

Figure 79 EEPROM Mode "Vendor ID" Example — Data Format

0	**Page Code (3Eh)**
1	Page Length (0Fh)
2	"v" (76h)
3	"e" (65h)
4	"n" (6Eh)
5	"d" (64h)
6	"o" (6Fh)
7	"r" (72h)
8	"i" (69h)
9	"d" (64h)
10	" " (20h)
11	"X" (58h)
12	"X" (58h)
13	"X" (58h)
14	"Y" (59h)
15	"Y" (59h)
16	(A0h) or (00h)

Changeable Parameters Within MODE SELECT

Table 88 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 SELECT** mode pages.

> Note: Parameter rounding is supported for all parameters except the Block Descriptor Length parameter.

Table 88 Changeable Mode Parameters Within **MODE SELECT**

Page: Parameter	Default	Minimum	Maximum
Header: Buffered Mode, Device Specific Byte	1	0	1
Block Descriptor Length	08h	00h	08h
Block Descriptor: Block Length	0	0	FFFFFCh[1]
Read / Write Error Recovery (01h): PER bit	0	0	1
Control Mode (0Ah): Report Log Exception Condition	0	0	1
Control Mode (0Ah): Autoload Mode	0	0	2
Data Compression (0Fh): Data Compression Enable	1	0	1
Disconnect / Reconnect (02h): Maximum Burst Size	0080h	0000h	FFFFh
Device Configuration (10h): Write Delay Time	64h	64h	1964h
Device Configuration (10h): Synchronize at Early Warning	1	0	1
Device Configuration (10h): Select Data Compression Algorithm	1	0	1
TapeAlert (1Ch): DExcpt	1	0	1
TapeAlert (1Ch): Perf	0	0	1
TapeAlert (1Ch): Test	0	0	1
TapeAlert (1Ch): MRIE	3	0	6
TapeAlert (1Ch): Test Flag	0	0	

1. All values between the minimum and maximum must be an even multiple of 4.

MODE SENSE (6) / (10) Command (1Ah / 5Ah)

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

Figure 80 shows the CDB for the 6-byte **MODE SENSE** (1Ah) command. An illustration of the CDB for the 10-byte **MODE SENSE** (5Ah) command is shown in figure 81.

Figure 80 **MODE SENSE** (6) Command Descriptor Block — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Ah)							
1	Reserved				DBD	Reserved		
2	PC		Page Code					
3	SubPage Code							
4	Allocation Length							
5	Control							

Note:	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 not changeable. In such cases, the drive does not change any parameters as a result of the command.

The 10-byte **MODE SENSE** command is required to request the vendor-specific 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).

Figure 81 **MODE SENSE** (10) Command Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (5Ah)							
1	Reserved			LLBAA	DBD	Reserved		
2	PC		Page Code					
3	SubPage Code							
4 — 6	Reserved							
7 — 8	(MSB) Allocation Length (LSB)							
9	Control							

Table 89 **MODE SENSE** Command Descriptor Block — Field Descriptions

Field	Description	
LLBAA	Long LBA Accepted. Must be set to 0.	
DBD	Disable Block Descriptors. When set to 0, the drive returns the block descriptor data. When set to 1, the drive does not return block descriptor information.	
PC	Page Control. Indicates the type of page parameter values the drive returns to the host:	
	PC	**Type of Parameter Values**
	00b	Report Current Values
	01b	Report Changeable Values
	10b	Report Default Values
	11b	Report Saved Values
Page Code	Allows the host to select a specific page or all of the pages the drive supports.	
SubPage Code	Specifies the subpage to return. Set to FFh to return all subpages.	
Allocation Length	Specifies the number of bytes that the host has allocated for returned **MODE SENSE** data. An Allocation Length of 0 indicates that the drive returns no **MODE SENSE** data. This is not considered an error and the drive returns GOOD status.	

MODE SENSE Data Headers

The **MODE SENSE** (6) and **MODE SENSE** (10) headers are depicted in figure 82 and figure 83.

Figure 82 **MODE SENSE** (6) Data Header — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Mode Data Length							
1	Medium Type							
2	WP	Buffered Mode			Speed (0)			
3	Block Descriptor Length							

Figure 83 **MODE SENSE** (10) Data Header — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0 — 1	(MSB) Mode Data Length (LSB)							
2	Medium Type							
3	WP	Buffered Mode			Speed (0)			
4 — 5	Reserved							
6 — 7	(MSB) Block Descriptor Length (LSB)							

Table 90 **MODE SENSE** Data Header — Field Descriptions

Field	Description	
Mode Data Length	Specifies the length in bytes of the **MODE SENSE** data that is available to be transferred. Note that the Mode Data Length does not include its own length.	
Medium Type	The drive checks the media type, which can be one of the following:	
	Type	**Description**
	00h	Unknown or not present
	81h	Cleaning tape
	86h	Super DLTtape I[1]
	87h	Super DLTtape II[1], Super DLTtape II WORM[1]
	91h	DLTtape S4, DLTtape S4 WORM
WP	Write Protect. When set to 0, indicates that the tape is write-enabled. When set to 1, indicates that the tape is write-protected.	
Buffered Mode	When set to 0, the drive does not report a GOOD status on **WRITE** commands until it actually writes the data blocks to tape. When set to 1, 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 drive suffers a degradation of performance and capacity.	
Speed	Always set to 0, indicating the default speed.	
Block Descriptor Length	Specifies the length in bytes of all of the block descriptors. If the DBD bit in the CDB is set to 0, this value is 8, indicating one Block Descriptor was sent. If the DBD bit in the CDB is set to 1, this value is 0, indicating no Block Descriptors were sent.	

1. When these cartridges are mounted in the drive, the **MODE SENSE** information reports the Media Type and the correct Density Code as detected on the tape and sets the Write Protect (WP) bit in the **MODE SENSE** header to 1. Any command that attempts to write to the medium (WRITE, WRITE FILEMARKS, ERASE) returns CHECK CONDITION status with Sense Key set to **DATA PROTECT** (7) and the Additional Sense Code or Additional Sense Code Qualifier set to CANNOT WRITE MEDIUM - INCOMPATIBLE FORMAT (30h/05h). The drive does not update the medium.

MODE SENSE Block Descriptor

Figure 84 describes the **MODE SENSE** block descriptor that follows the **MODE SENSE** header. A description of the **MODE SENSE** block descriptor is provided in table 91.

Figure 84 **MODE SENSE** Block Descriptor — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Density Code							
1 — 3	(MSB) Number of Blocks (000000h) (LSB)							
4	Reserved							
5 — 7	(MSB) Block Length (LSB)							

Table 91 **MODE SENSE** Block Descriptor — Field Descriptions

Field	Description	
Density Code	Matches the current tape medium density.	
	Density Code	**Description**
	00h	Default density
	49h	190,000 bpi, 56 logical tracks, serial cartridge tape, 160 GB / 320 GB (Super DLTtape I)
	4Ah	233,000 bpi, 40 logical tracks, serial cartridge tape, 300 GB / 600 GB (Super DLTtape II)
	4Bh	256,000 bpi, 80 logical tracks, serial cartridge tape, 800 GB / 1600 GB (DLTtape S4)

Field	Description
Number of Blocks	Set to 0, indicating that all of the remaining logical blocks on the tape have the medium characteristics specified by the block descriptor.
Block Length	Specifies the length in bytes of each logical block transferred. 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).

Page codes and supported pages are:

Table 92 Supported **MODE SENSE** Block Pages and Page Codes

Page Code	Description	SENSE/SELECT	Refer to
00h	No Requested Page	SENSE	---
01h	Read / Write Error Recovery Page (01h)	BOTH	page 164
02h	Disconnect / Reconnect Page (02h)	BOTH	page 165
0Ah	Control Mode Page (0Ah)	BOTH	page 171
0Fh	Data Compression Page (0Fh)	BOTH	page 173
10h	Device Configuration Page (10h)	BOTH	page 176
11h	Medium Partition Page (11h)	BOTH	page 179
18h	Logical Unit Control Page (18h)	BOTH	page 181
19h	Port Control Page (19h)	BOTH	page 184
19h/01h	SAS Phy Control and Discover Mode Subpage (19h/01h)	BOTH	page 188
19h/03h	SPI Negotiated Settings Mode Subpage (19h/03h)	BOTH	page 192
19h/04h	SPI Report Transfer Capabilities Mode Subpage (19h/04h)	BOTH	page 194
1Ch	TapeAlert Page (1Ch)	BOTH	page 196
27h	Data Security Mode Page (27h)	BOTH	page 201
3Eh	EEPROM Mode Page (3Eh)	BOTH	page 207
3Fh	All Pages (except EEPROM)	SENSE	---

Read / Write Error Recovery Page (01h)

The drive supports the Error Recovery Page for **READ** and **WRITE** operations. The format of the Error Recovery Page is shown in figure 85.

Figure 85 Read / Write Error Recovery **MODE SENSE** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (01h)					
1	Page Length (0Ah)							
2	Reserved		TB (0)	Reserved	EER (1)	PER	DTE (0)	DCR (0)
3	READ Retry Count							
4 — 7	Reserved							
8	WRITE Retry Count							
9 — 11	Reserved							

Table 93 Read / Write Error Recovery **MODE SENSE** Page — Field Descriptions

Field	Description
PS	Parameters Savable. Always set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SENSE** page being transferred. A value of 01h identifies this as the Read / Write Error Recovery Page.
Page Length	Indicates the number of bytes in the page, excluding bytes 0 and 1.

Field	Description
TB	Transfer Block. The drive does not support the Transfer Block (when not fully recovered) function. Always set to 0.
EER	Enable Early Recovery. Always set to 1.
PER	Parity Error. When set to 1, enables reporting of CHECK CONDITION for recovered **READ** / **WRITE** errors. Default is 0.
DTE	Disable Transfer on Error. Always set to 0.
DCR	Disable ECC Correction Bit. Always set to 0.
READ Retry Count	Reports the maximum number of re-reads the drive attempts before declaring an unrecoverable error.
WRITE Retry Count	Reports the maximum number or overwrite retries the drive attempts before declaring an unrecoverable error.

Disconnect / Reconnect Page (02h)

The drive supports the Disconnect / Reconnect Page, the format is shown in the following figures; for Parallel SCSI, see figure 86; for Fibre Channel, see figure 87; and for SAS, see figure 88.

Figure 86 ***Parallel SCSI*** — Disconnect / Reconnect **MODE SENSE** Page — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (02h)					
1	Page Length (0Eh)							
2	Buffer Full Ratio (0)							
3	Buffer Empty Ratio (0)							
4 — 5	(MSB) Bus Inactivity Limit (0) (LSB)							

Bit / Byte	7	6	5	4	3	2	1	0
6 — 7	(MSB) Disconnect Time Limit (0) (LSB)							
8 — 9	(MSB) Connect Time Limit (0) (LSB)							
10 — 11	(MSB) Maximum Burst Size (LSB)							
12	EMDP (0)	Fair Arbitration (0)			DIMM (0)	DTDC		
13	Reserved							
14 — 15	(MSB) Reserved (LSB)							

Table 94 ***Parallel SCSI*** — Disconnect / Reconnect **MODE SENSE** Page — Field Descriptions

Field	Description
PS	Parameters Savable. Always set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SENSE** page being transferred. A value of 02h identifies this as the Disconnect / Reconnect Page.
Page Length	Indicates the number of bytes in the page, excluding bytes 0 and 1.
Buffer Full Ratio	Always set to 0.
Buffer Empty Ratio	Always set to 0.

Field	Description
Bus Inactivity Limit	Always set to 0.
Disconnect Time Limit	Always set to 0.
Connect Time Limit	Always set to 0.
Maximum Burst Size	Defaults to 80h limiting bursts to a size of 64K.
EMDP	Enable Modify Data Pointers. Always set to 0.
DIMM	Disconnect Immediate. Always set to 0.
DTDC	Data Transfer Disconnect Control. Always set to 0.

Figure 87 ***Fibre Channel*** — Disconnect / Reconnect **MODE SENSE** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (02h)					
1	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)							

Byte \ Bit	7	6	5	4	3	2	1	0
10 — 11	(MSB) Maximum Burst Size (LSB)							
12	EMDP (0)	FAA (0)	FAB (0)	FAC (0)	Restricted	Restricted		
13	Reserved							
14 — 15	(MSB) First Burst Size (0) (LSB)							

Table 95 ***Fibre Channel*** — Disconnect / Reconnect **MODE SENSE** Page — Field Descriptions

Field	Description
PS	Parameters Savable. Always set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SENSE** page being transferred. A value of 02h identifies this as the Disconnect / Reconnect Page.
Page Length	Indicates the number of bytes in the page, excluding bytes 0 and 1.
Buffer Full Ratio	Always set to 0.
Buffer Empty Ratio	Always set to 0.
Bus Inactivity Limit	Always set to 0.
Disconnect Time Limit	Always set to 0.
Connect Time Limit	Always set to 0.
Maximum Burst Size	Defaults to 80h limiting bursts to a size of 64K.

Field	Description
EMDP	Enable Modify Data Pointers. Always set to 0. The drive does not support reordering FCP_Data IUs for a single SCSI command.
First Burst Size	Always set to 0. Indicates the maximum amount of data that can be transmitted in the first FCP_Data unit sent from the host. The drive always returns 0 for this field, indicating no size limit.

Figure 88 ***SAS*** — Disconnect / Reconnect **MODE SENSE** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (02h)					
1	Page Length (0Eh)							
2 — 3	(MSB) Reserved (LSB)							
4 — 5	(MSB) Bus Inactivity Time Limit (LSB)							
6 — 7	(MSB) Reserved (LSB)							
8 — 9	(MSB) Maximum Connect Time Limit (LSB)							
10 — 11	(MSB) Maximum Burst Size (LSB)							

Byte \ Bit	7	6	5	4	3	2	1	0
12	Reserved							
13	Reserved							
14 — 15	(MSB) First Burst Size (0) (LSB)							

Table 96 ***SAS*** — Disconnect / Reconnect **MODE SENSE** Page — Field Descriptions

Field	Description
PS	Parameters Savable. Always set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SENSE** page being transferred. A value of 02h identifies this as the Disconnect / Reconnect Page.
Page Length	Indicates the number of bytes in the page, excluding bytes 0 and 1.
Bus Inactivity Limit	Indicates the maximum period the tape drive is permitted to maintain a connection without transferring a frame. This value is specified in 100us increments. Always set to 1.
Maximum Connect Time Limit	Indicates the maximum duration of a connection. This value is specified in 100us increments. Always set to A0h.
Maximum Burst Size	Defaults to 80h limiting bursts to a size of 64K.
First Burst Size	Always set to 0.

Control Mode Page (0Ah)

The Control Mode Page allows the initiator to determine whether the drive returns a CHECK CONDITION status when one of the **WRITE** and **READ** counters has reached a specified threshold.

Figure 89 Control Mode **MODE SENSE** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (0Ah)					
1	Page Length (0Ah)							
2	TST (1)			Reserved		D_Sense (0)	GLTSD (0)	RLEC
3	Queue Algorithm Modifier (1)				Reserved	QErr (0)		DQue (0)
4	TAS (0)	RAC (0)	UA_Intlck_Ctrl (0)		SWP (0)	Obsolete		
5	Reserved					Autoload Mode		
6 — 7	Obsolete							
8 — 9	(MSB) Busy Timeout Period (FFFFh) (LSB)							
10 — 11	(MSB) Extended Self-test Completion Time (030Ch) (LSB)							

Table 97 Control Mode **MODE SENSE** Page — Field Descriptions

Field	Description
PS	Parameters Savable. Always set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SENSE** page being transferred. A value of 0Ah identifies this as the Control Mode page.
Page Length	Indicates the number of bytes, excluding bytes 0 and 1.
TST	Task Set Type. Always set to 1. The drive maintains a separate task sets for each initiator.
D_Sense	Descriptor Format Sense Data. Always set to 0. The drive always returns fixed-format autosense data.
GLTSD	Global Logging Target Save Disable. Always set to 0.
RLEC	Report Log Exception Condition. Indicates whether the 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. When set to 0, indicates that the drive does not return UNIT ATTENTION when a threshold has been met. When set to 1, indicates that the drive returns UNIT ATTENTION when a threshold is met.
Queue Algorithm Modifier	Always set to 0.
QErr	Queue Error. Always set to 0.
DQue	Disable Queuing. Always set to 0.
TAS	Task Aborted Status. Always set to 0. The drive does not return a status for tasks aborted by the actions of other initiators.
RAC	Report a Check. Always set to 0. The drive returns BUSY status rather than CHECK CONDITION status during long busy conditions.
UA_Intlck_Ctrl	Unit Attention Interlocks Control. Always set to 00b. The drive clears all UNIT ATTENTION conditions when they are reported.
SWP	Software Write Protect. Always set to 0.

<table>
<tr><th>Field</th><th colspan="2">Description</th></tr>
<tr><td>Autoload Mode</td><td colspan="2">Indicates the action the drive is to take when tape medium is loaded. All values not listed below are reserved.</td></tr>
<tr><td></td><td>Value</td><td>Description</td></tr>
<tr><td></td><td>000b</td><td>The medium is loaded for full access.</td></tr>
<tr><td></td><td>001b</td><td>The medium is loaded for Enhanced Medium Auxiliary Memory (EMAM) access only.</td></tr>
<tr><td></td><td>010b</td><td>The medium is not loaded.</td></tr>
<tr><td>Busy Timeout Period</td><td colspan="2">Specifies the maximum time, in 100 msec increments, that the initiator allows the drive to remain busy for unanticipated conditions that are not a routine part of commands from the initiator. A value of 0000h is undefined. A value of FFFFh specifies an unlimited busy timeout period.</td></tr>
<tr><td>Extended Self-test Completion Time</td><td colspan="2">The drive does not support extended self-test. Always set to 030Ch.</td></tr>
</table>

Data Compression Page (0Fh)

The Data Compression Page specifies parameters that control data compression.

Figure 90 Data Compression **MODE SENSE** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (0Fh)					
1	Page Length (0Eh)							
2	DCE	DCC (1)	Reserved					
3	DDE (0)	RED (0)	Reserved					

Byte \ Bit	7	6	5	4	3	2	1	0
4 — 7	(MSB) Compression Algorithm (10h) (LSB)							
8 — 11	(MSB) Decompression Algorithm (LSB)							
12 — 15	Reserved							

Table 98 Data Compression **MODE SENSE** Page — Field Descriptions

Field	Description
PS	Parameters Savable. Always set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SENSE** page being transferred. A value of 0Fh identifies this as the Data Compression page.
Page Length	Indicates the number of bytes in the page, excluding bytes 0 and 1.
DCE	Data Compression Enable. The value the drive returns depends on the current **WRITE** density of the drive.
DCC	Data Compression Capable. The value the drive returns indicates whether the drive supports data compression. Always set to 1 indicating the drive is capable or data compression.
DDE	Data Decompression Enable. The value the drive returns indicates whether data decompression is enabled or not. Always set to 1. When the drive reads compressed data from tape, it automatically decompresses the data before sending it to the host.

Field	Description
RED	Report Exception on Decompression. The drive does not report exceptions on decompression (boundaries between compressed and decompressed data). The drive always returns 00h.
Compression Algorithm	The value for this field is 10h, indicating that the Lempel-Ziv high-efficiency data compression algorithm is in use.
Decompression Algorithm	The value for this field is 10h, indicating that the Lempel-Ziv high-efficiency data decompression algorithm is in use. If EEPROM parameter EnaRepDCcomp is set, the drive reports a value of 0 if the last block read is not decompressed.

Device Configuration Page (10h)

The drive supports the Device Configuration Page. The format for the page is shown in figure 91.

Figure 91 Device Configuration **MODE SENSE** Page — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (10h)					
1	Page Length (0Eh)							
2	Reserved	Obsolete	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 (1)	RSmk (0)	AVC (0)	SOCF (0)		RBO (0)	REW (0)
9	Gap Size (0)							
10	EOD Defined (0)			EEG (0)	SEW	SWP (0)	Reserved	
11 — 13	(MSB) Buffer Size at Early Warning (0) (LSB)							
14	Select Data Compression Algorithm							
15	Reserved		OIR	Rewind on Reset (1)		AsocWP (0)	PersWP (0)	PrmWP (0)

Table 99 Device Configuration **MODE SENSE** Page — Field Descriptions

Field	Description
PS	Parameters Savable. Always set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SENSE** page being transferred. A value of 10h identifies this as the Device Configuration page.
Page Length	Indicates the number of bytes in the page, excluding bytes 0 and 1.
CAF	Change Active Format. Not supported.
Active Format	Not supported.
Active Partition	Indicates the current logical partition number in use. Always set to 0. The drive only supports partition 0.
Write Buffer Full Ratio	Indicates how full the buffer should be before the drive restarts writing to the medium. The drive sets this field to 0 (unused) since it uses an automatic adaptive mechanism to adjust its ratio dynamically according to the average data rates.
Read Buffer Empty Ratio	Indicates how empty the buffer should be before the drive restarts reading from the medium. The drive sets this field to 0 (unused) since it uses an automatic adaptive mechanism to adjust its ratio dynamically according to the average data rates.
Write Delay Time	Indicates the maximum time in 100 msec increments that 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 the drive to write data sooner than the **WRITE** delay time value indicates. The **WRITE** delay time defaults to 100 (64h). This causes the drive to flush the buffer after 10 seconds. The minimum value is 15 (Fh), the maximum value is 6500 (1964h), representing a range in delay of 1.5 seconds to 11 minutes.
DBR	Data Recovery. Always set to 0.
BIS	Block Identifiers Supported. This bit is supported and is always set to 1.
RSmk	Report Setmark. Always set to 0.
AVC	Automatic Velocity Control. Always set to 0.
SOCF	Stop on Consecutive Filemarks. Always set to 0.

Field	Description
RBO	Recover Buffer Order. Always set to 0.
REW	Report Early Warning. Always set to 0 (do not report Early Warning EOM on **READ**).
Gap Size	Always set to 0.
EOD Defined	End of Data. Always set to 0h.
EEG	Enable EOD Generation. When set to 1, indicates 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. When set to 1, the drive writes any unwritten data or tapemarks to the medium before each command completes once the End of Medium early warning point is reached, effectively operating as if in unbuffered mode. When set to 0, the drive continues to operate in buffered mode, if enabled, past the End of Medium early warning point. Default value is 1.
SWP	Software Write Protection. Always set to 0.
Buffer Size at Early Warning	Always set to 0.
Select Data Compression Algorithm	If set to 1, data compression is enabled. If set to 0, data compression is disabled.
OIR	If the only if reserved (OIR) bit is set to one, the device server will process a command only if a reservation (see *SPC-2*) or persistent reservation (see *SPC-3*) exists that allows access via the I_T nexus from which the command was received. If the OIR bit is set to one and a command is received from an I_T nexus for which no reservation exists, the device server will not process the command. If the OIR bit is set to one and a command is received from an I_T nexus for a logical unit upon which no reservation or persistent reservation exists, the device servers terminates the command with CHECK CONDITION status. The sense key is set to ILLEGAL REQUEST and the additional sense code is set to NOT RESERVED. Commands that are not be effected by the OIR bit set to one are defined as Allowed in the presence of persistent reservations in *SPC-3*, or are defined in *SPC-2* as Allowed in the presence of reservations. Commands that are effected by the OIR bit set to one are defined as Conflict in the presence of persistent reservations in *SPC-3*, except for the **RESERVE, RELEASE**, **PERSISTENT RESERVATION IN**, and **PERSISTENT RESERVATION OUT** commands, or are defined in SPC-2 as Conflict in the presence of reservations. An OIR bit set to zero specifies the device server will process commands as specified in SPC-3.

Field	Description
Rewind on Reset	Always set to 01b, indicating that the drive rewinds the tape medium on a logical unit reset operation.
AsocWP	Associated Write Protection. Always set to 0.
PersWP	Persistent Write Protection. Always set to 0.
PrmWP	Permanent Write Protection. Always set to 0.

Medium Partition Page (11h)

The drive supports the Medium Partition Page. The format for the page is shown in figure 92.

Figure 92 Medium Partition **MODE SENSE** Page — Data Format

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

Table 100 Medium Partition **MODE SENSE** Page — Field Descriptions

Field	Description
PS	Parameters Savable. Always set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SENSE** page being transferred. A value of 11h identifies this as the Medium Partition page.
Page Length	Indicates the number of bytes in the page, excluding bytes 0 and 1.
Maximum Additional Partitions	Always set to 0.
Additional Partitions Defined	Specifies the number of additional partitions 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. Always set to 0. The drive supports only one partition.
FDP	Fixed Data Partitions. Always set to 0.
SDP	Select Data Partitions. Always set to 0.
IDP	Initiator Defined Patrons. Always set to 0.
PSUM	Partition Size Unit of Measure. Always set to 0.
POFM	Partition on Format. Always set to 0.
Clear	Always set to 0.
ADDP	Additional Defined Data Partitions. Always set to 0.
Medium Format Recognition	Set to 01h, indicating that the drive supports automatic format recognition.
Partition Units	Always set to 0.

Logical Unit Control Page (18h)

This page contains the logical unit control parameters (For Parallel SCSI, see figure 93; for Fibre Channel, see figure 94; and for SAS, see figure 95).

Figure 93 ***Parallel SCSI*** — Logical Unit Control **MODE SENSE** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (18h)					
1	Page Length (06h)							
2	Reserved				Protocol Identifier (1h)			
3 — 7	Reserved							

Table 101 ***Parallel SCSI*** — Logical Unit Control **MODE SENSE** Page — Field Descriptions

Field	Description
PS	Parameters Savable. Always set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SENSE** page being transferred. A value of 18h identifies this as the Logical Unit Control page.
Page Length	Indicates the number of bytes in the page, excluding bytes 0 and 1.
Protocol Identifier	A value of 1h indicates that this mode page applies to an SPI-5 compliant port (see the *SCSI Parallel Interface - 5* (SPI-5) standard).

Figure 94 ***Fibre Channel*** — Logical Unit Control **MODE SENSE** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (18h)					
1	Page Length (06h)							
2	Reserved				Protocol Identifier (0h)			
3	Reserved							EPDC (0)
4 — 7	Reserved							

Table 102 ***Fibre Channel*** — Logical Unit Control **MODE SENSE** Page — Field Descriptions

Field	Description
PS	Parameters Savable. Always set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	A value of 18h identifies this as the Logical Unit Control page.
Page Length	Indicates the number of bytes in the page, excluding bytes 0 and 1.
Protocol Identifier	A value of 0h indicates that this mode page applies to an FCP-2 port (see the *Fibre Channel Protocol – 2* (FCP–2) standard).
EPDC	Enable Precise Delivery Checking. Indicates whether the drive uses the precise delivery function defined by the Fibre Channel standard. Always set to 0. The drive ignores the contents of the Command Reference Number (CRN) in the FCP command IU. This value cannot be changed using the **MODE SELECT** command.

