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DLT™4000/DLT™4500/DLT™4700
Cartridge Tape Subsystem

Product Manual

Quantum

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Cartridge Tape Subsystem
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The following FCC Notice applies to the DLT™4000 drive:

FCC NOTICE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in residential installation. Any changes or modifications made to this equipment may void the user's authority to operate this equipment.

This equipment generates, uses, and radiates radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by tuning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

1. Reorient or relocate the receiving antenna.

2. Increase the separation between the equipment and receiver.

3. Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

4. Consult the dealer or an experienced radio/TV technician for help. The shielded interconnect cable shipped with the unit should not be altered or modified in any way. The unit shipped without a shielded interconnect cable must use a shielded interconnect cable.

The user may find the following booklet prepared by the Federal Communications Commission helpful: How to Identify and Resolve Radio-TV Interference Problems. This booklet is available from the U.S. Government Printing Office, Washington D.C., 20402. Stock No. 004-00398-5.

All external I/O cables connecting to this unit need to be shielded. See the User Manual or installation instructions for more options.

This digital apparatus does not exceed the Class B limits for radio noise emissions set out in the radio interference regulations of the Canadian Department of Communications.

This equipment is in the 2nd Class Category (information equipment to be used in a residential area or an adjacent area thereto) and conforms to the standards set by the Voluntary Control Council For Interference by Data Processing Equipment and Electronic Office Machines aimed at preventing radio interference in such residential area.

This equipment meets or exceeds requirements for safety in the U.S. (UL 1950), Canada (CSA C22.2 N0. 950) and Europe (EN60950/IEC 950) requirements, and is certified to bear the GS mark by TUV.

The following FCC Notice applies to the DLT^{TM}4500 and DLT^{TM}4700 mini-libraries:

FCC NOTICE: This equipment has been tested and found to comply with the limits for a Class A device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Any changes or modifications made to this equipment may void the user's authority to operate this equipment. Operation of this equipment in a residential area may cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference. The shielded interconnect cable shipped with the unit should not be altered or modified in any way. The unit shipped without a shielded cable must use a shielded interconnect cable.

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

Achtung! Dieses ist ein Gerat der Funkstorgenzwertklasse A. In Wohnbereicghen konnen bei Betrieb dieses Gerates Runfunkstorungen auftreten, in welchen Fallen der Benutzer fur entsprechende GengenmaBnahmen verantwortlich ist.

Attention! Ceci est un produit de Classe A. Dans un environment domestique, ce produit risque de creer des interferences radioelectriques, il appartiendra alors a l'utilisateur de prendre les mesures specifiques appropriees.

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REVISION HISTORY

This Revision History provides a concise publication record of this manual. It lists the manual revision levels, release dates, and reasons for the revisions.

Manual No.	Date	Summary of Changes
81-108336-01	5 May 95	Original issue
81-108336-02		Caution added for unloading a tape cartridge
81-60043-01	10 Mar 96	Part Number 81-108336-02 disabled.
		Manual wide, trademark, copyrights and verbiage upgrades.
		Fast Data Transfer Rate correction, page(s) 1-2.
		Figure 2-1 upgraded, page(s) 2-2.
		Figure 3-6 upgraded, page(s) 3-11.
		Section E added to POST testing, page(s) 3-14.
		Table 3-2, Operate Handle description updated and label update page(s), 3-15.
		Description of tape cartridge updated, page(s) 3-17.
		Loading a Cartridge, Notes added, page(s) 3-20.

Manual No.	Date	Summary of Changes
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		Chapter four reconstructed.
		Run POST test updated, page(s) 4-8.
		Description of tape cartridge updated, page(s) 4-20.
		Figure 5-2 upgraded, page(s) 5-6.
		Table 5-1 upgraded, page(s) 5-11.
		Table 5-2 upgraded, page(s) 5-14.
		Table 7-1 added, page(s) 7-4.
		Table 7-1 consolidated, page(s) 7-8.
		CAUTION message added, page(s) 7-9.
		Table 8-1 modified, page(s) 8-8.
		Table 8-2 modified, page(s) 8-15.
		Figure 8-6 modified, page(s) 8-21.
		Product Family description and table added, page(s) 8-22.
		Density Code updated, page(s) 8-49.
		Table 8-3, additions and modifications, page(s) 8-65 and 8-67.
		Tables A-1, A-5, A-8, A-9, A-10, A-12, A-16, A-17, A-20 and A30 modifications, page(s) A-3, A-11, A-13, A-14, A-15, A-17, A-18, A-23.
		Altitude modified, A-14.

Preface

To the Reader:

QUANTUM makes every effort to ensure the accuracy of information. However, some errors may have been introduced inadvertently; they will be corrected in the next release. QUANTUM recognizes that some users may require additional content. We welcome your feedback and your suggestions for enhancements and we will evaluate your input for a future release. Please send your comments to:

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Purpose of This Manual

This manual introduces the DLT^{TM}4000/DLT^{TM}4500/DLT^{TM}4700 Cartridge Tape Subsystem and describes operating procedures, code update, and SCSI protocol features.

All care is taken to ensure accuracy, however, some of the parameters, drawings, and specifications being under constant review, and enhancement, may change.

Who Should Use This Manual

This manual is written for the subsystem or system integrator and users of the DLT4000/DLT4500/DLT4700 Cartridge Tape Subsystem.

Structure of This Manual

Chapter 1, Overview and Features of the DLT4000/DLT4500/DLT4700 Product, gives a product overview and lists the product features of the DLT4000/DLT4500/DLT4700 cartridge tape subsystem.

Chapter 2, Installing and Configuring the DLT4000 Tabletop Drive, describes installing and configuring the DLT4000 tabletop tape drive.

Chapter 3, Configuring and Operating the DLT4000 Tape Drive, includes selecting density, configuration, and other operation information for the tape drive, such as front panel indicators and controls, Power-on Self-test, the tape cartridge write-protect switch, loading a cartridge, using the cleaning tape, unloading a cartridge, and preserving cartridges.

Chapter 4, Configuring and Operating the DLT4500 Mini-Library, includes configuration, selecting density, and other operation information for the loader, such as the power-on process, the loader Mode Select key, the operator control panel, and functions of the Slot Select, Load/Unload, and Eject buttons.

Chapter 5, Configuring and Operating the DLT4700 Mini-Library, includes configuration, selecting density, and other operation information for the loader, such as the power-on process, the loader Mode Select key, the operator control panel, and functions of the Slot Select, Load/Unload, and Eject buttons.

Chapter 6, Troubleshooting Guide for the DLT4500/DLT4700 Mini-Library, gives instructions on how to clear failures and describes the necessary conditions to ensure the loader OCP pushbuttons operate effectively.

Chapter 7, Firmware Update (From Tape), provides an overview on updating the firmware, describes how to create a firmware update tape, and tells how to update the firmware.

Chapter 8, DLT4000 SCSI Interface, details the SCSI protocol features of the DLT4000 tape subsystem.

Appendix A, Technical Specifications, gives product specifications including physical dimensions, performance specifications, power requirements, environmental specifications, vibration and shock requirements, electromagnetic interference susceptibility, regulatory requirements, and reliability factors.

Appendix B, Definition of Vendor Unique Sense Data Information, describes the internal status codes for the DLT4000/DLT4500/DLT4700 product.

Appendix C, Sense Key Information, lists the sense key information for the DLT4000/DLT4500/DLT4700 product.

Appendix D, EEROM Packets (Last n Error Events), describes certain error events and error event logs.

Chapter 1

Overview and Features of the DLT4000/DLT4500/DLT4700 Product

1.1 In This Chapter

Chapter 1 includes the following main topics and sections:

Topic	Section
Product Overview	1.2
Fast Data Transfer Rate	1.3
High-Capacity	1.4
Compaction	1.5
Strong Media	1.6
Compatibility	1.7
Firmware Update Capability	1.8
Embedded Diagnostics	1.9

1.2 Product Overview

The DLT4000/DLT4500/DLT4700 Cartridge Tape Subsystem is a high-performance, high-capacity, streaming cartridge tape product designed for use on midrange and high-end computing systems. Using data compression and compaction, the DLT4000 drive features a formatted capacity of 40 GB and a sustained user data transfer rate of 3.0 MB/s.

The DLT4000 drive is a 5-1/4 inch form factor, half-inch tape drive. The design includes a dual-channel read/write head, Lempel-Ziv (DLZ) high-efficiency data compression, and tape mark directory to maximize data throughput and minimize data access time.

The DLT4500 Subsystem is a tape mini-library that performs automatic tape operations. The DLT4500 mini-library includes a high-capacity tape drive and a 5-cartridge, SCSI-2 medium changer device (loader). With a typical load/unload cycle time of 20 sec., the mini-library can provide unattended backup of 100 GB in about 11 hours.

The DLT4700 Subsystem is a tape mini-library that performs automatic tape operations. The DLT4700 mini-library includes the tape drive and a 7-cartridge SCSI-2 medium

changer device (loader). The mini-library provides unattended backup of 280 GB in less than 24 hours or up to 91 GB in an 8-hour shift in a compressed mode.

The drive and mini-libraries are available in a rack mountable form factor. Also, the DLT4000 drive, DLT4500 mini-library and DLT4700 mini-library are available with either single-ended or differential, fast driver/receivers.

1.3 Fast Data Transfer Rate

Used for unattended backups or archiving, the DLT4000/DLT4500/DLT4700 Subsystem allows you to back up a higher data capacity at a higher speed than earlier products. The DLT4000/DLT4500/DLT4700 Subsystem, when operating in a non-compressed mode, has a maximum transfer rate of 1.5 MB/s. When operating in the compressed mode, the maximum transfer rate is 3.0 MB/s write and over 2.5 MB/s read.

1.4 High-Capacity

The DLT4000 drive accepts the new DLTtape^{TM} IV cartridge. When this cartridge is used the amount of data you can store on the tape can be up to 20.0 GB native, or 40.0 GB of data using the compression mode. The actual amount of data stored in the compression mode is dependent on the data type. Compression can be selected on the drive front panel or from the host by using the SCSI MODE SELECT command.

The DLT4000 drive accepts the DLTtape^{TM} III cartridge. When this cartridge is used the amount of data you can store on the tape can be up to 10.0 GB native, or 20.0 GB of data using the compression mode. The actual amount of data stored in the compression mode is dependent on the data type. Compression can be selected on the drive front panel or from the host by using the SCSI MODE SELECT command.

The DLT4000 drive accepts the new DLTtape^{TM} IIIxt cartridge. When this cartridge is used the amount of data you can store on the tape can be up to 15.0 GB native, or 30.0 GB of data using the compression mode. The actual amount of data stored in the compression mode is dependent on the data type. Compression can be selected on the drive front panel or from the host by using the SCSI MODE SELECT command.

1.5 Compaction

The compaction feature of the DLT4000 drive helps you to store data efficiently. A read/write data cache of 2.0 MB allows working space for the compaction, enabling maximum use of available tape space.

1.6 Durable Media

The tape media can endure 500,000 passes and has a shelf life of 10 years, which provides superior media durability and data reliability.

1.7 Compatibility

Quantum is committed to maintaining compatibility within the DLT^{TM} family of tape drives. DLT4000/DLT4500/DLT4700 Subsystem tape products are the third generation of tape products, started with the DLT^{TM}260, DLT^{TM}600 and DLT^{TM}2000 drives.

The DLT4000/DLT4500/DLT4700 Subsystem complies with the ANSI standard for SCSI-2. The tape media format follows ECMA approved and ANSI proposed standards.

The DLTtape IV tape cartridge can be used in the DLT4000 drive. With this tape cartridge, you may store up to 20.0 GB native formatted data.

The DLTtape III and DLTtape IIIxt tape cartridge can be used in the DLT4000 drive. Using these tapes, the user may select tape densities for compatibility. The user can select tape density on the loader or drive front panel or by using the SCSI MODE SELECT command. The DLT4000/DLT4500/DLT4700 Subsystem can write 2.6, 6.0, 10.0 and 15.0 GB tape formats for 100% interchange compatibility with earlier drives. On a write from BOT, the DLT4000/DLT4500/DLT4700 Subsystem reformats the cartridge recorded at 2.6, 6.0, 10.0 or 15.0 GB format to the new specified format.

1.8 Firmware Update Capability

The DLT4000 drive includes Flash EEPROM technology that allows easy on-site installation of microcode updates from tape.

1.9 Embedded Diagnostics

The DLT4000 drive has embedded diagnostic software that tells you when head cleaning is required, and indicates diagnostic results, and drive operating status. The drive has embedded data logging of errors for failure analysis.

Chapter 2

Installing and Configuring the DLT4000 Tabletop

2.1 In This Chapter

Chapter 2 includes the following main topics and sections:

Topic	Section
Prepare for the Installation	2.2
Install the DLT4000 Tabletop Drive	2.3
Configure the DLT4000 Tabletop Drive	2.4
Connect the Cables	2.5
Test the Installation	2.6
DLT4000 Troubleshooting Chart	2.7

2.2 Prepare for the Installation

This section describes how to prepare for the installation of the DLT4000 tabletop drive including:

Topic	Section
Before You Start	2.2.1
Installation Setup	2.2.2
Site Setup	2.2.3
Site Guidelines	2.2.4

2.2.1 Before You Start

Installing the DLT4000 tabletop drive requires no special tools. If you need to change the switchpack settings on the rear panel, you will need a pen.

If you have problems during the installation, see Table 2-4 for troubleshooting.

2.2.2 Installation Setup

The steps for installation setup are:

Step	Action
1	Unpack and check your shipment.
2	Choose a site for the DLT4000 tabletop drive.
3	Power off the system on which the DLT4000 tabletop drive is to be installed.

2.2.3 Site Setup

Place the DLT4000 tabletop drive on a flat, sturdy, level area such as a desk or tabletop.

2.2.4 Site Guidelines

Be sure to follow these guidelines for your DLT4000 tabletop drive:

- The DLT4000 tabletop drive is designed to operate in harsh environments. However, use care in placing the drive in an environment that is free of dust and humidity.

Figure 2-1 shows the DLT4000 tabletop drive.

CARTRIDGE INSERT/RELEASE HANDLE (DOWN)
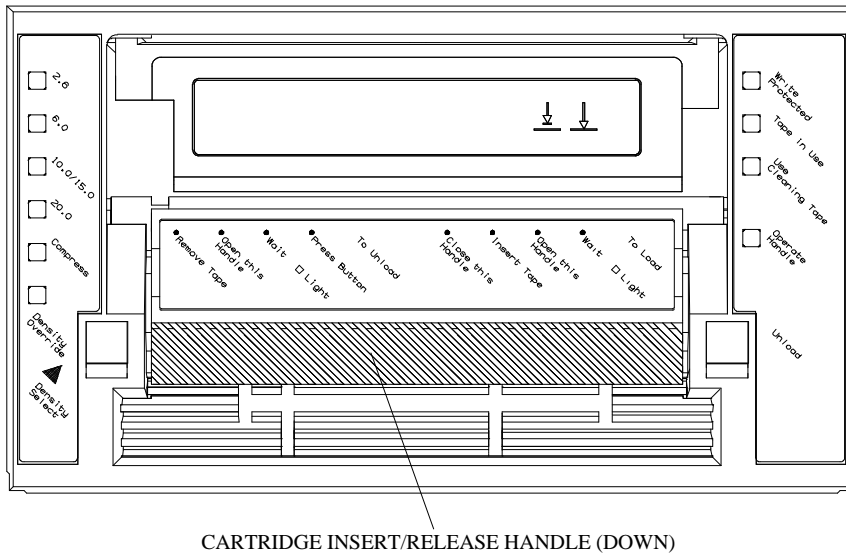
Figure 2-1 *Drive Front Panel*

Indicators (Left Side of Drive)	Indicators (Right Side of Drive)
Density indicator 2.6 (Yellow)	Write Protected indicator (Orange)
Density indicator 6.0 (Yellow)	Tape in Use indicator (Yellow)
Density indicator 10.0/15.0 (Yellow)	Use Cleaning Tape indicator (Yellow)
Density indicator 20.0 (Yellow)	Operate Handle indicator (Green)
Compress indicator (Yellow)	Beeper (audible) not visible
Density Override indicator (Yellow)	

Controls
Density Select button
Unload button
Cartridge insert/release handle

Figure 2-2 shows connector locations.
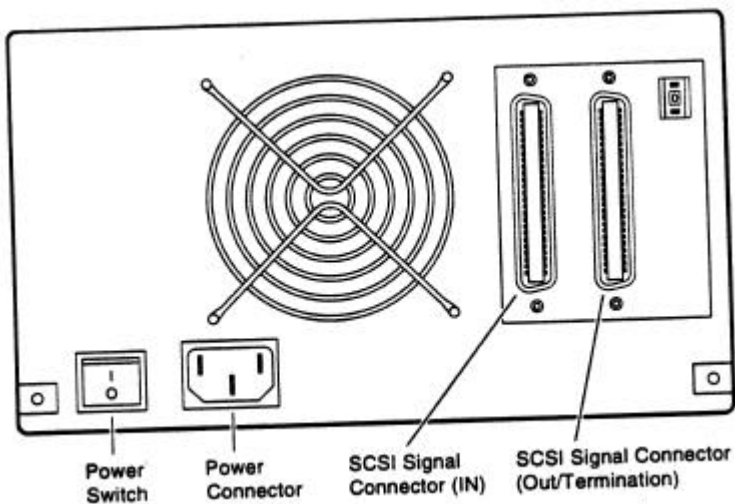
Figure 2-2 *DLT4000 Rear Panel*

2.3 Install the Drive

To install the DLT4000 tabletop drive:

Step	Action
1	Note the DLT4000 tabletop drive factory settings.
2	Review Section 2.4.1.
3	Configure the DLT4000 tabletop drive or use on your system:

If you need to …	See section
Disable parity checking	2.4.2
Change the SCSI ID	2.4.3

4	Connect the cables.

2.4 Configure the DLT4000 Tabletop

This section describes how to configure the DLT4000 tabletop drive including:

Topic	Section
Configuration Guidelines	2.4.1
Disable Parity Checking	2.4.2
Changing the SCSI ID	2.4.3

The DLT4000 tabletop drive is factory set to SCSI ID 5, unless otherwise specified. The drive is factory set for parity generation and checking is enabled.

2.4.1 Configuration Guidelines

All systems use the SCSI ID to identify, or address, the DLT4000 tabletop drive. Follow these guidelines when configuring the DLT4000 tabletop drive for use on your system:

If you are installing the DLT4000 as …	Then …
The only SCSI device on the bus or one of multiple SCSI devices on the bus	Be sure to use a SCSI ID that is unique from any other device or system ID on the SCSI bus.
The last or only device on the SCSI bus	You must terminate the bus by installing a terminator on the drive.

2.4.2 Disable Parity Checking

To disable parity, see your service representative.

2.4.3 Changing the SCSI ID

Change the SCSI ID via the pushbutton switch on the rear of the drive. Press the switch button(s) above or below the number display (0-7) to set the desired SCSI ID. Press the top button to increase the number or press the bottom button to decrease the number.

Figure 2-3 shows the SCSI ID pushbutton switch location.
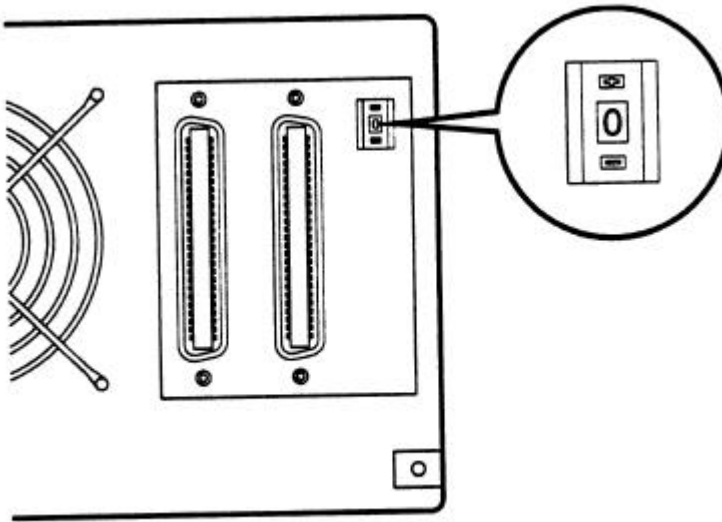
Figure 2-3 *Changing the SCSI ID via the Pushbutton Switch*

2.5 Connect the Cables

Section 2.5 includes the following topics:

Topic	Section
Examine the DLT4000 Rear Panel	2.5.1
Connect the SCSI Signal Cable	2.5.2
Terminate the SCSI Bus	2.5.3
Connect the Power Cord	2.5.4

2.5.1 Examine the DLT4000 Rear Panel

Examine the components on the DLT4000 rear panel to complete the physical installation (Figure 2-4).

Power Switch   Power Connector   SCSI Signal Connector (IN)   SCSI Signal Connector (Out/Termination)
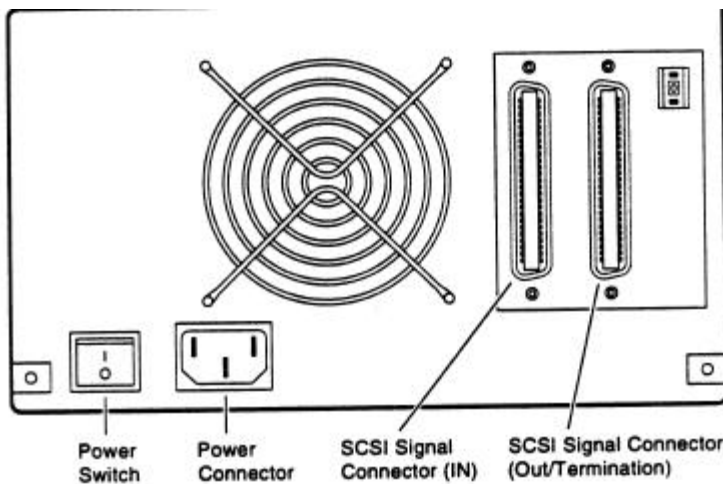
Figure 2-4 *Rear Panel Components*

2.5.2 Connect the SCSI Signal Cable

To connect the SCSI signal cable:

1. Connect one end of the SCSI cable to the leftmost SCSI signal connector on the DLT4000 rear panel.

2. Snap the wire cable clamps into place to secure the cable.

3. Connect the other end of the SCSI signal cable to the SCSI connector on your system or, for daisy-chained configurations, to another SCSI device.

See your system documentation for system SCSI connections.

2.5.3 Terminate the SCSI Bus

_____NOTE _____

The SCSI bus must be terminated at both ends and at least one device must supply terminator power.

_____

Table 2-1 tells you when and where to add a terminator.

Table 2-1 *Adding a Terminator*

If the DLT4000 is …	Then …
The last or only device on the bus and you are going to terminate the cables externally	1. Connect the SCSI terminator to one of the SCSI signal connectors on the DLT4000 rear panel. 2. Snap the wire cable clamps into place or tighten screws (whichever is supplied) to secure the terminator.
Not the last or only device on the SCSI bus	Be sure to install the terminator at the end of the bus.

The DLT4000 tabletop drive can be configured to supply TRM PWR on the bus by adding a jumper to the pins labeled TRM PWR on the controller printed circuit board adapter (PCBA).

2.5.4 Connect the Power Cord

To connect the power cord:

1. Ensure the DLT4000 power switch is set to 0.

2. Connect the power cord to the DLT4000 power connector. Make sure the connector is fully seated.

3. Connect the other end of the power cord to a nearby ac outlet.

2.6 Test the Installation

Section 2.6 includes the following topics:

Topic	Section
Run the Power-On Self-Test (POST)	2.6.1
What to Do after POST	2.6.2

2.6.1 Run POST

To test the installation for the DLT4000 tabletop drive by running POST:

1. Turn on the system power.

2. Set the power switch on the DLT4000 rear panel to on. POST runs automatically.

3. Observe the indicators on the DLT4000 front panel. Ensure the indicator sequence of events is the same as in Table 2-2 . Events on the right and left sides happen at the same time.

Table 2-2 *POST*

Event	Action
1	The indicators on the right front panel turn on sequentially from top to bottom. All indicators stay on for a few seconds.
2	All indicators on the left front panel turn on at the same time for about three seconds and then turn off.
3	The green Operate Handle, the orange Write Protected, and the Yellow Use Cleaning Tape indicators turn off. The yellow Tape in Use indicator blinks while the tape drive initializes.
4	After initialization, if no cartridge is loaded, the yellow Tape In Use indicator turns off, the green Operate Handle indicator turns on, the handle unlatches, and the beeper sounds.

For more information on what happens after initialization when a cartridge is present, but the handle is down; or a cartridge is present, but the handle is up (not recommended), see Section 3.5.4 in Chapter 3.

POST completes in about 13 seconds and the drive responds normally to all commands. However, it might take longer for the media to become ready. After a bus reset, the tape drive responds within a bus selection time-out period.

2.6.2 What to Do after POST

Table 2-3 *After POST*

If …	Then …
All the events in Table 2-2 took place	POST succeeded. Bring up the system and run the optional system tests. See Chapter 3 for operating the drive and selecting density.
All left- or right-side indicators on the DLT4000 front panel blink only	POST failed. See Table 2-4.

2.7 DLT4000 Troubleshooting Chart

If the DLT4000 tabletop drive fails during POST or operation, use Table 2-4 to determine the problem and the action to take.

Table 2-4 *DLT4000 Troubleshooting Chart*

If …	Then …	You should …
Your system does not recognize the DLT4000 tabletop drive	Your system might not be configured to see the SCSI ID	Configure your system to see the ID.
	The SCSI ID might not be unique	Change the SCSI ID and reconfigure the system. The new ID is effective at the next power-on.
	The parameters for your SCSI adapter might be incorrect	Check your SCSI adapter installation.
	The SCSI signal cable might be loose	Make sure the connector on each end of the cable is fully seated.
	The SCSI terminator might not be present or might be loose	Install the terminator; make sure the terminator is fully seated.
	The SCSI bus might not be correctly terminated	If the DLT4000 tabletop drive is the last or only device on the bus, make sure the terminator is installed on the DLT4000 tabletop drive. If the DLT4000 tabletop drive is not the last or only device on the bus, check the cable connections and make sure the terminator is installed at the end of the bus.
	The SCSI terminator might not be at the end of the bus, or more than two terminators might be present	Be sure to install a terminator at each end of the bus. One terminator is usually installed at the system.

Table 2-4 *DLT4000 Troubleshooting Chart (cont'd)*

If …	Then …	You should …
Your system does not recognize the DLT4000 tabletop drive	1. The SCSI bus might be too long. 2. Too many devices might be on the bus.	1. Limit the bus length to the ANSI SCSI standard of 6 meters (19 feet) for single ended (SE) or 25 meters (82 feet) for differential. 2. Limit the number of devices on the bus including the system) to eight. Check your system configuration rules.
The DLT4000 tabletop drive does not power up	The DLT4000 tabletop drive has no power	Check the DLT4000 power cord connections with the DLT4000 power switch off.
All right- or all left-side indicators on the DLT4000 front panel blink	A drive fault has occurred	Try to unload the tape and reinitialize the drive by pressing the Unload button or turn drive power off and then on again. The right- or left-side indicators stop blinking and the drive tries to reinitialize. The indicators turn on steady again and go off if the test succeeds.
You find fatal or nonfatal errors for which you cannot determine he cause	The bus termination or SCSI signal cable connections might be incorrect	Ensure the SCSI bus is terminated.
	The ac power source grounding might be incorrect	Use an ac outlet for the DLT4000 tabletop drive on the same ac line powering the system.

After taking the action listed in Table 2-4, power on the DLT4000 tabletop drive to rerun POST. If all right- or left-side indicators blink again, you most likely have a hardware failure.

Chapter 3

Configuring and Operating the DLT4000 Basic Tape Drive

3.1 In This Chapter

The configuration section in this chapter applies to the basic drive without the SCSI ID switchpack and power supply. (Chapter 2 applies to configuring the tabletop). Chapter 3 includes these main topics and sections:

Topic	Section
Before You Install the DLT4000 Drive	3.2
Selecting Density	3.3
Overview of the Front Panel	3.4
Description of Controls and Indicators	3.5
Description of the Tape Cartridge	3.6
Loading a Cartridge	3.7
Using the Cleaning Tape Cartridge	3.8
Unloading a Cartridge	3.9
Preserving Cartridges	3.10

3.2 Before You Install the DLT4000 Drive

Section 3.2 includes:

Topic	Section
Disabling Parity Checking	3.2.1
Changing the SCSI ID	3.2.2
Setting the TRM PWR jumpers	3.2.3
Locating the SCSI Cable and Power Connectors	3.2.4

3.2.1 Disabling Parity Checking

If your system does not generate parity, you can disable parity checking by adding a jumper to the SCSI connector on the left side of the DLT4000 drive (Figure 3-1).

_____**NOTE** _____

A jumper must always be placed on the Remote ID Present position (Figure 3-2) for the host to recognize any ID selection on this connector using jumpers. The default ID is factory set at 5.

_____

To disable parity:

1. Use Figure 3-1, Number ❷, to locate the SCSI ID connector on the drive.
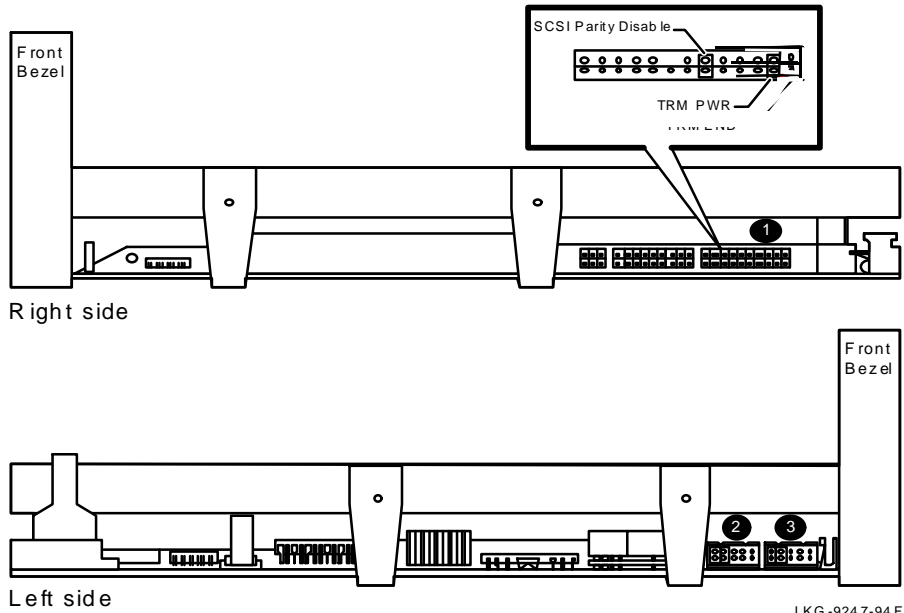
❶TRM PWR Connector	❷SCSI ID Connector	❸Loader Connector

Figure 3-1 *DLT4000 Drive Connectors*

Figure 3-2 shows what the pins on the SCSI ID connector represent.

LKG-9295-94F
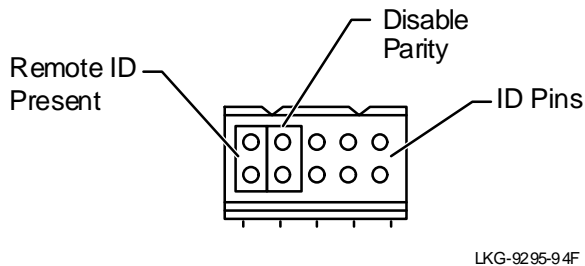
Figure 3-2 *SCSI ID Connector Pins*

_____**NOTE** _____

A jumper must always be placed on the Remote ID Present position
(Figure 3-2) for the host to recognize any ID selection on this connector.
_____

2.   Place the jumper in the disable parity check position, as shown in Letter I, Figure 3-3.

8 - Bit
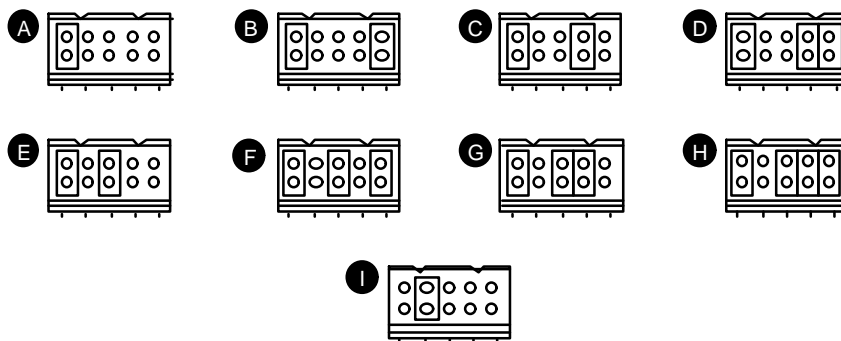
LKG-9294-94f

A. SCSI ID 0	D. SCSI ID 3	G. SCSI ID 6
B. SCSI ID 1	E. SCSI ID 4	H. SCSI ID 7
C. SCSI ID 2	F. SCSI ID 5	I. Disable parity checking. The jumper goes in this position with any SCSI ID you choose.

Figure 3-3 *Jumper Positions*

3.2.2 Changing the SCSI ID

The drive is shipped with SCSI ID 5, unless otherwise specified. You can change the SCSI ID by adding jumpers to the drive's SCSI connector (Figure 3-1).

To change the SCSI ID:

1. Use Figure 3-1, number ❷, to locate the SCSI ID connector on the drive.

2. Choose a SCSI ID from 0 to 7.

3. Use Figure 3-3, to see where to place the jumpers for the ID you choose. For example, if you chose SCSI ID 1, place the jumpers in the same positions as those in Letter B.

3.2.3 Setting the TRM PWR (Single-ended Only) Jumper

_____**NOTE** _____

The Small Computer System Interface (SCSI) bus must be terminated at both ends of the bus, and at least one device must supply terminator power.

_____

The DLT4000 drive does not have active termination. You can configure the DLT4000 drive to supply termination power.

To supply terminator power for the SCSI bus:

1. Use Figure 3-1, number ❶, to locate the TRM PWR connector on the drive.

2. Place jumper in the positions shown in Figure 3-4, number❷
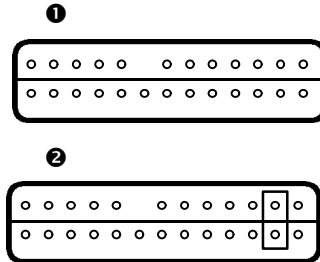
Figure 3-4 *Jumper Settings for TRM PWR*

❶	No Term Power	❷	Term Power

3.2.4 Locating the SCSI Cable and Power Connectors

To install the DLT4000 drive, note the location of the rear connectors (Figure 3-5).
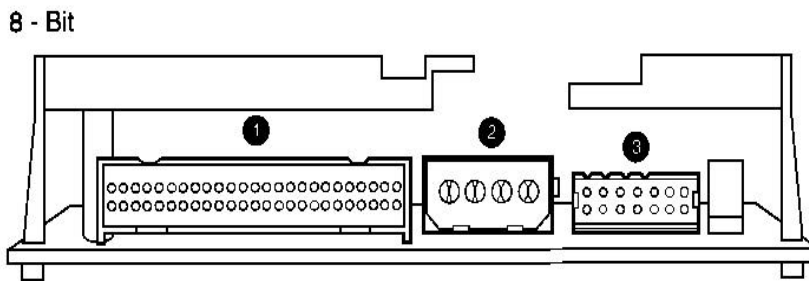
Figure 3-5 *DLT4000 Rear Connector*

❶	SCSI Connector	❷	Power Connector
❸	Power Connector (Custom Power Connection)		

3.3 Selecting Density

Section 3.3 describes the drive's density select features.

_____**CAUTION** _____

If a prerecorded tape is used and write from beginning of tape (BOT), all prerecorded data is lost. This includes density changes, since they only occur when writing from BOT.

_____

Ways of Selecting Density

Using DLTtape IV the density defaults to 20.0 GB native. The only selection is for compression on or off.

Using DLTtape III the density defaults to 10.0 GB native. The only selection for this cartridge is 2.6, 6.0, 10.0 GB compression off or 20.0 GB compression on.

Using DLTtape IIIxt the density defaults to 15.0 GB native or 30.0 GB compression.

Using DLTtape IV the user can select density by any of the following operations:

1. On all read operations and all write append operations, the recorded density is the density to be used.

2. On a Write from BOT, the tape density may be changed by:

    •   The Density Select button. Using the Density Select button always overrides a host selection.

    •   A programmable Host Selection via your operating system. (The Density Override indicator is off, indicating automatic or host density selection.)

    •   Native Default density 20.0 GB and Compress (assuming the Density Select button or the host selection was not used.)

How to Select Density

To select density with the DLT4000 drive:

1. Load the tape in the drive. The yellow Tape in Use indicator blinks while the tape loads and calibrates.

2. After calibration completes, Tape in Use remains lit.

3. The indicator shows the tape's prerecorded density, such as 2.6 GB or 6.0. GB

4. You can use the drive's control panel at various times, not just after loading a tape. Density selection is inactive until the write from BOT command is issued. The controller remembers the density selection state until you do one of the following:

    - Change the density selection
    - Unload the tape

Density Select Example

If you have loaded a tape with a prerecorded 2.6 GB density and you use the Density Select button to select 10.0 GB density, the following should happen:

- The 2.6 indicator remains lit—density has not changed yet and the steady light indicates recorded tape density
- The 10.0/15.0 indicator blinks—density change is pending
- Density Override lights

When a write from BOT occurs, the following should happen:

- The 2.6 indicator turns off
- 10.0/15.0 indicator is on steady
- Density Override remains lit

Table 3-1 shows the results of density selection.

Table 3-1 *Results of Density Selection*

If …	Then …
The Density Select button is not used	The indicators show the actual density when the tape is reading and writing. The indicators are on steady and Density Override is off.
The Density Select button is used, and if the actual tape density is the same as the density you selected	The actual density and the Density Override light. For example, if the actual tape density is 10.0 GB and the selected tape density is 10.0 GB, then the indicator next to 10.0/15.0 lights.
The Density Select button is used, and if the actual tape density differs from the density selected	1. The indicator with the actual density is on steady 2. The indicator with the selected density blinks 3. Density Override lights steady For example, if the actual tape density is 10.0 GB and the selected density is 6.0 GB, 10.0/15.0 lights steady, 6.0 blinks, and Density Override indicator is on steady.

To select density over the SCSI bus:

1. Do a SCSI MODE SELECT with the density you want. For more details, see Chapter 8.

2. Write data to the tape from BOT.

3.4 Overview of the Front Panel

The DLT4000 drive has the following indicators and controls for operating the drive (Figure 3-6):

Figure 3-6 shows the DLT4000 drive indicators and controls.

CARTRIDGE INSERT/RELEASE HANDLE (DOWN)
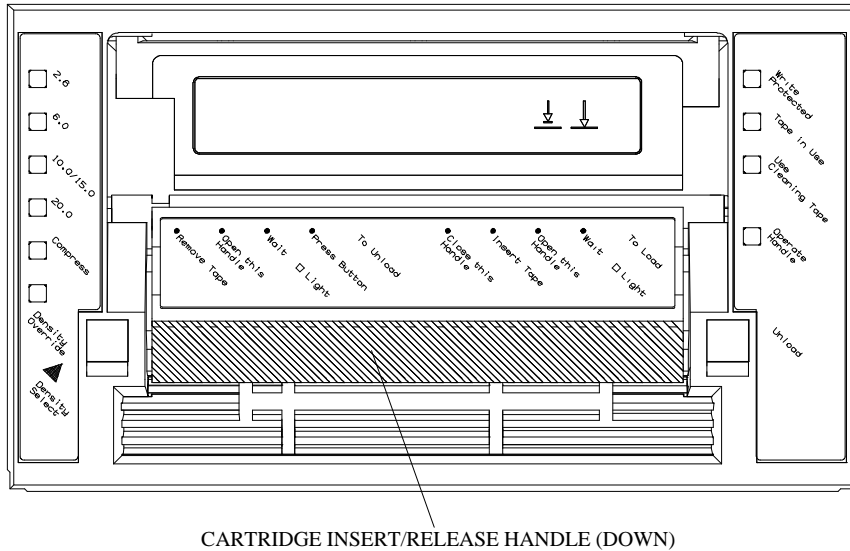
Figure 3-6 *DLT4000 Indicators*

Indicators (Left Side of Drive)	Indicators (Right Side of Drive)
Density indicator 2.6 (Yellow)	Write Protected indicator (Orange)
Density indicator 6.0 (Yellow)	Tape in Use indicator (Yellow)
Density indicator 10.0/15.0 (Yellow)	Use Cleaning Tape indicator (Yellow)
Density indicator 20.0 (Yellow)	Operate Handle indicator (Green)
Compress indicator (Yellow)	Beeper (audible) not visible
Density Override indicator (Yellow)	

Controls	
Density Select button	Unload button
Cartridge insert/release handle	

3.5 Description of Controls and Indicators

Section 3.5 includes the following sections:

Topic	Section
Beeper	3.5.1
Unload Button	3.5.2
Cartridge Insert/Release Handle	3.5.3
Indicator Action during Power-on Self-test and Operation	3.5.4

3.5.1 Beeper

A beeper sounds when you can operate the cartridge insert/release handle. When you hear the beep, the green Operate Handle indicator should be on.

3.5.2 Unload Button

The Unload button is used primarily to unload the tape. When the user pushes Unload, the DLT4000 drive waits until an active write to tape is completed before beginning the unload sequence.

The drive then rewinds the tape back into the cartridge. The tape must be completely rewound and unloaded into the cartridge before you can remove the cartridge from the drive. An unload operation may take 20 seconds from BOT.

If the drive is in error state (all right-side indicators are flashing on the front panel), pushing the Unload button causes the drive to reset and unload the tape if possible.

3.5.3 Cartridge Insert/Release Handle

Operate the cartridge insert/release handle to load a cartridge or to eject a cartridge only when the Operate Handle indicator is on, and after the momentary beep sounds. The handle lifts to the open position and lowers to the closed position. See Section 3.7 and Section 3.9 for the operating procedures.

3.5.4 Indicator Action during Power-On Self-Test and Operation

When you turn on system power, the drive performs the power-on self-test (POST). The sequence of events is:

Stage	What Happens
1	The indicators on the right front panel turn on sequentially from top to bottom. All indicators stay on for a few seconds.
2	The indicators on the left front panel turn on at the same time for about three seconds and then turn off.
3	The green Operate Handle, the orange Write Protected, and the yellow Use Cleaning Tape indicators turn off. The yellow Tape in Use indicator blinks while the tape drive initializes.
4	After initialization, the drive is in one of the following four states:

Drive State	Indicator Displays and Actions
a. No cartridge is present	1. The yellow Tape in Use indicator turns off. 2. The green Operate Handle indicator turns on. 3. The handle is unlatched. 4. The drive beeps momentarily. You can now raise the handle and insert a cartridge.
b. A cartridge is present and the handle is down	The drive loads the cartridge. When the yellow Tape In Use indicator stops blinking and stays on, the tape's actual density indicators. For example, if the actual tape density is 2.6 GB, then the indicator turns on next to the 2.6 label. When Density Override blinks, you can select a density. The drive is ready for use. (See Section 3.4.)
c. A cartridge is present, but the handle is up (not recommended)	The yellow Tape In Use indicator turns off. The green Operate Handle indicator flashes. When you lower the handle, the cartridge loads.
d. The drive detects an error condition	Right or left side indicators blink repeatedly. You may try to unload the tape and reinitialize the drive by pressing the Unload button or turn drive power off and then on again. The right- or left-side indicators stop blinking and the drive tries to reinitialize. The indicators turn on steady again and turn off if the test succeeds.
e. The drive is powered on with the handle open	The Operate Handle indicator is blinking; close handle and wait for a steady indications.