Figure 95 ***SAS*** — Logical Unit Control **MODE SENSE** Page — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (18h)					
1	Page Length (06h)							
2	Reserved			Transport Layer Retries	Protocol Identifier (6h)			
3	Reserved							
4 — 7	Reserved							

Table 103 ***SAS*** — Logical Unit Control **MODE SENSE** Page — Field Descriptions

Field	Description
PS	Parameters Savable. Always set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SENSE** page being transferred. A value of 18h identifies this as the Logical Unit Control page.
Page Length	Indicates the number of bytes in the page, excluding bytes 0 and 1. The length is returned on **MODE SENSE** and must subsequently be set to the same value when performing **MODE SELECT**.
Protocol Identifier	A value of 6h indicates that this mode page applies to an SAS-1.1 port (see the *Serial Attached SCSI – 1. 1 (SAS-1.1)* standard for specific SAS information).
Transport Layer Retries	Bit set to 1. Transport layer retries are supported by this devices as defined in SAS 1.1.

Port Control Page (19h)

This page contains the parameters that affect SCSI target port operation options (For Parallel SCSI, see figure 96; for Fibre Channel, see figure 97; and for SAS, see figure 98).

Figure 96 ***Parallel SCSI*** — Port Control **MODE SENSE** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (19h)					
1	Page Length							
2	Reserved				Protocol Identifier (1h)			
3	Reserved							
4 — 5	(MSB) Synchronous Transfer Timeout (LSB)							
6 — 7	Reserved							

Table 104 ***Parallel SCSI*** — Port Control **MODE SENSE** Page — Field Descriptions

Field	Description
PS	Parameters Savable. Always set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SENSE** page being transferred. A value of 19h identifies this as the Port Control page.
Page Length	Indicates the number of bytes in the page, excluding bytes 0 and 1.
Protocol Identifier	A value of 1h indicates that this mode page applies to an SPI-5 compliant port (see the *SCSI Parallel Interface – 5* (SPI–5) standard).
Synchronous Transfer Timeout	Indicates the amount of time, in 1 msec increments, that the drive waits for an ACK during data transfers before performing an unexpected BUS FREE operation.

Figure 97 ***Fibre Channel*** — Port Control **MODE SENSE** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (19h)					
1	Page Length							
2	Reserved				Protocol Identifier (0h)			
3	DTFD	PLPB	DDIS	DLM	RHA	ALWLI	DTIPE	DTOLI
4 — 5	Reserved							
6	Reserved					RR_TOV Units		
7	Resource Recovery Time-out (RR_TOV)							

Table 105 ***Fibre Channel*** — Port Control **MODE SENSE** Page — Field Descriptions

Field	Description
PS	Parameters Savable. Always set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SENSE** page being transferred. A value of 19h identifies this as the Port Control page.
Page Length	Indicates the number of bytes in the page, excluding bytes 0 and 1.
Protocol Identifier	A value of 0h indicates that this mode page applies to an FCP-2 port (see the *Fibre Channel Protocol – 2* (FCP–2) standard).
DTFD	Disable Tape Drive Fabric Discovery. Always set to 0. The drive always recognizes a fabric loop port if it is present.
PLPB	Prevent Loop Port Bypass. Always set to 1. The loop port is always participating and ignores all LPE and LPB primitives.

Field	Description
DDIS	Disable Discovery. Applies only if the drive is attached to an arbitrated loop. Always set to 1. The drive does not require receipt of an Address or Port Discovery following loop initialization.
DLM	Disable Loop Master. Always set to 0. The drive participates in loop master arbitration in the normal manner.
RHA	Require Hard Address. Always set to 0. The drive attempts to acquire a soft address if it cannot obtain a hard address.
ALWLI	Allow Login Without Loop Initialization. Always set to 0. The drive only enters the monitoring mode after it has gone through loop initialization.
DTIPE	Disable Tape Initiated Port Enable. Always set to 0. The drive performs an LIP and attempts to participate in the loop as soon as power is restored.
DTOLI	Disable Tape Originated Loop Initialization. Always set to 0. The drive generates the initializing LIP after it successfully enables a port into a loop.
RR_TOV Units	Resource Recovery Timeout Units. Always set to 101b. The drive uses a ten second unit of measure for RR_TOV in all cases.
RR_TOV	Resource Recovery Timeout Value. Always set to 1Eh. The drive always uses an RR_TOV value of 300 seconds.

Figure 98 ***SAS*** — Port Control **MODE SENSE** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (19h)					
1	Page Length (06h)							
2	Reserved			Ready LED Meaning	Protocol Identifier (6h)			
3	Reserved							
4 — 5	(MSB) I_T Nexus Loss Time (LSB)							
6 — 7	(MSB) Initiator Response Timeout (LSB)							

Table 106 ***SAS*** — Port Control **MODE SENSE** Page — Field Descriptions

Field	Description
PS	Parameters Savable. Always set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SENSE** page being transferred. A value of 19h identifies this as the protocol-specific Port Control page.
Page Length	Indicates the number of bytes in the page, excluding bytes 0 and 1.
Ready LED Meaning	Always set to 0.
Protocol Identifier	A value of 6h indicates that this mode page applies to an SAS-1.1 port (see the *Serial Attached SCSI – 1. 1 (SAS-1.1)* standard for specific SAS information).
I_T Nexus Loss Time	Contains the time that the SSP target retries connection requests to an SSP initiator that are reject with responses indicating the SSP initiator port may no longer be present before recognizing an I_T Nexus Loss (at 2000 ms).
Initiator Response Timeout	Contains the time in milliseconds that the SSP target port waits for the receipt of a frame (e.g., a write DATA frame) before aborting the command associated with that frame.

SAS Phy Control and Discover Mode Subpage (19h/01h)

The SAS Phy Control and Discover Mode subpage contains phy-specific parameters.

Figure 99 ***SAS*** Phy Control and Discover Mode Subpage — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (1)	Page Code (19h)					
1	SubPage Code (01h)							
2 — 3	(MSB) Page Length (34h) (LSB)							
4	Reserved							
5	Reserved				Protocol Identifier (6h)			
6	Reserved							
7	Number of Phys (1)							
8 — 55	SAS Phy Mode Descriptor (see figure 100)							

Table 107 ***SAS*** Phy Control and Discover Mode Subpage — Field Descriptions

Field	Description
PS	Parameters Savable. Always set to 0.
SPF	SubPage Format. Always set to 1. Indicates that this page uses the sub_page mode page format.
Page Code	Identifies the type of **MODE SENSE** page being transferred. A value of 19h identifies this is as the Port Control Page.
SubPage Code	Identifies the type of **MODE SENSE** Subpage being transferred. A value of 01h identifies this is as the SAS Phy Control and Discover Mode Subpage.
Page Length	Indicates the number of bytes in the page, excluding the 4 bytes that make up the header.
Protocol Identifier	A value of 6h indicates that this mode page applies to an SAS SSP-specific mode page (see the *Serial Attached SCSI – 1. 1 (SAS-1.1)* for specific SAS information).
Number of Phys	Indicates the Number of Phys. Always set to 1.
SAS Phy Mode Descriptor	See figure 100.

Figure 100 shows the SAS phy mode descriptor.

Figure 100 ***SAS*** Phy Mode Descriptor

Byte \ Bit	7	6	5	4	3	2	1	0
8	Reserved							
9	Phy Indentifier							
10	Reserved							
11	Reserved							
12	Reserved	Attached Device Type			Reserved			
13	Reserved				Negotiated Physical Link Rate			
14	Reserved				Attached SSP Initiator Port	Attached STP Initiator Port	Attached SMP Initiator Port	Reserved
15	Reserved				Attached SSP Target Port	Attached STP Target Port	Attached SMP Target Port	Reserved
16 — 23	SAS Address							
24 — 31	Attached SAS Address							
32	Attached Phy Identifier							
33 — 39	Reserved							
40	Programmed Minimum Physical Link Rate					Hardware Minimum Physical Link Rate		
41	Programmed Maximum Physical Link Rate					Hardware Maximum Physical Link Rate		
42 — 49	Reserved							
50 — 51	Vendor Specific							
52 — 55	Reserved							

Table 108 ***SAS*** Phy Mode Descriptor — Field Descriptions

Field	Descriptor
Phy Identifier	Phy Identifier Always set to 0.
Attached Device Type	Reflects the Device Type reported in the Identify Address frame received by the drive.
Attached SSP Initiator Port	Reflects the SSP Initiator Port Bit reported in the Identify Address frame received by the drive.
Attached STP Initiator Port	Reflects the STP Initiator Port Bit reported in the Identify Address frame received by the drive.
Attached SMP Initiator Port	Reflects the SMP Initiator Port Bit reported in the Identify Address frame received by the drive.
Attached SSP Target Port	Reflects the SSP Target Port Bit reported in the Identify Address frame received by the drive.
Attached STP Target Port	Reflects the STP Target Port Bit reported in the Identify Address frame received by the drive.
Attached SMP Target Port	Reflects the SMP Target Port Bit reported in the Identify Address frame received by the drive.
SAS Address	Indicates the SAS Address of the drive.
Attached SAS Address	Reflects the SAS Address reported in the Identify Address frame received by the drive.
Negotiated Physical Link Rate	The value for this field is either 8h or 9h, indicating a Physical Link Rate of 1.5 Gbps or 3.0 Gbps.
Attached Phy Identifier	Reflects the Phy Identifier reported in the Identify Address frame received by the drive.
Programmed Minimum Physical Link Rate	Always set to 8h, indicating the 1.5 Gbps.
Hardware Minimum Physical Link Rate	Always set to 8h, indicating the 1.5 Gbps.
Programmed Maximum Physical Link Rate	Always set to 9h, indicating the 3.0 Gbps.
Hardware Maximum Physical Link Rate	Always set to 9h, indicating the 3.0 Gbps.

SPI Negotiated Settings Mode Subpage (19h/03h)

The SPI Negotiated Settings Mode Subpage, shown in figure 101, is used to report the negotiated settings of a SCSI target port for the current I_T nexus for Parallel SCSI only. For additional information, see figure 68.

> Note: The values reported in this page pertain to protocol options negotiated or established on the SCSI Parallel interface used to transfer the data. None of these parameters are changeable with a **MODE SELECT** command. For a description of the possible settings, see the *SCSI Parallel Interface - 5* (SPI-5) standard.

Figure 101 ***Parallel SCSI*** — SPI Negotiated Settings Mode Subpage — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (1)	Page Code (19h)					
1	Subpage Code (03h)							
2 — 3	(MSB) Page Length (0Ah) (LSB)							
4	Reserved							
5	Reserved				Protocol Identifier (1h)			
6	Transfer Period Factor							
7	Reserved							
8	REQ/ACK Offset							
9	Transfer Width Exponent							
10	Reserved	Protocol Options Bits						
11	Reserved				Transceiver Mode		Sent PCOMP_EN	Received PCOMP_EN
12	Reserved							
13	Reserved							

Table 109 ***Parallel SCSI*** — SPI Negotiated Settings Mode Subpage — Field Descriptions

Field	Description	
PS	Parameters Savable. Always set to 0.	
SPF	SubPage Format. Always set to 1. Indicates that this page uses the sub_page mode format.	
Page Code	Identifies the type of **MODE SENSE** page being transferred. A value of 19h identifies this as the Port Control Page.	
Subpage Code	Identifies the type of **MODE SENSE** subpage being transferred. A value of 03h identifies this as the SPI Negotiated Settings Mode Subpage.	
Page Length	Indicates the number of bytes in the page, excluding the 4 bytes that make up the header.	
Protocol Identifier	A value of 1h indicates that this mode page applies to an SPI-5 compliant port (see the *SCSI Parallel Interface – 5* (SPI–5) standard.	
Transfer Period Factor	Indicates the negotiated Transfer Period Factor for the current I_T nexus (see the *SCSI Parallel Interface – 5* (SPI–5) standard.	
REQ/ACK Offset	Indicates the negotiated REQ / ACK Offset for the current I_T nexus (see the *SCSI Parallel Interface – 5* (SPI–5) standard).	
Transfer Width Exponent	Indicates the negotiated REQ / ACK Offset for the current I_T nexus.	
	Value	**Description**
	00h	Specifies 8 bit data bus (i.e. narrow transfer agreement).
	01h	Specifies 16 bit data bus (i.e. wide transfer agreement)
Protocol Options Bits	Indicates the negotiated Protocol Options for the current I_T nexus (see the *SCSI Parallel Interface – 5* (SPI–5) standard).	
Transceiver Mode	Indicates the current Transceiver Mode, as defined below:	
	Code	Bus Mode
	00b	Unknown
	01b	Single ended
	10b	Low Voltage Differential
	11b	High Voltage Differential (not supported)
Sent PCOMP_EN	Indicates the PCOMP_EN bit sent for the current I_T nexus.	
Received PCOMP_EN	Indicates the PCOMP_EN bit received for the current I_T nexus.	

SPI Report Transfer Capabilities Mode Subpage (19h/04h)

The SPI Report Transfer Capabilities Mode Subpage, shown in figure 102, is used to report the transfer capabilities for the SCSI target port for Parallel SCSI only. The values in this mode subpage are not changeable via a **MODE SELECT** command. For additional information, see figure 68.

> Note: The values reported in this page pertain to protocol options negotiated or established on the SCSI Parallel interface used to transfer the data. None of these parameters are changeable with a **MODE SELECT** command. For a description of the possible settings, see the *SCSI Parallel Interface - 5* (SPI-5) standard.

Figure 102 ***Parallel SCSI*** — SPI Report Transfer Capabilities Mode Subpage — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (1)	Page Code (19h)					
1	Subpage Code (04h)							
2 — 3	(MSB) Page Length (0Ah) (LSB)							
4	Reserved							
5	Reserved				Protocol Identifier (1h)			
6	Minimum Transfer Period Factor							
7	Reserved							
8	Maximum REQ/ACK Offset							
9	Maximum Transfer Width Exponent							
10	Protocol Options Bits Supported							
11	Reserved							
12	Reserved							
13	Reserved							

Table 110 ***Parallel SCSI*** — SPI Report Transfer Capabilities Mode Subpage — Field Descriptions

Field	Description
PS	Parameters Savable. Always set to 0.
SPF	SubPage format. Always set to 1. Indicates that this pages uses the sub_page mode format.
Page Code	Identifies the type of **MODE SENSE** page being transferred. A value of 19h identifies this as the Port Control Page.
Subpage Code	Identifies the type of **MODE SENSE** subpage being transferred. A value of 04h identifies this is as the SPI Report Transfer Capabilities Mode Subpage.
Page Length	Indicates the number of bytes in the page, excluding the 4 bytes that make up the header.
Protocol Identifier	A value of 1h indicates that this mode page applies to an SPI-5 compliant port (see the *SCSI Parallel Interface – 5* (SPI–5) standard).
Minimum Transfer Period Factor	Indicates the minimum Transfer Period Factor supported.
Maximum REQ/ACK Offset	Indicates the maximum REQ/ACK supported.
Maximum Transfer Width Exponent	Indicates the maximum Transfer Width Exponent supported.
Protocol Options Bits Supported	Indicates the Supported Protocol Option Bits.

TapeAlert Page (1Ch)

The TapeAlert configuration settings can be read using the **MODE SENSE** command's TapeAlert Page.

Figure 103 TapeAlert **MODE SENSE** Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (1Ch)					
1	Page Length (0Ah)							
2	Perf	Reserved	EBF (0)	EWASC (0)	DExcpt	Test (0)	Reserved	LogErr (0)
3	Reserved				MRIE			
4 — 7	(MSB) Interval Timer (0) (LSB)							
8 — 11	(MSB) Report Count / Test Flag Number (LSB)							

Figure 104 TapeAlert **MODE SENSE** Page — Field Descriptions

Field	Description	
PS	Parameters Savable. Always set to 0.	
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.	
Page Code	Identifies the type of **MODE SENSE** page being transferred. A value of 1Ch identifies this as the TapeAlert Page.	
Page Length	Indicates the number bytes in the page, excluding bytes 0 and 1.	
Perf	Performance. Always set to 0.	
EBF	Enable Background Function. Always set to 0.	
EWASC	Enable Warning. Always set to 0.	
DExcpt	Disable Information Exception Operations. Default value is 1. When set to 0, the reporting method specified by the contents of the MRIE field is selected. When set to 1, all information exception operations are disabled and the drive ignores the contents of the MRIE field. When in this mode, the software polls the TapeAlert Log page.	
Test	Always set to 0.	
LogErr	Error Log. Always set to 0.	
MRIE	Method for Reporting Informational Exceptions. The drive uses the contents of this field to report information about exception conditions. Four methods are available:	
	Value	**Method**
	00h	No reporting of Informational Exception Conditions. The drive does not report information exception conditions.
	03h	Conditionally Generate Recovered Error. This value is the default. The drive reports informational exception conditions, if reports of recovered errors are allowed, by returning CHECK CONDITION status on the next SCSI command (except **INQUIRY** and **REQUEST SENSE** commands) following detection of the condition.

Field	Description	
		The Sense Key is set to RECOVERED ERROR with the Additional Sense Code set to 5Dh / 00h (TapeAlert event). The SCSI command with CHECK CONDITION completes without error before the report of any exception condition and does not need to be repeated.
	04h	Unconditionally Generate Recovered Error. The drive reports informational exception conditions 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 the Additional Sense Code set to 5Dh / 00h (TapeAlert event). The SCSI command with CHECK CONDITION completes without error before the report of any exception condition and does not need to be repeated.
	06h	Only Report Informational Exception Condition on Request. The drive preserves information exception data. To access the data, issue an unsolicited **REQUEST SENSE** command to poll the drive. The Sense Key is set to NO SENSE with the Additional Sense Code set to 5Dh / 00h (TapeAlert event).
	The Additional Sense Code of 5Dh / 00h for values 03h and 06h signals that a TapeAlert occurred. The drive stores information about the event in the TapeAlert Log page. The setting of the MRIE field does not impact logging of events in the TapeAlert Log page.	
Interval Timer	Always set to 0.	
Report Count / Test Flag Number	Report Count or Test Flag Number. Must be set to 0 unless the Test bit is set to 1, in which case this field indicates a test condition to be generated as follows:	
	Value	**Result**
	0	Do not change the TapeAlert Flag but report an exception condition based on the value in the MRIE field.
	1 to 64	Set the TapeAlert flag indicated in the value and generate an exception condition based on the value in the MRIE field.
	-64 to -1	Clear the TapeAlert flag in an equivalent manner to taking corrective action for the flag indicated by the absolute number of the value.
	32,767	Set all TapeAlert flags and generate an exception condition based on the value in the MRIE field.

Medium Configuration Mode Page (1Dh)

The Medium Configuration Mode Page specifies any special considerations the device server uses when processing commands that access the medium.

Figure 105 Medium Configuration Mode Page

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (1Dh)					
1	Page Length (1Eh)							
2	Reserved							WORMM
3	Reserved							
4	WORM Mode Label Restrictions (00h)							
5	WORM Mode Filemark Restrictions (03h)							
6 — 31	Reserved							

Table 111 Medium Configuration Mode Page — Field Descriptions

Field	Description
PS	Parameters Savable. For **MODE SELECT**, must be set to 0.
SPF	SubPage Format. Always set to 0. Indicates that this page uses the page_0 page format.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 1Dh identifies this as the Medium Configuration Mode Page.
Page Length	Indicates the number bytes in the page, excluding bytes 0 and 1.
WORMM	The WORM mode (WORMM) bit is set to one when the device server is operating in WORM mode. The WORMM bit is set to zero the current medium is not a WORM medium. This bit is not changeable with a **MODE SELECT** command.
WORM MODE LABEL RESTRICTIONS	The field specifies the restrictions against overwriting format labels when operating in WORM mode. A series of filemarks with no interleaved logical blocks immediately preceding EOD is treated as a filemark sequence and is controlled by the WORM MODE FILEMARKS RESTRICTIONS field. The DLT-S4 supports only a setting of 00h indicating that it will not allow any logical blocks to be over-written on a WORM medium.
WORM MODE FILEMARKS RESTRICTIONS	The WORM MODE FILEMARKS RESTRICTIONS field specifies the restrictions against overwriting a series of filemarks immediately preceding EOD when operating in WORM mode. The WORM MODE FILEMARKS RESTRICTIONS field controls only the overwriting of a series of filemarks with no interleaved logical blocks immediately preceding EOD. The DLT-S4 supports only a setting of 03h indicating that it will allow any number of filemarks immediately preceding EOD to be over-written.

Data Security Mode Page (27h)

Figure 106 shows the page that controls uses a password verification mechanism to prevent or allow reading and writing the data to the tape. Its primary function is to provide a means of preventing unauthorized access to data on a DLT-S4 native cartridge. It has no impact on Back Read cartridges.

The password is written to the drive using a **MODE SELECT** command for the Data Security Mode Page and read from the drive using a **MODE SENSE** command for the Data Security Mode Page. The password is written to the tape in response to a **FORMAT** command or **WRITE** command when positioned at the beginning of the tape (**WRITE** from BOT).

The DLT-S4 drive checks for password protection on the DLT-S4 tape during the load process and if it is enabled, verifies that the drive has the same password. If the passwords match, the user can read and write data on the tape. If they do not match, **READ** and **WRITE** commands will be rejected and sense data will be presented to the initiator.

Figure 106 Data Security Mode Page — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS (0)	0	Page Code (27h)					
1	Additional Page Length (32h)							
2	Reserved	PAX	PCP	PWF	Reserved		CRA	CWA
3	Reserved							
4	Reserved		Password Selection			Scope		
5	Reserved		Action Code					
6	Reserved							
7	Reserved				Number of Passwords Supported			
8 — 9	Reserved		APB	APD	PA	TPP	DPS	PM
10	Reserved for Password 2 Status							
11	Reserved for Password 3 Status							

Byte \ Bit	7	6	5	4	3	2	1	0
12	Reserved for Password 4 Status							
13	Reserved for Password 5 Status							
14	Reserved for Password 6 Status							
15	Reserved for Password 7 Status							
16 — 19	Reserved							
20 — 51	Password Value							

Table 112 Data Security Mode Page — Field Descriptions

Field	Description
PS	Parameters Savable. Must be set to 0.
Page Code	Identifies the type of **MODE SELECT** page being transferred. A value of 27h identifies this as the Data Security Mode Page.
Additional Page Length	Indicates the number bytes in the page, excluding 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**.
PAX	Password Attempts Exceeded. This read only bit is set when the allowed number of attempts to unlock the cartridge with the correct password have been exceeded. The number of attempts allowed is 32 per cartridge per load. This bit is cleared when the cartridge is unloaded. When the number of password attempts has been exceeded the sense data reported when a medium access command is rejected, will change from Data Protect, Access Denied, Invalid Management ID Key (07,20,03) to Data Protect, Access Denied, Password Attempts Exceeded (07, 20, 80).

Field	Description	
PCP	Password Change Pending. This read only bit indicates that the desired tape password has been sent to the drive and is stored in drive memory but has not been written to tape. This bit is set anytime a tape is intended to be password protected with action codes 02 – Set Drive Password and write it to tape; 03 - Set Drive Password and write it to all blank tapes; and 04 – Set Drive Password and write it to all unprotected formatted tapes, and cleared by successful directory write or next load of the tape. • If the currently loaded tape is blank, a **WRITE**, **WRITE FM**, or **ERASE** command is required to write the password to tape. • If the currently loaded tape has data written on it, a **WRITE** or **WRITE FM** command from **BOT**; **REWIND**, or **UNLOAD** command will cause the password to be written to tape.	
PWF	Password Write Failed. This read only bit indicates that the password that was pending to be written to tape was not written due to a write error. This bit is set from the time of unloading the failing cartridge until the load of the next cartridge. If this bit is 0 after unloading a tape then the password was successfully written to tape. The PCP bit is cleared when this bit is set.	
CRA	Cartridge Read Access. This read only bit indicates if the cartridge can be accessed for the following **READ** type commands: **READ**, **SPACE**, **VERIFY** and **LOCATE**.	
CWA	Cartridge Write Access. This read only bit indicates if the cartridge can be accesses for the following **WRITE** type commands: **WRITE**, **WRITE FM**, **ERASE** and **WRITE ATTRIBUTE**.	
Password Selection	This read/write field selects the identification of the password to modify. The values are:	
	0	Host Read/Write Password
	1	Automation Read/Write Password
	On a **MODE SENSE** command this field will be set to the last password that was selected on a **MODE SELECT** for that port.	
Scope	Scope of Password Protection. This two bit read/write field determines who is allowed to access the drive in a multi-initiator environment. This field is reserved for the ADC device server. The last scope successfully selected determines the global scope for passwords. A Unit Attention (Mode Parameters Changed) will be sent to any other initiators affected by the scope change.03hReserved	
	Scope Value	Description
	00h	Only allow me to access the tape
	01h	Allow everyone with a reservation to access the tape. Loss of
	02h	Allow everyone to access the tape.
	03h	Reserved
Action Code	This 6 bit read/write field indicates the desired password protection action. The value in this field has the following meaning:	
	Action Value	Description

Field	Description	
	00h	No Action
	01h	Set Drive Password. This action can be done with or without a tape in the drive. If a tape is mounted and password protected, the value in the password field must match the password on the tape. The corresponding DPS bit is set and the APB, APD, PAX, PCP, and PWF bits are cleared.
	02h	Set the Drive Password and write it to tape. Tape must be mounted and either have no password or the value in the password field must match the password on the tape. The PCP bit is set until the password has been successfully written to tape. Upon successful completion of the **MODE SELECT** command, the PCP bit is set if the tape does not have a password. The APB, APD, PAX, and PWF bits are cleared.
	03h	Set Drive Password in drive memory and write it to all **blank** tapes. This action sets the APB bit. This action code can be sent with or without a tape in the drive. The currently loaded tape, if it is blank, and subsequent blank tapes that are loaded into the drive will become password protected. If a tape is mounted and password protected, the value in the password field must match the password on the tape. The password will be written to the tape in conjunction with a **WRITE**, **WRITE FM**, or **ERASE** command. If none of these commands are received prior to an **UNLOAD** command, the tape will not become formatted or Password Protected. Formatted and password protected tapes will not alter the APB state and will not be modified by this action code.
	04h	Set Drive Password in drive memory and write it to all **unprotected/ formatted** tapes. This action sets the APD bit. The currently loaded tape, if it is unprotected/formatted, and subsequent unprotected/formatted tapes loaded into the drive will become password protected. If a tape is mounted and password protected, the value in the password field must match the password on the tape. The password will be written to the tape in conjunction with a **WRITE**, **WRITE FM**, **ERASE**, or **UNLOAD** command. Blank tapes and password protected tapes will not alter the APD state and will not be modified by this action code.
	05h	Set Drive Password and write it to all **unprotected** tapes. All unprotected tapes will then automatically become password protected. This action sets the APB and APD bits. The currently loaded tape, if it is unprotected, and subsequent unprotected tapes loaded into the drive will become password protected. If a tape is mounted and password protected, the value in the password field must match the password on the tape. The password will be written to the tape in conjunction with a **WRITE**, **WRITE FM**, **ERASE**, or **UNLOAD** command. Password protected tapes will not be modified by this action code.