POST completes in about 15 seconds and the drive responds normally to all commands. However, it might take longer for the media to become ready. After a bus reset, the tape drive responds within a bus selection time-out period. Use this table to determine the drive's operating condition:

Table 3-2 *Determining the Drive's Operating Condition*

Label	Color	State	Operating Condition
Indicator (Right front panel)			
Write Protected	Orange	On	Tape is write-protected.
		Off	Tape is write-enabled.
Tape in Use	Yellow	Blinking	Tape is moving.
		On	Tape is loaded; ready for use.
Use Cleaning Tape	Yellow	On	Drive head needs cleaning, or the tape is bad (Section 3.8).
		Remains on after you unload the cleaning tape	Cleaning tape attempted to clean the drive head, but the tape expired, so cleaning was not done.
		After cleaning, turns on again when you reload the data cartridge	Problem data cartridge. Try another cartridge.
		Off	Cleaning is complete, or cleaning is unnecessary.
Operate Handle	Green	On	Okay to operate the cartridge/insert release handle.
		Off	Do not operate the cartridge insert/release handle.
		Blinking	Close handle and wait for a steady green indication before inserting cartridge.
All four right-side indicators or all left-side indicators	–	On	POST is starting.
		Blinking	An error has occurred. See Table 2-4, DLT4000 Troubleshooting Chart.

Table 3-2 *Determining the Drive's Operating Condition (cont'd)*

Label	Color	State	Operating Condition
Indicator (Left Front Panel)			
2.6	Yellow	On	Tape is recorded in 2.6 GB format.
		Blinking	Tape is recorded in another density. You selected this density for a write from BOT.
6.0	Yellow	On	Tape is recorded in 6.0 GB format.
		Blinking	Tape is recorded in another density. You selected this density for a write from BOT.
10.0/15.0	Yellow	On (default)	Tape is recorded in 10.0/15.0 GB format.
		Blinking	Tape is recorded in another density. You selected this density for a write from BOT.
20.0	Yellow	On (default)	Tape is recorded in 20.0 GB format.
		Blinking	Tape is recorded in another density. You selected this density for a write from BOT.
Compress	Yellow	On	Compression mode is enabled. (Compression can be done in 10.0/20.0 GB density only.)
		Off	Compression mode is disabled.
Density Override	Yellow	On	You selected a density from the front panel.
		Off (default)	Density to be selected by the host (automatic).
		Blinking	You are in density selection mode.
All four right-side or all left-side indicators		Blinking	A POST error occurred.

3.6 Description of the Tape Cartridge

The DLTtape III tape cartridge is a 4-inch, gray, plastic cartridge containing 1100 feet of 1/2 inch magnetic metal particle tape.

The DLTtape IIIxt tape cartridge is a 4-inch, white, plastic cartridge containing 1800 feet of 1/2 inch magnetic metal particle tape.

The DLTtape IV tape cartridge is a 4-inch, black, plastic cartridge containing 1800 feet of 1/2 inch magnetic metal particle tape.

3.6.1 Cartridge Write-Protect Switch

The tape cartridge has a write-protect switch to prevent accidental erasure of data. Before loading the tape cartridge into the drive, position the write-protect switch on the front of the cartridge (Figure 3-7).

- Left, so the cartridge is write-protected

- Right, so the cartridge is write-enabled

When you slide the switch to the left, the small orange rectangle is visible. This means data cannot be written to the tape. The arrow (beneath the orange rectangle and over the two lines on the write-protect switch) indicates data cannot be written to the tape.

On the right side of the write-protect switch an arrow over one line indicates that if you slide the write-protect switch to the right, data can be written to the tape.

Figure 3-7 shows the write-protect switch on the tape cartridge.

ZKO-1217-0
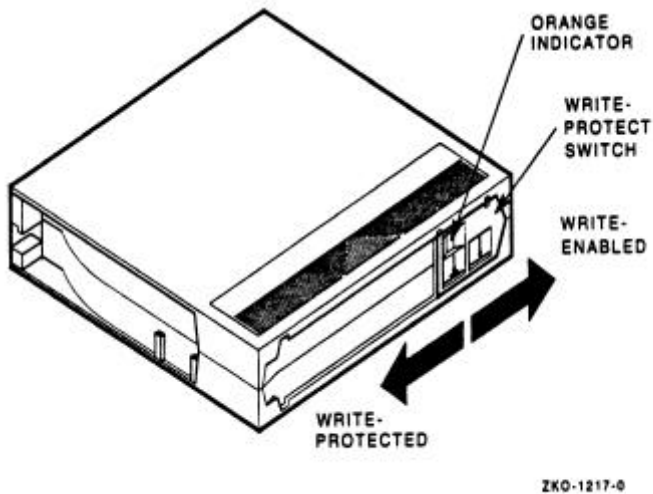
Figure 3-7 *Tape Cartridge*

3.6.2 Data Protection

When the cartridge write-protect switch is moved to the left, the drive turns on the write protect LED immediately. But, if the drive is writing to the tape, write protect does not take effect until the write completes.

Table 3-3 describes what happens to data protection when you move the write-protect switch before loading the cartridge.

Table 3-3 *Before Loading the Cartridge*

If you move the write-protect switch …	Then …
To the left, the tape is write-protected; the orange indicator on the cartridge shows	You cannot write data to the tape.
To the right, the tape is write-enabled	You can write data to the tape (if it is not software write-protected).

Table 3-4 describes what happens to data protection when you move the write-protect switch during operation.

Table 3-4 *After Loading the Cartridge and Operating*

If you move the write-protect switch …	Then …
From the write-protected position to write-enabled	The tape becomes write-enabled after a variable amount of time (seconds).
From write-enabled to write-protected	The tape becomes write-protected after a variable amount of time (seconds).

3.7 Loading a Cartridge

The following are more detailed steps for loading a cartridge (Figure 3-8):

1. When the Operate Handle green indicator is on steady, lift the cartridge insert/release handle open.

_____**NOTE** _____

If Operate Handle indicator is blinking, close handle and wait for a steady green indication, then lift handle and insert tape cartridge.
_____

2. Insert the cartridge.

3. Push the cartridge into the drive.

4. Push the handle closed.

_____**NOTE** _____

To prevent handle failures, assist the handle to the closed position. Do not flip it.
_____

The green indicator turns off and the yellow indicator blinks to show the tape is loading. When the tape is at the BOT marker, the yellow indicator turns on steady. The tape is now ready for use.

Figure 3-8 shows how to load a cartridge into the drive.
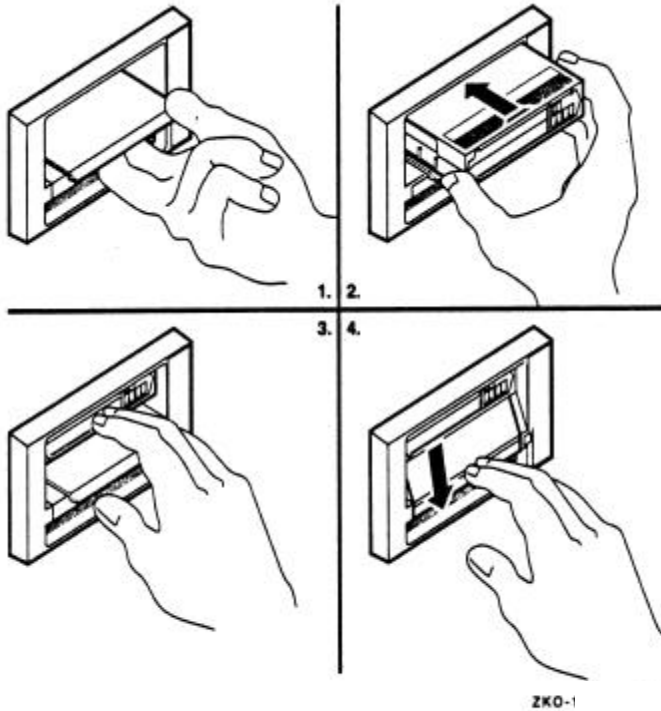
Figure 3-8 *Loading a Cartridge*

3.7.1 Tape in Use

Whenever the yellow Tape in Use indicator is on steady, the tape is ready to use. When the drive is calibrating, reading, writing or rewinding the tape, the Tape in Use indicator blinks.

Use Table 3-5 to determine what is happening during cartridge use.

Table 3-5 *What is Happening During Cartridge Use (Right Side Indicators)*

If …	It means …
The yellow indicator is on steady	A cartridge is loaded, but the tape is not moving. This can mean no application is communicating with the controller, or that the application is communicating, but is not delivering commands for tape motion.
The yellow indicator blinks irregularly	A calibration read or write is in progress.
The yellow indicator blinks regularly	The tape is loading, unloading, or rewinding.
The green indicator turns on and the beeper sounds	The tape is unloaded into the cartridge and the cartridge can now be removed, or if the drive is unloaded, a cartridge can now be inserted.
All four indicators blink	An error has occurred during operation. See Table 2-4, DLT4000 Troubleshooting Chart.

3.8 Using the Cleaning Tape Cartridge

Use Table 3-6 to determine when to use the cleaning cartridge.

Table 3-6 *When to Use the Cleaning Cartridge*

If …	It means …	And you should …
1. Use Cleaning Tape indicators (Figure 3-6)	The drive head needs cleaning or the tape is bad (see item 3)	Use the cleaning cartridge. Follow the instructions in Section 3.7 for loading a cartridge into the drive. When cleaning completes, the Use Cleaning Tape indicator shuts off and the beeper sounds for you to remove the cleaning cartridge.
2. A data cartridge causes Use Cleaning Tape to blink	The data cartridge may be damaged	Back up this data onto another cartridge. Discard the old cartridge, which may be damaged. A damaged cartridge may cause unnecessary use of the cleaning cartridge.
3. Use Cleaning Tape still indicators after you clean the drive head	Your data cartridge may be causing the problem	Try another data cartridge.
4. Use Cleaning Tape indicators after you load the cleaning cartridge	Cleaning has not been done and the cartridge is expired	Replace the cleaning cartridge.

_____ **NOTE** _____

The cleaning cartridge expires after about 20 uses.
_____

3.9 Unloading a Cartridge

_____**CAUTION**_____

Remove a cartridge from the drive before turning off host system power. Failure to remove a cartridge can result in cartridge and drive damage. When you remove the cartridge from the drive, return the cartridge to its plastic case to prolong the cartridge life.

_____

To unload a cartridge from the drive (Figure 3-9):

1. Press the Unload button (or issue the appropriate system software command). The yellow Tape in Use indicator blinks as the tape rewinds.

2. When the green indicator turns on (the beeper also sounds), pull the cartridge insert/release handle open to eject the cartridge.

_____**CAUTION**_____

Immediate extraction of the tape cartridge can lead to tape leader failure. Delay tape cartridge extraction by one to two seconds to avoid this problem.

_____

3. Remove the cartridge.

4. Push the handle closed.

ZKO-1217-0!
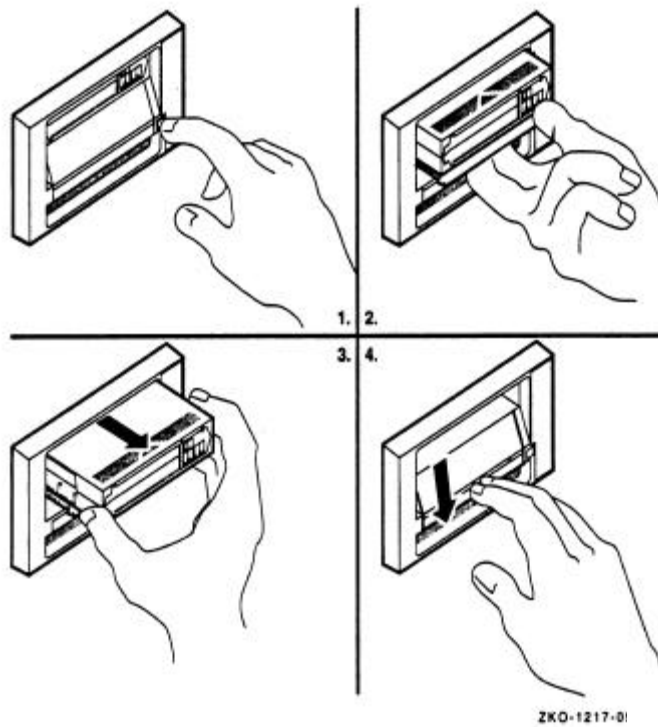
Figure 3-9 *Unloading a Cartridge*

3.10 Preserving Cartridges

For longer life of recorded or unrecorded cartridges, store cartridges in a clean environment with these conditions:

- Do not drop or bang the cartridge. This can displace the tape leader, making the cartridge unusable and possibly damaging the drive.

- Keep tape cartridges out of direct sunlight and away from heaters and other heat sources.

- Store tape cartridges in temperatures between 10°C and 40°C (50°F to 104°F). For longer cartridge life, always store the cartridge in its plastic container and in room environment conditions of 72°F ±7°F (22°C ±4°C).

- If the tape cartridge has been exposed to heat or cold extremes, stabilize the cartridge at room temperature for the same amount of time it was exposed---up to 24 hours.

- Do not place cartridges near electromagnetic interference sources, such as terminals, motors, and video or X-ray equipment. Data on the tape can be altered.

- Store tape cartridges in a dust-free environment where the relative humidity is between 20% and 80%. For longer cartridge life, store the cartridge at 40% ± 20% relative humidity.

- Place an identification label only in the slide-in slot on the front of the cartridge.

- Do not adhere labels to a cartridge anywhere except in the slide-in slot.

Chapter 4

Configuring and Operating the DLT4500 Mini-Library

4.1 In This Chapter

The configuration section in this chapter applies to the mini-library and its operation. Chapter 4 includes these main topics and sections:

Topic	Section
Introduction to the DLT4500 Mini-Library	4.2
Configure the DLT4500 Mini-Library	4.3
Installation Test	4.5
Operator Control Panel	4.6
Key Lock	4.8
Selecting Density	4.9
Tape Cartridge Description	4.10
Magazine Description	4.11
When to Use the Cleaning Tape Cartridge	4.12

4.2 Introduction to the Mini-Library

The mini-library includes a DLT4000 tape drive, a media loader, and a 5-cartridge removable magazine.

The same SCSI target controller board controls the tape drive and the media loader. If the controller detects the loader's presence when the system is turned on, the loader is presented as a SCSI-2 medium changer device on LUN 1.

If the user issues the SCSI-2 medium changer commands to the DLT4500 mini-library:

- Random access is enabled to the media stored in the magazine slots

- Sequential access is disabled to the media supported automatically in auto-loading mode

If the user does not issue the SCSI-2 medium changer commands, the default mode of operation is sequential access to the media supported automatically in auto-loading mode.

Auto-loading is implemented as a side effect of the SCSI UNLOAD command, as shown:

If …	Then …
An unload is specified	After winding the tape back into the cartridge and moving the cartridge from the drive to the magazine slot from which it came, the cartridge in the next slot is moved from the magazine into the drive and made ready.
The next slot is empty, or the cartridge unloaded was for the last slot in the magazine	No cartridge is loaded into the drive.

. **Configure and Install the DLT4500 Mini-Library**

This section describes how to configure and install the mini-library including:

-
- Connecting the SCSI signal cable to the mini-library

4 4. **Location of Controls, Switches, and Connectors**

Figures 4 1, -2 4- , 4 4 illustrate the front and rear panel layouts of the
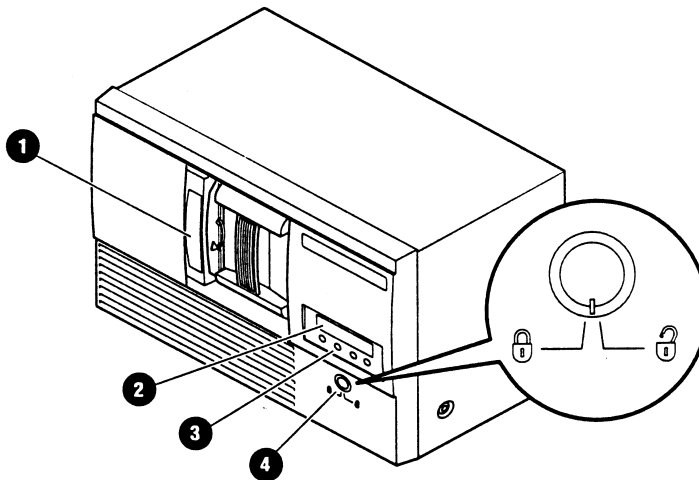
❶ Magazine Door	❷ Display	❸ Operator Buttons	❹ Key Lock

Figure 4-1 *Front of the DLT4500 mini-library*
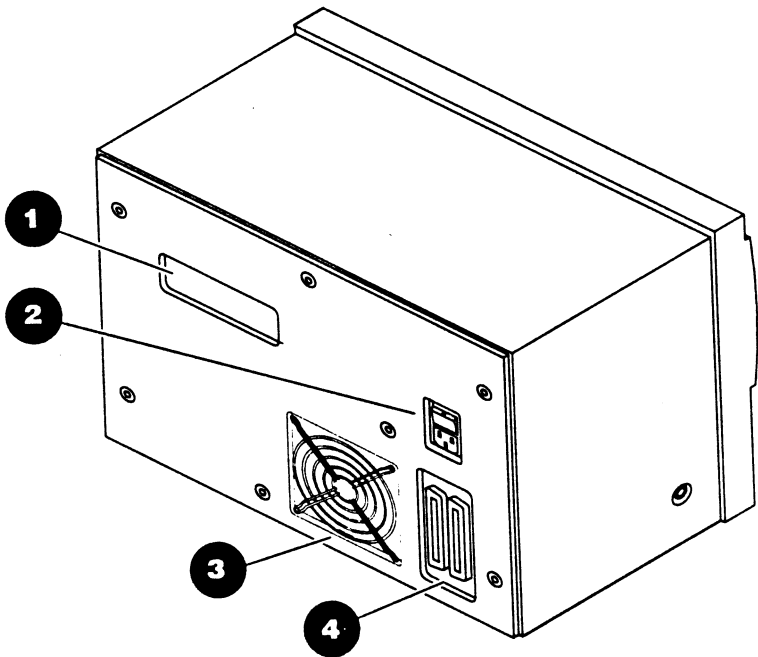
❶	Label	❷	Power Switch/Power Connector
❸	Fan	❹	SCSI Connectors

Figure 4-2 *Mini-Library Rear Panel Components*
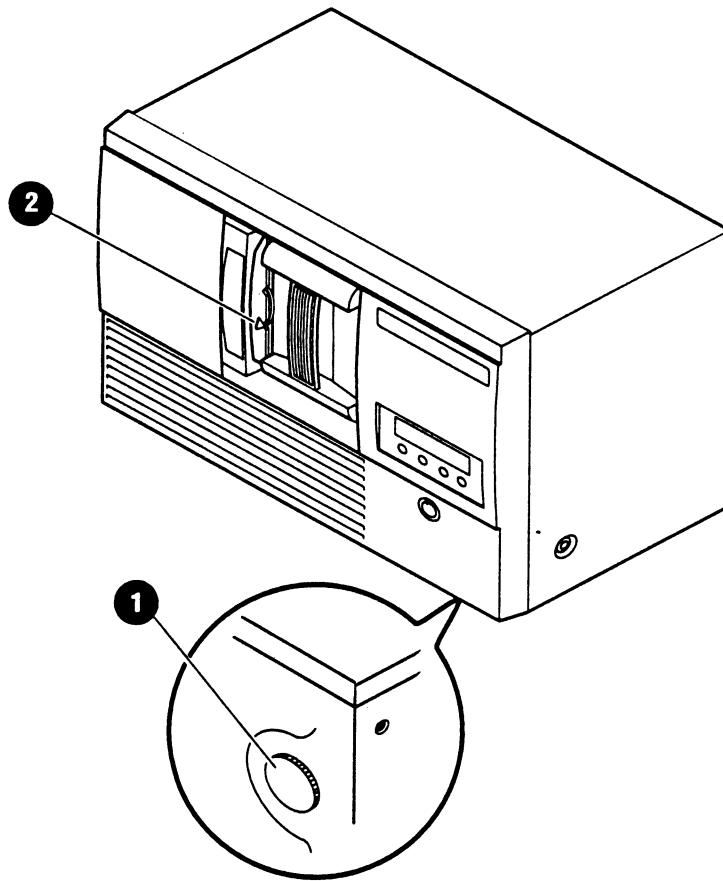
| ❶ | Shipping Screw | ❷ | Locking Lever |

Figure 4-3 *Loosening the Shipping Screw Under the Mini-Library*
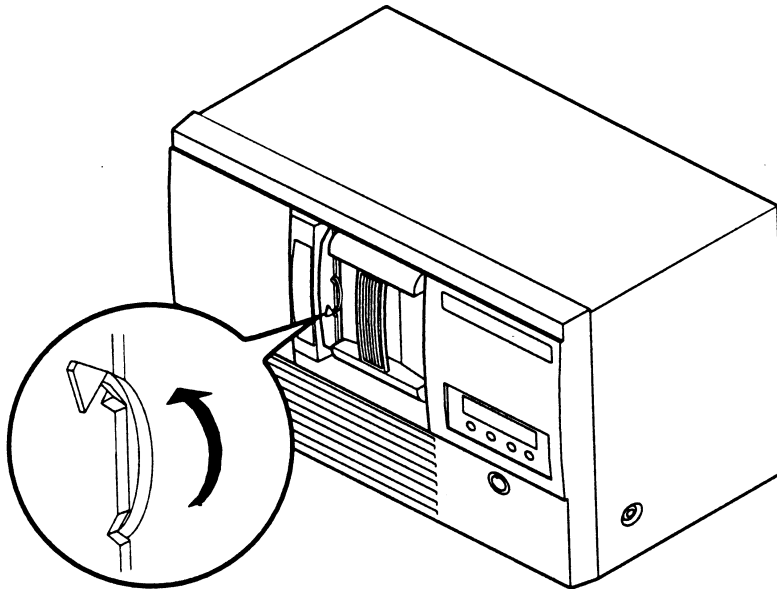
Figure 4-4 *Rotate the Locking Lever*

Lift the locking lever on the front of the mini-library (Figure 4-4) to rotate the magazine locking mechanism. This allows you to remove the magazine from the mini-library.

4.4.2 Configuration Guidelines

The mini-library is factory set to SCSI ID 5, unless otherwise specified.

The system uses the SCSI ID to identify, or address, the mini-library. Follow these guidelines when you configure the mini-library for your system:

If you are installing the mini-library as …	Then …
The only SCSI device on the bus or one of multiple SCSI devices on the bus	Be sure to use a SCSI ID that is unique from any other device or system ID on the SCSI bus. If you need to change the SCSI ID, see the section on setting the SCSI ID, later in this chapter.
The last or only device on the SCSI bus	You must terminate the bus by installing a terminator.

4.4.3 Setting the SCSI ID

Choose an unused SCSI ID between 0 and 7.

To set the SCSI ID via the front panel (See 4.8 Key Lock if the Operator Control Panel is locked or disabled):

1. Press and hold the Display Mode button (about 5 seconds) until the SCSI ID SEL message displays including the factory set SCSI ID (See 4.6.3 SCSI ID Select Mode displays).

Example

SCSI ID SEL   **SCSI ID 0**

2. Keep pressing the Select button quickly until the ID number you want displays (Figure 4-5).

3. Press the Display Mode button again. See the display message LDR RDY. At this point, the mini-library drive cannot yet recognize the SCSI ID.

4. Issue a bus reset or turn the mini-library power off and then on again so the drive can recognize the new SCSI ID.

4.4.4 Connecting the SCSI Signal Cable to the Mini-Library

Examine the components on the mini-library rear panel (Figure 4-2) to complete the physical installation.

To connect the SCSI signal cable:

1. Ensure the mini-library power is turned off.

2. Connect one end of the SCSI cable to an available SCSI signal connector on the mini-library rear panel.

3. Snap the wire cable clamps into place or tighten the screws (whichever are supplied) to secure the cable.

4. Connect the other end of the SCSI signal cable to the SCSI connector on your system, or for daisy-chained configurations, to another SCSI device.

    See your system documentation for system SCSI connections.

4.5 Test the Installation

This section tells you how to run the power-on self-test (POST) and what to do after POST.

4.5.1 Run POST

To test the installation for the mini-library by running POST:

1. Turn on the system power.

2. Set the power switch on the mini-library rear panel to on.

   Result: POST runs automatically when you turn on the mini-library.

3. Watch the display on the mini-library front panel. Ensure the sequence of events is the same as listed:

Event	Action
1	The message LDR RST (loader reset) displays.
2	The message LDR ACT (loader active) displays.
3	A series of numbers display as the mini-library elevator goes up and down.
4	The message DRV RDY (drive ready) or the message LDR RDY (loader ready) displays.
	a) LDR RDY : Cartridge is already in the drive.
	b) DRV RDY: cartridge is not loaded in the drive.

4.5.2 What to Do after POST

Verify whether the POST events took place.

If …	Then …
All the events took place	POST succeeded. The mini-library Autoloader is ready for operation.
All the events did not take place	POST failed. See Table 4-1

Error indications fall into these main categories:

- Magazine Error

- Loader Error

- Drive Error

- Controller Error

- Unknown Error

Table 4-1 *DLT4500 Mini-library Troubleshooting Chart*

Message…	Then …
LDR RST	1. Verify you terminated the SCSI bus. 2. Turn the mini-library Autoloader power off and then on again. If POST still does not succeed, call your service representative.
ERR MAG[1]	1. Message indicates the status of the cartridge(s) and/or magazine(s) are inconsistent. 2. Press the Open button, the mini-library attempts to clear the error. The doors open to allow removal of the magazine(s). Remove the magazine(s) and close the doors. Wait for the displayed message LDR RDY then open the doors and reinstall the magazine(s). Verify that cartridge(s) are inserted securely into the magazine(s) and the magazine(s) is/are not defective. If you cannot clear the error, call your service representative.
ERR LDR[1,2]	Message indicates an error was detected in the loader cartridge transport assembly.
ERR DRV[1,2]	Message indicates an error was detected in the tape drive.
ERR CTL[1,2]	Message indicates an error was detected in the controller. All loader errors cause the message to be displayed.
ERR UNK[1,2]	Message indicates an error was detected an error of unknown origin.

[1]In some errors, the mini-library Autoloader retries the error three times before showing failure

[2]When the user engages the Load/Unload button, the mini-library Autoloader attempts to clear the error.

When the user engages the Open button, the door is released to allow the user to open the door to access to the magazine.

If all of the actions taken by the user fails to clear the error, call your service representative.

4.6 Operator Control Panel

The operator control panel (OCP) has 4 pushbuttons (Figure 4-5 and Table 4-2).
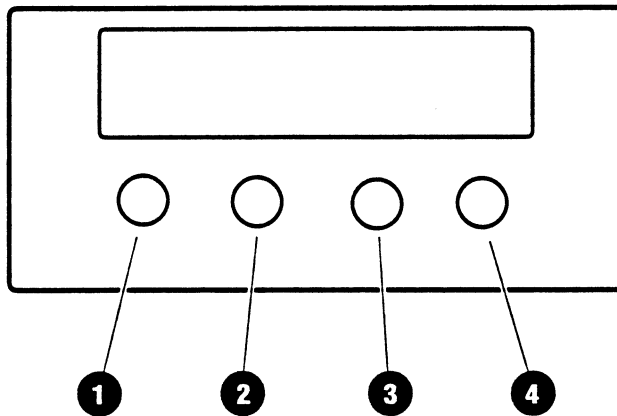
Figure 4-5 *Mini-Library Operator Control Panel*

❶ **Display Mode** ❷ **Select** ❸ **Load/ Unload** ❹ **Open**

The LCD Display features two lines of characters. Message content of either line can contain a mixture of messages and field codes.

Messages and field codes can be found in the following tables:

- Normal Mode - Table 4-3, 4-4
- Density Select Mode - Table 4-5, 4-6
- SCSI ID Select Mode - Table 4-7
- Firmware Update Mode - Table 4-8

Table 4-2 lists each button and its function.

Table 4-2 *Mini-Library Operator Control Panel*

Button	Function
Display Mode	The Display Mode button allows the user to select Normal, Density Select, SCSI ID Select mode, or Firmware Update Mode. Normal Mode is the default setting after either mini-library power-up or mini-library reset.
Select	• Selects SCSI ID and density. • Moves in increments the current slot number on the display to the next slot number .
Load/Unload	• Loads the currently selected cartridge into the tape drive • Unloads the cartridge currently in the tape drive • Resets the mini-library if a loader error has occurred. When the ERR LDR message displays, press the Load/Unload button to reset the mini-library.
Open	• Opens the magazine door to access the magazine for loading and unloading cartridges. • Unloads the cartridge currently in the tape drive and returns the cartridge to its original slot. Then, opens the magazine door.

4.6.1 Normal Mode Displays

In Normal Mode the two line display is defined in figure 4.6.

Autoloader Status (reference table 4-3).						
HC		SLOT NUMBER		DENSITY		WP

Figure 4-6 *Normal Mode Field Definition*

Table 4-3 lists the line one displayed messages during Normal Mode operation.

Table 4-3 *Normal Mode, Line One*

Display Message	Tells you …
DRV ACT	Tape is reading or writing
DRV RDY	A cartridge is in the drive and the tape is not moving.
DRV REW	Tape is rewinding.
LDR RDY	Power is on and no cartridge is in the drive.
LDR ACT	Loader is moving a cartridge.
ERR MAG	The status of cartridges reported by the loader and the drive is inconsistent.
ERR LDR	A loader transfer assembly error occurred.
ERR DRV	A drive error occurred.
ERR CTL	A controller error occurred.
ERR UNK	An error of unknown origin occurred.

Table 4-4 lists the line two displayed field codes during Normal Mode operation.

Table 4-4 *Normal Mode, Line Two*

Display Message	Tells you …
HC	HC when displayed indicates the need to use a cleaning cartridge Blank indicates normal operation
SLOT NUMBER	Displays the current slot number containing the cartridge. Each current slot number flashes in the display when its corresponding cartridge moves to or from the drive. Also used with the ERR MAG or ERR LDR message to show the type of error.
DENSITY	Displays Cartridge Density: 2.6 — On steady indicates the tape is recorded in 2.6 format. 6 — On steady indicates the tape is recorded in 6 GB format. 10/15 — On steady indicates the tape is recorded in 10 GB format. 10/15C — On indicates Compression mode is enabled. Compression can be done in 10 and 20 GB density only. 20 — On steady indicates the tape is recorded in 20 GB format. 20C — On indicates Compression mode is enabled. Compression can be done in 20 and 40 GB density only.
WP	WP when displayed indicates the cartridge in the drive is write-protected by one of these methods: • The write-protect switch on the cartridge is set to the write-protect position • Host software write-protect qualifiers Blank indicates cartridge is write-enabled

4.6.2 Density Select Mode Displays

In Density Select Mode the two line display is defined in figure 4-8

DNS		CURRENT DENSITY		OVR
SEL		NEW DENSITY		OVR[1]

Figure 4-7 *Density Mode Field Definition*

Table 4-5 lists the displayed field codes during Density Select Mode operation.

Table 4-5 *Density Select Mode Messages*

Display Message	Tells you …
DNS SEL	The mini-library is in Density Select mode.
CURRENT DENSITY	Displays current tape density (2.6, 6, 10/15, and 20).
NEW DENSITY	Displays tape density to be used at the next write from BOT.
OVR	• On steady indicates you selected a density from the front panel. • Off (default) indicates density is selected automatically. • Flashing indicates a new density has been selected but not yet written to tape.
OVR[1]	Displays what the tape density is to be changed to.

Table 4-6 lists displayed cartridge current and new density messages during Density Select Mode operation.

Table 4-6 *Cartridge Density Display*

Display Message	Tells you …
2.6	• On steady indicates the tape is recorded in 2.6 format. • Flashing indicates the tape is recorded in another density. You selected this density for a write from BOT.
6	• On steady indicates the tape is recorded in 6 GB format. • Blinking indicates the tape is recorded in another density. You selected this density for a write from BOT.
10/15	• On steady indicates the tape is recorded in 10 GB format. • Flashing indicates the tape is recorded in another density. You selected this density for a write from BOT.
10/15C	• On steady indicates Compression Mode is enabled. Compression can be active in 10 and 20 GB density only. • Off indicates Compression Mode is disabled
20	• On steady indicates the tape is recorded in 20 GB format. • Flashing indicates the tape is recorded in another density. You selected this density for a write from BOT.
20C	• On steady indicates Compression Mode is enabled. Compression can be active in 20 and 40 GB density only. • Off indicates Compression Mode is disabled.

4.6.3 SCSI ID Select Mode

SCSI ID Select mode allows you to select the SCSI ID for the tape drive and to enter Code Update mode. If you turn power off and then on again or reset the mini-library, the SCSI ID you chose reappears after being stored.

Table 4-7 lists displayed messages during *Firmware Update Mode* operation.

Table 4-7 *SCSI ID SELECT Mode Display Message*

Display Message …	Tells you …
SCSI ID SEL	Mini-library is in SCSI ID Select mode
SCSI ID 0	SCSI ID is set to 0
SCSI ID 1	SCSI ID is set to 1
SCSI ID 2	SCSI ID is set to 2
SCSI ID 3	SCSI ID is set to 3
SCSI ID 4	SCSI ID is set to 4
SCSI ID 5	SCSI ID is set to 5
SCSI ID 6	SCSI ID is set to 6
SCSI ID 7	SCSI ID is set to 7

If you press the Select button while in SCSI ID Select mode, the stored SCSI ID you chose moves by one increment. If you press the Select button when the stored SCSI ID is 7, then the SCSI ID moves to 0.

Switch Functions

While in SCSI ID Select mode:

If you press and release the Display Mode button, the mini-library enters Normal mode.

4.7.4 Firmware Update Mode

In Normal Mode note, pressing the Display Mode button twice will put the mini-library in Firmware Update mode.

In Density Select Mode the two line display is defined in figure 4-9

Firmware Update
Mode

Figure 4-9 *Firmware Update Mode Field Definition*

Table 4-8 lists displayed messages during operation.

Table 4-8 *Firmware Update Mode Display Message*

Display Message	Tells you ...
Firmware Update Mode	Used for code updates; refer to Chapter seven of this manual.

Switch Functions

While in Firmware Update Mode:

When you press and release the Display Mode button once, the mini-library enters Normal mode.

4.8 Key Lock

The key lock on the front of the mini-library (Figure 4-1) enables or disables use of the operator control panel (OCP) (Figure 2-5). The key lock prevents unauthorized removal of the magazine or cartridges, providing a measure of data security.

To unlock or enable the OCP, turn the key toward the opened lock icon next to the key lock.

To lock or disable the OCP, turn the key toward the locked icon next to the key lock.

_____**CAUTION** _____

Do not force open the magazine door manually. Always use the Open button to open the door electronically.

_____

4.8.1 OCP Locked or Disabled

When you insert the magazine into the mini-library and close the magazine door, the elevator scans the magazine. The OCP pushbuttons are disabled.

4.8.2 OCP Unlocked or Enabled

The OCP pushbuttons unlocked or enabled allow operator intervention.

4.9 Selecting Density

This section describes the mini-library's density select feature.

The user can select density by using any of the following:

1. On a write from beginning of tape (BOT), tape density is selected by one of the following:

   • Front panel Density Select mode

   _____ **NOTE** _____

   The user can perform a front panel density selection at any time, but the selection takes effect only on the next write from BOT.

   _____

   • Programmable host selection via your operating system

   • Native default density 20 GB, 30 GB or 40 GB at 2:1 Compression (assuming you did not use the Select mode or the host selection)

2. On all read operations and all write append operations, the recorded density is the density to be used.

   _____ **CAUTION** _____

   Doing any write from BOT destroys existing data on tape.

   _____

4.9.1 Front Panel Density Select Mode

To select density via the front panel:

1. If a tape is loaded in the drive, the display shows the tape's pre-recorded density.

2. The user can use the mini-library OCP at various times, not just after you load a tape. Density selection is inactive until you issue the write from BOT command. The controller remembers the density selection state until you do one of the following:

   • Change the density selection

   • Press the Open button to open the door

3. Enter Density Select mode by pressing the Display Mode button and then the Select button on the OCP. Using Density Select mode always overrides a host selection.

Example

If you loaded a tape with a prerecorded 2.6 GB density and you use Density Select mode to select 10 GB density:

Before a write from BOT occurs, you should see the 2.6 show steady, and the 10 and OVR flash in the display:

```
LDR RDY
2.6    10   OVR
```

After a write from BOT occurs, you should see the selected density 10 and the OVR show steady in the display:

```
LDR RDY
       10   OVR
```

Table 4-9 shows results.

Table 4-9 *Results of not Using or Using Density Select Mode*

If …	Then…
You did not use Density Select mode	The display shows the actual density when the tape is reading and writing.
You used Density Select mode and the actual tape density is the same as the density you selected	The display shows the actual density on steady and OVR on steady.
You used Density Select mode and the actual tape density differs from the density you selected	On operation before Write from BOT, the display shows: 1. Actual tape density on steady 2. Selected density flashing 3. OVR flashing On operation after write from BOT, the display shows: 1. Selected density on steady 2. OVR on steady

4.9.2 Programmable Host Selection via Your Operating System

To select density via the SCSI bus:

1.   Do a SCSI MODE SELECT with the density you want. For more details, see the chapter on SCSI Interface. .

2.   Write data to the tape from BOT.

4.9.3 2 Default Density 20 GB, 30 GB, 40 GB at Compression

If you did not use the front panel density select mode or programmable host selection, the selection becomes the default density of 20 GB Compress using a DLTtape III, 30 GB Compress using a DLTtape IIIxt or 40 GB compress when using a DLTtape IV.

4.10 Description of the Tape Cartridge

The DLTtape IV tape cartridge is a 4-inch, black, plastic cartridge containing 1800 feet of 1/2 inch magnetic metal particle tape.

The DLTtape III tape cartridge is a 4-inch, gray, plastic cartridge containing 1100 feet of 1/2 inch magnetic metal particle tape.

The DLTtape IIIxt tape cartridge is a 4-inch, white, plastic cartridge containing 1800 feet of 1/2 inch magnetic metal particle tape.

4.10.1 Cartridge Write-Protect Switch

The tape cartridge has a write-protect switch to prevent accidental erasure of data. Before you load the tape cartridge into the drive, position the write-protect switch on the front of the cartridge (Figure 4-10). The switch can move to the:

- Left, so the cartridge is write-protected
- Right, so the cartridge is write-enabled

When you slide the switch to the left, the small orange rectangle is visible. This indicates data cannot be written to the tape. The arrow (beneath the orange rectangle and over the two lines on the write-protect switch) lets you know that data cannot be written to the tape.

On the right side of the write-protect switch is another symbol: an arrow over one line. This symbol indicates that if you slide the write-protect switch to the right, data can be written to the tape.

Figure 4-10 shows the write-protect switch on the tape cartridge.
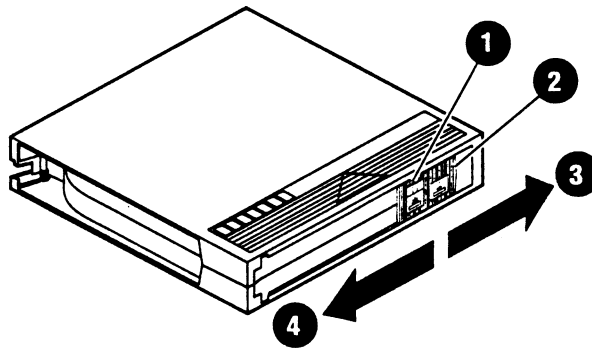
| ❶ | Orange Indicator | ❷ | Write-Protect Switch | ❸ | Write-Enabled | ❹ | Write-Protected |

Figure 4-10 *Write-Protect Switch on a Cartridge*

4.10.2 Data Protection

If you move the cartridge write-protect switch to the left, and then load the tape, the WP (write-protect) message displays.

Table 4-10 describes what happens to data protection when you move the write-protect switch before you load the cartridge.

Table 4-10 *Before Loading the Cartridge*

If you move the write-protect switch …	Then …
To the left, the tape is write-protected, with the orange indicator showing	You cannot write data to the tape.
To the right, the tape is write-enabled	You can write data to the tape (if it is not software write-protected).

4.11 Description of the Magazine

The front of the magazine has numbers 0 through 4 to indicate each slot number.

_____**NOTE** _____

Insert and remove all cartridges at the *front* of the magazine.
_____
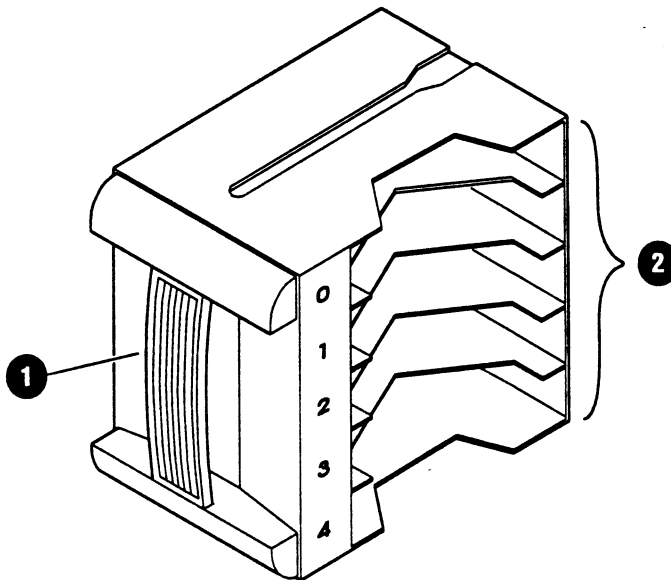
   ❶ Magazine Handle   ❷ Cartridge Slots

Figure 4-11 *DLT4500 Magazine*

4.11.1 Inserting a Cartridge into the Front of the Magazine

Before cartridge insertion:

1.   Grasp the cartridge with the write-protect switch on the right side facing you.

2.   Set the cartridge's write-protect switch to the desired position.

If you want to …	Then …
Write to the tape	Slide the switch to the right (orange indicator is not visible)
Write-protect the tape	Slide the switch to the left (orange indicator is visible)
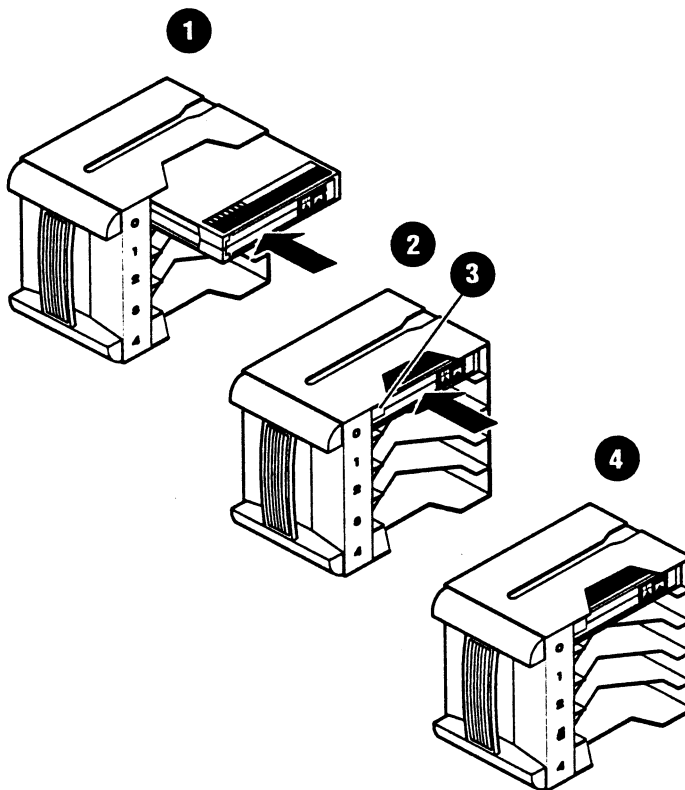
Figure 4-12 *Inserting a Cartridge into the Magazine*

To insert a cartridge into the magazine (Figure 4-12):

❶ Place the magazine on a flat surface with the slots facing you. Each slot is numbered—to ensure you are inserting the cartridge correctly in the front of the magazine. Usually, cartridges are inserted into consecutive slots.