Field	Description	
	06h	Remove Password from the tape. Tape must be mounted and the drive password(s) must match the tape password(s). This action clears the APB, APD, and the appropriate TPP bits. The drive password is not cleared from drive memory.
	07h	Clear Drive Password. This action clears the APB, APD and corresponding DPS bits, and the password from drive memory. If a password protected tape is loaded, the appropriate PMM bit will be set. Password field is ignored.
	08h-3Fh	Reserved
Number of Passwords Supported	This read only four bit field indicates the number of passwords supported. This field is currently set to two: one for the host interface and one for the automation interface. However, this design can handle up to 8 passwords.	
APB	Auto Password Blank Tapes. This read only bit indicates password protection mode for this password is set to auto-password protect all blank tapes.	
APD	Auto Password Unprotected Data Tapes. This read only bit indicates password protection mode for this password is set to auto-password protect all unprotected/formatted tapes.	
PA	Password Accessible on this interface. This read only status bit indicates if this password is accessible from this interface.	
TPP	Tape Password Protected. This read only bit indicates if this tape is password protected with this password.	
DPS	Drive Password Set. This read only bit indicates if the drive has a password set for this interface.	
PM	Password Mismatch. This read only bit indicates that this password on the tape does not match this password set in the drive.	
Password	This is a 32 byte write only field used to set the drive password to the desired value for the requesting interface. The password value is secret and will not be reported in **MODE SENSE** data. Instead, the password reported by the **MODE SENSE** command is all zeroes. For actions other than 00 or 05, the password must be non-zero or the command will be rejected. The password is cleared using action code 05 – Clear Drive Password	

General Operation

The password(s) are written to the drive using a **MODE SELECT** command for the Vendor-Unique Data Security Mode page. The password value will not be returned in the **MODE SENSE** data. The drive will create password protected tapes as instructed by the Action Code of the **MODE SELECT** command.

At the end of the load process there is a determination if the tape is password protected. If the tape is password protected, the password(s) on

the tape will be compared to the password(s) in the drive. If the password(s) are equal, subsequent write and read operations are allowed. If the passwords do not match, the following operations will be rejected and sense data presented to the host: **WRITE**, **WRITE FMs**, **READ**, **LOCATE**, **VERIFY**, **ERASE, SPACE, WRITE ATTRIBUTES, SEND DIAG** and **WRITE BUFFER**. If the tape is not password protected and the action code is to password protect the tape, then the passwords are written to tape at the next possible opportunity (when the tape is positioned at BOT).

In the event of a password mismatch, the following commands are rejected:

WRITE, WRITE FMs, READ, LOCATE, VERIFY, ERASE, SPACE, WRITE ATTRIBUTES, SEND DIAG and **WRITE BUFFER**.

The sense data returned when one of these commands is rejected is:

- Sense data (0x07, 0x20, 0x03) Data Protect, Access Denied, Invalid Management ID Key.

In the event of an attempt to disable a password protected tape or add a password to a non-protected tape **when not at BOT**, the following sense data will be available on the interface:

- Sense data (0x05, 0x82, 0x00) Illegal request, Action not allowed away from BOT.

In the event of excessive attempts to select the correct password, when the number of password attempts has been exceeded the sense data will change from:

- Data Protect, Access Denied, Invalid Management ID Key (07, 20, 03) to Data Protect, Access Denied, Password Attempts Exceeded (07, 20, 80).

Drive Password and Password Protection State Storage

The drive password and the 'Password Protection State' will be stored in the drive's volatile RAM. Passwords sent to the drive using action code 01 – Set Drive Password, will be saved in the drive's volatile RAM for automatic password validation on future tape loads. The default value of the Password bytes and Password Protection State will be 00. In a parallel SCSI drive, the drive password, Password field, and Password Protection State will be reset to default values only after a power-on reset. A device reset or bus reset will not reset the drive's passwords. For Fibre Channel and SAS drives, the drive password, Password field, and Password Protection State will be reset to default values after a power-on reset, device reset, or bus reset.

EEPROM Mode Page (3Eh)

This page returns all of the EEPROM parameters that can be set with the **MODE SELECT EEPROM** page; it sometimes returns an error message in the returned ASCII string.

The 10-byte **MODE SENSE** command for the EEPROM page returns data in the form of a **MODE SENSE** (10) data header followed by block and page descriptors.

Figure 107 EEPROM **MODE SENSE** Page — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	SPF (0)	Page Code (3Eh)					
1	Page Length							
2 — *n*	ASCII String of Parameter Name or Value							

As with other **MODE SENSE** pages, the data in the page descriptor is organized in the form of a parameter header followed by the parameter's value. The parameter is as follows:

```
Name    T    Current     Default    Minimum    Maximum
```

Table 113 lists the parameter definitions:

Table 113 EEPROM **MODE SENSE** Page Command Descriptor Block — Field Descriptions

Field	Description
Name	Refers to the parameter name, for example, ProductID or DefaultCompOn.
T	Type. Designates data type; "b" indicates binary, "A" indicates string type, no designator indicates that the data is in decimal format.
Current, Default, Minimum, and Maximum	Specifies the current, default, minimum, and maximum values of the parameter.

Tech Tip:	The length of the list of EEPROM parameters requires a 10-byte **MODE SENSE** command. If you use a 6-byte **MODE SENSE** command to retrieve the EEPROM parameters, you will receive the following response: Send a 10-byte **MODE SENSE** command to get the Parameter List

PERSISTENT RESERVE IN Command (5Eh)

The **PERSISTENT RESERVE IN** command is a 10-byte command used to obtain information about persistent reservations and registrations active in an DLT-S4 tape drive. This command works with the **PERSISTENT RESERVE OUT** command.

Figure 108 **PERSISTENT RESERVE IN** Command Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (5Eh)							
1	Reserved			Service Action				
2 — 6	Reserved							
7 — 8	(MSB) Allocation Length (LSB)							
9	Control							

Table 114 **PERSISTENT RESERVE IN** Command — Field Descriptions

Field	Description		
Service Action	The following service action codes are available. All other values are reserved.		
	Code	**Name**	**Description**
	00h	Read Keys	Reads all registered reservation keys.

<table>
<tr><th>Field</th><th colspan="3">Description</th></tr>
<tr><td></td><td>01h</td><td>Read Reservation</td><td>Reads all current persistent reservations.</td></tr>
<tr><td></td><td>02h</td><td>Report Capabilities</td><td>Returns persistent reservation capability information.</td></tr>
<tr><td></td><td colspan="3">A Read Keys service action requests that the drive return a parameter list that includes a header and a complete list of all of the reservation keys currently registered with the drive.</td></tr>
<tr><td></td><td colspan="2">If multiple initiators have registered with the same key, the key is listed multiple times, once for each registration.</td><td>See figure 109 and table 115 for information about Read Keys parameter data. See REPORT CAPABILITIES Service Action on page 216.</td></tr>
<tr><td></td><td colspan="2">A Read Reservation service action requests that the drive return a parameter list that contains a header and a complete list of all persistent reservations presently active in the drive.</td><td>See figure 110 and table 116 for information about Read Reservation parameter data. See REPORT CAPABILITIES Service Action on page 216.</td></tr>
<tr><td>Allocation Length</td><td colspan="3">This field indicates how much space is reserved for the returned parameter list (Read Keys or Read Reservation parameters). The actual length of the parameter data is indicated in the parameter data field for those parameters.

If the Allocation Length is not sufficient to contain the entire list of parameters, the drive returns a truncated list. If the remainder of the list is required, the host must send a new PERSISTENT RESERVE IN command with an Allocation Length field value large enough to contain the entire list of parameters.</td></tr>
</table>

READ KEYS Service Action

Figure 109 and table 115 illustrate and describe the data fields of Read Key data parameters.

Figure 109 **PERSISTENT RESERVE IN** Read Keys Parameters — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0 — 3	(MSB) PRGeneration (LSB)							
4 — 7	(MSB) Additional Length (*n* – 7) (LSB)							
	(Reservation Key List Follows in Bytes 8 – *n*)							
8 — 15	(MSB) First Reservation Key (LSB)							
(*n* — 7) - *n*	(MSB) Last Reservation Key (LSB)							

Table 115 Read Keys Parameters — Field Descriptions

Field	Description
PRGeneration	Persistent Reservations Generation. The value in this field is a 32-bit counter in the drive that is incremented each time a **PERSISTENT RESERVE OUT** command requests a Register, Clear, Preempt, Preempt & Abort, or Register & Move operation. Note that **PERSISTENT RESERVE IN** commands do not increment the counter, nor do P**ERSISTENT RESERVE OUT** commands that perform a Reserve or Release service action or that are not performed due to an error or a reservation conflict. The value in the Generation field is set to 0 as part of the power-on self test process. The value in the Generation field allows the application client that examines the value to verify that another application client has not modified the configuration of the initiators attached to a logical unit without notifying the application client doing the examination.
Additional Length	Contains the count of the number of bytes that are in the Reservation Key list (bytes 8 – *n*). Note that this field contains the number of bytes in the reservation key list regardless of the value prescribed by the Allocation Length field in the command's CDB.
Reservation Keys	All of the Reservation Keys appear as items in a list as bytes 8 through *n*. Each entry reflects an 8-byte reservation key registered with the drive using the **PERSISTENT RESERVE OUT** Register or Register and Ignore Existing Key service actions. The application client can examine each key for correlation with a set of initiators and SCSI ports.

READ RESERVATION Service Action

Figure 110 and table 116 illustrate and describe the data fields of Read Reservation data parameters.

Figure 110 **PERSISTENT RESERVE IN** Read

Reservation Parameters — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0 — 3	(MSB) PRGeneration (LSB)							
4 — 7	(MSB) Additional Length (*n* – 7) (LSB)							
8 — *n*	(MSB) Reservation Descriptors (LSB)							

Table 116 Read Reservation Parameters — Field Descriptions

Field	Description
PRGeneration	Persistent Reservations Generation. The value in this field is a 32-bit counter in the drive that is incremented each time a **PERSISTENT RESERVE OUT** command requests a Register, Clear, Preempt, Preempt & Abort, or Register & Move operation. Note that **PERSISTENT RESERVE IN** commands do not increment the counter, nor do **PERSISTENT RESERVE OUT** commands that perform a Reserve or Release service action, or that are not performed due to an error or a reservation conflict. The value in the Generation field is set to 0 as part of the power-on self test process. The value in the Generation field allows the application client that examines the value to verify that another application client has not modified the configuration of the initiators attached to a logical unit without notifying the application client doing the examination.

Field	Description
Additional Length	Contains the count of the number of bytes that are in the Read Reservation descriptors (bytes 8 – *n*). Note that this field contains the number of bytes regardless of the value prescribed by the Allocation Length field in the command's CDB.
Reservation Descriptors	The drive reports one Reservation descriptor for each unique persistent reservation on the logical unit when the **PERSISTENT RESERVE IN** command has indicated a Read Reservation action. Figure 111 and table 117 contain details about the contents of each Reservation Descriptors field.

Figure 111 and table 117 illustrate and describe the data fields of each Read Reservation descriptor's data fields.

Figure 111 **PERSISTENT RESERVE IN** Read Reservation Descriptor — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0 — 7	(MSB) Reservation Key (LSB)							
8 — 11	(MSB) Scope-Specific Address (LSB)							
12	Reserved							
13	Scope				Type			
14 — 15	Obsolete							

Table 117 **PERSISTENT RESERVE IN** Read Reservation Descriptor — Field Descriptions

Field	Description
Reservation Key	Contains an 8-byte value that identifies the reservation key under which the persistent reservation is held.
Scope-Specific Address	Always set to 0.
Scope	The drive only supports reservations of the entire logical unit. Always set to 0.
Type	Specifies the characteristics of the persistent reservation (see table 118 for the applicable Type codes and their meanings).

Table 118 describes the available Type values from the Type field of the **PERSISTENT RESERVE IN** Read Reservation parameters. Each of the codes provides handling instructions for **READ** and **WRITE** operations and for subsequent attempts to establish persistent reservations (referred to as "Additional Reservations Allowed" in the table).

Table 118 **PERSISTENT RESERVATION IN** Type Codes

Code	Name	Description
0h	Obsolete	---
1h	**WRITE** Exclusive	**READS**: Shared; any application client on any initiator can execute commands that perform transfers from the drive to the host. **WRITES**: Exclusive; any command from any initiator other than the initiator that holds the persistent reservation that attempts a transfer to the drive results in a reservation conflict. ADDITIONAL RESERVATIONS: Allowed; any initiator may reserve the logical unit, extents, or elements as long as the persistent reservations do not conflict with any reservations already known to the drive.
2h	Obsolete	---

Code	Name	Description
3h	Exclusive Access	**READS**: Exclusive; any command from any initiator other than the initiator holding the persistent reservation that attempts a transfer from the drive results in a reservation conflict. **WRITES**: Exclusive; any command from any initiator other than the initiator holding the persistent reservation that attempts a transfer to the drive results in a reservation conflict. ADDITIONAL RESERVATIONS: Restricted; any **PERSISTENT RESERVE OUT** command with the Reserve service action from any initiator other than the initiator holding the persistent reservation results in a reservation conflict. The initiator that holds the persistent reservation can reserve the logical unit, extents, or elements as long as the persistent reservations do not conflict with any reservations already known to the drive.
4h	Obsolete	---
5h	**WRITE** Exclusive Registrants Only	**READS**: Shared; any application client on any initiator may execute commands that perform transfers from the drive to the host. **WRITES**: Exclusive; any command from an initiator that has not previously performed a Register service action with the drive that attempts a transfer to the drive results in a reservation conflict. ADDITIONAL RESERVATIONS: Allowed; any initiator may reserve the logical unit, extents, or elements as long as the persistent reservations to not conflict with any reservations already known to the drive.
6h	Exclusive Access Registrants Only	**READS**: Exclusive; any command from an initiator that has not previously performed a Register service action with the drive that attempts a transfer from the drive results in a reservation conflict. **WRITES**: Exclusive; any command from an initiator that has not previously performed a Register service action with the drive that attempts a transfer to the drive results in a reservation conflict. ADDITIONAL RESERVATIONS: Allowed; any initiator may reserve the logical unit, extents, or elements as long as the persistent reservations to not conflict with any reservations already known to the drive.
7h - Fh	Reserved	Not applicable.

REPORT CAPABILITIES Service Action

The REPORT CAPABILITIES service action requests that the device server return information on persistent reservation features. The format for the

parameter data provided in response to a **PERSISTENT RESERVE IN** command with the REPORT CAPABILITIES service action is shown in figure 112 and table 119.

Figure 112 **PERSISTENT RESERVE IN** Parameter Data for REPORT CAPABILITIES—Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0 — 1	(MSB) Length (0008h) (LSB)							
2	Reserved			CRH (1)	SIP_C (0)	ATP_C (0)	Reserved	PTPL_C (1)
3	TMV (1)	Reserved						PTPL_A
4 — 5	Persistent Reservation Type Mask							
6 — 7	Reserved							

Table 119 **PERSISTENT RESERVE IN** Parameter Data for REPORT CAPABILITIES — Field Descriptions

Field	Description
Length	The LENGTH field indicates the length in bytes of the parameter data.
CRH	A Compatible Reservation Handling (CRH) bit set to one indicates that the device server supports the exceptions to the SPC-2 **RESERVE** and **RELEASE** commands described in SPC-3. Always set to 1.
SIP_C	Always set to 0, the drive does not support the SIP.
ATP_C	Always set to 0, the drive does not support the ATP bit.

Field	Description
PTPL_C	Always set to 1 indicating the drive support the APTPL feature.
TMV	Always set to 1 indicating the Persistent Reservation Type Mark field is valid.
PTPL_A	A Persist Through Power Loss Activated (PTPL_A) bit set to one indicates that persist through power loss capability (see SPC-3) is activated because the most recent successfully completed **PERSISTENT RESERVE OUT** command with REGISTER or REGISTER AND IGNORE EXISTING KEY service action had the APTPL bit set to one in the parameter data. A PTPL_A bit set to zero indicates that the persist through power loss capability is not activated.
Persistent Reservation Type Mask	The PERSISTENT RESERVATION TYPE MASK field (see figure 113) contains a bit map that indicates the persistent reservation types that are supported by the device server.

Figure 113 **PERSISTENT RESERVATION IN** Type Mask — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
4	WR_EX_AR	EX_AC_RO	WR_EX_RO	Reserved	EX_AC	Reserved	WR_EX	Reserved
5	Reserved							EX_AC_AR

Table 120 **PERSISTENT RESERVATION IN** Type Mask — Field Descriptions

Field	Description
WR_EX_AR	The WR_EX_AR bit is set to zero, indicating that the device server does not support the Write Exclusive – All Registrants persistent reservation type.

Field	Description
EX_AC_RO	The Exclusive Access – Registrants Only (EX_AC_RO) bit is set to one, indicating that the device server supports the Exclusive Access – Registrants Only persistent reservation type.
WR_EX_RO	The Write Exclusive – Registrants Only (WR_EX_RO) bit is set to one, indicating that the device server supports the Write Exclusive – Registrants Only persistent reservation type.
EX_AC	The Exclusive Access (EX_AC) bit is set to one, indicating that the device server supports the Exclusive Access persistent reservation type.
WR_EX	The Write Exclusive (WR_EX) bit is set to one, indicating that the device server supports the Write Exclusive persistent reservation type.
EX_AC_AR	The EX_AC_AR bit is set to zero, indicating that the device server does not support the Exclusive Access – All Registrants persistent reservation type.

PERSISTENT RESERVE OUT Command (5Fh)

PERSISTENT RESERVE OUT is a 10-byte command used to reserve a logical unit for exclusive or shared use of an initiator. The command is used with the **PERSISTENT RESERVE IN** command.

Initiators that perform **PERSISTENT RESERVE OUT** actions are identified by a Reservation Key the application client assigns. The application client uses the **PERSISTENT RESERVE IN** command to identify which other initiators within a system hold conflicting or invalid persistent reservations and uses the **PERSISTENT RESERVE OUT** command to preempt those reservations, if necessary.

Since the bus reset of TARGET RESET or other global action does not reset persistent reservations, they can be used to enact device sharing among multiple initiators.

The **PERSISTENT RESERVE OUT** and **PERSISTENT RESERVE IN** commands provide the means for resolving contentions in multiple-initiator systems with multiple port targets. By using the Reservation Key to identify persistent reservations, it is possible to determine which ports hold conflicting persistent reservations and to reclaim these reservations from failing or “greedy” initiators.

Table 121 illustrates the format of the **PERSISTENT RESERVE OUT** command.

Table 121 **PERSISTENT RESERVE OUT** Command Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (5Fh)							
1	Reserved				Service Action			
2	Scope				Type			
3 — 6	Reserved							
7 — 8	(MSB) Parameter List Length (18h) (LSB)							
9	Control							

Table 122 **PERSISTENT RESERVE OUT** Command — Field Descriptions

Field	Description		
Service Action	The following service action codes are available. All other values are reserved.		
	Code	**Name**	**Description**
	00h	Register	Registers a Reservation Key with the drive.
	01h	Reserve	Creates a persistent reservation using a Reservation Key.

Field	Description		
	02h	Release	Releases a persistent reservation.
	03h	Clear	Clears all Reservation Keys and all persistent reservations.
	04h	Preempt	Preempts persistent reservations from another initiator.
	05h	Preempt & Abort	Preempts persistent reservations and/or removes registrations and aborts all tasks for all preempted I_T nexuses.
	06h	Register and Ignore Existing Key	Registers a Reservation Key with the tape drive; Existing Reservation Key is ignored.
	07h	Register and Move	Registers the specified initiator port and moves the reservation to the initiator port.
	See table 123 for detailed descriptions of each of the Service Action codes.		
Scope	The drive only supports reservations of the entire logical unit. Must be set to 0.		
Type	Specifies the characteristics of the persistent reservation being established for all data blocks within the extent or within the logical unit (see table 124 for the applicable Type codes and their meanings).		
Parameter List Length	Fields contained in the **PERSISTENT RESERVE OUT** parameter list specify the Reservation Keys and extent information required to perform a persistent reservation.		

See table 123 for detailed descriptions of each of the **PERSISTENT RESERVE OUT** command's seven possible service actions (Service Action codes appear in bits 0 to 4 of Byte 1).

Table 123 **PERSISTENT RESERVE OUT** Command's Service Action Descriptions

Code	Name	Description
00h	Register	When the command executes a Register service action, it registers a Reservation Key with the drive without generating a reservation. The drive holds these Reservation Keys from each initiator that performs a **PERSISTENT RESERVE OUT** command with a Register service action until a new **PERSISTENT RESERVE OUT** command with Register service action from the same initiator changes the key or until the initiator registration is removed by any of the following: • Powering down the drive, if the last Activate Persist Through Power Loss (APTPL; see figure 114 on page 227 and table 125 on page 228) the drive received was 0. • Performing a Clear service action. • Performing a Preempt service action. • Performing a Preempt & Abort service action. • Performing a Register service action from the same initiator with the value of the service action Reservation Key set to 0. When a Reservation Key has not yet been established or when the Reservation Key has been removed, a Reservation Key of 0 is used when the initiator issues a **PERSISTENT RESERVE OUT** command with the Register service action. When the reservation has been removed, no information is reported for the initiator in the Read Keys service action of the resulting **PERSISTENT RESERVE IN** command.
01h	Reserve	A **PERSISTENT RESERVE OUT** command with Reserve service action creates a persistent reservation with a specified Scope and Type. Persistent reservations are not superseded by a new persistent reservation from any initiator except by the execution of a **PERSISTENT RESERVE OUT** command that specifies a Release, Clear, Preempt, or Preempt & Abort service action.

Code	Name	Description
02h	Release	A **PERSISTENT RESERVE OUT** command with Release service action removes a persistent reservation held by the same initiator. The fields associated with a Release service action match fields of the active persistent reservation. Sending a **PERSISTENT RESERVE OUT** command that specifies a Release service action when no persistent reservation exists from that initiator does not result in an error. Instead, the drive returns a GOOD status without altering any other reservation; the Release service action does not change the Reservation Key. The drive returns a CHECK CONDITION status for any **PERSISTENT RESERVE OUT** command that specifies the release of a persistent reservation held by the requesting initiator that does not match the Scope and Type. The Sense Key is set to ILLEGAL REQUEST and the Additional Sense Code is set to INVALID RELEASE OF ACTIVE PERSISTENT RESERVATION. Attempts to release persistent reservations in which none of the Scope, Type, Reservation Key, and extent values match an existing persistent reservation held by the initiator making the request are not errors. An active persistent reservation may also be released by either of the following: • Powering off. When the most recent APTPL value received by the drive is 0, a power-off performs a hard reset, clears all persistent reservations, and removes all registered Reservation Keys. • Executing a **PERSISTENT RESERVE OUT** command from another initiator with a persistent reserve service action of Clear, Preempt, or Preempt & Abort. Do not perform a Release service action if any operations interlocked by the persistent reservation have not yet completed.
03h	Clear	A **PERSISTENT RESERVE OUT** command with a successful Clear service action removes all persistent reservations for all initiators. All Reservation Keys are also removed. Any commands from any initiator that have been accepted by the drive as non-conflicting continue their normal executions. A UNIT ATTENTION condition is established for all registered initiators for the logical unit. The Sense Key is set to UNIT ATTENTION and the Additional Sense Code is set to RESERVATIONS PREEMPTED. Applications should not use the Clear service action except during recoveries associated with initiator or system reconfiguration as this may compromise data integrity.

Code	Name	Description
04h	Preempt	A **PERSISTENT RESERVE OUT** command with a successful Preempt service action removes all persistent reservations for all initiators that have been registered with the service action Reservation Key specified in the **PERSISTENT RESERVE OUT** command's parameter list. A persistent reservation is also established for the preempting initiator. Any commands from any initiator that the drive has accepted as non-conflicting continue their normal executions. If an initiator sends a **PERSISTENT RESERVE OUT** command that specifies a Preempt service action and no persistent reservation exists for the initiator identified by the service action Reservation Key, it is not an error condition. A UNIT ATTENTION condition is established for the preempted initiators. The Sense Key is set to UNIT ATTENTION; the Additional Sense Code is set to RESERVATIONS PREEMPTED. Commands that follow are subject to the persistent reservation restrictions set by the preempting initiator. The persistent reservation the preempting initiator created is defined by the Scope and Type fields of the **PERSISTENT RESERVE OUT** command and the corresponding fields of the command's parameter list. The Preempt service action removes the registration keys for the preempted initiators; the Reservation Key for an initiator that has performed a Preempt service action with its own Reservation Key specified in the service action Reservation Key remains unchanged, although all other specified releasing actions and reservation actions are performed. Note that persistent reservations are not superseded by a new persistent reservation from any initiator except by the execution of a **PERSISTENT RESERVE OUT** command that specifies either the Preempt or the Preempt & Abort service actions. New persistent reservations that do not conflict with an existing persistent reservation execute normally.

Code	Name	Description
05h	Preempt & Abort	A **PERSISTENT RESERVE OUT** command with a Preempt & Abort service action removes all persistent reservations for all initiators that have been registered with the service action Reservation Key specified in the **PERSISTENT RESERVE OUT** command's parameter list. It also establishes a persistent reservation for the preempting initiator. Any commands from the initiators being preempted are terminated as if the preempted initiator had performed an ABORT TASK management function. If a **PERSISTENT RESERVE OUT** command is sent that specifies a Preempt & Abort service action and no persistent reservation exists for the initiator identified by the service action Reservation Key, it is not an error condition. If the key is registered, however, the Clear portion of the action executes normally. A UNIT ATTENTION condition is established for the preempted initiators. The Sense Key is set to UNIT ATTENTION, the Additional Sense Code is set to RESERVATIONS PREEMPTED. Commands that follow, and retries of commands that timed out because they were cleared, are subject to the persistent reservation restrictions set by the preempting initiator. The persistent reservation the preempting initiator created is defined by the Scope and Type fields of the **PERSISTENT RESERVE OUT** command and the corresponding fields of the command's parameter list. The Preempt & Abort service action clears any CA condition with the initiator that is preempted. The Reservation Keys for the other initiators preempted are removed by the Preempt & Abort service action. The Reservation Key for an initiator that has sent a Preempt & Abort action with its own Reservation Key specified in the service action's Reservation Key remains unchanged, although all other specified clearing actions, releasing actions, and reservation actions are performed. Persistent reservations are not superseded by a new persistent reservation from any initiator except by executing a **PERSISTENT RESERVE OUT** command that specifies either the Preempt or Preempt & Abort service action. New persistent reservations not in conflict with an existing persistent reservation execute normally.
06h	Register and Ignore Key	Behaves like the Register (00h) action except that it ignores the Reservation Key in the parameter list and treats it as if it matched the current registration, if one exists, for the initiator.
07h	Register and Move	Registers the specified initiator port and moves the reservation to the initiator port.

Table 124 presents the definitions of the available Type values from the Type field of the **PERSISTENT RESERVE OUT** Read Reservation parameters. Each of the codes provides handling instructions for **READ** operations, for **WRITE** operations, and for subsequent attempts to establish persistent reservations (referred to as "Additional Reservations Allowed" in the table).

Table 124 **PERSISTENT RESERVE OUT** Type Codes

Code	Name	Description
0h	Obsolete	---
1h	**WRITE** Exclusive	**READS**: Shared. Any application client on any initiator may execute commands that perform transfers from the tape medium to the initiator. **WRITES**: Exclusive. Any command from any initiator other than the initiator that holds the persistent reservation that attempts a transfer to the tape medium results in a reservation conflict.
2h	Obsolete	---
3h	Exclusive Access	**READS**: Exclusive. Any command from any initiator other than the initiator holding the persistent reservation that attempts a transfer from the tape medium results in a reservation conflict. **WRITES**: Exclusive. Any command from any initiator other than the initiator holding the persistent reservation that attempts a transfer to the tape medium results in a reservation conflict.
4h	Obsolete	---
5h	**WRITE** Exclusive Registrants Only	**READS**: Shared. Any application client on any initiator may execute commands that perform transfers from the tape medium to the initiator. **WRITES**: Exclusive. Any command from an initiator that has not previously performed a Register service action with the drive that attempts a transfer to the tape medium results in a reservation conflict.
6h	Exclusive Access Registrants Only	**READS**: Exclusive. Any command from an initiator that has not previously performed a Register service action with the drive that attempts a transfer from the tape medium results in a reservation conflict. **WRITES**: Exclusive. Any command from an initiator that has not previously performed a Register service action with the drive that attempts a transfer to the tape medium results in a reservation conflict.