❷ Insert the cartridge by pushing it into the slot until you hear a click.

❸ Notice a small metal tab. ❹ This holds the cartridge in place.
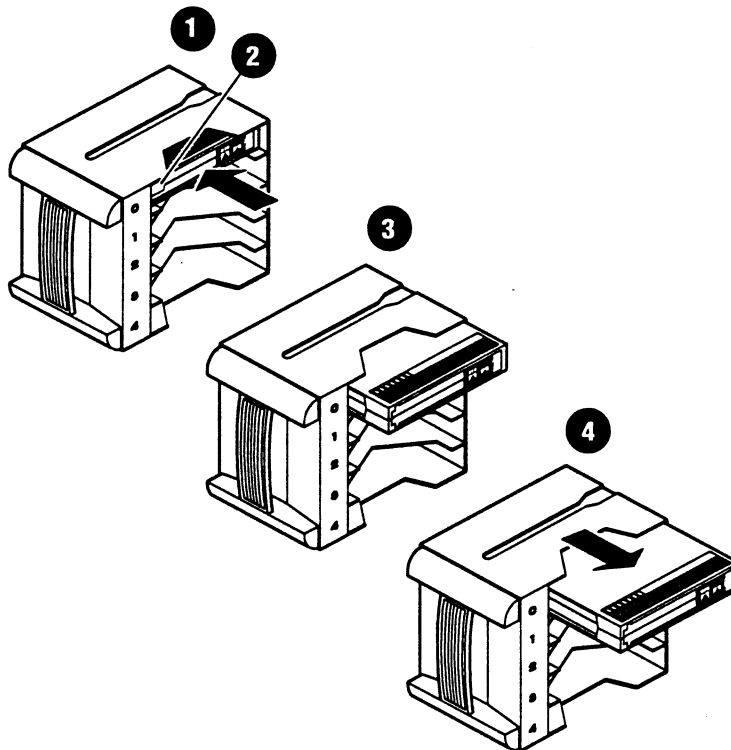
Figure 4-13 *Removing a Cartridge from the Magazine*

4.11.2 Removing a Cartridge from the Magazine

To remove a cartridge from the magazine (Figure 4-13):

❶ At the front of the magazine, ❷ where you can see the metal tab next to the slot number, press in on the cartridge until it stops and you hear a click.

❸ Then, release.

❹ The slot has a spring-release action.

_____**NOTE** _____

Never apply labels to the top or bottom of tape cartridges. Doing so can
cause cartridge jams in the mini-library. Use the space on the front of the
cartridge for labels.

_____

4.11.3 Removing the Magazine from the Mini-Library

To remove the magazine from the mini-library, first ensure the OCP is enabled or
unlocked via the key lock (Figure 4-1).

Then:

1. If a tape is loaded in the drive, press the Load/Unload button to unload the tape
    from the drive and load it into the magazine. Press the Open button (Figure 4-5)
    to open the door of the mini-library. (Pressing just the Open button also returns
    the tape to the magazine and opens the door.)

2. Slide the door all the way to the left.

3. Grasp the magazine's handle and pull the magazine out of the mini-library.

4.11.4 Installing the Magazine into the Mini-Library

To install the magazine into the mini-library, open the mini-library door by pressing
the Open button.

_____**CAUTION** _____

Do not force open the magazine door manually. Always use the Open
button to open the door electronically

_____

Ensure the door is moved all the way to the left.

1. Hold the magazine by the handle (Figure 4-11) and slide the magazine into the
    mini-library doorway. Since the magazine is slotted, you can insert the magazine
    in the correct orientation only.

2. Slide the door to close.

3. Ensure the door is fully closed before you proceed.

4.11.5 Selecting a Cartridge from the Magazine

After a successful initialization, the mini-library automatically selects the first slot containing a cartridge and the Select button becomes active.

To select a cartridge: press the Select button to advance to the next slot containing a cartridge.

4.11.6 Loading the Cartridge into the Drive

To load the cartridge from the magazine into the drive: press the Load/Unload button. Table 4-11 explains what happens after you press the button.

Table 4-11 *After Loading the Cartridge*

Stage	What Happens
1	The elevator moves to the selected slot.
2	The cartridge is then removed from the magazine and placed in the elevator.
3	The elevator moves to the drive position and inserts the cartridge into the drive.
4	The display reads LDR ACT until the tape loads to BOT.
5	After the cartridge is inserted into the drive, the display reads DRV ACT.
6	After the cartridge is fully loaded and at BOT, the display reads DRV RDY.

4.11.7 Unloading the Cartridge

_____**CAUTION** _____

Do not press the Load/Unload button until backup or other tape operations are stopped at the terminal. Doing so can result in operation failure and drive unavailability.

_____

If …	Then …
You want to unload the cartridge from the drive	Press the Load/Unload button. • The DRV REW message displays • The cartridge unloads from the drive and the display reads LDR ACT. When the cartridge returns to the magazine, the display reads LDR RDY.
The ERR LDR message displays, showing a malfunction	Press the Load/Unload button to reset the mini-library and try to clear the error.

4.11.8 Opening the Magazine Door

The Open button opens the magazine door for inserting or removing the magazine. The button is disabled when the key lock is in the locked or disabled position.

When …	Then …	You should …
A cartridge is not in the drive	The LDR RDY message displays before any operation begins.	Press the Open button. The door opens.
A cartridge is in the drive	The DRV RDY message displays before the operation begins	Press the Open button so the cartridge unloads from the drive and moves back into the magazine. The door opens.

Result: In both situations, once you close the door again, a magazine scan begins. The LDR ACT message displays. When the scan completes, LDR RDY message displays.

4.12 When to Use the Cleaning Tape Cartridge

Use Table 4-12 to determine when to use the cleaning cartridge.

Table 4-12 *When to Use the Cleaning Cartridge*

If …	It means …	And you should …
1. The HC message displays	The drive head needs cleaning or the tape is bad (item 3 in this table).	Use the cleaning cartridge. Follow the instructions in this chapter to insert a cartridge into the magazine and load into the drive. When cleaning completes, the cleaning cartridge unloads from the drive and returns to the magazine. The LDR RDY message displays.
2. A data cartridge causes the HC message to display frequently	The data cartridge may be damaged.	Back up this data onto another cartridge. Discard the old cartridge, which may be damaged. A damaged cartridge may cause unnecessary use of the cleaning cartridge.
3. The HC message still displays after you clean the drive head	Your data cartridge may be causing the problem.	Try another data cartridge.
4. The HC message displays after you load the cleaning cartridge	Cleaning has not been done and the cartridge is expired.	Replace the cleaning cartridge.

_____ **NOTE** _____

The cleaning cartridge expires after about 20 uses.
_____

Chapter 5

Configuring and Operating the DLT4700 Mini-Library

5.1 In This Chapter

The configuration section in this chapter applies to the mini-library and its operation. Chapter 5 includes these main topics and sections:

Topic	Section
Introduction to the Media Loader	5.2
Configure the DLT4700 Mini-Library	5.3
Mode Select Key	5.4
Selecting Density	5.5
Operator Control Panel (OCP)	5.6
Power-On Process	5.7
Slot Select, Load/Unload, and Eject Button Functions	5.8
Magazine	5.9

5.2 Introduction to the Mini-Library

The mini-library option includes a DLT4000 tape drive, a media loader, and a 7-cartridge removable magazine.

The same SCSI target controller board controls the tape drive and the media loader. The tape drive is always LUN 0. If the controller detects the loader's presence when the system is turned on, the loader is presented as a SCSI-2 medium changer device on LUN 1.

The SCSI-2 medium changer commands allow:

1.   Random access to the media stored in the magazine slots

2.   Sequential access of the media supported automatically in auto-loading mode

Auto-loading is implemented as a side effect of the SCSI UNLOAD command.

If …	And …	Then …
An unload is specified	A media loader is present	After winding the tape back into the cartridge and moving the cartridge from the drive to the magazine slot from which it came, the cartridge in the next slot is moved from the magazine into the drive and made ready.
The next slot is empty, or the cartridge unloaded was for the last slot in the magazine		No cartridge is loaded into the drive.

5.3 Configure the DLT4700 Mini-Library

This section describes how to configure the DLT4700 mini-library including:

Topic	Section
Configuration Guidelines	5.3.1
Disable Parity Checking	5.3.2
Change the SCSI ID	5.3.3

The DLT4700 mini-library is factory set to SCSI ID 5, unless otherwise specified.

If your system generates parity, the DLT4700 mini-library can check for correct parity on the SCSI bus.

5.3.1 Configuration Guidelines

The system uses the SCSI ID to identify, or address, the DLT4700 mini-library.
Follow these guidelines when configuring the DLT4700 mini-library for your system:

If you install the DLT4700 as …	Then …
The only SCSI device or one of multiple SCSI devices on the bus	Be sure to use a SCSI ID that is unique from any other device or system ID on the SCSI bus.
The last or only device on the SCSI bus	You must terminate the bus by installing a terminator.

5.3.2 Disable Parity Checking

To disable parity, see your service representative.

5.3.3 Change the SCSI ID

Change the SCSI ID via the pushbutton switch on the mini-library rear panel. Press
the switch button(s) above or below the number display (0-7) to set the desired SCSI
ID. Press the top button to increase the number or press the bottom button to decrease
the number.

Figure 5-1 shows the SCSI ID pushbutton switch location.
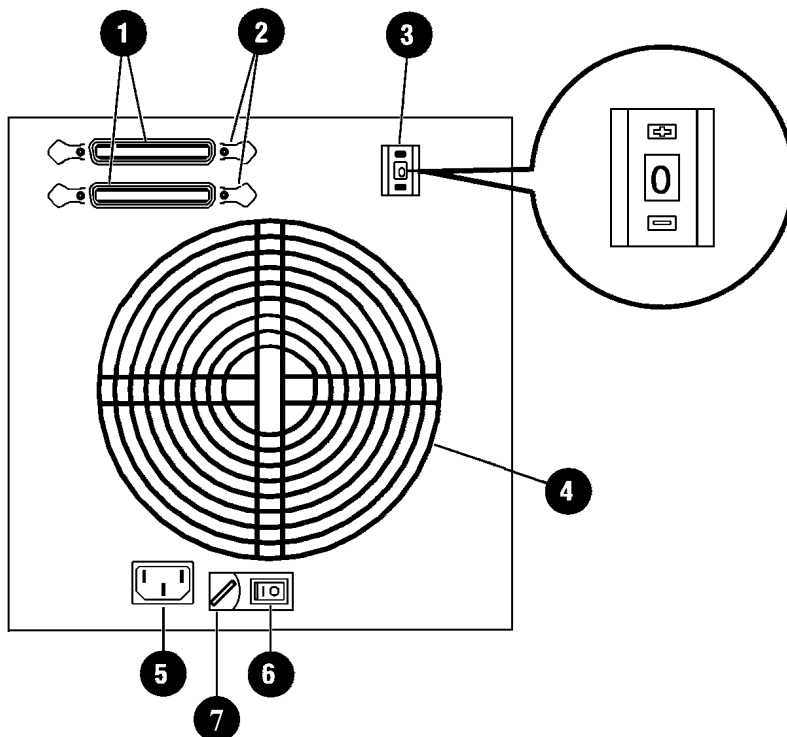
Figure 5-1 *Changing the SCSI ID via the Pushbutton Switch*

❶ SCSI Connector	❷ Wire Cable Clamps	❸ Pushbutton Switch
❹ Fan	❺ Power Connector	❻ Power Switch
❼ Voltage Selection Switch		

5.4 Mode Select Key

The Mode Select key (Figure 5-2), on the front of the loader, locks the loader transfer assembly into the enclosure and locks the receiver closed. The key has four modes:

Mode	Use
OCP Disabled	Operational
Automatic	Operational
Manual	Operational
Service	Servicing procedures

5.4.1 OCP Disabled Mode

When the magazine is inserted into the receiver and the receiver is closed, the loader transfer assembly scans the magazine. The first cartridge in the magazine automatically loads into the drive.

When you copy data to the tape, operations stop if one of the following happens:

- Storage capacity of the last tape cartridge is exceeded

- No tape cartridge is in the next sequential slot in the magazine

To lock the DLT4700 mini-library into the enclosure and lock the receiver, set the Mode Select key to OCP Disabled.

The following results of setting the Mode Select key to OCP Disabled are:

- The OCP pushbuttons are disabled.

- SCSI media changer commands are disabled.

- If the receiver were open and a magazine were then inserted, the lowest-numbered cartridge is automatically loaded into the drive. Subsequently, issuing the SCSI 'unload' command would unload the cartridge and load the next higher-numbered cartridge.
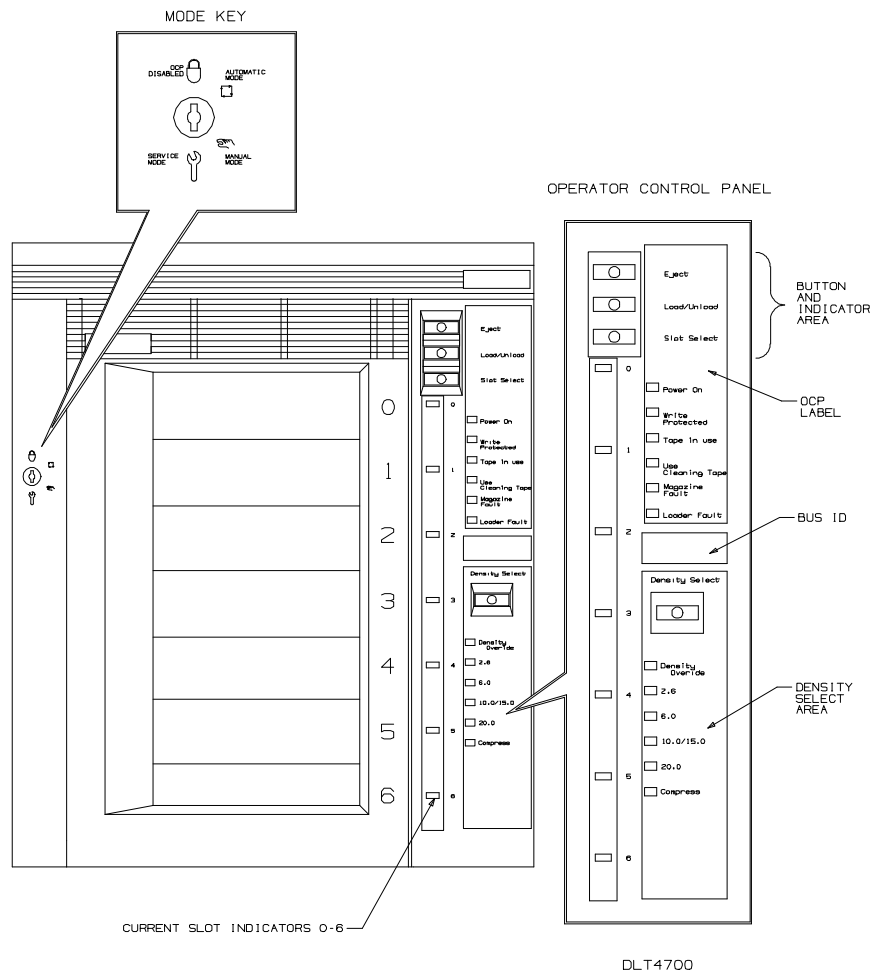
Figure 5-2 *DLT4700 Operator Control Panel* **Error! Bookmark not defined.**

5.4.2 Automatic Mode

This is the default or normal mode of the DLT4700 mini-library. This mode allows the DLT4700 mini-library to load and unload cartridges as needed during backup procedures.

When the user engages the Automatic Mode a SCSI 'unload' command is issued, not only is the currently loaded cartridge unloaded from the drive and restored to its position in the magazine, the next higher-numbered cartridge is loaded into the drive.

A SCSI 'load' command is unnecessary, except to load the lowest-numbered cartridge upon inserting the magazine.

When you copy data to the tape, operations stop if one of the following happens:

- Storage capacity of the last tape cartridge is exceeded

- No tape cartridge is in the next sequential slot in the magazine

To lock the DLT4700 mini-library into its normal operating position in the enclosure, but leave the receiver unlocked, set the Mode Select key to Automatic mode.

The following results of setting the Mode Select key to Automatic mode are:

- The OCP pushbuttons are enabled.

- SCSI media changer commands are enabled.

- Cartridges are sequentially loaded by the SCSI 'unload' command, but the lowest-numbered cartridge is not automatically loaded upon magazine insertion. Behavior in this mode is modified by the EEPROM parameters ENALDRAUTOLD (1) and DISLDRAUTOLDMC (0), which enable both sequential and random-access functionality.

5.4.3 Manual Mode

Automatic loading and unloading of cartridges does not occur in this mode. You must press the Load/Unload button to move each cartridge. This mode is most useful for, but not restricted to, copying specific files to or from tape. Basically, only the OCP pushbuttons are enabled, as SCSI commands are disabled.

To lock the DLT4700 mini-library into the enclosure, set the Mode Select key to Manual mode.

The following results of setting the Mode Select key to Manual mode are:

- The receiver is unlocked and can be opened.

- The OCP pushbuttons are enabled.

- SCSI move media commands are disabled.

- SCSI load/unload commands are disabled.

_____**NOTE** _____

During Manual mode, the cartridge returns to the magazine, but the current
Slot Select indicator does not advance forward to the next available cartridge.
_____

5.4.4 Service Mode

Service mode allows for servicing procedures.

- SCSI 'test unit ready' commands always return not ready.

For details on controls and indicators and operation, see the sections after Section 5.5
in this chapter.

5.5 Selecting Density

Section 5.5 describes the loader's density select feature.

Ways of Selecting Density

The user can select density by using any of the following:

1. On all read operations and all write append operations, the recorded density is the density to be used.

2. On a Write from BOT, the tape density may be changed by:

   - The Density Select button. Using the Density Select button always overrides a host selection.

   - A programmable host selection via your operating system. (The Density Override indicator is off, indicating automatic or host density selection.)

   - Native default density 20.0 GB and 40.0 GB Compress (assuming the use of a DLTtape IV and the Density Select button or the host selection was not used.)

   _____ **CAUTION** _____

   Doing any Write from BOT destroys data on tape.

   _____

How to Select Density

To select density with the DLT4700 mini-library:

1. Press the Load/Unload button to load the cartridge into the drive. The yellow Tape in Use indicator blinks while the tape loads and calibrates.

2. After calibration completes, the yellow Tape in Use indicator remains lit.

3. The indicator showing the tape's prerecorded density indicators, such as 2.6 or 6.0.

4. The user can use the loader operator control panel at various times, not just after loading a tape. Density selection is inactive until the write from BOT command is issued. The controller remembers the density selection state until you do one of the following:

   - Change the density selection

   - Eject the magazine from the loader

Density Select Example

If you have loaded a tape with a prerecorded 2.6 GB density and you use the Density Select button to select 10.0/15.0 GB density, the following should happen:

- The 2.6 indicator remains lit−density has not changed yet and the steady indicator indicates recorded tape density

- The 10.0/15.0 indicator blinks−density change is pending

- Density Override indicators

When a write from BOT occurs, the following should happen:

- 2.6 turns off

- 10.0/15.0 indicators steady

- Density Override remains lit

Table 5-1 shows the results of density selection.

Table 5-1 *Results of Density Selection*

If …	Then …
You did not select the Density Select button	The indicators show the actual density when the tape is reading or writing. The indicators are on steady and the Density Override indicator is off.
You select the Density Select button, and if the actual tape density is the same as the density you selected	The actual density and Density Override indicator is on. For example, if the actual tape density is 10.0 GB and the selected tape density is 10.0 GB, then the indicator next to 10.0/15.0 is on.
You select the Density Select button, and if the actual tape density differs from the density selected	1. The indicator with the actual density is on steady 2. The indicator with the selected density blinks 3. Density Override indicators steady For example, if the actual tape density is 10.0 GB and the selected density is 6.0 GB, 10.0/15.0 indicators steady, 6.0 blinks, and Density Override indicators steady.

To select density over the SCSI bus:

1. Do a SCSI MODE SELECT with the density you want. For more details, see Chapter 8.

2. Write data to the tape from BOT.

5.6 Operator Control Panel

The DLT4700 Operator Control Panel (OCP) has 4 OCP pushbuttons and 22 indicators (Table 5-2) used with the Mode Select key. See Section 5.4 for information on the Mode Select key and its functions. See Section 5.8 for more details on button and indicator operations.

Table 5-2 lists each button/indicator and its function.

Table 5-2 *DLT4700 Operator Control Panel*

Button/Indicator	Color	Function
Eject button	–	Opens the receiver, allowing access to the magazine for removal and insertion of cartridges. Also unloads the tape from the drive to the magazine, if a tape is inserted.
Eject indicator	Green	Indicates the user can press the Eject button to unload cartridges from the drive to the magazine and open the receiver. Is on when a magazine fault has occurred to indicate Eject is the only function available at that time.
Load/Unload button	–	• Loads the currently selected cartridge into the tape drive • Unloads the cartridge currently in the tape drive • Resets the mini-library if there is a loader fault
Load/Unload indicator	Green	You can press the Load/Unload button.
Slot Select button	–	Increments the current slot indicator to the next slot.
Slot Select indicator	Green	You can press the Slot Select button to move the current slot indicator to the next slot.
Power On indicato	Green	The DLT4700 mini-library is in a known good power state and dc voltages are within tolerance).

Table 5-2 *DLT4700 Operator Control Panel (Cont'd)*

Button/Indicator	Color	Function
Write Protected indicator	Orange	Indicates the cartridge in the drive is write-protected by one of these methods: • The write-protect switch is set to the write-protect position • Host software write-protect qualifiers • When off, indicates that the cartridge in the drive is write-enabled.
Tape In Use indicator	Yellow	Indicates tape drive activity as follows: • Slow blinking indicates tape is rewinding • Rapid blinking indicates tape is reading or writing • When on steadily, indicates a cartridge is in the drive and the tape is not moving • When off, indicates no cartridge is in the drive
Use Cleaning Tape indicator	Orange	The read/write head needs cleaning. See Chapter 3.
Magazine Fault indicator	Red	Indicates a magazine failure.
Loader Fault indicator	Red	Indicates a loader transfer assembly error or drive error.
Current Slot indicators 0-6	Green	Identifies the current slot (see Slot Select button). Each current slot indicator blinks when its corresponding cartridge moves to or from the drive. Also used with the Magazine Fault or Loader Fault indicator to show the type of fault (Section 6.6.1 and Section 6.6.2.).
Density Select	Green	Indicates the user can choose a density on the OCP

Table 5-2 *DLT4700 Operator Control Panel (Cont'd)*

Button/Indicator	Color	Function
Density Override	Yellow	Indicates tape drive activity as follows: • On steady—you selected a density from the front panel. • Off (default)—density to be selected by the host (automatic). • Blinking—you are in density selection mode.
2.6	Yellow	Indicates tape drive activity as follows: • On steady—tape is recorded in 2.6 GB format. • Blinking—tape is recorded in another density. You selected this density for a write from BOT (only in DLTtape III).
6.0	Yellow	Indicates tape drive activity as follows: • On steady—tape is recorded in 6.0 GB format. • Blinking—tape is recorded in another density. You selected this density for a write from BOT (only in DLTtape III).
10.0/15.0	Yellow	Indicates tape drive activity as follows: • On steady—tape is recorded in 10.0/15.0 GB format. • Blinking—tape is recorded in another density. You selected this density for a write from BOT (only in DLTtape III for 10.0 format and only in DLTtape IIIxt for 15.0 format).
20.0	Yellow	Indicates tape drive activity as follows: • On steady—tape is recorded in 20.0 GB format. • Blinking—tape is recorded in another density. You selected this density for a write from BOT (only in DLTtape IV).

Table 5-2 *DLT4700 Operator Control Panel (Cont'd)*

Button/Indicator	Color	Function
Compress	Yellow	Indicates tape drive activity as follows: • On—Compression mode enabled. Compression can be done in 10.0/15.0/20.0 GB density only. • Off—Compression mode disabled.

5.7 Power-On Process

_____**CAUTION** _____

Before applying power, verify the DLT4700 mini-library is set (see the
label on the mini-library rear panel) for the available ac supply voltage.

_____

Table 5-3 explains what happens during each phase of the DLT4700 mini-library operation.

Table 5-3 *Loader Power-On Self-Test*

Phase	What Happens
1	When you power on the DLT4700 mini-library, the Loader Fault and Power On indicators on the loader OCP are on.
2	One second later, all indicators are on. Within 15 seconds, POST of the loader mechanics completes. - If the Magazine Fault and Loader Fault indicators turn off, loader POST succeeded. - If the Magazine Fault and Loader Fault indicators stay on, loader POST failed.
3	A few seconds later, the drive controller resets the loader.
4	Loader POST starts again.

If …	Then POST …
The Magazine Fault and Loader Fault indicators turn off and shortly after, all OCP indicators but Power On turn off	Passed
The Magazine Fault and Loader Fault indicators stay on	Failed

_____ **NOTE** _____

If the Magazine Fault or Loader Fault indicators remain on, POST detected an error. See Chapter 6 for error conditions.

_____

Phase	What Happens
5	The elevator scans the magazine to determine which slots contain cartridges.
6	If the mini-library magazine has a cartridge in slot 0, and no cartridge is in the drive, these indicators should be on: - Power On - Eject - Load/Unload - Slot Select - Slot 0

5.8 Slot Select, Load/Unload, and Eject Button Functions

The Slot Select, Load/Unload, Eject, and Density Select buttons are OCP pushbuttons. They contain a green indicator and they are operable only when their corresponding indicators are on.

_____**NOTE** _____

The Load/Unload button has three functions:
- Load
- Unload
- Reset

If a loader fault occurred and the Loader Fault indicator is on, press Load/Unload to reset the DLT4700 mini-library.

_____

5.8.1 Selecting a Cartridge

To select a cartridge: press the Slot Select button to advance the slot indicator to the next available slot. After a successful initialization, the DLT4700 mini-library automatically selects slot 0 and the Slot Select button becomes active. The Load/Unload and Eject indicators remain on during slot selection.

5.8.2 Loading the Cartridge

To load the cartridge from the loader into the drive: press the Load/Unload button. Table 5-4 explains what happens after pressing the button.

Table 5-4 *Load/Unload Functions*

Stage	What Happens
1	The Select Slot, Load/Unload, and Eject indicators turn off, and the elevator moves to the selected slot, indicated by the indicator.
2	The cartridge is then removed from the magazine and placed in the elevator.
3	The elevator moves to the drive position and inserts the cartridge into the drive.
4	The indicators remain off until the tape loads to the (BOT).
5	After the cartridge is loaded into the drive, the Eject and Load/Unload indicators turn on, and the corresponding buttons are enabled. The Slot Select indicator remains off.

5.8.3 Unloading the Cartridge

_____ **CAUTION** _____

Do not press the Load/Unload button until backup or other
tape operations are stopped at the terminal. Doing so can
result in operation failure and drive unavailability.

_____ **NOTE** _____

The Load/Unload indicator must be on before you press the
Load/Unload button to load or unload a cartridge.

_____

If …	Then …
You want to unload the cartridge from the drive	Press the Load/Unload button. • The Select Slot, Load/Unload, and Eject indicators turn off. • The cartridge unloads from the drive into the magazine. However, automatic operation now stops and the Select Slot operation does not move in increments. The indicators turn on once the cartridge is returned to the magazine.
The Loader Fault indicator is on, showing a malfunction	Press the Load/Unload button to reset the mini-library and clear the error.

5.8.4 Opening the Receiver

The Eject button opens the receiver for insertion or removal of the magazine. The button is disabled when the Mode Select key is in the OCP Disabled position. The Eject button can also be used to *unload* a tape from the drive.

When …	Then …	You should …
A cartridge is not in the drive	The Slot Select, Load/Unload, and Eject indicators are on before any operation begins.	Press the Eject button to turn off all indicators. The elevator then returns to its home position and the receiver opens.
A cartridge is in the drive	The Eject and Load/Unload indicators are on before the operation begins	Press the Eject button to turn off both indicators and the cartridge unloads from the drive and moves back into the magazine. The receiver then opens to allow access to the magazine.

Result: In both situations, once the receiver is closed again, a magazine scan begins, and the indicators turn back on when the scan completes.

5.9 Magazine

The front of the magazine has numbers, 0 through 6, that indicate the number of the slot.

_____ **NOTE** _____

Insert and remove all cartridges at the front of the magazine.
_____

5.9.1 Inserting a Cartridge into the Front of the Magazine

To simplify cartridge insertion: place the magazine on a flat surface with the slots facing you (Figure 5-4). Each slot is numbered to ensure you are inserting the cartridge correctly in the front of the magazine. Usually, cartridges are inserted into consecutive slots.

To insert a cartridge into the magazine:

1. Grasp the cartridge with the write-protect switch on the right side facing you (Figure 5-3).

2. Set the cartridge's write-protect switch to the desired position.

If you want to …	Then …
Write to the tape	Slide the switch to the right (orange indicator is not visible)
Write-protect the tape	Slide the switch to the left (orange indicator is visible)

3. Insert the cartridge (Figure 5-4) by pushing it into the slot until you hear a click. A small metal tab holds the cartridge in place.

Figure 5-3 shows the operation of the Write-Protect switch.
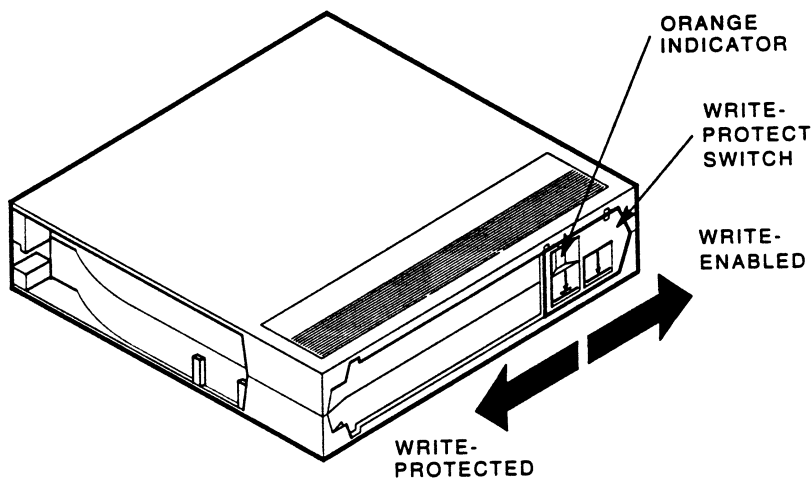
Figure 5-3 *Write-Protect Switch on a Cartridge*

Figure 5-4 shows inserting a cartridge into the magazine.

BACK OF
MAGAZINE

NOTE: Push tape in
until a click is heard

SLOT
NUMBERS
0-6
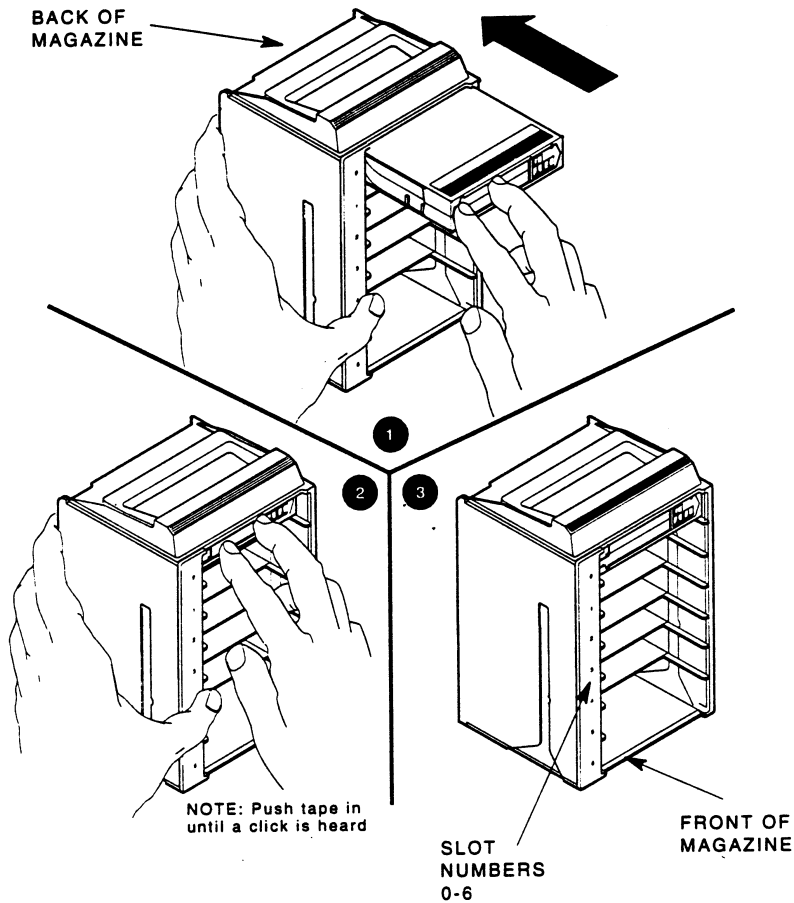
FRONT OF
MAGAZINE

Figure 5-4 *Inserting a Cartridge into the Magazine*

5.9.2 Removing a Cartridge from the Magazine

To remove a cartridge from the magazine: at the front of the magazine press in on the cartridge (Figure 5-5) until it stops and you hear a click. Then, release. The slot has a spring-release action.

_____**NOTE** _____

Never apply labels to the top or bottom of tape cartridges. Doing so can cause cartridge jams in the DLT4700 mini-library. Use the space on the front of the cartridge for labels.

_____

5.9.3 Removing the Magazine from the Receiver

To remove the magazine from the receiver, first ensure:

1. The Power On indicator is on (Figure 5-2).

2. The Eject indicator is on. (It must be on before you can press the Eject button.)

Then:

1. Press the Eject button (Figure 5-2) to open the receiver. If a tape is loaded in the drive, pressing the Eject button also causes the tape to unload.

2. Grasp the receiver after it opens (Figure 5-6), and gently pull it forward to access the magazine.

3. Grasp the magazine's handle only to lift the magazine out of the receiver.

5.9.4 Installing the Magazine into the Receiver

To install the magazine into the receiver:

1. Slide the magazine down into the receiver (Figure 5-6) while holding the magazine by the handle. Since the magazine is slotted, you can restore it in the correct orientation only.

2. Push the receiver closed.

3. Observe that the receiver is fully closed in the DLT4700 mini-library before proceeding.

Figure 5-5 shows the removal of a cartridge from the magazine.
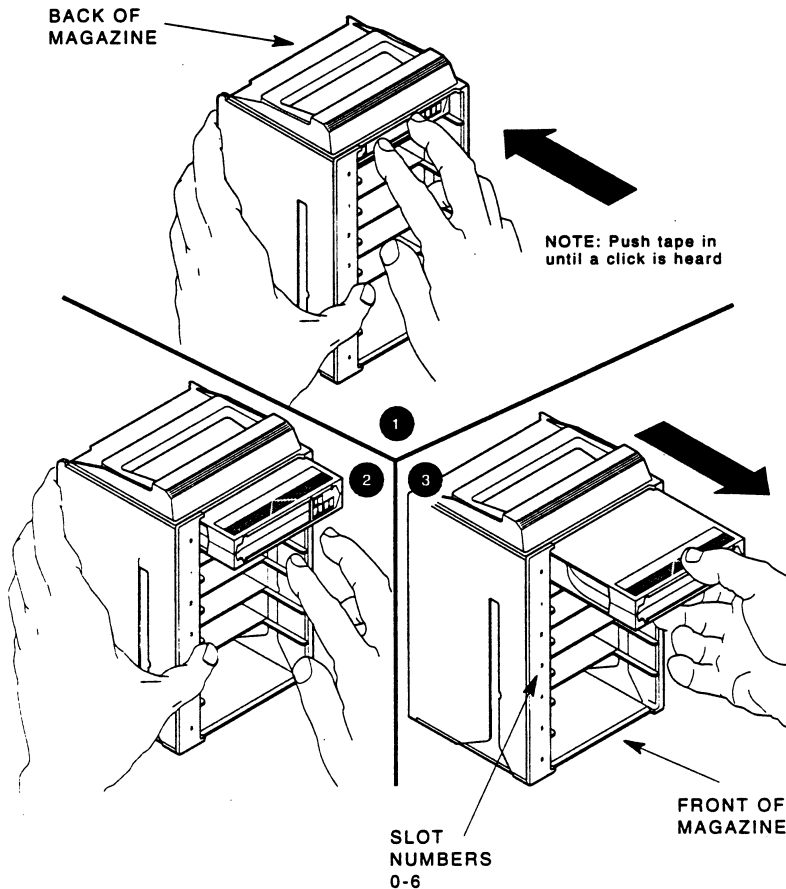
Figure 5-5 *Removing a Cartridge from the Front of the Magazine*

Figure 5-6 shows the open receiver.
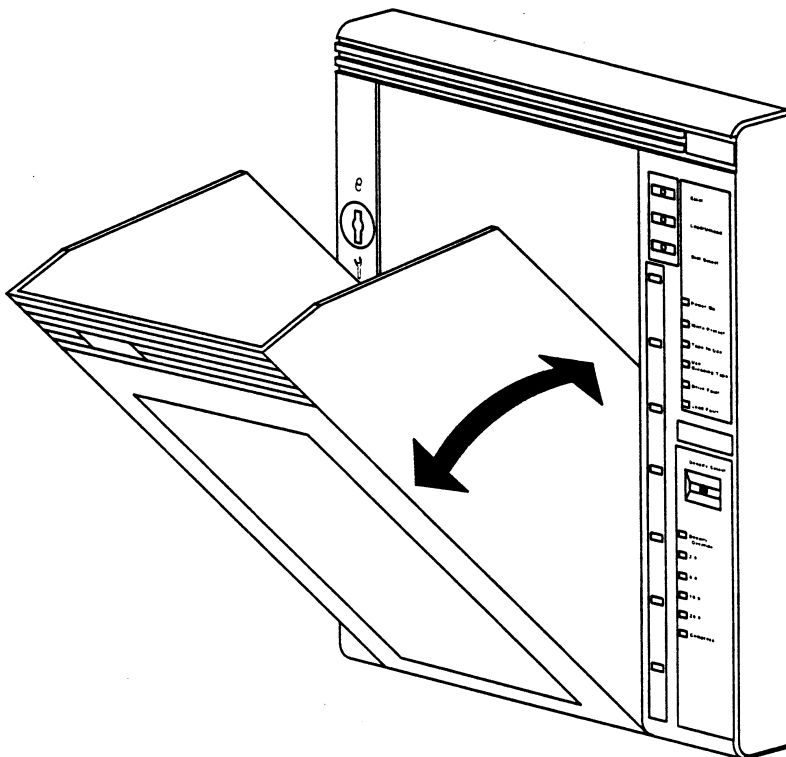
Figure 5-6 *Receiver Opened*

Chapter 6

Troubleshooting Guide for the DLT4500/DLT4700 Mini-Library

6.1 In This Chapter

Chapter 6 includes the following main topics and sections:

Topic	Section
Conditions Necessary for Button Operation	6.2
Operation Failure	6.3
Avoiding Basic Problems	6.4
Error Conditions : DLT4500 Mini-Library	6.5
DLT4700 Mini-Library	6.6
Power Problems	6.7

6.2 Conditions Necessary for Button Operation

Be sure to review information in the previous chapters to ensure you are correctly operating the DLT4500/DLT4700 mini-library.

Before you press the Slot Select, Load/Unload, or Eject button on the DLT4500/DLT4700 OCP, check for the conditions listed in Table 6-1 and ensure the:

- Power On indicator is on

- Receiver is closed

- Mode Select key is *not* set to OCP Disabled

Pressing these buttons has no effect if their indicators are off.

_____**NOTE**

Do not press the Load/Unload button to abort any function of the
DLT4500/DLT4700 mini-library. Press [Ctrl/Y] or [Ctrl/C] instead.
_____

See Chapter 4 for more information on the functions of the DLT4500 OCP
buttons.

Table 6-1 *DLT4500 OCP Button Conditions*

If you want to …	First, ensure the …	Then you can press this button …
Select another slot in the magazine	• Magazine contains at least two cartridges • LDR RDY displays	Select
Load the selected cartridge into the tape drive	• Magazine contains at least one cartridge • LDR RDY displays	Load/Unload
Return the selected cartridge to its original slot in the magazine	DRV RDY displays	Load/Unload
Clear a magazine or loader error	ERR MAG or ERR LDR displays	Load/Unload
Open the door or unload the cartridge from the drive and open the door	LDR RDY displays	Open

See Chapter 5 for more information on the functions of the DLT4700 OCP buttons.

Table 6-2 *DLT4700 OCP Button Conditions*

If you want to …	First ensure the …	Then you can press this button …
Select another slot in the magazine	• Magazine contains at least two cartridges • Slot Select indicator is on	Slot Select
Load the selected cartridge into the tape drive	• Magazine contains at least one cartridge • Load/Unload indicator is on	Load/Unload
Return the selected cartridge to its original slot in the magazine	Load/Unload indicator is on	Load/Unload
Clear a magazine or loader fault	• Load/Unload indicator is on • Magazine Fault or Loader Fault indicator is on	Load/Unload
Open the receiver, or unload the cartridge from the drive and open the receiver	Eject indicator is on	Eject

6.3 Operation Failure

Some manual operations, if not performed correctly, may cause write operations to fail during. Examples are:

• Loading write-protected DLTtape III, DLTtape IIIxt or DLTtape IV cartridges when executing write operations

• Selecting the incorrect cartridge slot from which to initialize operations

6.4 Avoiding Basic Problems

Follow these guidelines when you operate the DLT4500/DLT4700 mini-library to avoid basic problems:

- Use only DLTtape III, DLTtape IIIxt or DLTtape IV cartridges.

- Check the tape leader in the cartridge by lifting the cartridge latch that opens the door to expose the leader. Be sure the leader is in the same position as the one shown in Figure 6-1.

_____**CAUTION** _____

Do not touch the exposed magnetic tape. If the tape leader
is not in the correct position, use a new cartridge.

_____

- Be sure the receiver is fully closed and the current slot indicator is on for the starting cartridge.

- Be sure *no* slots in the magazine are empty between the starting cartridge and the expected completion cartridge.

Cartridge
Leader

Door Lock
(Release by lifting
door lock with thumb)
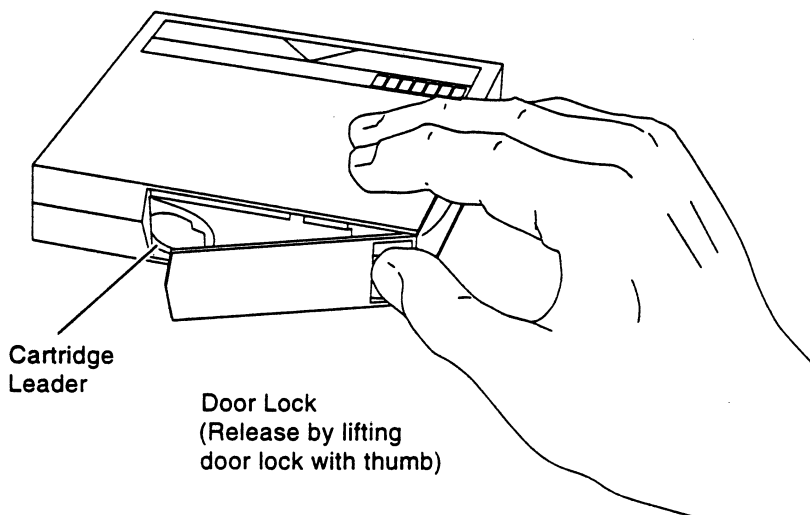
Figure 6-1 *Opening the Cartridge Door to Check the Tape Leader*

6.5 DLT4500 Error Conditions

Error indications fall into these main categories:

- Magazine Error

- Loader Error

- Drive Error

- Controller Error

- Unknown Error

6.5.1 DLT4500 Magazine Error

The ERR MAG message displays the status of cartridges reported by the loader and drive is inconsistent. In some magazine errors, the mini-library retries the error three times before showing failure. All magazine errors cause the ERR MAG message to display.