Code	Name	Description
7h - Fh	Reserved	Not applicable

A **PERSISTENT RESERVE OUT** command with a Service Action value of Register and Move uses a parameter list as described in figure 115 and table 126. All other service actions of the **PERSISTENT RESERVER OUT** command use the parameter list shown in figure 114 and defined in table 125. Every **PERSISTENT RESERVE OUT** command sends all of the fields of the parameter list, even if the field is not required for the specific service action or scope values.

Figure 114 **PERSISTENT RESERVE OUT** Parameter List — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0 — 7	(MSB) Reservation Key (LSB)							
8 — 15	(MSB) Service Action Reservation Key (LSB)							
16 — 19	(MSB) Scope-Specific Address (LSB)							
20	Reserved				Spec_I_PT	All_TG_PT	Reserved	APTPL
21	Reserved							
22 — 23	Obsolete							

Table 125 **PERSISTENT RESERVE OUT** Parameter List — Field Descriptions

Field	Description
Reservation Key	Contains an 8-byte token that the application client provides to the drive to identify the initiator that is the source of the **PERSISTENT RESERVE OUT** command. For all service actions except Register and Ignore Existing Key, the drive verifies that the Reservation Key in the **PERSISTENT RESERVE OUT** command matches the Reservation Key that is registered for the initiator from which the command is received. If there is no match, the drive returns a RESERVATION CONFLICT status. The Reservation Key of the initiator is valid for all service action and scope values.
Service Action Reservation Key	Contains information needed for three different service actions: Register, Preempt, and Preempt & Abort. The Service Action Reservation Key is ignored for all other service actions. For the Register service action, the Service Action Reservation Key field contains the new Reservation Key to be registered. For the Preempt and the Preempt & Abort service actions, the Service Action Reservation Key contains the reservation key of the preempted persistent reservations. For the Preempt and the Preempt & Abort service actions, any failure of the Service Action Reservation Key to match any registered keys results in the drive returning a RESERVATION CONFLICT status.
Scope-Specific Address	Ignored.
Spec_I_PT	Specify Initiator Ports. Must be set to 0.
All_TG_PT	All Target Ports. Must be set to 0.
APTPL	Activate Persist Through Power Loss. Valid only for Register and Register and Ignore Existing Key service actions. It is ignored for all other types of service actions. If the last valid APTPL bit value the drive received is 0, loss of power in the drive releases any persistent reservations and removes all reservation keys. If the last valid APTPL bit value is 1, the drive retains all persistent reservations and all reservation keys for all initiators even if power is lost and later restored. The most recently received valid APTPL value from any initiator governs the drive's behavior in the event of a power loss.

Table 126 illustrates the fields the application client sets and which the drive interprets for each service and scope value.

Table 126 DLT-S4 Tape Drive Interpretation of Service and Scope Value

Service Action	Allowed Scope	Parameters		
		Type	Service Action Reservation Key	Reservation Key
Register	Ignored	Ignored	Valid	Valid
Register and IgnoreExisting Key	Ignored	Ignored	Valid	Ignored
Reserve	LU	Valid	Ignored	Valid
Release	LU	Valid	Ignored	Valid
Clear	Ignored	Ignored	Ignored	Valid
Preempt	LU	Valid	Valid	Valid
Preempt & Abort	LU	Valid	Valid	Valid
Register and Move	LU	Valid	Valid	Valid

PERSISTENT RESERVE OUT Command with REGISTER AND MOVE Service Action Parameters

The parameter list format shown in figure 115 is used by the **PERSISTENT RESERVE OUT** command with REGISTER AND MOVE service action.

Figure 115 **PERSISTENT RESERVE OUT** Command with REGISTER AND MOVE

Service Action Parameter List
— Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0 — 7	(MSB) Reservation Key (LSB)							
8 — 15	(MSB) Service Action Reservation Key (LSB)							
16	Reserved							
17	Reserved						UNREG	APTPL
18 — 19	(MSB) Relative Target Port Identifier (LSB)							
20 — 23	(MSB) TransportID Parameter Data Length (n − 23) (LSB)							
24 — *n*	TransportID							

Table 127 **PERSISTENT RESERVE OUT** Command with REGISTER AND MOVE Service Action Parameter List — Field Descriptions

Field	Description
Reservation Key	The RESERVATION KEY field contains an 8-byte value provided by the application client to the device server to identify the I_T nexus that is the source of the **PERSISTENT RESERVE OUT** command. The device server verifies that the contents of the RESERVATION KEY field in a **PERSISTENT RESERVE OUT** command parameter data matches the registered reservation key for the I_T nexus from which the command was received. If a **PERSISTENT RESERVE OUT** command specifies a RESERVATION KEY field other than the reservation key registered for the I_T nexus, the device server returns a RESERVATION CONFLICT status.
Service Action Reservation Key	The SERVICE ACTION RESERVATION KEY field contains the reservation key to be registered to the specified I_T nexus.
APTPL	If the last valid APTPL bit value received by the device server is zero, the loss of power in the SCSI target device releases the persistent reservation for the logical unit and remove all registered reservation keys. If the last valid APTPL bit value received by the device server is one, the logical unit retains any persistent reservation(s) that may be present and all reservation keys (i.e., registrations) for all I_T nexuses even if power is lost and later returned.
UNREG	An UNREG bit set to one specifies that the device server removes the registration for the I_T nexus on which the **PERSISTENT RESERVE OUT** command REGISTER AND MOVE service action was received. If the UNREG bit is set to zero, the registration for the I_T nexus that originated the **PERSISTENT RESERVE OUT** command is not affected.
Relative Target Port Identifier	The RELATIVE TARGET PORT IDENTIFIER field specifies the relative port identifier of the target port in the I_T nexus to which the persistent reservation is to be moved.
TransportID Descriptor Length	The TRANSPORTID DESCRIPTOR LENGTH field specifies the number of bytes of the TransportID that follows, is a minimum of 24 bytes, and is a multiple of 4.

Field	Description
TransportID	The TransportID specifies the initiator port in the I_T nexus to which the persistent reservation is to be moved. The format of the TransportID is defined in SPC-3. The TransportID field must use the format for the interface type that is present on the drive.

PREVENT / ALLOW MEDIUM REMOVAL Command (1Eh)

This command enables or disables unloading the data cartridge. The drive maintains **PREVENT / ALLOW** status for each initiator separately.

Figure 116 **PREVENT / ALLOW MEDIUM REMOVAL** Command Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (1Eh)							
1	Reserved							
2 — 3	Reserved							
4	Reserved							Prevent
5	Control							

Table 128 **PREVENT / ALLOW MEDIUM REMOVAL** Command Descriptor Block — Field Descriptions

Field	Value	Description
Prevent	0	Clears the Prevent state corresponding to the initiator. When all initiators have cleared their Prevent states, the Eject button and **UNLOAD** commands are enabled both for the drive and for any attached tape automation system, library, or loader. By default after power-on or a logical unit reset, the PREVENT MEDIUM REMOVAL function is cleared.
	1	Effectively disables the Eject button on the drive's front panel or a **LOAD UNLOAD** command from unloading the medium. If the drive is in a tape automation system, any **MOVE MEDIUM** command is prevented from removing a data cartridge.

READ Command (08h)

The **READ** command transfers one or more data blocks from the medium to the initiator starting with the next block on the tape.

Figure 117 **READ** Command Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (08h)							
1	Reserved						SILI	Fixed
2 — 4	(MSB) Transfer Length (LSB)							

Byte \ Bit	7	6	5	4	3	2	1	0
5	Control							

Table 129 **READ** Command Descriptor Block — Field Descriptions

Field	Description
SILI	Suppress Incorrect Length Indicator. If the SILI bit is set to 1 and the Fixed bit is set to 1, the drive terminates the command with CHECK CONDITION status, Sense Key set to ILLEGAL REQUEST, and Additional Sense Code set to INVALID FIELD IN CDB. If the SILI bit is set to 0 and the actual block length is different than the specified transfer length, the drive returns CHECK CONDITION status. Within the Sense Data, the Incorrect Length Indicator (ILI) bit and Valid bit are set to 1. The Sense Key field is set to 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 drive logically positions the tape after the block (EOM side). If the SILI bit is set to 1: • The drive reports CHECK CONDITION status for an incorrect length condition only if the overlength condition exists and the Block Length field in the mode parameter block descriptor is non-zero, or • The drive does not report CHECK CONDITION status if the only error is the underlength condition or if the only error is the overlength condition and the Block Length field of the mode parameters block descriptor is set to 0.
Fixed	Specifies whether the drive is to transfer fixed-length or variable-length blocks and gives meaning to the Transfer Length field of the **READ** command. When set to 0, requests variable-block mode. A single block is transferred with the Transfer Length specifying the maximum number of bytes the initiator has allocated for the returned data. When set to 1, requests fixed-block mode.

Field	Description
Transfer Length	When set to 1, specifies the number of blocks to be transferred to the initiator. This setting is valid only if the drive is currently operating in fixed-block mode. When set to 0, no data is transferred and the current position on the drive does not change. This is not an error condition. A successful **READ** operation with the Fixed bit set to 1 transfers *x* byes of data, where *x* = (current block length) × (# of blocks) × (block size) bytes of data to the initiator. Upon termination of the **READ** command, the drive logically positions the medium after the last block of data transferred (EOM side).

Filemark and End-of-Data Handling

If the drive reads a Filemark, it returns a CHECK CONDITION status. Within the Sense Data, the Filemark and Valid bits are set to 1 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 drive logically positions the medium after the Filemark.

If the drive detects End of Data (EOD) during a **READ**, it returns CHECK CONDITION status. Within the Sense Data, the Valid bit is set to 1 and the Sense Key field is set to BLANK CHECK. The information fields contain the residue count. The Additional Sense Code Qualifier fields are set. Upon termination, the drive physically positions the medium after the last block on tape.

End-of-Medium/Partition Handling

The meaning of EOM is different for a **READ** command than it is for a **WRITE**-related command. The drive reports EOM only when it encounters the physical EOM or End-of-Partition (EOP). The drive returns a CHECK CONDITION status. The EOM and Valid bits are set to 1 and the Sense Key field 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 drive physically positions the medium at EOM / P.

READ ATTRIBUTE Command (8Ch)

The **READ ATTRIBUTE** command (see figure 118) allows an application client to read attribute values from Enhanced Medium Auxiliary Memory (EMAM).

Figure 118 **READ ATTRIBUTE** Command Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (8Ch)							
1	Reserved			Service Action				
2 — 4	Restricted (00h)							
5	Volume Number							
6	Reserved							
7	Partition Number							
8 — 9	(MSB) First Attribute Identifier (LSB)							
10 — 13	(MSB) Allocation Length (LSB)							
14	Reserved							
15	Control							

Table 130 READ ATTRIBUTE Command Descriptor Block — Field Descriptions

Field	Description
Service Action	See READ ATTRIBUTE Service Action Codes.
Volume Number	Specifies a volume within the medium auxiliary memory. Must be set to 0. Super DLTtape media comprises a single volume.
Partition Number	Specifies a partition within a volume. Must be set to 0. Super DLTtape media comprises a single partition.
First Attribute Identifier	Specifies the attribute identifier of the first attribute to be returned.
Allocation Length	Specifies how many bytes are allocated for the returned parameter list. If the value in this field is not sufficient to contain the entire parameter list, the drive returns the truncated list; this is not considered an error. If the remainder of the list is required, the application client either: 1) sends a new **READ ATTRIBUTE** command with the Allocation Length field set to a large enough value to contain the entire parameter list, or 2) uses the First Attribute Identifier field to restrict the attributes returned.

Error Summary for the READ ATTRIBUTE Command

If the medium auxiliary memory is not accessible because the medium is not present, the drive terminates the **READ ATTRIBUTE** command with a CHECK CONDITION status. The Sense Key is set to NOT READY and the Additional Sense Code is set to MEDIUM NOT PRESENT.

If the medium is present but the medium auxiliary memory is not accessible, the drive terminates the **READ ATTRIBUTE** command with a CHECK CONDITION status. The Sense Key is set to NOT READY and the Additional Sense Code is set to LOGICAL UNIT NOT READY, MAM NOT AVAILABLE.

If the combination of volume number and partition number is not valid, the drive terminates the **READ ATTRIBUTE** command with a CHECK CONDITION status. The Sense Key is set to ILLEGAL REQUEST and the Additional Sense Code is set to INVALID FIELD IN CDB.

If the specified attribute identifier does not exist, the drive terminates the **READ ATTRIBUTE** command with a CHECK CONDITION status. The Sense

Key is set to ILLEGAL REQUEST and the Additional Sense Code is set to INVALID FIELD IN CDB.

If the medium auxiliary memory has failed, the drive terminates the **READ ATTRIBUTE** command with a CHECK CONDITION status. The Sense Key is set to MEDIUM ERROR and the Additional Sense Code is set to AUXILIARY MEMORY READ ERROR.

READ ATTRIBUTE Service Action Codes

The service actions defined for the **READ ATTRIBUTE** command are listed in table 131.

Table 131 **READ ATTRIBUTE** Command Service Action Codes

Code	Name	Description	Refer to
00h	ATTRIBUTE VALUES	Returns attribute values.	page 238
01h	ATTRIBUTE LIST	Returns a list of available attribute identifiers.	page 239
02h	VOLUME LIST	Returns a list of known volume numbers.	page 240
03h	PARTITION LIST	Returns a list of known partition numbers.	page 241
04h	Restricted		
05h-1Fh	Reserved		

Note: The format of the parameter data the **READ ATTRIBUTE** command returns depends on the service action the command specified.

ATTRIBUTE VALUES Service Action

The **READ ATTRIBUTE** E command with the ATTRIBUTE VALUES service action returns parameter data containing the attributes specified by the Partition Number, Volume Number, and First Attribute Identifier fields in the CDB.

The returned parameter data contains the requested attributes in ascending numerical order by attribute identifier value, using the format shown in figure 119.

Figure 119 **READ ATTRIBUTE** with ATTRIBUTE VALUES Service Action — Parameter List Format

Bit / Byte	7	6	5	4	3	2	1	0
0 — 3	(MSB) Available Data (n – 3) (LSB)							
	Attributes							
4 — (*x* + 3)	Attribute (first attribute) Length (x)							
(*n* — y + 1) — *n*	Attribute (last attribute) Length (y)							

Table 132 **READ ATTRIBUTE** with ATTRIBUTE VALUES Service Action Parameter — Field Descriptions

Field	Description
Available Data	Contains the number of bytes of attribute information in the parameter list. If the parameter list is truncated as a result of insufficient allocation length, the contents of the Available Data field are not altered.
Attribute	The drive returns each Attribute formatted as described in Enhanced Medium Auxiliary Memory (EMAM) Attributes.

ATTRIBUTE LIST Service Action

The **READ ATTRIBUTE** command with the ATTRIBUTE LIST service action returns parameter data containing the attribute identifiers for the

specified partition and volume number. The contents of the First Attribute Identifier field in the CDB are ignored. The returned parameter data contains the requested attribute identifiers in ascending numerical order by attribute identifier value and using the format shown in figure 120.

Figure 120 **READ ATTRIBUTE** with ATTRIBUTE LIST Service Action — Parameter List Format

Bit / Byte	7	6	5	4	3	2	1	0
0 — 3	(MSB) Available Data (*n* – 3) (LSB)							
4 — 5	Attribute Identifier 0							
	. . .							
(*n* — 1) — *n*	Attribute Identifier *x*							

Table 133 **READ ATTRIBUTE** with ATTRIBUTE LIST Service Action Parameter Data — Field Descriptions

Field	Description
Available Data	Contains the number of bytes of attribute information in the parameter list. If the parameter list is truncated as a result of insufficient allocation length, the contents of the Available Data field are not altered.
Attribute Identifier	Contains a 2-byte attribute ID. The attribute IDs are listed in table 139 on page 245, table 144 on page 255, and table 146 on page 257.

VOLUME LIST Service Action

The **READ ATTRIBUTE** command with the VOLUME LIST service action returns parameter data (see figure 121) identifying the supported number of volumes. The contents of the Volume Number, Partition Number, and First Attribute Identifier fields in the CDB are ignored.

Figure 121 **READ ATTRIBUTE** with VOLUME LIST Service Action — Parameter List Format

Bit / Byte	7	6	5	4	3	2	1	0
0 — 1	(MSB) Available Data (02h) (LSB)							
2	First Volume Number							
3	Number of Volumes Available							

Table 134 **READ ATTRIBUTE** with VOLUME LIST Service Action Parameter Data — Field Descriptions

Field	Description
First Volume Number	Indicates the first volume available. Volume numbering starts at 0.
Available Data	Preset to 02h.
First Volume Number	Indicates the first volume available. Volume numbering starts at 0.
Number of Volumes Available	Indicates the number of volumes that are available. Tape drives only support one volume on the medium.

PARTITION LIST Service Action

The **READ ATTRIBUTE** command with the PARTITION LIST service action returns parameter data (see figure 122) identifying the number of partitions supported in the specified volume number. The contents of the Partition Number and First Attribute Identifier fields in the CDB are ignored.

Figure 122 **READ ATTRIBUTE** with PARTITION LIST Service Action — Parameter List Format

Bit / Byte	7	6	5	4	3	2	1	0
0 — 1	(MSB) Available Data (02h) (LSB)							
2	First Partition Number							
3	Number of Partitions Available							

Table 135 **READ ATTRIBUTE** with PARTITION LIST Service Action Parameter Data — Field Descriptions

Field	Description
Available Data	Preset to 02h.
First Partition Number	Indicates the first partition available on the specified volume number. Partition numbering starts at 0.
Number of Partitions Available	Indicates the number of partitions that are available. DLT-S4 tape drives only support one partition on the medium.

Enhanced Medium Auxiliary Memory (EMAM) Attributes

This section describes the specific composition of Enhanced Medium Auxiliary Memory (EMAM) attributes. Each EMAM attribute is identified by a 2-byte attribute ID.

Attribute Format

Each EMAM attribute is communicated between the application client and the drive in the format shown in figure 123 and described in table 136. This format is used in the parameter data for the **WRITE ATTRIBUTE** command (see WRITE ATTRIBUTE Command (8Dh) on page 336) and the **READ ATTRIBUTE** command (see READ ATTRIBUTE Command (8Ch) on page 235).

The attribute ID, format, and length are also sometimes referred to as the *attribute header*. The value of the EMAM attribute header implies nothing about the physical representation of an attribute in the medium auxiliary memory.

Figure 123 EMAM Attribute — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0 — 1	(MSB) Attribute Identifier (LSB)							
2	Read Only	Reserved					Format	
3 — 4	(MSB) Attribute Length (*n* – 4) (LSB)							
5 — *n*	(MSB) Attribute Value (LSB)							

Table 136 EMAM Attribute Parameter Data — Field Descriptions

Field	Description
Attribute Identifier	Contains a code value identifying the attribute (see Attribute Identifier Values on page 244).
Read Only	Indicates whether the attribute is read only. When set to 1, the attribute is read only. When set to 0, the attribute is read / write.
Format	Specifies the format of the data in the Attribute Value field (see table 137).
Attribute Length	Specifies the length in bytes of the Attribute Value field.
Attribute Value	Contains the current (**READ ATTRIBUTE**) or desired (**WRITE ATTRIBUTE**) value of the attribute.

Table 137 EMAM Attribute Formats

Format	Name	Description
00b	BINARY	The Attribute Value field contains binary data.
01b	ASCII	The Attribute Value field contains only graphic codes; that is, byte code values 20h through 7Eh, and is left-aligned, placing any unused bytes at the highest offset in the field. The field contains 20h, the ASCII space character, in any unused bytes.
10b	TEXT	The Attribute Value field contains text data.
11b	Reserved	

Attribute Identifier Values

The values in the Attribute Identifier field (see Attribute Format) are assigned according to the attribute type and whether the attribute is standard or vendor unique (see table 138).

Table 138 EMAM Attribute Identifier Range Assignments

Attribute Identifiers	Attribute Type	Subtype
0000h - 03FFh	Device	Standard
0400h - 07FFh	Medium	Standard
0800h - 0BFFh	Host	Standard
0C00h - 0FFFh	Device	Vendor Unique
1000h - 13FFh	Medium	Vendor Unique
1400h - 17FFh	Host	Vendor Unique
1800h - FFFFh	Reserved	

Only parameters with an Attribute Type of Host can be written using the **WRITE ATTRIBUTES** commands. All other attributes are reported as read only.

Standard Device Type Attributes 4

The drive maintains and updates device type attributes (see table 139) when the medium and associated medium auxiliary memory are present.

Table 139 Device Type Attributes (for EMAM) Supported by the DLT-S4 Tape Drive Firmware

Attribute Identifier	Name	Attribute Length	Format	Refer to
0000h	REMAINING CAPACITY IN PARTITION	8	BINARY	page 246
0001h	MAXIMUM CAPACITY IN PARTITION	8	BINARY	page 246
0002h	TAPE ALERT FLAGS	8	BINARY	page 246
0003h	LOAD COUNT	8	BINARY	page 246
0004h	MAM SPACE REMAINING	8	BINARY	page 246
0005h	ASSIGNING ORGANIZATION	8	ASCII	---
0006h	FORMATTED DENSITY CODE	1	BINARY	page 246
0007h	INITIALIZATION COUNT	2	BINARY	page 247
0008h - 020Ah	Reserved			
020Ah	DEVICE VENDOR/SERIAL NUMBER AT LAST LOAD	40	ASCII	page 247
020Bh	DEVICE VENDOR/SERIAL NUMBER AT LOAD-1	40	ASCII	page 247
020Ch	DEVICE VENDOR/SERIAL NUMBER AT LOAD-2	40	ASCII	page 247
020Dh	DEVICE VENDOR/SERIAL NUMBER AT LOAD-3	40	ASCII	page 247
020Eh - 021Fh	Reserved			
0220h	TOTAL MBYTES WRITTEN IN MEDIUM LIFE	8	BINARY	page 247
0221h	TOTAL MBYTES READ IN MEDIUM LIFE	8	BINARY	page 247
0222h	TOTAL MBYTES WRITTEN IN CURRENT/LAST LOAD	8	BINARY	page 248
0223h	TOTAL MBYTES READ IN CURRENT/LAST LOAD	8	BINARY	page 248

Attribute Identifier	Name	Attribute Length	Format	Refer to
0224h - 033Fh	Reserved			
0340h	MEDIUM USAGE HISTORY	90	BINARY	page 248
0341h	PARTITION USAGE HISTORY	60	BINARY	page 251
0342h - 03FFh	Reserved			

REMAINING CAPACITY IN PARTITION and **MAXIMUM CAPACITY IN PARTITION:** These are native capacities, assuming no data compression for the specified medium partition, expressed in increments of 1,048,576 bytes; that is, a value of 1 means 1,048,576 bytes, 2 means 2,097,152 bytes, and so on.

TAPE ALERT FLAGS: Provides a means of reporting the state of the Tape Alert flags for the previous load of the medium. Each Tape Alert flag occupies 1 bit (Flag 1 = MSB, byte 1; Flag 64 = LSB, byte 8). The bits specify all the Tape Alert flags set during the previous load — the bits are "sticky" for the load.

LOAD COUNT: Indicates how many times this medium has been fully loaded. The drive does not reset this attribute.

MAM SPACE REMAINING: Indicates the space currently free in the medium auxiliary memory. The total medium auxiliary memory capacity is reported in the MAM CAPACITY attribute (see MAM CAPACITY: on page 256).

You cannot always use all of the free space in a particular medium auxiliary memory implementation. Depending on the internal organization of the memory and the software that controls it, fragmentation issues may mean that certain attribute sizes might not be fully accommodated as the medium auxiliary memory nears its maximum capacity.

FORMATTED DENSITY CODE: If the drive formats the medium using a format other than the one specified in the MEDIUM DENSITY CODE attribute (for example, for compatibility with a previous generation format), the FORMATTED DENSITY CODE specifies the DENSITY CODE of the format chosen. Otherwise, this attribute is the same as the MEDIUM DENSITY CODE.

INITALIZATION COUNT: Indicates the number of times that a drive has logically formatted the medium. This figure is cumulative over the life of the medium and is never reset.

DEVICE VENDOR/SERIAL NUMBER AT LAST LOAD, DEVICE VENDOR/SERIAL NUMBER AT LOAD–1, DEVICE VENDOR/SERIAL NUMBER AT LOAD–2 and **DEVICE VENDOR/SERIAL NUMBER AT LOAD–3:** Provides a rolling history of the last four drives in which the medium has been loaded. The format of the attributes is shown in figure 124.

Figure 124 DEVICE VENDOR/SERIAL NUMBER Attribute — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0 — 7	(MSB) Vendor Identification (ID) (LSB)							
8 — 39	(MSB) Product Serial Number (LSB)							

Table 140 DEVICE VENDOR/SERIAL NUMBER Attribute Parameter Data — Field Descriptions

Field	Description
Vendor ID	Contains the same value returned in the STANDARD INQUIRY data.
Product Serial Number	Contains the unit serial number.

TOTAL MBYTES WRITTEN IN MEDIUM LIFE and TOTAL MBYTES READ IN MEDIUM LIFE: Indicates the total number of data bytes transferred to or from the medium surface, after any data compression has been applied, over the entire medium life. These values are cumulative and are never reset. These values are expressed in increments of 1,048,576 bytes; that is, a value of 1 means 1,048,576 bytes, 2 means 2,097,152 bytes, and so on.

TOTAL MBYTES WRITTEN IN CURRENT/LAST LOAD and **TOTAL MBYTES READ IN CURRENT/LAST LOAD:** Indicates the total number of data bytes transferred to or from the medium surface, after any data compression has been applied, during the current load if the medium is currently loaded or the last load if the medium is currently unloaded. The drive resets these attributes to 0 when the medium is loaded.

These values are expressed in increments of 1,048,576 bytes; that is, a value of 1 means 1,048,576 bytes, 2 means 2,097,152 bytes, and so forth.

MEDIUM USAGE HISTORY: Provides statistics (see figure 141) for the entire medium. If a field is not used, it is set to 0.