6.5.1.1 DLT4500 Clearing a Magazine Error

Pressing the Open button, the mini-library attempts to clear the error. The door opens to let you remove the magazine. Verify that cartridges are inserted securely into the magazine and the magazine is not defective.

If you still cannot clear the error, call your service representative.

6.5.2 DLT4500 Loader Error Description

The ERR LDR message displays the mini-library detected an error in the loader transfer assembly. In some loader transfer assembly errors, the mini-library retries the error three times before showing failure. All loader errors cause the ERR LDR message to display.

6.5.3 DLT4500 Drive Error Description

The ERR DRV message displays the mini-library detected an error in the tape drive. In some drive errors, the mini-library retries the error three times before showing failure. All drive errors cause the ERR DRV message to display.

6.5.4 DLT4500 Controller Error Description

The ERR CTL message displays the mini-library detected an error in the controller. In some controller errors, the mini-library retries the error three times before showing failure. All controller errors cause the ERR CTL message to display.

6.5.5 DLT4500 Unknown Error Description

The ERR UNK message displays the mini-library detected an error of unknown origin. In some unknown errors, the mini-library retries the error three times before showing failure.

6.5.5.1 DLT4500 Clearing a Loader, Drive, Controller, or Unknown Error

Pressing the Load/Unload button, the mini-library attempts to clear the error. Pressing the Open button, the door opens to let you access the magazine.

If you still cannot clear the error, call your service representative.

6.6 DLT4700 Error Conditions

Error indications fall into two main categories:

- Magazine Fault – In most cases, this is an operator-correctable condition, indicated when the Magazine Fault indicator is on. If you cannot resolve the fault, call your service representative.

- Loader Fault – This condition most likely requires service from a service representative. It is indicated when the Loader Fault indicator is on.

6.6.1 DLT4700 Magazine Fault Cases

A magazine fault can occur during any of the following cases:

1. A cartridge has been removed from the magazine incorrectly.

2. A cartridge was manually unloaded from the drive.

3. A cartridge that was loaded into a drive by the loader was manually unloaded and put back into the magazine.

4. A cartridge was manually inserted into the drive.

_____**NOTE** _____

This can only occur if the loader has been opened in service mode. This cannot occur under normal operation.

_____

When these conditions are present, the Magazine Fault indicator turns on, indicating a situation that can be corrected by the operator. Eject is also on to inform you that this is the only function available at this time.

6.6.1.1 Detecting Cases 1, 2, and 3

The user can tell these cases have occurred when the Magazine Fault indicator and slot indicators 0 and 5 are on.

_____ **CAUTION** _____

Never remove a cartridge from the magazine by moving the metal tab in front of the cartridge. This is the main source of magazine faults. Use the proper procedure, Chapter 5.

_____

To clear a magazine fault caused by cases 1, 2, and 3:

1. Press the Eject button to open the receiver.

2. Remove the magazine and check for a metal tab over an open slot. This is the slot from which the cartridge was removed.

If …	Then …
A metal tab is found over an open slot	1. Reinsert the missing cartridge properly by pushing it in until it snaps into place. If no cartridge is needed in this slot, push one into the slot and then remove it according to normal procedure (Chapter 5). This step is critical to avoid more magazine faults.
	2. Insert the magazine into the receiver.
	3. Close the receiver.
No metal tab is covering an empty slot	The cartridge loaded into the drive was manually reinserted into the magazine. To clear this, simply close the receiver.

6.6.1.2 Detecting Case 4

The user can tell this case occurred when the Magazine Fault indicator and slot indicators 0 and 6 are on. This is the only time slot indicators 0 and 6 are on for a magazine fault. Only service personnel can resolve this condition by doing the following:

1. Press the Eject button to open the receiver.

2. Close the receiver to clear the Fault indicator.

3. Press the Load/Unload button; the cartridge loads, but is not removed from the drive. The Magazine Fault indicator comes on, and the receiver opens. The service person must remove the magazine, reach in and lift the handle on the front of the drive, and pull out the cartridge.

_____**NOTE** _____

Slot 0 indicator is lit in all error conditions to indicate an error occurred. It is not a Slot Select indicator in this case.

_____

After you clear the error try loading and unloading cartridges to verify operation.

6.6.2 DLT4700 Loader Fault Description

A loader fault indicates the DLT4700 mini-library detected a fatal error in the loader transfer assembly or in the tape drive. In some loader transfer assembly errors, the mini-library retries the error three times before indicating failure. All loader faults cause the Loader Fault indicator and an associated subcode to light.

Loader Fault indicates errors in the loader transfer assembly, controller module, or drive. The suspected fault location is indicated by the following slot indicators:

*   Slots 4 and 0—a controller module

*   Slots 5 and 0—a loader transfer assembly

*   Slots 6 and 0—drive

_____ **NOTE** _____

Error indicators do not blink. During hardware failures, the controller
module determines action.

_____

6.6.2.1 Clearing a DLT4700 Loader Fault

When a loader fault occurs, the Load/Unload and Eject indicators are on. Pressing the
Load/Unload button, the DLT4700 loader attempts to clear the error. Pressing Eject,
the receiver opens to let you access the magazine.

6.7 Power Problems

If the Power On indicator is not on, or your system does not recognize the
DLT4500/DLT4700 mini-library:

- Ensure the power plug is secure.

- Verify with your system manager that the mini-library configuration is correct.

Chapter 7

Firmware Update (From Tape)

7.1 In This Chapter

Chapter 7 includes the following main topics and sections:

Topic	Section
DLT4000 Firmware Update Overview	7.2
Creating a "Firmware Update Tape"	7.3
Firmware Update Procedure	7.4

7.2 DLT4000 Firmware Update Overview

The DLT4000 Cartridge Tape Subsystem family can automatically update the controller firmware directly from a tape containing the appropriate information.

The user places the subsystem into Firmware Update Mode via the front panel and then simply load a tape that includes the DLT4000 firmware image file.

The subsystem automatically reads and verifies the tape information as a valid DLT4000 firmware image. If the image data passes all the verifications, the image data is installed into the controller's nonvolatile code memory.

This chapter details the firmware update procedure.

Before doing the procedure, remember:

_____ **CAUTION** _____

During the firmware update, when the new image is actually being programmed into the FLASH EEPROMs, a powerfail (but not BUS RESET) causes the controller module to be unusable. When doing a firmware update, take reasonable precautions to prevent a powerfail.

_____

7.2.1 Updating Firmware on a Standalone System

The user can update the subsystem, even when the subsystem is not attached to a SCSI bus, that is, a standalone system. However, to perform an update, the Power-On Self-Test (POST) must pass first, and to pass, POST needs a properly terminated bus.

The single-ended DLT4000 controller module has active terminators. Note the jumper covering the two pins labeled on the etch: TRM PWR.

The differential DLT4000 controller module does not have on-board termination.

To do a firmware update on a standalone system:

1. Find the TRM PWR connector on the right side of the DLT4000 drive (Figure 7-1, number ❶).
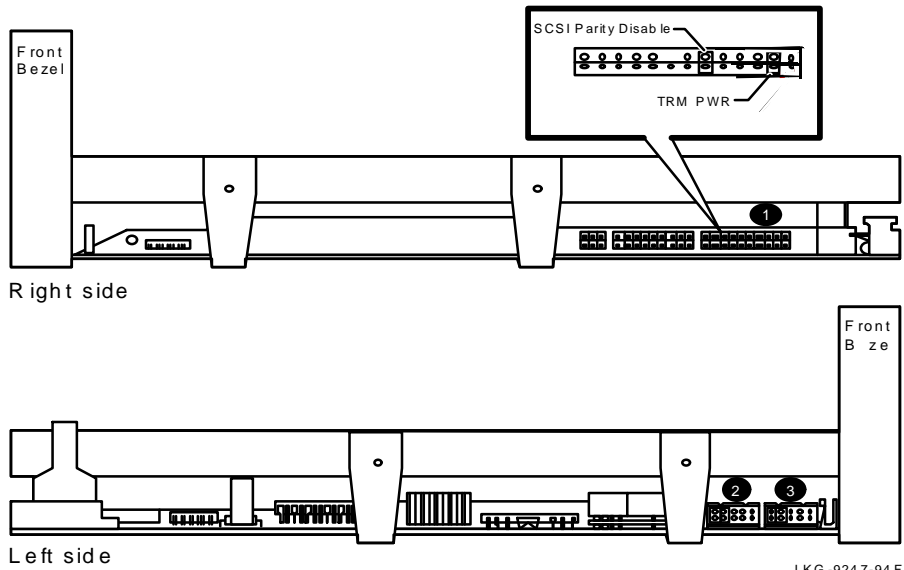
Figure 7-1 *DLT4000 Subsystem Connectors*

❶TRM PWR Connector	❷SCSI ID Connector	❸Loader Connector

2. Ensure the TRM PWR jumpers are in position (Figure 7-2, number❷).

❶

❷
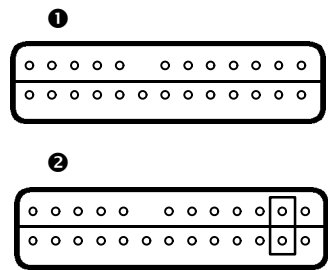
Figure 7-2 *Jumper Settings for TRM PWR Connector*

❶   No Term Power   ❷   Term Power

From the time the tape is inserted and the drive handle is closed, updating the firmware takes from 2 to 3 minutes.

7.3 Creating a "Firmware Update Tape"

To perform the firmware update, you must have a DLTtape III, DLTtape IIIxt, or DLTtape IV cartridge with a copy of the firmware image Table 7-1.

Table 7-1 *Block Size used for Firmware Update Tape*

Tape Format	Density	Upgrade Tape Block
DLTtape III	2.6 GB	4 Kbytes Multiple
	6.0 GB	4 Kbytes Multiple
	10.0 GB	4 Kbytes Only
DLTtape IIIxt	15.0 GB	4 Kbytes Only
DLTtape IV	20.0 GB	4 Kbytes Only

7.3.1 On UN*X Systems

The FTP utility can be used to transfer the binary firmware image file onto the UN*X system. Be sure to specify "type image" before doing the "get" or "put." Otherwise, extra characters may be added to the file, causing the image file to be invalid. The image file should be exactly 1152*512 bytes in size.

When making the update tape, copy the image file to the tape media using a block size as defined in Table 7-1, that is dd, ltf, and so forth. The tape has to be uncompressed.

7.4 Firmware Update Procedure

Section 7.4 describes the procedure for updating the firmware (code) of the DLT4000 subsystem controller. The update is done from a cartridge that stores the firmware image. Firmware update from the host is also supported. See the section on the SCSI WRITE BUFFER command in Chapter 8 for details.

Firmware updates are supported on the DLT4000 drive with and without the media loader. The steps for performing the update are similar for each. To update the firmware with the:

- **Drive only configuration**, **see** "Updating the Firmware on DLT4000 (Drive Only Configuration)"

- **Drive and loader configuration**, **see** "Updating the Firmware on the DLT4500 (Drive and Loader Configuration)" **and** "Updating the Firmware on the DLT4700 (Drive and Loader Configuration)"

_____**CAUTION** _____

Never turn off power if you think the firmware is being updated. This can damage the controller.
_____

7.4.1 Updating the Firmware on DLT4000 (Drive Only Configuration)   drive

1. Obtain or make a DLTtape III, DLTtape IIIxt, or DLTtape IV with the firmware image of the desired revision level copied to it.

2. Put the DLT4000 subsystem into firmware update mode. To do this:

   a. Remove any cartridge that is in the target DLT4000 drive and close the handle (down position).

   b. Press the Unload button on the drive front panel and hold the button (about 6 seconds) until the Write Protect indicator blinks. This means the DLT4000 subsystem has recognized your request for firmware update mode and is waiting for the sequence to complete.

      If the Write Protect indicator does not blink, check that:

         1. POST passed

         2. The drive is unloaded

         3. The drive handle is in the down position

    c.   Release the Unload button and press the button again within 4 seconds. The second press should take less than 1 second.

    d.   The Tape in Use and the Write Protect indicators blink, showing the tape subsystem recognizes the firmware update mode has been selected.

    e.   If selecting the firmware update mode is not successful (for example, pressing the button the second time takes longer than one second) the Write Protect indicator should stop blinking within several seconds.

        Try the procedure again. If the drive and controller are not properly communicating, you cannot select firmware update.

3.   Once you have selected the firmware update mode, insert a cartridge into the drive, which:

    a.   Temporarily turns off the Tape in Use and Write Protect indicators.

_____ **NOTE** _____

Calibration and directory processing cause the tape to move for a few minutes before data is actually read.

_____

    b.   Automatically reads the cartridge

    c.   Examines the data

    d.   Verifies the data is a valid DLT4000 firmware image

        Firmware update mode is automatically cleared at this point. If the firmware image is valid and:

- If the drive code is up-to-date, the drive code does not go through an update.

- If the drive code is not up-to-date, the drive code goes through an update, taking 2 to 3 minutes.

4.   While the drive code goes through the update, the Write Protect and Tape in Use indicators flash alternately.

5.   When the drive code update is complete, the drive resets, and goes through Power-On Self-Test (POST). The process waits until the tape is reloaded at beginning of tape (BOT).

6. If the firmware image is valid, the controller's flash EEPROM memory is automatically updated with the new firmware image. The Write Protect and Tape in Use indicators flash again during the controller firmware update.

7.4.1.1 Interpreting the Results (DLT4000) Code Update)

Two possible results can occur:

- The firmware update cartridge is unloaded: this means a successful update.

  On the DLT4000 drive, the media is placed into the cartridge, the door is unlocked, and the green Operate Handle indicator is turned on.

- The firmware update cartridge is NOT unloaded: this means the update was unsuccessful.

  The subsystem should still be usable, but this depends on why the update failed. Reasons for failure could be:

  1. Power failure
  2. Bad image on the tape
  3. Broken Flash EEPROMs

Table 7-1 gives additional details.

Table 7-1 *Results (DLT4000) Code Update)*

If...	Then...
The image is valid	1. The flash EEPROM containing the current firmware is erased. 2. The new image is programmed in. The subsystem completes the update in about 2 minutes. Then: • The tape drive resets itself. • POST takes place. • The drive automatically unloads the tape cartridge containing the firmware image, so you can remove the cartridge. This shows a successful firmware update.

Table 7-1 *Results (DLT4000) Code Update) (Cont'd)*

If...	Then...
1. The tape is NOT a valid firmware update tape 2. The tape does not contain a valid image	No update is attempted. The Write Protect and Tape In Use indicators do not blink. The drive resets and the tape stays loaded to signal the firmware update was unsuccessful.
The tape contains a valid image, but for some reason the reprogramming flash memory fails	The controller is probably unusable and needs to be replaced. The tape drive resets itself and reruns POST, which fails if flash memory does not contain a valid image.

7.4.2 Updating the Firmware on the DLT4500 (Drive and Loader Configuration)

1. Obtain or make a DLTtape III, DLTtape IIIxt , or DLTtape IV with the code image of the specified revision level copied to it.

2. Put the mini-library into code update mode. To do this:

    a. With the LDR RDY message displaying, press the OCP Open button to open the door and remove the magazine. Then, close the door.

    b. Remove all cartridges from the magazine and install the code update cartridge into the magazine.

    c. Press and hold the Display Mode button (about 5 seconds) until the SCSI ID SEL message displays.

    d. Press and hold the Load/Unload button until the SCSI ID SEL message starts to flash. Immediately release the button, and then press it again. The CODE UPDATE MODE message now displays.

_____ **CAUTION** _____

Code update can appear to be finished, but in fact it is still processing.
Wait 20 seconds for the green indicator to appear to ensure code updating
has been competed

_____

3. Press the Open button two times to open the magazine door. Load the magazine with the code update tape into the mini-library and close the door. Wait until the

elevator stops scanning the magazine. Press the Load/Unload button to load the code update tape into the tape drive.

If …	Then …
The DLT4500 code revision is the same revision as that of the update tape	The DLT4500 code does not go through an update.
The DLT4500 code revision is not the same revision as that of the update tape	The DLT4500 code goes through an update, taking about 5 minutes.

4. During a DLT4500 code update, the drive:

   a.   Automatically reads the tape.

_____**NOTE** _____

   Calibration and directory processing cause the tape to move for a few minutes before data is actually read.

   b.   Examines the data.

   c.   Verifies the data is a valid DLT4500 code image. When the drive code update completes, the controller's flash EEPROM memory is updated with the new code image.

   d.   Resets and goes through POST, and the code update tape cartridge returns to the magazine. The LDR RDY message displays.

5. If the code update succeeds, the mini-library resets itself. A magazine scan takes place.

7.4.2.1 Interpreting the Results (DLT4500 Code Update)

The following results can occur:

Table 7-2 *Results (DLT4500) Code Update)*

If …	This means …	And you should …
The code update cartridge unloads from the drive and loads into the magazine slot from which it came	The update *succeeded.* The controller's flash EEPROM memory is updated with the new firmware image.	Begin operating the mini-library.
The code update cartridge does *NOT* unload from the drive and load into the magazine.	The update *failed*. The drive may reset and the ERR UNK message may display. The mini-library should still be usable, but this depends on why the update failed. The reasons for failure could be:	

Table 7-2 *Results (DLT4500) Code Update) (Cont'd)*

If …	This means …	And you should …
	• The code update cartridge contains a corrupted image file or the file is built improperly.	1. Press the Unload button to unload the tape cartridge from the drive. 2. Press the Open button to open the magazine door. 3. Remove the magazine and close the door. The mini-library does an elevator scan. 4. Open the door again. The message LDR RDY displays. 5. Verify you have the valid image for your drive type (variant) in the magazine. Ensure the image copied to the tape cartridge is using a block size of 4096. 6. Try the code update procedure again using the valid tape image. If you still cannot do the update, call your service representative.

Table 7-2 *Results (DLT4500) Code Update) (Cont'd)*

If …	This means …	And you should …
	• The tape cartridge with the valid update image is not readable.	1. Press the Unload button to unload the tape cartridge from the drive.
		2. Press the Open button to open the magazine door.
		3. Remove the magazine and close the door. The mini-library does an elevator scan.
		4. Open the door again. The message LDR RDY displays.
		5. Rebuild the valid image on a good cartridge.
		6. Try the code update procedure again using the valid tape image.
		If you still cannot do the update, call your service representative.
	• A power failure occurs during the code update. The drive may be unusable.	Try unloading the cartridge from the drive, as described in this table, to do the code update again.
		If you still cannot do the update, call your service representative.

Table 7-2 *Results (DLT4500) Code Update) (Cont'd)*

If …	This means …	And you should …
	• A controller failure occurs. The drive is most likely unusable and needs to be replaced.	Turn off mini-library power and then on again. If you still have a drive controller failure, see your service representative.

7.4.3 Updating the Firmware on the DLT4700 (Drive and Loader Configuration)

1. Obtain or make a DLTtape III, DLTtape IIIxt, or DLTtape IV with the firmware image of the desired revision level copied to it.

2. Put the DLT4700 subsystem into Firmware Update Mode. To do this:

   a. Remove any magazine in the DLT4700 loader receiver and close the receiver.

   b. Put the Mode Select key in Service Mode (wrench icon).

   c. Press the Load/Unload button on the operator control panel (OCP) and hold the button (about 6 seconds) until the Write Protect indicator blinks. This means the DLT4700 mini-library has recognized your request for firmware update mode and is waiting for completion of the sequence.

   If the Write Protect indicator never blinks, check that:

   1. POST succeeded

   2. The drive is unloaded

   3. The drive handle is in the down position

   4. No magazine is in the loader

   5. The receiver door is closed

   6. The Mode Select key is in Service Mode

   d. Then, press and release the Unload button and press the button again within 4 seconds. The second press should be less than 1 second.

    e.   The Tape in Use and the Write Protect indicators blink, showing the subsystem recognizes the firmware update mode has been selected.

    f.   If selecting firmware update mode is not successful (for example, because of not pushing the Unload button properly the second time), the Write Protect indicator should stop blinking within several seconds. Try the procedure again.

3.   Once you have selected the firmware update mode, press the OCP EJECT button twice, which causes the receiver door to open. The Write Protect and Tape In Use indicators stop blinking, even though the subsystem is still in Update mode.

4.   Place a magazine with the Firmware Update Tape in the first slot in the loader receiver and close the receiver. (The remainder of the update procedure goes faster if the magazine contains only the firmware update cartridge. But the procedure still works if other cartridges are present.)

5.   Press the Load/Unload button to load the Firmware Update Tape into the drive.

6.   Once you have selected the firmware update mode, the drive:

    a.   Automatically reads the tape

_____ **NOTE** _____

Calibration and directory processing cause the tape to move for a few minutes before data is actually read.

_____

    b.   Examines the data

    c.   Verifies the data is a valid DLT4700 firmware image

Firmware update mode is automatically cleared at this point. If the firmware image is valid and:

    d.   If the drive code is up-to-date, the drive code does not go through an update.

    e.   If the drive code is *not* up-to-date, the drive code goes through an update, taking 2 to 3 minutes.

    f.   While the drive code goes through the update, the Write Protect and Tape in Use indicators flash alternately.

g. When the drive code update is complete, the drive resets, and goes through Power-On Self-Test (POST). The process waits until the tape is reloaded at beginning of tape (BOT).

h. If the firmware image is valid, the controller's flash EEPROM memory is automatically updated with the new firmware image.

i. Whether the firmware update is successful, the subsystem resets itself. A full, extended scan of the loader takes place. The scan goes quickly if the firmware update cartridge was the only tape cartridge in the magazine. If six other cartridges are present, the scan takes an extra minute or more.