Table 141 MEDIUM USAGE HISTORY Attribute — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0 — 5	(MSB) Current Amount of Data Written (LSB)							
6 — 11	(MSB) Current Write Retries Count (LSB)							
12 — 17	(MSB) Current Amount of Data Read (LSB)							
18 — 23	(MSB) Current Read Retries Count (LSB)							
24 — 29	(MSB) Previous Amount of Data Written (LSB)							

Byte \ Bit	7	6	5	4	3	2	1	0
30 — 35	(MSB) Previous Write Retries Count (LSB)							
36 — 41	(MSB) Previous Amount of Data Read (LSB)							
42 — 47	(MSB) Previous Read Retries Count (LSB)							
48 — 53	(MSB) Total Amount of Data Written (LSB)							
54 — 59	(MSB) Total Write Retries Count (LSB)							
60 — 65	(MSB) Total Amount of Data Read (LSB)							
66 — 71	(MSB) Total Read Retries Count (LSB)							
72 — 77	(MSB) Load Count (LSB)							
78 — 83	(MSB) Total Change Partition Count (LSB)							
84 — 89	(MSB) Total Partition Initialize Count (LSB)							

Table 142 MEDIUM USAGE HISTORY Attribute Parameter Data — Field Descriptions

Field	Description
Current Amount of Data Written	Indicates the amount of data physically written to the medium during this load of the medium. This value is expressed in increments of 1,048,576 bytes; that is, a value of 1 means 1,048,576 bytes, 2 means 2,097,152 bytes, and so on.
Current Write Retries Count	Indicates the total number of times the drive performed a Write retry during this load of the medium.
Current Amount of Data Read	Indicates the amount of data physically read from the medium during this load of the medium. This value is expressed in increments of 1,048,576 bytes; that is, a value of 1 means 1,048,576 bytes, 2 means 2,097,152 bytes, and so on.
Current Read Retries Count	Indicates the number of times the drive performed a Read retry during this load of the medium.
Previous Amount of Data Written	Indicates the amount of data physically written to the medium during the previous load of the medium. This value is expressed in increments of 1,048,576 bytes; that is, a value of 1 means 1,048,576 bytes, 2 means 2,097,152 bytes, and so on.
Previous Write Retries Count	Indicates the total number of times the drive performed a Write retry during the previous load of the medium.
Previous Amount of Data Read	Indicates the amount of data physically read from the medium during the previous load of the medium. This value is expressed in increments of 1,048,576 bytes; that is, a value of 1 means 1,048,576 bytes, 2 means 2,097,152 bytes, and so on.
Previous Read Retries Count	Indicates the number of times the drive performed a Read retry during the previous load of the medium.
Total Amount of Data Written	Indicates the amount of data physically written to the medium since the last medium format. This value is expressed in increments of 1,048,576 bytes; that is, a value of 1 means 1,048,576 bytes, 2 means 2,097,152 bytes, and so on.
Total Write Retries Count	Indicates the total number of times the drive performed a Write retry since the last medium format.
Total Amount of Data Read	Indicates the amount of data physically read from the medium since the last medium format. This value is expressed in increments of 1,048,576 bytes; that is, a value of 1 means 1,048,576 bytes, 2 means 2,097,152 bytes, and so on.
Total Read Retries Count	Indicates the number of times the drive performed a Read retry since the last medium format.

Field	Description
Load Count	Indicates the number of loads since the last medium format. This count accumulates over the life of the medium but it is reset to 0 after a medium format.
Total Change Partition Count	Indicates the number of times that switches between partitions have been performed on the medium. Must be set to 0. Super DLTtape media comprises a single volume.
Total Partition Initialize Count	Indicates number of times that any of the partitions on the medium have been erased. This count accumulates over the life of the medium but it is reset to 0 after a medium format.

PARTITION USAGE HISTORY: Provides statistics (see figure 125) for the partition specified by the Partition Number field in the CDB. If a field is not used, it is set to 0.

Figure 125 PARTITION USAGE HISTORY Attribute — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0 — 3	(MSB) Current Amount of Data Written (LSB)							
4 — 7	(MSB) Current Write Retries Count (LSB)							
8 — 11	(MSB) Current Amount of Data Read (LSB)							
12 — 15	(MSB) Current Read Retries Count (LSB)							
16 — 19	(MSB) Previous Amount of Data Written (LSB)							

Byte \ Bit	7	6	5	4	3	2	1	0
20 — 23	(MSB) Previous Write Retries Count (LSB)							
24 — 27	(MSB) Previous Amount of Data Read (LSB)							
28 — 31	(MSB) Previous Read Retries Count (LSB)							
32 — 35	(MSB) Total Amount of Data Written (LSB)							
36 — 39	(MSB) Total Write Retries Count (LSB)							
40 — 43	(MSB) Total Amount of Data Read (LSB)							
44 — 47	(MSB) Total Read Retries Count (LSB)							
48 — 51	(MSB) Load Count (LSB)							
52 — 55	(MSB) Total Change Partition Count (LSB)							
56 — 59	(MSB) Total Partition Initialize Count (LSB)							

Table 143 PARTITION USAGE HISTORY Attribute Parameter Data — Field Descriptions

Field	Description
Current Amount of Data Written	Indicates the amount of data physically written to the medium in the partition specified by the Partition Number field in the CDB during this load of the medium. This value is expressed in increments of 1,048,576 bytes; that is, a value of 1 means 1,048,576 bytes, 2 means 2,097,152 bytes, and so on.
Current Write Retries Count	Indicates the total number of times the drive performed a Write retry in the partition specified by the Partition Number field in the CDB during this load of the medium.
Current Amount of Data Read	Indicates the amount of data physically read from the medium in the partition specified by the Partition Number field in the CDB during this load of the medium. This value is expressed in increments of 1,048,576 bytes; that is, a value of 1 means 1,048,576 bytes, 2 means 2,097,152 bytes, and so on.
Current Read Retries Count	Indicates the number of times the drive performed a Read retry in the partition specified by the Partition Number field in the CDB during this load of the medium.
Previous Amount of Data Written	Indicates the amount of data physically written to the medium in the partition specified by the Partition Number field in the CDB during the previous load of the medium. This value is expressed in increments of 1,048,576 bytes; that is, a value of 1 means 1,048,576 bytes, 2 means 2,097,152 bytes, and so on.
Previous Write Retries Count	Indicates the total number of times the drive performed a Write retry in the partition specified by the Partition Number field in the CDB during the previous load of the medium.
Previous Amount of Data Read	Indicates the amount of data physically read from the medium in the partition specified by the Partition Number field in the CDB during the previous load of the medium. This value is expressed in increments of 1,048,576 bytes; that is, a value of 1 means 1,048,576 bytes, 2 means 2,097,152 bytes, and so on.
Previous Read Retries Count	Indicates the number of times the drive performed a Read retry in the partition specified by the Partition Number field in the CDB during the previous load of the medium.
Total Amount of Data Written	Indicates the amount of data physically written to the medium in the partition specified by the Partition Number field in the CDB since the last medium format. This value is expressed in increments of 1,048,576 bytes; that is, a value of 1 means 1,048,576 bytes, 2 means 2,097,152 bytes, and so on.

Field	Description
Total Write Retries Count	Indicates the total number of times the drive performed a Write retry in the partition specified by the Partition Number field in the CDB since the last medium format.
Total Amount of Data Read	Indicates the amount of data physically read from the medium in the partition specified by the Partition Number field in the CDB since the last medium format. This value is expressed in increments of 1,048,576 bytes; that is, a value of 1 means 1,048,576 bytes, 2 means 2,097,152 bytes, and so on.
Total Read Retries Count	Indicates the number of times the drive performed a Read retry in the partition specified by the Partition Number field in the CDB since the last medium format.
Load Count	Indicates the number of loads in the partition specified by the Partition Number field in the CDB since the last medium format. This count accumulates over the life of the medium but it is reset to 0 after a medium format.
Total Change Partition Count	Indicates the number of times that switches to the partition specified by the Partition Number field in the CDB have been performed on the medium. Must be set to 0. Super DLTtape media comprises a single volume.
Total Partition Initialize Count	Indicates the number of times that the partition specified by the Partition Number field in the CDB has been initialized. This count accumulates over the life of the medium but it is reset to 0 after a medium format.

Standard Medium Type Attributes 4

Medium type attributes (see table 144) are hard-coded into the medium auxiliary memory at the time of manufacture. All supported medium type attributes have a status of read only, except MEDIUM TYPE. A WORM tape can be created if the MEDIUM TYPE attribute (0408h) is used.

Table 144 Medium Type Attributes (for EMAM) Supported by the DLT-S4 Tape Drive Firmware

Attribute Identifier	Name	Attribute Length	Format	Refer to
0400h	MEDIUM MANUFACTURER	8	ASCII	page 255
0401h	MEDIUM SERIAL NUMBER	32	ASCII	page 255
0402h	MEDIUM LENGTH	4	BINARY	page 255
0403h	MEDIUM WIDTH	4	BINARY	page 256
0404h	ASSIGNING ORGANIZATION	8	ASCII	page 256
0405h	MEDIUM DENSITY CODE	1	BINARY	page 256
0406h	MEDIUM MANUFACTURE DATE	8	ASCII	page 256
0407h	MAM CAPACITY	8	BINARY	page 256
0408h	MEDIUM TYPE (and MEDIUM TYPE INFORMATION)	1	BINARY	page 256
0409h	MEDIUM TYPE INFOMATION	2	BINARY	page 256
040Ah - 07FFh	Reserved			

MEDIUM MANUFACTURER: Contains 8 bytes of ASCII data (see Attribute Format on page 242) identifying the vendor of the media.

MEDIUM SERIAL NUMBER: Identifies the manufacturer's serial number for the medium.

MEDIUM LENGTH: Specifies the length of the medium in meters. A value of 00h specifies that the length of the medium is undefined.

MEDIUM WIDTH: Specifies the width of the medium supported by this density. The value is expressed in units of tenths of millimeters. The value in this field is rounded up if the fractional value of the actual value is greater than or equal to 0.5. The Medium Width field may vary for a given density depending on the mounted medium. A value of 00h specifies the width of the tape is undefined.

ASSIGNING ORGANIZATION: Identifies the organization responsible for the specifications defining the values in the MEDIUM DENSITY CODE attribute. The Assigning Organization field is set to "Quantum."

MEDIUM DENSITY CODE: Contains the actual density of the tape based on the following rules:

1 If the tape has been written, this attribute reports the actual density of the data on the medium.

2 If the host has selected a valid density with a **MODE SELECT** command, this attribute reports the selected density.

3 If neither rule **1** nor **2** is true, this field reports the native density that can be written on this tape.

MEDIUM MANUFACTURE DATE: Identifies the date of manufacture of the medium. The format is YYYYMMDD; that is, 4 numeric ASCII characters for the year followed by 2 numeric ASCII characters for the month followed by 2 numeric ASCII characters for the day with no intervening spaces.

MAM CAPACITY: The total capacity of the medium auxiliary memory, in bytes, at manufacture time. It does not indicate the free space of an unused medium auxiliary memory because some of the medium auxiliary memory space may be reserved for device-specific use making it inaccessible to the application client.

MEDIUM TYPE and **MEDIUM TYPE INFORMATION:** Indicates the type of media on which the MAM chip resides. At this time, Super DLTtape media only supports the Data Medium type.

Table 145 MEDIUM TYPE and MEDIUM TYPE INFORMATION Attributes

Medium Type	Description	Medium Type Information
00h	Data medium	Reserved
01h-7Fh	Reserved	Reserved
80h	Write-once medium	Reserved
81h-FFh	Reserved	Reserved

Standard Host Type Attributes

Application clients use the **WRITE ATTRIBUTE** and **READ ATTRIBUTE** commands to maintain the attributes listed in table 146. All host type attributes have a status of read/write.

Table 146 Host Type Attributes (for MAM) Supported by the DLT-S4 Tape Drive Firmware

Attribute Identifier	Name	Attribute Length	Format	Refer to
0800h	APPLICATION VENDOR	8	ASCII	page 258
0801h	APPLICATION NAME	32	ASCII	page 258
0802h	APPLICATION VERSION	8	ASCII	page 258
0803h	USER MEDIUM TEXT LABEL	160	TEXT	page 258
0804h	DATE & TIME LAST WRITTEN	12	ASCII	page 258
0805h	TEXT LOCALIZATION IDENTIFIER	1	BINARY	page 258
0806h	BARCODE	32	ASCII	page 258
0807h	OWNING HOST TEXTUAL NAME	80	TEXT	page 258
0808h	MEDIA POOL	160	TEXT	page 258
0809h	PARTITION USER TEXT LABEL	16	ASCII	page 259
080Ah	LOAD/UNLOAD AT PARTITION	1	BINARY	page 259
080Bh - 0BFFh	Reserved			

APPLICATION VENDOR: Contains 8 bytes of ASCII data (see Attribute Format on page 242) identifying the manufacturer of the application client (for example, class driver or backup program), that most recently sent a **WRITE ATTRIBUTE** command to the drive while this medium auxiliary memory was accessible.

APPLICATION NAME: The name of the application client.

APPLICATION VERSION: The version of the application client.

USER MEDIUM TEXT LABEL: The user level identifier for the medium.

DATE & TIME LAST WRITTEN: Contains when the application client last wrote to the medium auxiliary memory. The format is YYYYMMDDHHMM; that is, four numeric ASCII characters for the year followed by two numeric ASCII characters for the month followed by two numeric ASCII characters for the day followed by two numeric ASCII characters between 00 and 24 for the hour followed by two numeric ASCII characters for the minute with no intervening spaces.

TEXT LOCALIZATION IDENTIFIER: Defines the character set (see table 147) used for attributes with a TEXT format. At this time, Super DLTtape only supports the ASCII character set.

Table 147 TEXT LOCALIZATION IDENTIFIER — Attribute Values

Field	Description
00h	No code specified (ASCII)
01h - FFh	Reserved

BARCODE: The contents of a barcode associated with the medium in the medium auxiliary memory.

OWNING HOST TEXTUAL NAME: Indicates the host from which the USER MEDIUM TEXT LABEL originates.

MEDIA POOL: Indicates the media pool to which this medium belongs.

PARTITION USER TEXT LABEL: A user-level identifier for the partition specified by the Partition Number field in the CDB.

LOAD/UNLOAD AT PARTITION: Indicates whether the media can be loaded or unloaded at the partition specified by the Partition Number field in the CDB.

Support for Host Vendor-Unique Attributes

Tape drives allocate a fixed size (1,029 bytes) for the host to write its host vendor-unique EMAM attributes. These attributes can be numbered in the range 1400h through 17FFh. Since attribute headers are 5 bytes in length, if the host wants to write one attribute, there are 1,024 bytes of attribute data space available. If the host wants to write two attributes—one maximum and one minimum—the largest the maximum can be is 1,029 (total) – 5 (max. attribute header) – 5 (min. attribute header) – 1 (min. attribute data) or 1,018 data bytes, and the smallest the minimum can be is 1 byte.

Host vendor-unique attributes can be added and deleted. A write to a host vendor-unique attribute causes the drive to test the size remaining (Attribute ID 4:MAM Space Remaining) and if the write does not cause an out-of-memory condition, the drive allows it. An application is allowed to write an attribute marked as read only to the host vendor-unique area, but this attribute can never be deleted.

Note:	The format of the host vendor-unique attributes contents are up to the host to determine.

Unique Features of the DLT-S4 Tape Drive Implementation of Read / Write Attributes

Keep these features and considerations in mind:

- Super DLTtape media does not support the non-existent state for attributes.
- All attributes that exist are reported in the attribute list and attribute values.
- The tape drive does not support deleting standard host type attributes (**WRITE ATTRIBUTE** commands with attribute length of 0). The only attributes that can be deleted are host vendor-unique attributes.
- Super DLTtape media only supports ASCII text in the TEXT LOCALIZATION IDENTIFIER attribute.

- Super DLTtape media does not require that attributes be written (using the **WRITE ATTRIBUTE** command) in ascending order. The attributes that can be written are independent of one another and can be written in any order.
- Since EMAM is written to the tape, there is always a short window during which the tape is loaded but the attributes have not been read from the tape and stored in RAM. If, during this brief span of time, the drive receives a **READ ATTRIBUTE** or **WRITE ATTRIBUTE** command, it responds with the Sense Key set to NOT READY, and the Additional Sense Code set to LOGICAL UNIT NOT READY, MAM NOT AVAILABLE. The application should retry the command in this case.

A Comparison of MAM and EMAM

The tape drive incorporates a new feature called Enhanced Medium Auxiliary Memory (EMAM). This feature is used to store MAM attributes in a log file on the tape itself. The attributes are accessed using the **READ ATTRIBUTE** and **WRITE ATTRIBUTE** commands. An EMAM device mimics a MAM device, with the following exceptions:

- If the tape is bulk erased, the EMAM attribute data is lost. The next time the tape is used, it has default values in the attribute fields.
- Since the EMAM data is read off the tape, the host needs to wait for one of two ready states to read and write attributes. If the DLT-S4 tape drive is configured to report the MAM Available Unit Attention using the EEPROM setting "RepMAMAvailUA" (see table 87 on page 151), once that UA is reported to the host, it can read and write MAM attributes.

  If the DLT-S4 tape drive is not configured to report the MAM Available Unit Attention, the host needs to wait for the Not Ready to Ready transition prior to reading and writing MAM attributes. If the host sends **READ ATTRIBUTE** or **WRITE ATTRIBUTE** commands prior to the Ready state, the drive returns a CHECK CONDITION status. The Sense Data is set to NOT READY, the Sense Key is set to LOGICAL UNIT NOT READY, and the Additional Sense Code is set to MAM NOT AVAILABLE.

READ BLOCK LIMITS Command (05h)

The **READ BLOCK LIMITS** command directs the tape drive to report its block length limits.

Figure 126 **READ BLOCK LIMITS** Command Descriptor Block — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (05h)							
1 — 4	Reserved							
5	Control							

The **READ BLOCK LIMITS** data shown in figure 127. The command does not reflect the currently selected block size, only the available limits. The **MODE SENSE** command returns the current block size.

Figure 127 **READ BLOCK LIMITS** Data — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved			Granularity (0)				
1 — 3	(MSB) Maximum Block Length (0xFFFFFC) (LSB)							
4 — 5	(MSB) Minimum Block Length (0004H) (LSB)							

Figure 128 **READ BLOCK LIMITS** Data — Field Descriptions

Field	Description
Granularity	Indicates the granularity of block sizes the drive supports. Block sizes must be an even multiple of 2 raised to the granularity power. This field is set to 0 for all densities indicating any block size between the minimum and the maximum is acceptable.
Maximum Block Length	Indicates the maximum block length. The drive supports a maximum block length of 16,777,212 (16 MB - 4).
Minimum Block Length	Indicates the minimum block length. For Super DLTtape format, the minimum block length is 4.

READ BUFFER Command (3Ch)

The **READ BUFFER** command is used with the **WRITE BUFFER** command as a diagnostic function for testing the tape drive's data buffer for possible diagnostic data and for checking the integrity of the SCSI bus or Fibre Channel or SAS network.

Figure 129 **READ BUFFER** Command Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (3Ch)							
1	Reserved			Mode				
2	Buffer ID							
3 — 5	(MSB) Buffer Offset (LSB)							
6 — 8	(MSB) Allocation Length (LSB)							
9	Control							

Table 148 **READ BUFFER** Command Descriptor Block — Field Descriptions

Field	Description	
Mode	The drive supports the following values for this field.	
	Mode	**Description**
	00h	Combined Header and Data Mode (see page 266)
	02h	Data Mode (see page 266)
	03h	Descriptor Mode (see page 267)
	0Ah	Read Data from Echo Buffer (see page 267)
	0Bh	Echo Buffer Descriptor Mode (see page 268)
Buffer ID	Indicates from which buffer the data is to be transferred. Possible values are:	
	Buffer	**Description**
	00h	This 32 KB buffer is used with the **WRITE BUFFER** command to provide a diagnostic capability for testing the SCSI bus or Fibre Channel or SAS network, hardware integrity, or both.
	01h	This buffer is used to read the drive's RAM and EEPROM. Its effective size is 8186 KB.
	02h	This buffer is used to read the drive's data cache RAM. The Available Length field returned in Combined Header and Data mode and the Buffer Capacity field returned in Descriptor mode are not large enough to express the size of the data cache RAM, so both fields return to 0.
	03h	This buffer is used to read the DMARK table.
	A1h	This buffer provides access to diagnostic information saved from an earlier event. (Saved Buffer.)
	A2h	This buffer provides real-time access to diagnostic information. (Live Buffer.)
	Note: In Data mode or Combined Header and Data mode, any other value besides those listed is illegal. In Descriptor mode, any other value returns all zeros in the descriptor. In Read Data from Echo Buffer and Echo Buffer Descriptor modes, this field is ignored.	
Buffer Offset	Allows the host to specify the location of the start of the data within the buffer. This field is reserved and must be set to 0 for all modes except Data modes.	
Allocation Length	Specifies the maximum number of bytes 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.	

Retrieving Diagnostic Data

The host should first send a **READ BUFFER** command in Descriptor mode (Mode 3) to determine the size of the buffer being returned. In response to the **READ BUFFER** command, the drive returns 4 bytes of data, 3 of which contain the size of the buffer. Note that this may take a while to complete (possibly as much as 1 minute). The host uses this data to establish the Buffer Offset and Allocation Length fields of the CDB. Once the host knows the size of the buffer, the host sends a Mode 2 **READ BUFFER** command to transfer the data.

Read Data from the Saved Buffer (A1h)

The A1h buffer (the saved buffer) contains information saved from an event that caused the drive to unexpectedly reset. Use Mode 3 to test for event data. The event data is not actually generated with this first **READ BUFFER** command—instead, the size of the data is returned.

Note:	If the length of this buffer is 0, an unexpected reset event has not occurred.

Read Data from the Live Buffer (A2h)

The A2h buffer (the live buffer) contains the latest information about the current state of the tape drive. The buffer is populated each time a **READ BUFFER** command using Mode 3 with the A2h buffer ID is received by the drive. The information in this buffer is most useful when an error occurred that did not cause an unexpected reset of the drive; for example, a Hard Read Error (HRE) or a Hard Write Error (HWE).

The buffer contains actual event data. Note that retrieving this information overwrites any other saved event information, so it is best to check the size of the Saved Buffer *first* to check if there is any useful information available (do this with a Mode 3 **READ BUFFER** command, described in Descriptor Mode (03h) on page 267).

Combined Header and Data Mode (00h)

In this mode, the drive returns a 4-byte header followed by data bytes. The drive terminates the DATA IN phase or FCP_DATA IU 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. Figure 130 illustrates the format of the header.

Figure 130 **READ BUFFER** Header — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved							
1 — 3	(MSB) Available Length (LSB)							

Table 149 **READ BUFFER** Header — Field Description

Field	Description
Available Length	Specifies the total number of data bytes available in the target's buffer. This number is neither reduced to reflect the allocation length nor to reflect the actual number bytes written using the **WRITE BUFFER** command. Following the **READ BUFFER** header, the drive transfers data from its data buffer.

Data Mode (02h)

In this mode, the DATA IN phase or FCP_DATA IU sent to the initiator contains only buffer data. This mode can be used to check the diagnostic read buffer to see if an unexpected error has occurred.

Descriptor Mode (03h)

In this mode, the drive returns a maximum of 4 bytes of **READ BUFFER** descriptor information. The drive returns the descriptor information for the buffer specified by the Buffer ID. In this mode, the drive does not reject the invalid Buffer IDs with a CHECK CONDITION status, but returns all zeros in the **READ BUFFER** descriptor. The Offset Boundary is 3, indicating that buffer offsets should be integral multiples of 8.

Figure 131 **READ BUFFER** Descriptor — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Offset Boundary							
1 — 3	(MSB) Buffer Capacity (LSB)							

Read Data from Echo Buffer (0Ah)

In this mode the drive transfers data to the application client from the Echo Buffer. The Echo Buffer transfers the same data as when the **WRITE BUFFER** command with the mode field set to Echo Buffer was issued. The Buffer ID and Buffer Offset fields are ignored in this mode.

The **READ BUFFER** command returns the same number of bytes of data as the drive received in the previous Echo Buffer mode **WRITE BUFFER** command from the same initiator. If a previous Echo Buffer mode **WRITE BUFFER** command did not complete successfully, the drive terminates the Echo Buffer mode **READ BUFFER** command with a CHECK CONDITION status, with Sense Key set to ILLEGAL REQUEST, and the Additional Sense Code set to COMMAND SEQUENCE ERROR. If the data in the Echo Buffer has been overwritten by another initiator, the drive terminates the command with a CHECK CONDITION status, with Sense Key set to ABORTED COMMAND and the Additional Sense Code set to ECHO BUFFER OVERWRITTEN.

Echo Buffer Descriptor Mode (0Bh)

In this mode, the drive returns a maximum of 4 bytes of **READ BUFFER** descriptor information. The drive returns the descriptor information for the Echo Buffer. The Buffer Offset field is reserved in this mode. The allocation length should be set to 4 or greater. The drive transfers the lesser of the allocation length or 4 bytes of the **READ BUFFER** descriptor.

Figure 132 ECHO BUFFER Descriptor — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved							EBOS
1	Reserved							
2	Reserved				Buffer Capacity			
3	Buffer Capacity							

Figure 133 ECHO BUFFER Descriptor — Field Descriptions

Field	Description
EBOS	Echo Buffer Overwritten Supported. Set to 1 to indicate that the drive returns the Additional Sense Code ECHO BUFFER OVERWRITTEN if the data being read from the Echo Buffer is not the data previously written by the same initiator.
Buffer Capacity	Always returns 252, indicating the size of the Echo Buffer.

READ POSITION Command (34h)

The **READ POSITION** command reads a position identifier or SCSI Logical Block Address (LBA). The **LOCATE** command uses this identifier or LBA for high-performance repositioning of the tape medium to a known logical position.

Figure 134 **READ POSITION** Command Descriptor Block — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (34h)							
1	Reserved			Service Action				
2 — 6	Reserved							
7 — 8	(MSB) Allocation Length (LSB)							
9	Control							

Table 150 **READ POSITION** Command Descriptor Block — Field Descriptions

Field	Description	
Service Action	Determines the format of the positional data the drive returns. All values other than those listed below are reserved or unsupported.	
	Value	**Description**
	00h	The drive returns 20 bytes of data in the format described in Read Position Data — Short Form on page 270.
	01h	The drive returns 20 bytes of data in the format described in Read Position Data — Short Form on page 270.
	06h	The drive returns 32 bytes of data in the format described in Read Position Data — Long Form on page 273.
Allocation Length	Only used with service actions that are not supported by the DLT-S4. Must be zero.	

Read Position Data — Short Form

Data returned when the service action value is 00h or 01h takes the following form:

Figure 135 **READ POSITION** (Short Form) — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	BOP	EOP	LOCU	BYCU	Reserved	LOLU	PERR	Reserved
1	Partition Number							
2 — 3	Reserved							
4 — 7	(MSB) First Logical Object Location (LSB)							

Byte \ Bit	7	6	5	4	3	2	1	0
8 — 11	(MSB) Last Logical Object Location (LSB)							
12	Reserved							
13 — 15	(MSB) Number of Logical Objects in Object Buffer (LSB)							
16 — 19	(MSB) Number of Bytes in Object Buffer (LSB)							

Table 151 **READ POSITION** (Short Form) Data — Field Descriptions

Field	Description
BOP	Beginning of Partition. When set to 1, indicates that the drive is at the Beginning of Partition (BOP) in the current partition. When set to 0, indicates that the current logical position is not at BOP. Since DLT-S4 tape drives do not support more than one partition, the value of this bit is 1 when at BOT.
EOP	End of Partition. When set to 1, indicates that the drive is positioned between early warning and the End of Partition (EOP) in the current partition. When set to 0, indicates that the current logical position is not between early warning and EOP.
LOCU	Logical Object Count Unknown. When set to 1, indicates that the value contained in the Number of Logical Objects in Object Buffer field does not accurately represent the actual number of logical objects in the object buffer. When set to 0, indicates that the value contained in the Number of Logical Objects in Object Buffer field is accurate.
BYCU	Byte Count Unknown. When set to 1, indicates that the value contained in the Number of Bytes in Object Buffer field does not accurately represent the actual number of bytes in the object buffer. When set to 0, indicates that the value contained in the Number of Bytes in Object Buffer field is accurate.

Field	Description
LOLU	Logical Object Location Unknown. When set to 1, indicates that the values contained in the Partition Number, First Logical Object Location, or Last Logical Object Location fields are not known or accurate reporting is not currently available. When set to 0, indicates that the values these fields contain are accurate.
PERR	Position Error. When set to 1, indicates that the drive is unable to report the correct position as a result of an overflow in any of the returned positional data fields. When set to 0, indicates that there were no overflow conditions in any of the returned positional data fields.
Partition Number	The partition number for the current logical position.
First Logical Object 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 Logical Object Location	The block address associated with the current physical position; the next block to be transferred to tape medium from the drive'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 Logical Objects in Object Buffer	The number of data blocks in the drive's buffer that have not been written to the tape medium.
Number of Bytes in Object Buffer	The number of data bytes in the drive's buffer that have not been written to the tape medium.

Read Position Data — Long Form

Data returned when the service action value is 6 takes the following form:

Figure 136 **READ POSITION** (Long Form) — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	BOP	EOP	Reserved		MPU	LONU	Reserved	
1 — 3	Reserved							
4 — 7	(MSB) Partition Number (LSB)							
8 — 15	(MSB) Logical Object Number (LSB)							
16 — 23	(MSB) Logical File Identifier (LSB)							
24 — 31	(MSB) Logical Set Identifier (LSB)							

Table 152 **READ POSITION** (Long Form) Data — Field Descriptions

Field	Description
BOP	Beginning of Partition. When set to 1, indicates that the drive is at the Beginning of Partition (BOP) in the current partition. When set to 0, indicates that the current logical position is not at BOP. Since DLT-S4 tape drives do not support more than one partition, the value of this field is 1 when at BOT.
EOP	End of Partition. When set to 1, indicates that the drive is positioned between early warning and the End of Partition (EOP) in the current partition. When set to 0, indicates that the current logical position is not between early warning and EOP.
MPU	Mark Position Unknown. When set to 1, indicates that the values contained in the Logical File Identifier and Logical Set Identifier fields are not known or accurate reporting is not currently available. When set to 0, indicates that the values these fields contain are accurate.
LONU	Logical Object Number Unknown. When set to 1, indicates that the values contained in the Logical Object Number or Partition Number fields are not known or accurate reporting is not currently available. When set to 0, indicates that the values these fields contain are accurate.
Partition Number	The partition number for the current logical position.
Logical Object Number	The number of logical blocks between the beginning of partition and the current logical position. Filemarks and Setmarks count as one logical block each.
Logical File Identifier	The number of Filemarks between the beginning of partition and the current logical position.
Logical Set Identifier	The number of Setmarks between the beginning of partition and the current logical position.

RECEIVE DIAGNOSTIC RESULTS Command (1Ch)

The **RECEIVE DIAGNOSTIC RESULTS** command fetches the results of the last **SEND DIAGNOSTIC** command sent to the tape drive.

Figure 137 **RECEIVE DIAGNOSTIC RESULTS** Command Descriptor Block — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Ch)							
1	Reserved							PCV
2	Page Code							
3 — 4	(MSB) Allocation Length (LSB)							
5	Control							

Table 153 **RECEIVE DIAGNOSTIC RESULTS** Command Data — Field Descriptions

Field	Description
PCV	Page Code Valid. Must be set to 0, indicating that the most recent **SEND DIAGNOSTIC** command defines the data this command returns.
Page Code	Not used.
Allocation Length	Specifies the number of bytes of diagnostic page results the drive is allowed to send to the initiator.

The drive returns the following data as a result of the **RECEIVE DIAGNOSTIC RESULTS** command. The sense data will contain more detailed information following a CHECK CONDITION status on a **SEND DIAGNOSTIC** command.

Figure 138 **RECEIVE DIAGNOSTIC RESULTS** — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Controller Present Flag[1]							
1	Controller Error ASQ[2]							
2	Drive Present Flag[1]							
3	Drive Error ASQ[2]							
4 — 7	MB Written							
8 — 11	Total Write Errors							
12 — 15	MB Read							
16 — 19	Total Read Errors							
20	Drive Health Check Status[3]							
21	Media Health Check Status[3]							

Notes:

1. Controller and Drive Present Flags: 1 = Present; 0 = Not present.
2. Controller and Drive Error ASQs: 0 = No error; Non-zero = Error.
3. Contains the highest severity TapeAlert flag set against the drive or media.

This information indicates which of the main components of the DLT-S4 tape drive subsystem may have failed diagnostic testing. For the Level 1 Electronics test, the first four fields are set to 1 and the second four fields are set to 0. For the Level 2 Write / Read Functionality test, the first four fields are set to the defaults of 1, 0, 1, and 0 respectively, and the second four fields are set to the read and write statistics that the test collected.

RELEASE (10) Command (57h)

The **RELEASE** and **RESERVE** commands provide contention resolution in multiple-initiator systems. The **RELEASE** (10) command releases a previously reserved logical unit. The tape drive does not return an error if an initiator attempts to release a reservation that is not currently valid.

> Note: This command has been made obsolete in the latest version of SCSI-3 and should not be used with any new implementations. The tape drive supports this command for legacy applications only.

Figure 139 **RELEASE (10)** Command Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (57h)							
1	Reserved			3rdPty	Reserved		LongID	Extent (0)
2	Reservation Identification							
3	Third Party Device ID							
4 — 6	Reserved							
7 — 8	(MSB) Parameter List Length (LSB)							
9	Control							

Table 154 **RELEASE (10)** Command — Field Descriptions

Field	Description
3rdPty	Third Party Release allows an initiator to release a previously established third party reservation. When set to 0, third-party release is not requested. When set to 1, the drive releases the specified logical unit, but only if the initiator ID, 3rdPty bit, and Third Party Device ID are identical to those of the **RESERVE** command that established the reservation.
LongID	When set to 1, the Parameter List Length is 8 and the 8 bytes of the parameter list carry the device ID of the third-party device. The drive ignores the contents of the Third Party Device ID in the CDB (byte 3). This bit is ignored if the 3rdPty bit is not set.
Extent	The drive supports reservations only on entire logical units. Must be set to 0.
Reservation Identification	The drive ignores the value in this field.
Third Party Device ID	If the Third Party Device ID value that is connected with the reservation release is less than 255, the LongID bit may be set to 0 and the ID value can be sent in the CDB. If the LongID bit is set to 0, the Parameter List Length field must also be set to 0. If the Third Party Device ID value is greater than 255, the LongID bit must be set to 1.
Parameter List Length	The contents of this field specify the length, in bytes, of the parameter list transferred from the initiator to the drive. This field is ignored and no parameter data is transferred unless the 3rdPty bit and LongID bits are both set.

Note: Assuming that the RELEASE CDB is valid, the drive always returns GOOD status for this command. An actual release only happens if the initiator has the drive reserved for itself or a third-party initiator.

If LongID is set to 1, the parameter list length is 8 bytes and the parameter list has the following format.

Figure 140 **RELEASE (10)** ID Only Parameter List — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0 — 7	(MSB) Third Party Device ID (LSB)							

RELEASE UNIT Command (17h)

The **RELEASE UNIT** command releases the tape drive if it is currently reserved by the requesting initiator. It is not an error to release the drive if it is not currently reserved by the requesting initiator. If the drive is reserved by another initiator, however, it is not released; the drive is only released from the initiator that issued the **RELEASE UNIT** command.

> Note: This command has been made obsolete in the latest version of SCSI-3 and should not be used with any new implementations. The tape drive supports this command for legacy applications only.

Figure 141 **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			3rdPty	Third Party Device ID			Reserved
2 — 4	Reserved							
5	Control							

Table 155 **RELEASE UNIT** Command — Field Descriptions

Field	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. When set to 0, the third-party release option is not requested. When set to 1, the drive is released if the same initiator originally reserved it using the third-party reservation option and if the drive is the same SCSI device specified in the Third Party Device ID field.
Third Party Device ID	Required if 3rdPty is set to 1. This field specifies the SCSI ID of the initiator whose third-party reservation is being released. This field must be used if the initiator of the original third-party **RESERVE** is the source of the **RELEASE**.

REPORT DENSITY SUPPORT Command (44h)

The **REPORT DENSITY SUPPORT** command is a 10-byte command that the application client uses to request information about the densities or the medium types the DLT-S4 tape drive supports.

Figure 142 illustrates the format of the **REPORT DENSITY SUPPORT** command; the table that follows explains the data fields of the command.

Figure 142 **REPORT DENSITY SUPPORT** Command Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (44h)							
1	Reserved						Medium Type	Media
2 — 6	Reserved							
7 — 8	(MSB) Allocation Length (LSB)							
9	Control							

Table 156 **REPORT DENSITY SUPPORT** Command — Field Descriptions

Field	Description
Media	When set to 0, the drive returns density support data blocks for the densities of *any supported medium*. When set to 1, the drive returns density support data blocks for the densities supported by the *mounted medium* only.
Medium Type	When set to 0, the drive returns a **REPORT DENSITY SUPPORT** header followed by one or more Density Report descriptors as shown in figure 143. When set to 1, the drive returns a **REPORT DENSITY SUPPORT** header followed by one or more Medium Type descriptors are shown in figure 145.
Allocation Length	Specifies the maximum number of data bytes that the drive is allowed to return.

Report Density Support

Figure 143 illustrates the **REPORT DENSITY SUPPORT** header.

Figure 143 **REPORT DENSITY SUPPORT** Header — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0 — 1	(MSB) Available Density Support Length (LSB)							
2 — 3	Reserved							
4 — *n*	Density Support or Medium Type Descriptor(s)							

Table 157 provides a description of the fields in the **REPORT DENSITY SUPPORT** header.

Table 157 **REPORT DENSITY SUPPORT** Header — Field Descriptions

Field	Description
Available Density Support Length	Specifies the number of bytes in the data that follows that are available to be transferred. Note that the length value does not include the length of the field itself.
Density Support or Medium Type Descriptor(s)	See figure 144 and figure 145.

The **REPORT DENSITY SUPPORT** command with a Medium Type bit set to zero returns a header followed by one or more density support data blocks. The data blocks are presented in ascending numerical order of the primary density code value.

Figure 144 and table 158 provide information about the Density Support Descriptor.

Figure 144 DENSITY SUPPORT Descriptor — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Primary Density Code							
1	Secondary Density Code							
2	WrtOk	DUP	Deflt	Reserved				
3 — 5	Reserved							
5 — 7	(MSB) Bits Per MM (LSB)							
8 — 9	(MSB) Media Width (LSB)							

Byte \ Bit	7	6	5	4	3	2	1	0
10 — 11	(MSB) Tracks (LSB)							
12 — 15	(MSB) Capacity (LSB)							
16 — 23	(MSB) Assigning Organization (LSB)							
24 — 31	(MSB) Density Name (LSB)							
32 — 51	(MSB) Description (LSB)							

Table 158 DENSITY SUPPORT Descriptor — Field Descriptions

Field	Description
Primary Density Code	Contains the value returned by a **MODE SENSE** command for the density described in the remainder of the Density Support Data Block Descriptor.
Secondary Density Code	When multiple density code values are assigned to the same recording technology, this field lists the equivalent density code value. If no secondary density code exists, the drive returns the primary device code value in this field.
WrtOK	Write OK. When set to 0, indicates that the drive does not support writing to the media at this density. When set to 1, indicates that the drive is capable of writing at this density to either the currently mounted medium, if the Media bit in the Command Block Descriptor is set to 1, or to any media, if the Media bit in the Command Block Descriptor is set to 0. Note that all density code values the **REPORT DENSITY SUPPORT** command returns are supported for READ operations.

Field	Description
DUP	Duplicated. When is set to 0, indicates that this Primary Density Code has exactly one density support data block. When set to 1, indicates that this Primary Density Code is specified in more than one density support data block.
Deflt	Default. When set to 0, indicates that this is not the default density of the drive. If neither the Primary nor Secondary Density Code fields are set to 0 and this bit is set to 1, the drive accepts a **MODE SELECT** header with a density code of 00h as equivalent to the Primary and Secondary Density Codes. The default density of the drive may vary depending on the currently mounted media. Multiple codes may return a Deflt bit of 1 when the Media field is set to 0 since more than one default may be possible.
Bit Per MM	Indicates the number of bits per millimeter per track as recorded on the tape medium.
Media Width	Indicates the width of the tape medium supported by this density. This field is expressed in units of tenths of millimeters.
Tracks	Indicates the number of data tracks supported on the medium by this density.
Capacity	If the Media bit is set to 0, the Capacity field indicates the approximate capacity of the longest supported medium. If the Media bit is set to 1, the Capacity field indicates the approximate capacity of the current medium. The capacity assumes that compression is disabled. The capacity also assumes that the media is in good condition and that normal data and block sizes are used. The value is given in units of megabytes (1,048,576 bytes). Note that the drive does not guarantee that this space is actually available in all cases. The Capacity field is intended to be used by the client to determine that the correct density is being used, especially when a lower density format is required.
Assigning Organization	Contains 8 bytes of ASCII data identifying the organization responsible for the specifications that define the values in the density support data block.
Density Name	Contains 8 bytes of ASCII data identifying the document associated with this density support data block.
Description	Contains 20 bytes of ASCII data describing the density.

Medium Type Support Report

The **REPORT DENSITY SUPPORT** command with a MEDIUM TYPE field bit set to one returns the **REPORT DENSITY SUPPORT** header (see figure 142) followed by one or more medium type descriptors (see figure 145). The medium type descriptors is in numerical ascending order of the medium type value.

Figure 145 Medium Type Descriptor — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Medium Type							
1	Reserved							
2 — 3	(MSB) Descriptor Length (52) (LSB)							
4	Number of Density Codes							
5 — 13	(MSB) Primary Density Codes (LSB)							
14 — 15	(MSB) Media Width (LSB)							
16 — 17	(MSB) Medium Length (LSB)							
18	Reserved							
19	Reserved							
20 — 27	(MSB) Assigning Organization (LSB)							
28 — 35	(MSB) Medium Type Name (LSB)							

Bit / Byte	7	6	5	4	3	2	1	0
36 — 55	(MSB) Description (LSB)							

Table 159 Medium Type Descriptor — Field Descriptions

Field	Description
Medium Type	The MEDIUM TYPE field contains the value returned by a **MODE SENSE** command in the Medium Type field in the Mode Parameter Header for the medium type described in the remainder of the medium type descriptor.
Descriptor Length	The DESCRIPTOR LENGTH field contains the length of the descriptor minus 4.
Number of Density Codes	The NUMBER OF DENSITY CODES field contains the number of valid density codes present in the PRIMARY DENSITY CODES field.
Primary Density Codes	The PRIMARY DENSITY CODES field contains a list of primary density code values supported by the drive for the medium type. The primary density code values are listed in ascending order. Any unused bytes in this field contain zero.
Media Width	The MEDIA WIDTH field specifies the width of the medium. This field has units of tenths of millimeters.
Media Length	The MEDIUM LENGTH field specifies the nominal length of the medium. This field has units of meters.
Assigning Organization	The ASSIGNING ORGANIZATION field contains eight bytes of ASCII data identifying the organization responsible for the specifications defining the values in this medium type descriptor.
Medium Type Name	The MEDIUM TYPE NAME field contains eight bytes of ASCII data identifying the document (or other identifying name) that is associated with this medium type descriptor.
Description	The DESCRIPTION field contains twenty bytes of ASCII data describing the medium type.

REPORT DEVICE IDENTIFIER Command (A3h/05h)

The **REPORT DEVICE IDENTIFIER** command requests that the drive send device identification information established through the use of a **SET DEVICE IDENTIFICATION** command.

Figure 146 **REPORT DEVICE IDENTIFIER** Command Descriptor Block — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (A3h)							
1	Reserved			Service Action (05h)				
2 — 5	Reserved							
6 — 9	(MSB) Allocation Length (LSB)							
10	Reserved							
11	Control							

Table 160 **REPORT DEVICE IDENTIFIER** Command Descriptor Block — Field Descriptions

Field	Description
Service Action	A service action of 05h identifies this as the **REPORT DEVICE IDENTIFIER** command.
Allocation Length	If the Allocation Length is not large enough to hold all of the parameter data, the drive truncates the data it returns. This is not considered an error. The actual length of the parameter data is available in the Identifier Length field in the parameter data. If the remainder of the parameter data is required, the application client must send a new **REPORT DEVICE IDENTIFIER** command with a value in the Allocation Length field large enough to hold all of the data.

The **REPORT DEVICE IDENTIFIER** parameter list contains a 4-byte field that sets the length in bytes of the parameter list and the drive's identifier.

Figure 147 **REPORT DEVICE IDENTIFIER** — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0 — 3	(MSB) Identifier Length (n – 4) (LSB)							
4 — *n*	Identifier							

Table 161 **REPORT DEVICE IDENTIFIER** Parameter Data — Field Descriptions

Field	Description
Identifier Length	Specifies the length in bytes of the Identifier field. If the value of the Allocation Length field in the CDB is too small to transfer all of the identifier, the length is not adjusted to reflect the truncation. The identifier length is initially set to 0. Only a successful **SET DEVICE IDENTIFIER** command changes the value of the identifier.
Identifier	The value reported is the last value written by a successful **SET DEVICE IDENTIFIER** command. Only a successful **SET DEVICE IDENTIFIER** command changes the value of the identifier. The identifier value persists through resets, power cycles, media **WRITE** operations, and media replacement.

REPORT LUNS Command (A0h)

The **REPORT LUNS** command requests that the DLT-S4 tape drive send the peripheral device logical unit numbers of known logical units to the applications client. The command only returns information about the logical units that accept commands.

Figure 148 **REPORT LUNS** Command Descriptor Block — Data Format

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							

Table 162 **REPORT LUNS** Command Descriptor Block — Field Descriptions

Field	Description	
Select Report	Specifies the type of logical unit addresses to be reported. All values other than those listed are reserved.	
	Value	**Description**
	00h	The logical unit addresses reported are limited to the following addressing methods: • Logical unit addressing • Peripheral device addressing • Flat space addressing
	01h	The list of logical units only contains well-known logical units, if any.
	02h	The list of logical units contains all logical units accessible to the initiator through the addressed SCSI target port.
Allocation Length	If the Allocation Length is not sufficient to contain the logical unit number values for all configured logical units, the tape drive reports as many logical number values as fit in the Allocation Length. The format of the report of configured logical units is shown in figure 149.	

Figure 149 LUN Reporting Parameter List — Data Format

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 8. 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.

REPORT SUPPORTED OPERATION CODES Command (A3h/0Ch)

The **REPORT SUPPORTED OPERATION CODES** command requests information on commands the DLT-S4 tape drive supports. An application client may request a list of all operation codes and service actions the drive supports or the command support data for a specific command.

Figure 150 **REPORT SUPPORTED OPERATION CODES** Command Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (A3h)							
1	Reserved				Service Action (0Ch)			
2	Reserved					Reporting Options		
3	Requested Operation Code							
4 — 5	(MSB) Requested Service Action (LSB)							
6 — 9	(MSB) Allocation Length (LSB)							
10	Reserved							
11	Control							

Table 163 **REPORT SUPPORTED OPERATION CODES** Command Descriptor Block — Field Descriptions

Field	Description	
Service Action	A service action of 0Ch identifies this as the **REPORT SUPPORTED OPERATION CODES** command.	
Reporting Options	Specifies the type of information to be returned in the parameter data. All values other than those listed are reserved.	
	Value	**Description**
	000b	The drive returns a list of all supported operation codes and service actions in the *all_commands* parameter data format. The drive ignores any values in the Requested Operation Code and Requested Service Action fields (see All_commands Parameter Data Format on page 296 for more information).
	001b	The drive returns the command support data in the *one_command* parameter data format for the operation code specified in the Requested Operation Code field. The drive ignores any value in the Requested Service Action field.
	010b	The drive returns the command support data in the *one_command* parameter data format for the operation code and service action specified in the Requested Operation Code and Requested Service Action fields.
Requested Operation Code	Specifies the operation code of the command to be returned in the *one_command* parameter data format (see One_command Parameter Data Format on page 298 for more information).	
Requested Service Action	Specifies the service action of the command to be returned in the *one_command* parameter data format (see One_command Parameter Data Format on page 298 for more information).	
Allocation Length	Specifies the number of bytes allocated for the returned parameter data. If the Allocation Length value is not large enough to hold all of the parameter data, the drive truncates the data it returns. This is not considered an error. The actual length of the parameter data is available in the Additional Length field in the parameter data. If the remainder of the parameter data is required, the application client must send a new **REPORT SUPPORTED OPERATION CODES** command with an Allocation Length field value large enough to hold all of the data.	

All_commands Parameter Data Format

The **REPORT SUPPORTED OPERATION CODES** *all_commands* parameter data format begins with a 4-byte header that contains the length in bytes of the parameter data, followed by a list of the returned commands. Each command descriptor contains information about a single supported command, including operation code and service action, if applicable. The list of command descriptors contains all commands the drive supports.

Figure 151 All_ commands Parameter Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0 — 3	(MSB) Command Data Length (*n* – 3) (LSB)							
	Commands							
4 — *n*	Command Descriptor 0 . . . Command Descriptor *n*							

Table 164 All_ commands Parameter Data — Field Descriptions

Field	Description
Command Data Length	The number of bytes in the returned command descriptor list.
Command Descriptors	Each command descriptor contains information about a single supported command, including operation code and service action, if applicable (see figure 152 for the command descriptor data format).

Figure 152 All_commands Command Descriptor — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Reserved							
2 — 3	(MSB) Service Action (LSB)							
4	Reserved							
5	Reserved							ServActV
6 — 7	(MSB) CDB Length (LSB)							

Table 165 All_commands Command Descriptor — Field Descriptions

Field	Description
Operation Code	The operation code of the returned command.
Service Action	The service action of the returned command. If the command does not have service actions, this field is set to 00h.
ServActV	Service Action Valid. When set to 0, indicates that the returned command does not have service actions and that the Service Action field should be ignored. When set to 1, indicates that the returned command has service actions and that the Service Action field contains valid information.
CDB Length	Contains the length of the CDB indicated by the Operation Code and, if the ServActV bit is set to 1, the Service Action fields.

One_command Parameter Data Format

The **REPORT SUPPORTED OPERATION CODES** one_command parameter data format contains information about the CDB and a usage map for fields in the CDB of the command specified in the Reporting Options, Requested Operation Code, and Requested Service Action fields of the **REPORT SUPPORTED OPERATION CODES CDB**.

Figure 153 One_command Parameter Data — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved							
1	Reserved					Support		
2 — 3	(MSB) CDB Size (n – 3) (LSB)							
4 — *n*	CDB Usage Data							

Table 166 One_command Parameter Data — Field Descriptions

Field	Description	
Support	Indicates how the drive supports the requested command. All values other than those listed are reserved.	
	Value	**Description**
	000b	The drive cannot currently return data about the requested command. All data following byte 1 is invalid. Another request for command data may be successful.
	0001b	The drive does not support the requested command. All data following byte 1 is invalid.
	011b	The drive supports the requested command as defined in the appropriate SCSI standards specification. The parameter data after byte 1 is valid.
	101b	The drive supports the requested command in a vendor-specific manner. The parameter data after byte 1 is valid.
CDB Size	Contains the size in bytes of the data returned in the CDB Usage Data field as well as the number of bytes in the CDB of the returned command.	
CDB Usage Data	Contains information about the CDB of the returned command. The first byte contains the operation code of the returned command. If the returned command has a service action, the service action code is placed in this field in the exact location that the service action code appears in the returned command CDB. The remaining bytes in this field contain a usage map of the fields in the CDB of the returned command. If the drive evaluates a bit, the corresponding bit in this field is set to 1. If the drive ignores or treats a bit as reserved, the corresponding bit in this field is set to 0. If a field contains more than one bit, the drive fills all bits in that field with the same value.	

REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS Command (A3h/0Dh)

The **REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS** command requests information on task management functions the DLT-S4 tape drive supports.

Figure 154 **REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS** Command Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (A3h)							
1	Reserved			Service Action (0Dh)				
2 — 5	(MSB) Reserved (LSB)							
6 — 9	(MSB) Allocation Length (4h or larger) (LSB)							
10	Reserved							
11	Control							

Table 167 **REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS** Command Descriptor Block — Field Descriptions

Field	Description
Service Action	A service action of 0Dh identifies this as the **REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS** command.
Allocation Length	Specifies the number of bytes allocated for the returned parameter data. The Allocation Length value must be at least 4 bytes.

The **REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS** command may return any of the values shown in figure 155.

Figure 155 **TASK MANAGEMENT FUNCTIONS** Command Parameter Data — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	ATS	ATSS	CACAS	CTSS	LURS	QTS	TRS	WAKES
1 — 3	(MSB) Reserved (LSB)							

Table 168 **TASK MANAGEMENT FUNCTIONS** Command Parameter Data — Field Descriptions

Field	Description
ATS	Abort Task Supported. Always set to 1.
ATSS	Abort Task Set Supported. Always set to 1.
CACAS	Clear ACA Supported. Always set to 0.
CTSS	Clear Task Set Supported. Always set to 1.
LURS	Logical Unit Reset Supported. Always set to 1.
QTS	Query Task Supported. Set to 0 for parallel SCSI and Fibre Channel interface drives, set to 1 for SAS interface drives.
TRS	Target Reset Supported. Set to 1 for parallel SCSI and Fibre Channel interface drives, set to 0 for SAS interface drives.
WAKES	Wakeup Supported. Always set to 0.

REPORT TIMESTAMP Command (A3h/0Fh)

The **REPORT TIMESTAMP** command (see figure 156) requests that the device server return the value of the DLT-S4 tape drive's timestamp.

Figure 156 **REPORT TIMESTAMP** Command — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (A3h)							
1	Reserved			Service Action (0Fh)				
2 — 5	(MSB) Reserved (LSB)							
6 — 9	(MSB) Allocation Length (LSB)							
10	Reserved							
11	Control							

Table 169 **REPORT TIMESTAMP** Command — Field Descriptions

Field	Description
Service Action	A service action of 0Fh identifies this as the **REPORT TIMESTAMP** command.
Allocation Length	Specifies the number of bytes allocated for the returned parameter data. The Allocation Length value should be at least 12 bytes.

The format of the parameter data is shown in figure 157.

Figure 157 **REPORT TIMESTAMP** Command Parameter Data — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0 — 1	(MSB) Timestamp Parameter Data Length (0Ah) (LSB)							
2	Reserved					Timestamp Origin		
3	Reserved							
4 — 9	Timestamp							
10	Reserved							
11	Reserved							

Table 170 **REPORT TIMESTAMP** Command Parameter Data — Field Descriptions

Field	Description
Timestamp Parameter Data Length	The TIMESTAMP PARAMETER DATA LENGTH field indicates the number of bytes of parameter data that follow.
Timestamp Origin	The TIMESTAMP ORIGIN field indicates the origin of the timestamp. The TIMESTAMP ORIGIN field, supports either a value of 0 or 2, depending on whether a **SET TIMESTAMP** command has been processed.
Timestamp	The TIMESTAMP field contains the current value of the timestamp.

REQUEST SENSE Command (03h)

The **REQUEST SENSE** command directs the DLT-S4 tape drive to transfer detailed Sense Data to the initiator.

Figure 158 **REQUEST SENSE** Command Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (03h)							
1	Reserved							DESC
2 — 3	Reserved							
4	Allocation Length							
5	Control							

Table 171 **REQUEST SENSE** Command Data — Field Descriptions

Field	Description
DESC	Descriptor. Indicates which sense data format the drive returns. The drive does not support descriptor format sense data. Must be set to 0, indicating that the drive returns fixed format sense data.
Allocation Length	Specifies the maximum number of Sense Data bytes to be returned. The drive terminates the transfer when it has transferred this number of bytes or all available Sense Data to the host, whichever is less.

The Sense Data are valid for a CHECK CONDITION or RESERVATION CONFLICT status returned on the previous command. The drive preserves the Sense Data bytes until it is passed to the host as autosense data, it is 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 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 fields.

Figure 159 illustrates the **REQUEST SENSE** data format.

Figure 159 **REQUEST SENSE** — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Valid	Response Code (70h or 71h)						
1	Obsolete							
2	Filemark	EOM	ILI	Reserved	Sense Key			
3 — 6	(MSB) Information (LSB)							
7	Additional Sense Length (*n* – 7)							
8 — 11	(MSB) Command Specific Information (LSB)							
12	Additional Sense Code (ASC)							
13	Additional Sense Code Qualifier (ASCQ)							
14	Field Replaceable Unit Code							
15	SKSV	C/D	Reserved		BPV	Bit Pointer		

Byte \ Bit	7	6	5	4	3	2	1	0
16 — 17	(MSB) Field Pointer (LSB)							
18	Internal Status Code							
19 — 20	Tape Motion Hours							
21 — 24	Power On Hours							
25 — 28	Tape Remaining							
29 — *n*	Reserved							

Table 172 **REQUEST SENSE** Data — Field Descriptions

Field	Description
Valid	When set to 1, indicates that the Information field contains valid SCSI-3 information. When set to 0, indicates that the contents of the Information field are not defined.
Response 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.
Filemark	When set to 1, indicates that the current command read a Filemark.
EOM	End of Medium. When set to 1, 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 Code Qualifier to END OF PARTITION or BEGINNING OF PARTITION.
ILI	Incorrect Length Indicator. When set to 1, 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** commands cause this bit to be set to 1.

Field	Description
Sense Key	The Sense Key values are described in table 173.
Information	Contains the difference (residue) between 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** commands for which the drive generated a CHECK CONDITION status.
Additional Sense Length	Specifies the number of additional sense bytes to follow. If the value in the Allocation Length field of the CDB 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	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 (LBA).
Additional Sense Code (ASC)	This field and the Additional Sense Code Qualifier field provide additional information about the Sense Key and the cause of a CHECK CONDITION status. Additional Sense Codes are listed in table 174.
Additional Sense Code Qualifier (ASCQ)	This field and the Additional Sense Code field provide additional information about the Sense Key and the cause of a CHECK CONDITION status. Additional Sense Code Qualifiers are discussed in table 174.
Field Replaceable Unit Code	Not used. Always set to 0.
SKSV	Sense-Key Specific Valid. When set to 1, indicates that the data in the Sense-Key Specific fields is valid.
C/D	Command / Data. When set to 1, indicates that the illegal parameter is contained in the CDB. When set to 0, indicates that the illegal parameter is in the Parameter List from the initiator.
BPV	Bit Pointer Valid. When set to 1, 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.
Bit Pointer	When BPV is set to 1, indicates either the most significant bit of the field in error or the most significant invalid bit within the field. Reserved fields are treated as individual bit fields— the most significant reserved bit that is set is indicated rather than the most significant bit of the entire reserved field. When the field in error uses an entire byte, the Bit Pointer field is typically not used (BPV is set to 0).

Field	Description
Field Pointer	If the Sense Key is ILLEGAL REQUEST, this field indicates which byte of the CDB or Parameter List is in error. For a multi-byte field, the most significant byte is indicated. If the Sense Key is NO SENSE and the Additional Sense Code field is OPERATION IN PROGRESS, this field indicates the progress toward completion as the numerator of a fraction with 65,536 as the denominator.
Internal Status Code	Vendor specific.
Tape Motion Hours	Reports the number of tape motion (head wear) hours. Format is given as a hexadecimal word (2 bytes).
Power On Hours	Reports the total number of hours that drive power has been applied over the drive's lifetime. Format is given as a hexadecimal longword (4 bytes).
Tape Remaining	Reports the amount of tape remaining in 4 KB (4096 bytes) blocks.

Table 173 Supported Sense Keys for **REQUEST SENSE** Command

Sense Key	Description
0h	NO SENSE. Check the Filemark, EOM, ILI, Additional Sense Code, and Additional Sense Code Qualifier fields.
1h	RECOVERED ERROR. Can result from rounding of Mode Parameters on a MODE SELECT command or may report that **READ** / **WRITE** error rates are reaching drive specification limits for optimal operation. The drive may still be able to continue to function without any unrecovered errors for a long period of time, however. The drive generates a CHECK CONDITION status only if the PER field of Mode Page 01h is set to 1.
2h	NOT READY. The tape medium is not ready for tape operation commands. The 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 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.

Sense Key	Description
5h	ILLEGAL REQUEST. The CDB or supplied parameter data specified an unsupported or illegal operation. Check the Byte Pointer and Bit Pointer fields for an indication of the field in error.
6h	UNIT ATTENTION. The drive generates Unit Attentions after a device reset if: 1) the medium asynchronously becomes ready to the initiator, 2) if another initiator changes Mode Parameters, 3) if the firmware is updated, or 4) if the latter two items occur together.
7h	DATA PROTECTED. The current tape medium is write-protected. Either the Write Protect switch on the cartridge is in its enabled position, the tape medium is not the appropriate type, or a software write protect is in effect.
8h	BLANK CHECK. The drive encountered End of Data or a blank tape.
Bh	COMMAND ABORTED. Generated when the drive aborts a command.
Dh	VOLUME OVERFLOW. Indicates that the drive reached the physical end of tape medium during writing. The initiator ignored the End of Medium condition and continued to write to the tape.

Table 174 provides the Additional Sense Codes (ASCs) and Additional Sense Code Qualifiers (ASCQs) that the drive may report. Additional information, explanations, or suggestions for action are included with some of the descriptions.

Table 174 Supported ASC / ASCQ (Hex) for **REQUEST SENSE** Command

Text Name	Sense Key	ASC	ASCQ	Description
NO SENSE	00h	00h	00h	No Additional Sense Code
		00h	01h	FileMark Encountered
		00h	02h	End of Medium (EOM) Encountered
		00h	03h	SetMark Encountered
		00h	04h	Beginning of Medium (BOM) Encountered
		00h	05h	EOD Encountered
		00h	16h	Operation in Progress
		30h	05h	Cannot Write Medium - Incompatible Error

Text Name	Sense Key	ASC	ASCQ	Description
NO SENSE (continued)	00h	5Dh	00h	TapeAlert Failure Prediction Threshold Exceeded
		5Dh	FFh	False Exception Condition
RECOVERED ERROR	01h	00h	17h	Clean Requested (Non-Vendor Specific)
		0Ah	00h	Error Log Overflow
		0Ah	80h	Error Log Generated
		37h	00h	Rounded Parameter
		3Bh	08h	Repositioning Error
		44h	C1h	EEPROM Copy 1 Area Bad
		44h	C2h	EEPROM Copy 2 Area Bad
		47h	00h	SCSI Parity Error
		48h	00h	IDE Message Received
		51h	00h	ERASE Failure
		53h	01h	Unload Tape Failure
		5Bh	01h	Threshold Condition Met
		5Bh	02h	Log Counter at Maximum
		5Dh	00h	Failure Predictive Threshold Exceeded
		5Dh	FFh	Failure Predictive Threshold Exceeded (False)
NOT READY	02h	04h	00h	Unit Not Ready, Cause Nonreportable
		04h	01h	Unit Not Ready, Calibration in Process
		04h	02h	Unit Not Ready, LOAD Command Needed. A tape cartridge is loaded but the tape medium is in an unloaded state.
		04h	03h	Unit Not Ready, Manual Intervention Needed. No tape cartridge is present or a mechanical failure has occurred.
		04h	07h	Unit Not Ready, Loader Operation in Progress
		25h	90h	Bad Code Update Image Header
		30h	00h	Incompatible Medium Installed
		30h	02h	Incompatible Format
		30h	03h	Cleaning Cartridge Installed
		3Ah	00h	Medium Not Present
		3Eh	00h	Logical Unit Has Not Self-Configured Yet

Text Name	Sense Key	ASC	ASCQ	Description
NOT READY (continued)	02h	52h	00h	Cartridge Error, Calibration Failure
		53h	00h	Media Load or Eject Failed
		5Ah	01h	Operator Media Removal Request
MEDIUM ERROR	03h	00h	00h	Medium Error
		00h	17h	Cleaning Required
		0Ch	00h	**WRITE** Error
		11h	00h	Unrecovered **READ** Error
		11h	03h	Incomplete Block **READ**
		11h	08h	Incomplete Block **READ** (Partial Record Found)
		14h	00h	Recorded Entity Not Found. Logical DLT block not found
		15h	02h	Position Error Detected by Read of Medium
		30h	02h	Incompatible Format
		3Bh	00h	Sequential Positioning Error
		3Bh	08h	Repositioning Error
		51h	00h	ERASE Failure
		52h	00h	Cartridge Error, Calibration Failed
		53h	04h	Medium Error/Media Load or Eject Failed/Medium Thread or Unthread Failure **Note:** Operator must press unload button for recovery.
		81h	00h	Directory Write Error
		83h	90h	DLTWorm Erase Failed
		83h	91h	DLTWorm Rewind Failed
		83h	92h	DLTWorm Read Failed
		83h	93h	DLTWorm Initialization Failed
		83h	94h	DLTWorm Corrupted
HARDWARE ERROR	04h	08h	00h	LUN Communication Failure
		08h	01h	LUN Communication Timeout Failure
		0Bh	01h	Over Temperature Condition Error
		0Ch	80h	Write SCSI FIFO CRC Error
		0Ch	84h	Parity or CRC Error Detected in Compression Engine
		0Ch	85h	Parity or CRC Error Detected in Data Formatter

Text Name	Sense Key	ASC	ASCQ	Description
HARDWARE ERROR (continued)	04h	11h	80h	Read SCSI FIFO CRC Error
		11h	81h	Block Port Detected EDC Error
		11h	82h	Block Port Detected Record CRC Error
		11h	83h	Interface Buffer CRC Error
		15h	01h	Random Mechanical Positioning Error
		3Bh	08h	Repositioning Error
		40h	84h	Diagnostic / POST Failure, POST Soft Failure[1]
		44h	80h	Unexpected Selection Interrupt
		44h	82h	Command Complete Sequence Failed
		44h	83h	SCSI Chip Gross Error / Illegal Command Status
		44h	84h	Unexpected/Unexplained Residue Count in Transfer Register
		44h	85h	Immediate Data Transfer Timeout
		44h	86h	Insufficient CDB Bytes
		44h	87h	Disconnect / SDP Sequence Failed
		44h	88h	Bus DMA Transfer Timeout
		44h	8Eh	XEZ Block Formatter Object Error During Write
		44h	90h	Channel 1 FIFO CRC Error
		44h	91h	SCSI FIFO Parity Error
		44h	92h	SCSI FIFO Under Run or Over Run Error
		44h	93h	SCSI Synchronous Offset Error
		44h	C0h	Internal Target Failure
		44h	C1h	EEPROM Copy 1 Area Bad
		44h	C2h	EEPROM Copy 2 Area Bad
		44h	C3h	Both EEPROM Copy Areas Bad
		47h	00h	SCSI Parity Error
		51h	00h	Erase Failure
		53h	00h	Media Load / Eject Failure
		53h	01h	Unload Tape Failure
		53h	04h	Hardware Error/Media Load or Eject Failed/Medium Thread or Unthread Failure
		84h	01h	Basic Health Check (BHC) Diagnostic Test Failed

Text Name	Sense Key	ASC	ASCQ	Description
ILLEGAL REQUEST	05h	0Eh	03h	Invalid Field in Command Information Unit
		1Ah	00h	Parameter List Length Error
		20h	00h	Illegal OpCode
		20h	81h	Illegal Command While In Recovery Mode
		24h	00h	Invalid CDB Field. May occur if odd block counts are attempted in fixed mode
		24h	82h	Media in Drive
		24h	83h	Command Queue Not Empty
		24h	84h	Insufficient Resources
		24h	86h	Invalid Offset
		24h	87h	Invalid Size
		24h	89h	Write Buffer Overrun
		24h	8Ch	Not Immediate Command
		25h	00h	Illegal LUN
		26h	00h	Parameter List Error, Invalid Field
		26h	01h	Parameter List Error, Parameter Not Supported
		26h	02h	Parameter List Error, Parameter Value Invalid
		26h	04h	Invalid Release of Persistent Reservation
		26h	88h	Out of Sequence Image Data
		26h	89h	Image Data Over Limit[2]
		26h	8Ah	Update in Progress
		26h	8Bh	Image / Personality is Bad[2]
		26h	8Dh	Bad Drive / Server Image EDC[2]
		26h	8Eh	Invalid Personality for Code Update (CUP)[2]
		26h	8Fh	Bad Controller Image EDC[2]
		26h	90h	CUP File Header Failed Validation
		26h	91h	Bad Loader Image EDC
		26h	92h	CUP Failed, Unsupported Code Rev
		26h	93h	CUP With Different Product Code Image
		2Ch	00h	Command sequence error

Text Name	Sense Key	ASC	ASCQ	Description
ILLEGAL REQUEST (continued)	05h	2Ch	B0h	Not Reserved, a command that respects reservation was received with the OIR bit in the Device Configuration Mode Page set to 1.
		30h	00h	Incompatible Medium. Drive Cannot Read Medium
		30h	02h	Incompatible Format. Drive Cannot Read Medium
		39h	00h	Saving Parameters not Supported
		3Bh	11h	Medium Magazine not Accessible
		3Bh	12h	Medium Magazine Removed
		3Bh	14h	Medium Magazine Locked
		4Bh	00h	Data Phase Error
		50h	01h	Write Append Position Error
		50h	95h	DLTWorm Write Append Error
		53h	02h	Media Removal Prevented
		55h	06h	Illegal Command, System Resource Failure, Medium Auxiliary Memory Out of Space
		82h	00h	Not Allowed Away From BOT
UNIT ATTENTION	06h	28h	00h	Not Ready to Ready Transition
		29h	00h	Reset Occurred
		29h	01h	Power On Occurred
		29h	02h	SCSI Bus Reset Occurred
		29h	03h	Device Reset Function Occurred
		29h	04h	Device Internal Reset
		29h	05h	Transceiver Mode Changed to Single-Ended
		29h	06h	Transceiver Mode Changed to LVD
		2Ah	01h	Mode Parameters Changed
		2Ah	02h	Log Parameters Changed
		2Ah	03h	Reservations Preempted
		2Ah	04h	Reservations Released
		2Ah	05h	Registrations Preempted
		2Fh	00h	Tasks Cleared By Another Initiator
		3Bh	13h	Medium Magazine Inserted

Text Name	Sense Key	ASC	ASCQ	Description
UNIT ATTENTION (continued)	06h	3Bh	15h	Medium Magazine Unlocked
		3Fh	01h	Microcode has been Changed
		3Fh	05h	Device Identifier Changed
		3Fh	11h	Medium Auxiliary Memory Accessible
		5Bh	01h	Log Threshold Condition Met
DATA PROTECTED	07h	20h	03h	Access Denied, Invalid Management ID Key
		20h	05h	Access Denied, Incompatible Write Format
		20h	80h	Access Denied, Password Attempts Exceeded
		20h	88h	Access Denied, Decryption Not Supported
		27h	01h	Write Protect, Hardware Write Protect Switch
		27h	02h	Logical Unit Software Write Protected
		27h	80h	Unable to Decrypt, Incompatible Hardware
		30h	05h	Password Invalid, Incompatible Medium
		50h	95h	DLTWorm Write Append Error
		82h	00h	Operation Not Allowed Away from BOT
BLANK CHECK	08h	00h	05h	EOD Encountered
COMMAND ABORTED	0Bh	0Eh	01h	Information Unit Too Short
		1Bh	00h	Synchronous Data Transfer Error
		24h	3Fh	Target Operating Conditions Changed
		3Fh	0Fh	Echo Buffer Overwritten
		43h	00h	Message Error
		44h	80h	Unexpected Selection Interrupt
		44h	82h	Command Complete Sequence Failure
		44h	83h	SCSI Chip, Gross Error / Illegal Command Status
		44h	84h	Unexpected / Unexplained Residue Count in Transfer Register
		44h	87h	Disconnect / SDP Sequence Failed
		45h	00h	Select / Reselect Failure
		47h	00h	SCSI Parity Error. Check SCSI bus configuration and connections.
		47h	01h	Data Phase CRC Error Detected

Text Name	Sense Key	ASC	ASCQ	Description
COMMAND ABORTED (continued)	0Bh	48h	00h	IDE Message Error
		49h	00h	Invalid Message Error
		4Ah	00h	Command Phase Error
		4Bh	00h	Data Phase Error
		4Bh	01h	Invalid Target Port Transfer Tag
		4Bh	02h	Too Much Write Data
		4Bh	03h	ACK/NAK Timeout
		4Bh	04h	NAK Received
		4Bh	05h	Data Offset Error
		4Bh	06h	Initiator Response Timeout
		4Eh	00h	Overlapped Commands Attempted. Queue tag is not unique, CDB sent with abort tag message, or untagged CDBs are outstanding.
VOLUME OVERFLOW	0Dh	00h	02h	End of Medium

1. Contact a service representative.
2. Bad firmware image or code download possible.

RESERVE (10) Command (56h)

The **RESERVE** and **RELEASE** commands provide contention resolution in multiple-initiator systems. The **RESERVE** command reserves a logical unit number. The **RESERVE** (10) CDB is shown in figure 175, and the data fields are described in table 157. If **RESERVE** (10) is used, **RELEASE** (10) must also be used.

> Note: This command has been made obsolete in the latest version of SCSI-3 and should not be used with any new implementations. The tape drive supports this command for legacy applications only.

Table 175 **RESERVE (10)** Command Descriptor Block — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (56h)							
1	Reserved			3rdPty	Reserved		LongID	Extent (0)
2	Reservation Identification							
3	Third Party Device ID							
4 — 6	Reserved							
7 — 8	(MSB) Parameter List Length (LSB)							
9	Control							

Table 176 **RESERVE (10)** Command Descriptor Block — Field Descriptions

Field	Description
3rdPty	When set to 1, indicates that the Third Party Device ID field is valid.
LongID	When set to 1, the Parameter List Length is 8 and the 8 bytes of the parameter list carry the device ID of the third-party device. The drive ignores the contents of the Third Party Device ID in the CDB (byte 3). This bit is ignored if the 3rdPty bit is not set.
Extent	Must be set to 0.
Reservation Identification	Ignored.
Third Party Device ID	Required and used only when the 3rdPty bit is set to 1, in which case this field specifies the SCSI ID of the initiator to be granted the reservation of the drive. The drive ignores any attempt to release the reservation made by any other initiator. For example, if ID7 sends ID2 a third-party reservation on behalf of ID6 (the target at ID2 gets reserved for the initiator ID6), only ID7 can release the target at ID2 (using a third-party release). ID6 cannot release the reservation even though the reservation was made on its behalf.
Parameter List Length	The contents of this field specify the length, in bytes, of the parameter list transferred from the initiator to the drive. This field is ignored and no parameter data is transferred unless the 3rdPty bit and LongID bits are both set.

If LongID is set to 1 and Extent is set to 0, the Parameter List Length is 8 and the parameter list has the format shown below. The drive preserves the reservation until one of the following occurs:

- Another valid **RESERVE** command from the initiator supersedes it.
- The same initiator releases it.
- A **TARGET RESET** message from any initiator releases it.
- A reset condition releases it.

Table 177 **RESERVE (10)** ID Only Parameter List — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0 — 7	(MSB) Third Party Device ID (LSB)							

RESERVE UNIT Command (16h)

The **RESERVE UNIT** command reserves the specified tape drive for the exclusive use of the requesting initiator or for another specified SCSI device.

> Note: This command has been made obsolete in the latest version of SCSI-3 and should not be used with any new implementations. The tape drive supports this command for legacy applications only.

Figure 160 **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			Reserved
2 — 4	Reserved							
5	Control							

Figure 161 **RESERVE UNIT** Command Data — Field Descriptions

Field	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 drive. When set to 1, the drive is reserved for the SCSI device whose ID appears in the Third Party Device ID field. The drive ignores any attempt made by any other initiator to release the reservation and returns a GOOD status. When set to 0, no third-party reservation is requested and the drive 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 drive for another SCSI device, this field contains the ID number of the SCSI device for which the reservation was made.

A reservation with the **RESERVE UNIT** command remains in effect until one of the following conditions is met:

- Another valid **RESERVE UNIT** command from the initiator holding the reservation supersedes it.
- A **RELEASE UNIT** command from the same initiator releases it.
- A Logical Unit reset request from any initiator releases it.
- A reset condition releases it.

The occurrence of the last two conditions is indicated by the drive returning a CHECK CONDITION status, Sense Key set to 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 drive, the drive returns a RESERVATION CONFLICT status.

If, after honoring the reservation, any other initiator attempts to perform any command that is subject to reservations, the drive rejects the command with a RESERVATION CONFLICT status. That drive 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 drive.

REWIND Command (01h)

The **REWIND** command directs the DLT-S4 tape drive to position the tape at the beginning of the currently active partition, always Beginning of Media (BOM). Before rewinding, the drive writes any data in the write buffer to the tape medium and appends an End of Data marker.

Figure 162 **REWIND** Command Descriptor Block — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (01h)							
1	Reserved							Immed
2 — 4	Reserved							
5	Control							

Table 178 **REWIND** Command Descriptor Block — Field Description

Field	Description
Immed	Immediate. When set to 1, the drive first writes any remaining buffered data to the tape medium and adds an EOD marker. It then returns status to the host **before** beginning the actual rewind operation. When set to 0, the drive returns status **after** the rewind has completed.

SEND DIAGNOSTIC Command (1Dh)

The **SEND DIAGNOSTIC** command directs the DLT-S4 tape drive to perform its self-diagnostic tests. Two levels of drive-resident diagnostic tests are available: the Level 1 Electronics Test and the Level 2 Write / Read Functionality Test.

Figure 163 **SEND DIAGNOSTIC** Command Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (1Dh)							
1	Self-Test Code			PF (0)	Reserved	Selftst	DevOfl	UnitOfl
2	Reserved							
3 — 4	(MSB) Parameter List Length (LSB)							
5	Control							

Table 179 **SEND DIAGNOSTIC** Command Data — Field Descriptions

Field	Description
PF	Page Format. Must be set to 0 when the SelfTst bit is set to 1.
Selftst	Self Test. Used with DevOfl and UnitOfl to specify the type of testing to be done (see table 180 for specific information).
DevOfl	Device Offline. Used with Selftst and UnitOfl to specify the type of testing to be done (see table 180 for specific information).
UnitOfl	Unit Offline. Used with Selftst and DevOfl to specify the type of testing to be done (see table 180 for specific information).
Parameter List Length	Indicates the number of bytes of parameter data that will be sent to the drive. Must be 0 when the SelfTst bit is set to 1.

Level 1 Test: Electronics Test

Running a Level 1 test requires that a major portion of the controller hardware and software be functioning properly. The Level 1 test is based on the premise that full power-up testing is not necessary; therefore, it is an extension of the power-on tests that the drive runs. The test verifies the controller software Error Detection Code (EDC) and checks one queue that much of the controller software uses by dequeuing and enqueuing items. The test also runs a cache memory test. Finally, this test checks the status of the servo subsystem by sending a **STATUS** command to the servo and interpreting the results.

The Level 1 test does not attempt a **WRITE** or **READ** to or from the tape medium. If an error occurs during the Level 1 test, the drive reports a CHECK CONDITION status and reports any errors that occurred in the extended Sense Data bytes.

The Level 1 test has an execution time of approximately 5 seconds. See table 180 for information on setting the **SEND DIAGNOSTIC** CDB fields to select a Level 1 test.

Level 2 Test: Write / Read Functionality Test

The Level 2 test performs the following actions:

1 Writes two tracks of data, one in each direction.

2 Rewinds the tape.

3 Reads the two tracks of data.

4 Rewinds the tape.

The execution time for the Level 2 test is approximately 12 minutes. See table 180 for information on setting the **SEND DIAGNOSTIC** CDB fields to select a Level 2 test.

The Level 1 and Level 2 diagnostic tests do not take parameters.

If the PF bit is set to one and the SelfTst bit is set to one, the drive will reject the command and indicate an Illegal Request. If the PF bit is set to one and the SelfTst bit is set to zero, the Dev Ofl and Unit Ofl bits are ignored and the drive will request the number of page bytes specified in the Parameter List Length field. If the PF bit is set to zero, the SelfTst, DevOfl, and UnitOfl bits are interpreted as defined in table 180.

Table 180 **SEND DIAGNOSTIC CDB** Fields — Selftst, DevOfl, and UnitOfl

Selftst	DevOfl	UnitOfl	Diagnostic Test Run
0	0	0	Level 1 Test with Drive and Media Health Check[1] (drive is on-line)
0	0	1	Illegal Combination
0	1	0	Illegal Combination
0	1	1	Level 1 Test and Level 2 Test with Drive and Media Health Check* (drive is on-line)
1	0	0	Level 1 Test only (drive is on-line)
1	0	1	Illegal Combination
1	1	0	Level 1 Test (drive is off-line)
1	1	1	Level 2 Test (drive is off-line)

1. Drive and Media Health Check. This test checks for the highest priority DLTSage Tape Alert that has been set against the drive and/or the media. This information is reported in response to the next RECEIVE DIAGNOSTIC RESULTS command.

If the specified diagnostic test passes, the drive returns GOOD status. If the specified diagnostic test fails, the drive returns CHECK CONDITION status with Sense Data containing information about the failure, as described in table 181.

Table 181 Sense Keys for **SEND DIAGNOSTIC** Command

Sense Key	Description
3h	Medium Error. The drive returns a medium error if it encounters a Hard Read or Hard Write error during the test.
4h	Hardware Error. The Additional Sense Code and any Additional Sense Code Qualifiers provide more specific information (see table 182 for more information).
5h	ILLEGAL REQUEST. Illegal parameter settings in the **SEND DIAGNOSTIC** command.

Additional Sense Codes and Additional Sense Code Qualifiers that apply to **SEND DIAGNOSTIC** test results are described in table 182.

Table 182 ASC / ASCQ for **SEND DIAGNOSTIC** Command

ASC	ASCQ	Description
40h	80h	Level 1 Controller Software EDC test failed
40h	81h	Level 1 test failed; RAM diagnostic failed
40h	82h	Level 1 test failed; bad drive status
40h	83h	Level 1 test failed; loader diagnostic failed
40h	84h	Level 1 test failed; POST has soft failure
40h	85h	Level 1 Queue Handler test failed
40h	86h	Level 1 Cache Interface test failed
40h	87h	Level 1 drive tape alert set
40h	88h	Level 1 medium tape alert set
40h	89h	Level 2 failed.

SET DEVICE IDENTIFIER Command (A4h/06h)

The **SET DEVICE IDENTIFIER** command requests that the device identifier information in the DLT-S4 tape drive be set to the value contained in the parameter list. This information is then accessible using the **REPORT DEVICE IDENTIFIER** command. The device identifier is persistent through Reset and power cycles.

On successful completion of a **SET DEVICE IDENTIFIER** command, the drive generates a UNIT ATTENTION condition for all initiators except the one that issued the command with the Additional Sense Code set to DEVICE IDENTIFIER CHANGED.

Figure 164 **SET DEVICE IDENTIFIER** Command Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (A4h)							
1	Reserved			Service Action (06h)				
2 — 5	Reserved							
6 — 9	(MSB) Parameter List Length (LSB)							
10	Reserved							
11	Control							

Table 183 **SET DEVICE IDENTIFIER** Command Descriptor Block — Field Descriptions

Field	Description
Service Action	A service action of 06h identifies this as the **SET DEVICE IDENTIFIER** command.
Parameter List Length	Specifies the length in bytes of the Identifier that is transferred from the application client to the tape drive. The maximum value for this field is 64 bytes. A Parameter List Length of 0 indicates that no data is to be transferred and that subsequent **REPORT DEVICE IDENTIFIER** commands return an Identifier length of 0.

The **SET DEVICE IDENTIFIER** parameter list contains the identifier to be set by the drive.

Figure 165 **SET DEVICE IDENTIFIER** Parameter List — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0 — *n*	Identifier							

Table 184 **SET DEVICE IDENTIFIER** Parameter List — Field Description

Field	Description
Identifier	The Identifier field is a vendor-specific value. This value is returned by all subsequent **REPORT DEVICE IDENTIFIER** commands, until replaced by another valid **SET DEVICE IDENTIFIER** command.

SET TIMESTAMP Command (A4h/0Fh)

The **SET TIMESTAMP** command (see figure 166) requests the DLT-S4 tape drive to initialize the timestamp.

Figure 166 **SET TIMESTAMP** Command — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (A4h)							
1	Reserved			Service Action (0Fh)				
2 — 5	Reserved							
6 — 9	(MSB) Parameter List Length (LSB)							
10	Reserved							
11	Control							

Table 185 **SET TIMESTAMP** Command — Field Descriptions

Field	Description
Service Action	A service action of 0Fh identifies this as the **SET TIMESTAMP** command.
Parameter List Length	The PARAMETER LIST LENGTH field specifies the length in bytes of the **SET TIMESTAMP** parameters that is transferred from the application client to the device server. A parameter list length of zero indicates that no data is transferred, and that no change is made to the timestamp.

The format for the parameter data returned by the **SET TIMESTAMP** command is shown in figure 167.

Figure 167 **SET TIMESTAMP** Command Parameter List — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0 — 3	Reserved							
4 — 9	Timestamp							
10	Reserved							
11	Reserved							

Table 186 **SET TIMESTAMP** Command Parameter List — Field Descriptions

Field	Description
Timestamp	The timestamp should be the number of milliseconds that have elapsed since midnight, 1 January 1970 UT.

SPACE Command (11h)

The **SPACE** command provides a variety of positioning functions that are determined by the Code and Count fields in the Command Descriptor Block. This command provides both forward (toward End of Partition) and reverse (toward Beginning of Partition) positioning.

Table 187 **SPACE** Command Descriptor Block — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (11h)							
1	Reserved				Code			
2 — 4	(MSB) Count (LSB)							
5	Control							

Table 188 **SPACE** Command Data — Field Descriptions

Field	Description	
Code	The code can be one of the following values. All other values are reserved.	
	Space Code	**Space By**
	0000b	Logical Blocks
	0001b	Filemarks
	0010b	Sequential Filemarks
	0011b	End-of-Data
Count	When spacing over Blocks or Filemarks, the Count field is interpreted as follows: • A positive value *n* causes forward motion over *n* blocks or filemarks. The drive logically positions the tape after the *n*th Block or Filemark 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 Filemarks. The drive logically positions the tape on the BOM or BOP side of the *n*th Block or Filemark. • When spacing to End of Data (EOD), the drive ignores the Count field. Forward movement occurs until the drive encounters EOD. The position is such that a subsequent **WRITE** command appends data after the last object that the drive has written to tape before EOD.	

A **SPACE** command in the form "SPACE *n* blocks" halts with GOOD status after the *n*th block, or with CHECK CONDITION status on any occurrence of Filemark, EOD, or BOP. A SPACE command in the form "SPACE *n* Filemarks" halts on the *n*th Filemark with GOOD status or with CHECK CONDITION status on any occurrence of EOD.

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 Command (00h)

The **TEST UNIT READY** command checks the DLT-S4 tape drive to ensure that it is ready for commands involving tape movement.

Figure 168 **TEST UNIT READY** Command Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (00h)							
1	Reserved							
2 — 4	Reserved							
5	Control							

VERIFY Command (13h)

The **VERIFY** command directs the tape drive to verify one or more blocks beginning with the next block on the tape. The drive verifies both CRCs and EDCs.

Figure 169 **VERIFY** Command Descriptor Block — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (13h)							
1	Reserved					Immed	BytCmp	Fixed
2 — 4	(MSB) Verification Length (LSB)							
5	Control							

Table 189 **VERIFY** Command Data — Field Descriptions

Field	Description
Immed	Immediate. When set to 1, the **VERIFY** command completes, provided it has begun processing, before the drive performs any tape medium movement.
BytCmp	Byte Compare. Must be set to 0.
Fixed	Specifies whether the drive is to verify fixed-length or variable-length blocks. When set to 0, variable-block mode is requested. The drive verifies a single block with the Verification Length specifying the block size. When set to 1, the Verification Length specifies the number of blocks the drive is to verify. This is valid only if the drive is currently operating in fixed-block mode.
Verification Length	Specifies the amount of data to verify, in blocks or bytes, as indicated by the Fixed field.

WRITE Command (0Ah)

The **WRITE** command transfers one or more data blocks from the host to the current logical position on tape. When in Buffered Mode, which is the default mode of operation, the DLT-S4 tape drive reports GOOD status on **WRITE** commands as soon as the requested data block or blocks have been transferred to the data buffer. See MODE SELECT (6) / (10) Command (15h / 55h) on page 98 for more information on Buffered Mode.

Figure 170 **WRITE** Command Descriptor Block — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (0Ah)							
1	Reserved							Fixed
2 — 4	(MSB) Transfer Length (LSB)							
5	Control							

Table 190 **WRITE** Command Data — Field Descriptions

Field	Description
Fixed	Sets both the meaning of the Transfer Length field. When set to 0, a single block is transferred from the initiator and is written to the drive beginning at the current logical tape position. Upon successful termination, the drive logically positions the tape after this block on the EOM / EOP side. The Transfer Length specifies the length of block in bytes. When set to 1, the Transfer Length field specifies the number of blocks to be transferred to the drive and written to the medium beginning at the current tape position. This form of WRITE is valid only if the drive is currently operating in fixed-block mode, as indicated by the Block Size field in the Mode Parameter Block Descriptor (see Mode Parameter Block Descriptor on page 104). The current block length is the block length defined in the **MODE SELECT** command. Upon termination, the drive logically positions the tape after these blocks.
Transfer Length	Contains the length of the data transfer in bytes or blocks depending on whether fixed- or variable-block mode is selected. When set to 0, no data is transferred and the current position on the drive is not changed.

Exception Conditions

If the drive detects End of Tape (EOT) while writing, it finishes writing any buffered data. The command terminates with CHECK CONDITION status. Within the Sense Data, the EOM field 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 drive encounters the physical EOM when attempting a **WRITE**, it returns a CHECK CONDITION status. Within the Sense Data, the EOM and Valid fields 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 drive physically positions the tape at EOM / P.

WRITE ATTRIBUTE Command (8Dh)

The **WRITE ATTRIBUTE** command allows an application client to write attributes to Enhanced Medium Auxiliary Memory (EMAM). The **WRITE ATTRIBUTE** command is the functional counterpart of the **READ ATTRIBUTE** command. Application clients issue **READ ATTRIBUTE** commands before using this command to discover DLT-S4 tape drive support for EMAM features.

Table 191 **WRITE ATTRIBUTE** Command Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (8Dh)							
1	Reserved							
2 — 4	Restricted							
5	Volume Number							
6	Reserved							
7	Partition Number							
8 — 9	Reserved							
10 — 13	(MSB) Parameter List Length (LSB)							
14	Reserved							
15	Control							

Table 192 **WRITE ATTRIBUTE** Parameter Command Data — Field Descriptions

Field	Description
Volume Number	Specifies a volume within the medium auxiliary memory. Must be set to 0. Super DLTtape media comprises a single volume.
Partition Number	Specifies a partition within a volume. Must be set to 0. Super DLTtape media comprises a single partition.
Parameter List Length	Specifies the length in bytes of the parameter list contained in the Data-Out Buffer. A Parameter List Length of 0 indicates that no parameter data is present; this is not considered an error.

The parameter list has the format shown in figure 171.

Figure 171 **WRITE ATTRIBUTE** — Parameter List Format

Byte \ Bit	7	6	5	4	3	2	1	0
0 — 3	(MSB) Parameter Data Length (n – 3) (LSB)							
	Attributes							
4 — (x + 3)	Attribute (First Attribute) Length (x)							
(n — y + 1) — n	Attribute (Last Attribute, if more than 1) Length (y)							

Table 193 **WRITE ATTRIBUTE** Command Parameter Data — Field Descriptions

Field	Description
Parameter Data Length	Indicates the number of bytes in the page, excluding the 4 bytes that make up the header.
Attribute	Contains: 1) an attribute header, and 2) data. Each attribute must be formatted as described in Enhanced Medium Auxiliary Memory (EMAM) Attributes on page 242.

Error Summary for the WRITE ATTRIBUTE Command

If there is not enough space to write the attributes to the medium auxiliary memory, no attributes are changed and the **WRITE ATTRIBUTE** command terminates with a CHECK CONDITION status. The Sense Key is set to ILLEGAL REQUEST and the Additional Sense Code is set to AUXILIARY MEMORY OUT OF SPACE.

If the medium auxiliary memory is not accessible because no medium is present, no attributes are changed and the **WRITE ATTRIBUTE** command terminates with a CHECK CONDITION status. The Sense Key is set to NOT READY and the Additional Sense Code is set to MEDIUM NOT PRESENT.

If the medium is present, but the medium auxiliary memory is not accessible, no attributes are changed and the **WRITE ATTRIBUTE** command terminates with a CHECK CONDITION status. The Sense Key is set to NOT READY and the Additional Sense Code is set to LOGICAL UNIT NOT READY, MAM NOT AVAILABLE.

If the combination of volume number and partition number is not valid, the command terminates with a CHECK CONDITION status. The Sense Key is set to ILLEGAL REQUEST and the Additional Sense Code is set to INVALID FIELD IN CDB.

If the medium auxiliary memory has failed as a result of, for example, a bad checksum, the **WRITE ATTRIBUTE** command terminates with a CHECK CONDITION status. The Sense Key is set to MEDIUM ERROR and the Additional Sense Code is set to AUXILIARY MEMORY WRITE ERROR.

If the **WRITE ATTRIBUTE** command parameter data contains an attribute with an Attribute Length field (see Attribute Format on page 242) set to 0, one of the following actions occurs:

- If the attribute is Read Only, no attributes are changed and the **WRITE ATTRIBUTE** command terminates with a CHECK CONDITION status. The Sense Key is set to ILLEGAL REQUEST and the Additional Sense Code is set to INVALID FIELD IN PARAMETER LIST.

- If the attribute is Read / Write, the attribute is deleted. The attribute is not returned in response to a **READ ATTRIBUTE** command and not reported by the **READ ATTRIBUTE** command with the ATTRIBUTE LIST service action.
- If the attribute does not exist, the attribute in the **WRITE ATTRIBUTE** command parameter list is ignored; this is not considered an error.

If either of the following conditions occurs, no attributes are changed, the **WRITE ATTRIBUTE** command terminates with a CHECK CONDITION status, the Sense Key is set to ILLEGAL REQUEST, and the Additional Sense Code is set to INVALID FIELD IN PARAMETER LIST:

- The parameter data attempts to change a read-only attribute.
- The parameter data contains an attribute with incorrect contents in the Attribute Length field (see Attribute Format on page 242).

WRITE BUFFER Command (3Bh)

The **WRITE BUFFER** command works with the **READ BUFFER** command as a diagnostic function for testing the device data buffer, DMA engine, interface hardware, and interface network integrity. It is also used to download and update microcode (firmware).

Figure 172 **WRITE BUFFER** Command Descriptor Block — Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (3Bh)							
1	Reserved			Mode				
2	Buffer ID (00h)							
3 — 5	(MSB) Buffer Offset (LSB)							
6 — 8	(MSB) Parameter List Length (LSB)							
9	Control							

Table 194 **WRITE BUFFER** Command Descriptor Block — Field Descriptions

Field	Description	
Mode	The drive supports the following values in this field.	
	Mode	**Description**
	00h	Write Combined Header and Data
	02h	Write Data
	04h	Download Microcode
	05h	Download Microcode and Save
	0Ah	Write Data to Echo Buffer
Buffer ID	The modes described for the Mode field only support a Buffer ID of 0, except Echo Buffer mode, which ignores the Buffer ID field. If the Buffer ID field is a value other than 0, the drive rejects the command. The drive also detects and rejects commands that would overrun the buffer.	
Buffer Offset	This field contains the offset in bytes from the beginning of the buffer.	

Write Combined Header and Data Mode (00h)

The data to be transferred is preceded by a 4-byte header consisting entirely of reserved bytes. The drive discards this header (it is not stored in the buffer).

The Buffer Offset field must be set to 0 for this mode.

Write Data Mode (02h)

This mode is similar to Header and Data Mode, except that there is no header in the data passed to the drive. The drive detects any potential buffer overruns and rejects the **WRITE BUFFER** command.

Download Microcode Mode (04h)

This mode uses this mode to download the firmware image into the drive's buffer. A **WRITE BUFFER** command with a mode of DOWNLOAD MICROCODE does cause the new image to become active. A Download Microcode and Save Mode **WRITE BUFFER** command must be issued for the image to become active.

The drive must not contain any tape medium before starting an image download. This is to safeguard against accidentally starting a firmware update. If a tape cartridge is loaded when all or part of a firmware image has been downloaded, the drive rejects another **WRITE BUFFER** command with Download Microcode mode.

An error on a **WRITE BUFFER** command causes the drive to discard any downloaded image data.The download must be restarted from the beginning.

Download Microcode and Save Mode (05h)

This mode downloads and saves the entire image at once, or downloads the image and saves it, or starts a save operation after the image data has been downloaded using the Download Microcode mode (04h) described above.

This mode of the **WRITE BUFFER** command causes the drive to verify the image data and update the Flash EEPROM firmware area. During the reprogramming of the Flash EEPROM, the Write Protect and Drive Status LEDs on the drive's front panel blink. Also, while it is updating the EEPROM, the drive disconnects from the network and does not respond until the update is complete.

When the Save operation completes successfully, the firmware restarts itself, causing the power-on self-test (POST) to run. At that point, the drive generates two UNIT ATTENTION conditions: POWER UP RESET and OPERATING CODE HAS CHANGED.

Caution:	If any type of power failure occurs during the actual reprogramming of the FLASH EEPROM or if the reprogramming fails before completion, the drive subsystem becomes unusable and the drive must be serviced.

Write Data to Echo Buffer Mode (0Ah)

In this mode, the drive transfers data from the application client and stores it in an Echo Buffer. The drive ignores the Buffer ID and Buffer Offset fields in this mode. Once a **WRITE BUFFER** command completes successfully, the data is preserved in the Echo Buffer *unless* there is an intervening command to write to the Echo Buffer or unless the drive is reset by any means.

WRITE FILEMARKS Command (10h)

The **WRITE FILEMARKS** command directs the tape drive to write the specified number of Filemarks onto the tape, beginning at the current logical position. If the Immed bit is not set to 1, the drive writes any data or Filemarks in the **WRITE** cache buffer to tape.

Figure 173 **WRITE FILEMARKS** Command Descriptor Block — Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (10h)							
1	Reserved						WSMK (0)	Immed
2 — 4	(MSB) Transfer Length (LSB)							
5	Control							

Table 195 **WRITE FILEMARKS** Command — Field Descriptions

Field	Description
WSMK	Write Setmark. Must be set to 0.
Immed	Immediate. When set to 0, the drive does not return status until all buffered data and Filemarks are written to the medium. When set to 1, the drive returns status as soon as it validates the CDB. If set to 1 and the drive is not operating in Buffered mode (see table 53 on page 101), the drive returns a CHECK CONDITION status with the Sense Key set to ILLEGAL REQUEST and the Additional Sense Code set to INVALID FIELD IN CDB.
Transfer Length	Contains the number of consecutive Filemarks to be written to the tape medium. A value of 0 is not considered an error; the drive returns GOOD status.

The **WRITE FILEMARKS** command can be used to force the drive to write any buffered WRITE data to the tape medium. If the drive is in Buffered mode when it receives a **WRITE FILEMARKS** with the Immed bit set to 0, it appends the requested Filemarks to the data and flushes the **WRITE** buffer contents to the 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 if Immed is set to 0.

Appendix A

DLTSage WORM

DLTSage WORM is the name of the DLT-S4 feature that allows the DLTtape S4 cartridges to be used in Write Once Read Many (WORM) mode. This feature is enabled by the presence of a standard DLTtape S4 cartridge that has been initialized as a WORM medium cartridge. After the cartridge has been initialized to work in WORM mode, write operations are only allowed at the End of Data position.

The Initialization Process

During the DLTSage WORM initialization process, the drive will execute a series of commands and validate the result of each command. If any command fails, the cartridge is not initialized as a DLTSage WORM cartridge.

First, the firmware will make sure that the initial criteria for the initialization as a DLTSage WORM cartridge are met. These are that the loaded cartridge is a DLTtape S4 cartridge and it is either:

- An unformatted native cartridge;
- A blank native cartridge;
- Or a native cartridge with only one filemark and an EOD on it.

If the initial criteria are met the following operations are done:

The cartridge is formatted;

The DLTSage WORM indicator is written in three places;

- An End Of Data (EOD) marker is placed at the Beginning of Tape (BOT); and
- The DLTSage WORM tag is created and written to the MAM data.

Once the initialization process successfully completes, the DLTtape S4 cartridge is ready to be used in WORM mode.

Use of *DLT*Sage WORM Tapes

After a DLTSage WORM tape has been created, it may be used to record write once datasets. When writing a new dataset, it must be appended to the End of Data position on the tape. Attempts to write while the tape is at a position other than EOD will be rejected and no data will be accepted from the host. The EOD mark will be written at the end of each new dataset. EOD will be written after all remaining user data is flushed to the tape and any type of position command or read command is given to the drive (e.g. **REWIND**). EOD will be written to tape if a WRITE FILEMARK 0 command is received by the drive. EOD will also be written if the Write Delay Time parameter of the **MODE SELECT/SENSE** Device Configuration Page is reached (no further data was received from the host).

A DLTSage WORM tape may be read as often as the user requires.

*DLT*Sage WORM Details

The following sections contain specific methods to:

- Determining if the SDLT drive is DLTSage WORM capable;
- Determining if the currently loaded cartridge is a DLTSage WORM tape;
- Converting an SDLT data cartridge into a DLTSage WORM cartridge;
- Reading the DLTSage WORM signature;
- Understanding unique sense data reported while using DLTSage WORM cartridges,

- Understanding the timeout value for creating the DLTSage WORM cartridge,
- Determining if tampering of the DLTSage WORM cartridge has occurred,
- Responding to DLTSage WORM sense data and DLTSage WORM TapeAlerts and,
- Failure Modes and Recovery Actions

Determining if the SDLT Drive is *DLT*Sage WORM Capable

The Sequential-Access Device Capabilities Page (0xB0) contains an indicator that the drive is DLTSage WORM Capable. This indicator defined as "WORM" will always be set for the DLT-S4 drive.

Determining if the Current Cartridge is a *DLT*Sage WORM

Once a DLTSage WORM tape is created, a **READ ATTRIBUTE** command for the MEDIUM TYPE Attribute (0x0408) of MAM will return the Medium Type as Write-Once media (0x80).

Converting an SDLT Data Cartridge to *DLT*Sage WORM

A standard DLTtape S4 cartridge is converted to a DLTSage WORM tape by sending a **WRITE ATTRIBUTE** command to the drive that sets the MEDIUM TYPE Attribute (0x0408) to "Write Once" (0x80). This is only allowed for blank unformatted tapes; formatted native tapes with no data on them; or formatted native tapes with one filemark and an EOD on them.

> Note: In order to convert a formatted tape with one filemark and an EOD on it to a DLTSage WORM tape, the filemark and EOD must be read into the drive's cache. This happens automatically at load time and if one filemark is written. If the host or test software issues a **REWIND** command after writing the filemark, then it is the host or test software's responsibility to issue a **READ** command to read the filemark and EOD back into the drive's cache.

Reading the *DLT*Sage WORM Signature

The DLTSage WORM signature is read using the **READ ATTRIBUTE** command to read the Medium Serial Number Attribute (0x0401). The DLTSage WORM signature consists of the drive power on hours, drive serial number and unique media ID.

Understanding Unique Sense Data while Using the *DLT*Sage WORM Cartridge

Error Trying to Convert a Write Protected DLTTapeS4 to WORM

If you try to convert a Write Protected DLTTapeS4 cartridge the following sense data is reported:

- Sense Key — Data Protect (07)
- Additional Sense Code — Write Protected (0x27)
- Additional Sense Code Qualifiers — Hardware Write Protect(0x01)

Error Trying to Convert SDLT II and SDLT I Cartridge to WORM

If you try to convert an SDLT II or SDLT I cartridge to WORM, the following sense data is reported:

- Sense Key — Data Protect (07)
- Additional Sense Code — Incompatible (0x30)
- Additional Sense Code Qualifiers — Hardware Write Protect(0x01)

Append/Write Errors While Using a DLTSage WORM Tape

The DLTSage WORM firmware only allows appends at EOD. Any WRITE type operation not at EOD is rejected. If a **WRITE** or **WRITE FILEMARK** command is attempted at a location that is not EOD, or if an **ERASE** or **DIAG WRITE** command is received, the following sense is reported:

- Sense Key — Data Protect (07)
- Additional Sense Code — Write Append Error (0x50)
- Additional Sense Code Qualifier —DLTWorm Write Append Error (0x95)

Errors While Creating a *DLT*Sage WORM Tape

If you already have a DLTSage WORM tape and you try to convert it to a DLTSage WORM the following sense data will be presented:

- Sense Key — Illegal Request (05)
- Parameter List Error, Invalid Field (26/00)
- The **REQUEST SENSE** data will point to the attribute (0x0408) field that you are incorrectly trying to modify.

If you have a standard DLTtape S4 cartridge and there is an error in the process of converting it to a DLTSage WORM tape, the following sense data will be presented:

- Sense Key — Medium Error (03)
- Additional Sense Code — DLTWorm Creation Error (0x83)
- Additional Sense Code Qualifiers:
  - DLTWorm Erase Failed (0x90)
  - DLTWorm Rewind Failed (0x91)
  - DLTWorm Read Failed (0x92)
  - DLTWorm Creation Invalid (0x93)

If a DLTtape S4 cartridge fails DLTSage WORM initialization, the application needs to report the above sense data. If failures 0x90, 0x91, or 0x92 occur, the initialization of the DLTSage WORM tape was not successful. If failure 0x93 occurs, the cartridge is either the wrong type or has data on it. For all failures, the best recovery is to degauss the tape and try the operation again. If DLTSage WORM initialization fails a second time, the tape should be considered defective.

Determining if the Integrity of the *DLT*Sage WORM Cartridge has been Compromised

The DLTSage WORM firmware will report the WORM Medium Integrity Check Failed Tape Alert (0x3B) if the integrity of the DLTSage WORM cartridge has been compromised. The drive will come ready but will respond to all write commands with the following sense:

- Sense Key — Medium Error (03)
- Additional Sense Code — Format Corrupted (0x31)
- Additional Sense Code Qualifiers — DLTWorm Corrupted (0x94)

Understanding the Timeout Value for Creating the *DLT*Sage WORM Cartridge

The timeout value for the creation of the DLTSage WORM tape is 5 minutes. The process of creating the DLTSage WORM tape takes 60 seconds. Additional time is added for error recovery retries.

Responding to *DLT*Sage WORM Sense Data and *DLT*Sage WORM TapeAlerts

TheDLTSage WORM TapeAlerts are as follows:

0x3B – WORM Medium Integrity Check Failed

The tape drive has detected an inconsistency during WORM medium integrity checks.

Detection — The application will receive a WORM Integrity Check Failed Tape Alert (0x3B) after the cartridge is loaded.

Recovery — The recommended recovery action is to copy all the data from the problem DLTSage WORM cartridge to a new DLTSage WORM cartridge.

0x3C – WORM Medium - Overwrite Attempted

An attempt has been made to overwrite user data on a WORM medium.

Detection — The application will receive a Check Condition with the following sense data:

- Sense Key — Data Protect (07)
- Additional Sense Code — Write Append Error (0x50)
- Additional Sense Code Qualifier — DLTWorm Write Append Error (0x95)

Recovery —

1. If the WORM medium was used inadvertently, replace it with a normal data medium.
2. If the WORM medium was used intentionally, check that the software application is compatible with the WORM medium format that you are using.
3. If you consistently get this error and the cause is not #1 or #2, then the recovery action is to copy all the data from the problem DLTSage WORM cartridge to a newDLTSage WORM cartridge.

Failure Modes and Recovery Actions

Loss of Directory or MAM due to Read Failures

In the event the standard directory or MAM data is not readable, the drive may still be able to recover the user data and thereby reconstruct these directories from a user data point of view. The drive firmware will be able to detect all cases of this failure mode, write protect the medium, and allow full recovery of the user data from the tape.

Recovery — The recommended recovery action is to copy all the data from the problem DLTSage WORM cartridge to a new DLTSage WORM cartridge.

User Data Write Failures on an DLTSage WORM cartridge

In the event of a write failure in the data area of a DLTSage WORM cartridge, that cartridge will become unusable for future data append operations. The tape can no longer be written.

Recovery — The recommended recovery action is to copy all the data from the problem *DLT*Sage WORM cartridge to a newDLTSage WORM cartridge.

Loss of Directory or MAM due to Write Failures

In the event that a write failure occurs while updating the Directory and/or MAM data of a DLTSage WORM cartridge, partial knowledge that the cartridge is a DLTSage WORM cartridge may be lost. The drive firmware will be able to detect all cases of this failure mode, write protect the medium, and allow full recovery of the user data from the tape.

Recovery — The recommended recovery action is to copy all the data from the problem DLTSage WORM cartridge to a new DLTSage WORM cartridge.