7.4.3.1 Interpreting the Results (DLT4700) Code Update)

Two possible results can occur:

- The firmware update cartridge is unloaded: this means a successful update.

  On the DLT4000 drive, the cartridge is unloaded from the drive and into the magazine slot from which it came. If another cartridge is in the magazine, that next cartridge loads into the drive.

- The firmware update cartridge is *NOT* unloaded: this means the update was *unsuccessful*.

The subsystem should still be usable, but this depends on why the update failed. Reasons for failure could be:

1. Power failure

2. Bad image on the tape

3. Broken Flash EEPROMs

Table 7-3 gives additional details.

Table 7-3 *Results (DLT4700) Code Update)*

If …	Then …
The image is valid	1. The Flash EEPROM containing the current firmware is erased.
	2. The new image is programmed in.
	The subsystem completes the update in about 2 minutes. Then:
	1. The tape drive resets itself.
	2. POST takes place.
	3. The drive automatically unloads the tape cartridge containing the firmware image so you can remove the cartridge.
	This shows a successful firmware update.
The tape is NOT a valid firmware update tape	No update is attempted. Write Protect and Tape In Use do not blink.
The tape contains a valid image, but for some reason reprogramming of Flash memory fails	The controller is probably unusable and needs to be replaced. The tape drive resets itself and reruns POST, which fails if the Flash memory does not contain a valid image.

_____ **CAUTION** _____

Never turn off power if you think the firmware is being updated. Doing so can damage the controller.
_____

Chapter 8

DLT4000 SCSI Interface

8.1 Overview

This chapter details the SCSI Protocol features the DLT4000 drive implements.

The following sections do not fully reiterate the ANSI SCSI messages, options and command code specifications, but describe the supported commands, messages, and options supported, and the error recovery procedures.

8.2 General SCSI Bus Operation

8.2.1 Data Transfer

The DLT4000 drive supports asynchronous and synchronous data transfers. The product has differential and single ended versions. Odd parity is generated during all information transfer phases where the device writes data to the SCSI bus, and checked during all information transfer phases where data is read from the bus. Parity checking can be disabled. Refer to Chapter 2 for details.

_____ **NOTE** _____

The SCSI specification referrers to mini-libraries as "medium changers" where as Quantum uses the term "mini-libraries" throughout this manual.

_____

The DLT4000 drive supports a maximum block size of 1 Byte to 16 MBytes.

Disconnects from the SCSI bus will be done at regular intervals during a data transfer. This allows other devices to access the bus. This disconnecting is configurable by use of the Disconnect-Reconnect Mode Parameters page.

8.2.2 Initiator/Target Operation

The DLT4000 drive does not act as an initiator on the SCSI bus. Therefore, the device will not do any of the following:

- Generate unsolicited interrupts to the host

- Initiate its own SCSI commands

- Assert bus reset

8.2.3 SCSI IDs and Logical Unit Numbers (LUNs)

The DLT4000 drive with optional medium changer has two logical units. The tape drive will always appear as LUN 0. The medium changer defaults to appearing as LUN 1, but may be configured via the MODE SELECT command to any LUN from 0 to 7. Refer to MODE SELECT section in this chapter.

Unsupported LUNs will be treated as follows: If the LUN specified in the IDENTIFY message is invalid, the DLT4000 drive accepts the Command Descriptor Block (CDB). There are three cases of what happens next:

1. If the command is INQUIRY, the target returns the INQUIRY data with the peripheral qualifier set to 011, indicating that the target will never support the LUN in question.

2. If the command is REQUEST SENSE, the target returns sense data. The sense key is ILLEGAL REQUEST, with an additional sense code of INVALID Logical Unit Number.

3. For any other command, the target terminates the command with CHECK CONDITION status, and generate the above Sense Data.

8 2.   **Unit Attention Condition**

Queued Unit Attentions are implemented on this device, and are maintained

following circumstances:

-

- BUS Reset

  Bus Device Reset message

-               media may have changed asynchronously

-

- A firmware (microcode) update has completed

a cartridge is loaded, Power Up and Not-ready to Ready Transition Unit Attentions are created. Due to a limited number of Unit Attention buffers, if an initiator does not

new Unit Attentions for that I-L combination (but existing ones will be left queued).

A LOAD command will not generate a Unit Attention for the initiator that issued the

8.   .5

- All device SCSI lines go to high impedance when the DLT4000 drive is powered

- The DLT4000 drive will not generate any spurious signals on the SCSI bus at

- Within 5 seconds of power on, and within 250 milliseconds (typically under 4 ms)

  return appropriate, normal, responses. Tape motion commands will be returned with Check Condition status, Sense Key Not Ready, until the media has been

- The Hard Bus Reset option is implemented.

  The media is rewound to BOP (Beginning of Partition, i.e. Beginning of Tape).

resets of arbitrarily long duration. It will recover within the time limits specified above, following the last bus reset.

8.2.6 Data Cache and Tape Write Interaction

The DLT4000 drive contains a data cache that buffers blocks (records) until they are written. This section defines specific times that blocks are written to the tape. A Mode Select parameter allows the data cache to be disabled (unbuffered mode). In this mode, every WRITE command will cause the data to be written to the media before the STATUS byte and the COMMAND COMPLETE message is returned to the host. Unbuffered mode is *not* recommended due to the poor performance that will result.

_____**NOTE**_____

Unbuffered mode is not recommended due to the poor performance that will result.
_____

The write data cache are written (flushed) to the media under the following circumstances:

- When two or more WRITE FILEMARKS commands are issued without intervening tape motion commands, the immediate bit is set.

- When a WRITE 0 FILEMARKS command is issued.

- Data in the cache longer than specified by the value of the Mode Parameter "Write Delay Time" is automatically written to media.

- When a nonwrite type media access command is received (for example, SPACE, READ, UNLOAD, . . .)

8.2.7 Other SCSI Functionality

1. Linked commands are supported.

2. Untagged queuing is supported.

8.2.8 Bus Phases

The DLT4000 drive conforms to the bus state transition table shown in the SCSI-2 standard, "Phase Sequences." The information in the following sections also applies.

8.2.9 ATTENTION Signal Response

The DLT4000 drive will respond to an ATN condition at least at every phase transition, as long as the initiator sets the ATN bit before the target desserts the REQ for the last byte of the previous phase. Generally ATN will be recognized immediately by the DLT4000 drive, and it will change the bus phase to Message Out.

. .   STATUS phase

is requested by the initiator. The only exception is during error cases when the device

Status bytes the tape drive returns are as follows:

GO

- REQUEST SENSE command should be sent following this status to determine

- unable to accept a command from an otherwise acceptable initiator. The initiator

- for commands issued with the LINK bit set. Following the return of this status,

command.

RESERVATION CONFLICT (18h): This status is returned by the drive whenever

initiator with a RESERVE UNIT command.

COMMAND TERMINATED (22h): This is the status returned for a command

indicates that a contingent allegiance condition has occurred.

NOTE

In contrast to the BUSY status condition, the DRIVE NOT READY Sense

command and indicates that a media access command has been issued

installed, the media has been unloaded, the drive is currently initializing

_____

In the not ready state, the initiator cannot perform any operation which would cause

will return a CHECK CONDITION status with a DRIVE NOT READY sense key.

and a GOOD status may be returned.

These commands are as follows:

- INQUIRY

- LOAD UNLOAD

- LOG SENSE/SELECT

- MODE SELECT

- MODE SENSE

- PREVENT/ALLOW MEDIUM REMOVAL

- READ BLOCK LIMITS

- READ BUFFER

- READ ELEMENT STATUS

- RECEIVE DIAGNOSTIC RESULTS

- REQUEST SENSE

- RESERVE/RELEASE UNIT

- SEND DIAGNOSTIC (non-media access diagnostics)

- WRITE BUFFER

The TEST UNIT READY command is used to determine whether the tape drive would accept a media access command without returning CHECK CONDITION status.

8.2.11 BUS FREE

There are several situations when the device might or will go to BUS FREE unexpectedly, as defined in the SCSI-2 standard (See sections 6.1.1 and 6.3):

- An internal hardware or firmware fault that makes it unsafe for the device to continue operation without a full reset (similar to a power-up reset).

- ATN asserted or bus parity error detected during non-tape data transfers.

8.2.12 BUS PARITY ERRORS

The occurrence of bus parity errors (i.e. single bit errors) are very serious because they imply the possibility of undetected double-bit errors on the bus, which most likely would result in undetected data corruption. On properly configured SCSI buses, parity errors should be extremely rare. If any are detected, they should be quickly addressed

normal environment should be virtually free of bus parity errors

Bus parity errors cause the drive to either retry the operation, go to STATUS phase, or

Retrying of parity errors during Data Out Phase when writing is normally not done, but can be enabled by changing the EnaParErrRetry parameter in the VU EEROM

device performance (the data stream on writes cannot be pipelined as well).

8 3 SCSI Message System

purpose of physical path management.

To support certain SCSI-1 initiators, an Identify message is not required by the

should be an IDENTIFY, ABORT, or BUS DEVICE RESET message. If the DLT4000 drive receives any other message in this case, it will go directly to BUS

The following messages are supported:

Table 8-1 *Supported SCSI Messages*

Code	In/Out	Description	Section
06	Out	ABORT	ABORT (06h)
0D	Out	ABORT TAG	ABORT TAG (0Dh)
0C	Out	BUS DEVICE RESET	BUS DEVICE RESET (0Ch)
0E	Out	CLEAR QUEUE	CLEAR QUEUE (0Eh)
00	In	COMMAND COMPLETE	COMMAND COMPLETE (00h)
04	In	DISCONNECT	DISCONNECT (04h)
01	Both	EXTENDED MESSAGE (SDTR only)	EXTENDED MESSAGE (01h)
80-FFh	Both	IDENTIFY	IDENTIFY (80h-FFh)
05	Out	INITIATOR DETECTED ERROR	INITIATOR DETECTED ERROR (05h)
0A	In	LINKED COMMAND COMPLETE	LINKED COMMAND COMPLETE (0Ah)
0B	In	LINKED COMMAND COMPLETE w/flag	LINKED COMMAND COMPLETE, with flag (0Bh)
09	Out	MESSAGE PARITY ERROR	MESSAGE PARITY ERROR (09h)
07	Both	MESSAGE REJECT	MESSAGE REJECT (07h)
08	Out	NO-OP	NO-OP (NO OPERATION)(08h)
03	In	RESTORE POINTERS	RESTORE POINTERS (03h)
02	In	SAVE DATA POINTER	SAVE DATA POINTER (02h)

ABORT (06h)

This message is sent from the initiator to the target to clear, on the selected unit, the current I/O process. Buffered (cached) write operations will be completed if possible. The target goes directly to the BUS FREE phase after successful receipt of this message. Current settings of Mode Select parameters and reservations are not affected. Commands, data, and status for other initiators is not affected.

This message can be sent to a logical unit that is not currently performing an operation for the initiator. If no unit has been selected, the target goes to BUS FREE and no commands, data, or status on the target is affected.

ABORT TAG (0Dh)

This message is sent from the initiator to the target to clear, on the selected unit, the current I/O operation only. The target goes directly to the BUS FREE phase after successful receipt of this message. Current settings of Mode Select parameters and reservations are not affected. The data on the cache will be flushed to the tape.

BUS DEVICE RESET (0Ch)

This message from an initiator clears all commands, data, and status in the tape controller. When it recognizes this message, the drive flushes the cache to tape and proceeds to the BUS FREE state. The drive then executes a hard reset which leaves it as if a Bus Reset had occurred.

CLEAR QUEUE (0Eh)

This message clears all I/O processes for all initiators. A Unit Attention condition will be generated for all other initiators that had outstanding I/O processes, with Additional Sense Code (ASC) of Command Cleared by Another Initiator. The target goes directly to the BUS FREE phase after successful receipt of this message. Current settings of Mode Select parameters and reservations are not affected. The data on the cache will be flushed to the tape.

COMMAND COMPLETE (00h)

This message is sent from a target to an initiator to indicate that the execution of a command (or a series of linked commands) has completed and valid status has been sent to the initiator. After it has sent the message successfully, the target goes to the BUS FREE phase by releasing BSY. If received by the tape unit, it is handled as an illegal message; the drive returns MESSAGE REJECT and enters the STATUS phase reporting CHECK CONDITION with the sense key set to COMMAND ABORTED.

DISCONNECT (04h)

A target sends DISCONNECT to tell an initiator that the present physical path is going to be broken (the target intends to disconnect by releasing BSY). Later, reselection is required in order to complete the current operation. This message does not cause the initiator to save the Data pointer.

When received from an initiator, the tape drive may respond in one of two ways. First, it may take the message as a request by the initiator to disconnect and comply by entering message in phase and sending the DISCONNECT message back to the initiator (possibly preceded by the SAVE DATA POINTERS message). In this case, it will delay a minimum of 200 μs before arbitrating for the bus again. Alternately, it may enter the message in phase and return MESSAGE REJECT.

EXTENDED MESSAGE (01h)

This is sent as the first byte of a multiple-byte message (> 2 bytes) by either initiator or target. EXTENDED MESSAGE has the following format:

Byte 0	Extended Message Identifier – 01h
Byte 1	Extended Message Length
Byte 2	Extended Message Code
Byte 3	Extended Message Additional Parameters

Figure 8-1 *Extended Message Format*

The Extended Message Length specifies the length of the Extended Message plus the number of additional parameter bytes that are to follow. The length does not include bytes 0 and 1. A value of zero for the Extended Message Length indicates 256 bytes to follow.

Possible Extended Message codes are:

00h - MODIFY DATA POINTER (not supported)

01h - SYNCHRONOUS DATA TRANSFER REQUEST (See page 8-13)

02h - Reserved

03h - WIDE DATA TRANSFER REQUEST (not supported)

04h-7Fh - Reserved

80-FFh - Vendor Unique (See page 8-21)

If the tape drive receives an extended message which it does not support, it switches to message in phase and returns MESSAGE REJECT after all the bytes of the message have been transferred.

IDENTIFY (80h-FFh)

These messages are sent either by the initiator or by the target to establish (or reestablish) the physical connection path between an initiator and target for a particular logical unit. The message byte consists of the following bits:

Bit 7: Always set to one.

Bit 6: Set by initiator if target is allowed to disconnect/reconnect.

Bit 5: Must be set to zero ("Target Routines" not supported).

Bit 4: Reserved. Must be set to zero.

Bit 3: Reserved. Must be set to zero.

Bits 2-0: Logical Unit Number (LUN).

When the Identify message is sent from a target to an initiator during reconnection, a RESTORE POINTERS message is implied.

INITIATOR DETECTED ERROR (05h)

This message is sent from an initiator to inform a target that an error (for example, a bus parity error) has occurred that does not prevent the target from trying the operation again. When received, the DLT4000 drive attempts to retransfer the last command, data, or status bytes by using the RESTORE POINTERS message mechanism.

LINKED COMMAND COMPLETE (0Ah)

This message is sent from a target to an initiator to indicate that the execution of a linked command (with the Flag bit zero) is complete and that status has been sent. The initiator then sets the pointers to the initial state for the next command.

When received as a target, it is handled as an illegal message; the drive enters the MESSAGE IN phase and returns MESSAGE REJECT.

LINKED COMMAND COMPLETE, with flag (0Bh)

This message is sent from a target to an initiator to indicate that the execution of a linked command (with the Flag bit set to one) is complete and that status has been sent.

MESSAGE PARITY ERROR (09h)

This message is sent from the initiator to the target to indicate that one or more bytes in the last message it received had a parity error.

To indicate that it intends to send the message, the initiator sets the ATN signal before it releases ACK for the REQ/ACK handshake of the message that has the parity error. This provides an interlock so that the target can determine which message has the parity error. If the target receives this message under any other conditions, it proceeds

directly to the BUS FREE state by releasing the BSY signal, signifying a catastrophic error.

The target's response to this message is to switch to the MESSAGE IN phase and re-send from the beginning all the bytes of the message which generated the original MESSAGE PARITY ERROR message.

MESSAGE REJECT (07h)

This message is sent from the initiator or target to indicate that the last message received was inappropriate or has not been implemented.

To indicate its intentions of sending this message, the initiator asserts the ATN signal before it releases ACK for the REQ/ACK handshake of the message that is to be rejected.

MESSAGE REJECT is issued in response to any messages the drive considers to be illegal or not supported. When sending to the initiator, the tape device will do so before requesting any additional message bytes.

NO-OP (NO OPERATION) (08h)

If a target requests a message, the initiator sends NO-OP if it does not currently have any other valid message to send. The message is accepted when the drive is acting as a target, and may be sent when it is an initiator. If NO-OP is received during a selection, the drive proceeds to the COMMAND phase (provided ATN does not continue being asserted). The NO-OP message is ignored by the tape drive.

RESTORE POINTERS (03h)

This message is sent from a target to direct the initiator to restore the most recently saved pointers (for the currently attached logical unit). Pointers to the command, data, and status locations for the logical unit are restored to the active pointers. Command and Status pointers are restored to the beginning of the present Command and Status areas. The Data pointer is restored to the value at the beginning of the data area in the absence of a SAVE DATA POINTER message, or to the value at the last SAVE DATA POINTER message that occurred for that logical unit.

When the RESTORE POINTERS message is received as a target, the target switches to the message in phase and returns MESSAGE REJECT.

SAVE DATA POINTER (02h)

This message, sent from a target to the initiator, saves a copy of the present active Data pointer for the logical unit currently attached.

 As a target, the tape drive sends this message before a disconnect during a data transfer. It does not send a SAVE DATA POINTER message if it intends to move directly to STATUS phase. When received as a target, it switches to message in phase and returns MESSAGE REJECT.

Synchronous Data Transfer Request (SDTR)

This extended message allows the target and initiator to agree on the values of the parameters relevant to synchronous transfers. DLT4000 drive will *not* initiate the Synchronous Data Transfer Request message, but relies on the Initiator to do so. The SDTR message has the following format:

Byte 0	Extended Message Identifier – 01h
Byte 1	Length = 3
Byte 2	Message Code = 1 (SDTR msg)
Byte 3	Transfer Period (min=50. = 32h)
Byte 4	Transfer Req/Ack Offset (max=15)

Figure 8-2 *SDTR Extended Message Format*

_____ **NOTE** _____

The tape drive supports initiating synchronous transfer negotiations with the host, but this feature is disabled by default. To enable it, set the Mode Select VU ERROM parameter EnaInitSyncNeg.
_____

8.4 Tape Drive SCSI Commands

8.4.1 Control Byte - Flag and Link Bits

The control byte of the Command Descriptor Block contains the Flag and Link bits. Use of these bits is entirely initiator dependent. Setting the Link bit provides an automatic link to the next command, bypassing the usual ARBITRATION, SELECTION, and MESSAGE OUT phases which would normally occur between commands.

All other bits in the Control Byte are considered to be reserved.

8.4.2 Summary of Supported Sequential-Access Device Commands

The following table shows what SCSI commands are supported by the DLT4000 tape drive.

Table 8-2 *DLT4000 Supported SCSI Commands*

Opcode	Command	Section
19	ERASE	8.4.3
12	INQUIRY	8.4.4
1B	LOAD-UNLOAD	8.4.5
2B	LOCATE	8.4.6
4C	LOG SELECT	8.4.7
4D	LOG SENSE	8.4.8
15	MODE SELECT	8.4.9
1A/5A	MODE SENSE	8.4.10
1E	PREVENT/ALLOW MEDIUM REMOVAL	8.4.11
08	READ	8.4.12
05	READ BLOCK LIMITS	8.4.13
3C	READ BUFFER	8.4.14
34	READ POSITION	8.4.15
1C	RECEIVE DIAG RESULTS	8.4.16
17	RELEASE UNIT	8.4.17
03	REQUEST SENSE	8.4.18
16	RESERVE UNIT	8.4.19
01	REWIND	8.4.20
1D	SEND DIAGNOSTIC	8.4.21
11	SPACE	8.4.22
00	TEST UNIT READY	8.4.23
13	VERIFY	8.4.24
0A	WRITE	8.4.25
3B	WRITE BUFFER	8.4.26
10	WRITE FILEMARK	8.4.27

8.4.3 ERASE (19h)

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

Bit heading above columns; *Byte* label to the left of the row numbers.

Figure 8-3 *ERASE CDB*

ERASE causes data on the tape to be erased. Any write data currently held in buffer memory and not written to tape yet is flushed to tape before the ERASE is executed.

Immed

If the Immediate bit is set to zero, the target will not return status until the selected operation has completed. If the bit is set to one, status will be returned as soon as the operation has been initiated.

Long

The Long bit controls the distance to be erased. If the bit is set, filler and EOD blocks will be written if needed, and then the entire rest of the tape will be erased.

_____**NOTE**_____

This command is an NOP on the DLT4000 drive unless the Long bit is set. Issuing the ERASE command away from BOT is an ILLEGAL REQUEST.

_____

8.4.4 INQUIRY (12h)

Bit							
7	6	5	4	3	2	1	0

Byte

0	Operation Code (12h)						
1	Logical Unit Number			Reserved			Long
2	Page Code						
3	Reserved						
4	Allocation Length						
5	Unused		Reserved			Flag	Link

Figure 8-4 *INQUIRY CDB*

INQUIRY tells the drive to send information regarding the device's parameters to the initiator.

The INQUIRY command executes normally even if the specified LUN is not attached. INQUIRY returns a Check Condition status only when the target cannot return the requested Inquiry data. If INQUIRY is received from an initiator with a pending UNIT ATTENTION condition (before the drive reports CHECK CONDITION status), the target will perform the INQUIRY and will not clear the UNIT ATTENTION condition.

EVPD

The DLT4000 drive implements the Vital Product Data pages option on LUNs 0 and the optional medium loader LUN.

Page Code

There are three Vital Product Data pages implemented:

00h - Supported Vital Product Data pages

80h - Unit Serial Number page

C0h - Code Build Information page

If the page code field contains a different value, the drive generates a CHECK CONDITION with ILLEGAL REQUEST sense key.

Allocation Length

This specifies the maximum number of bytes that the initiator has allocated for returned Inquiry data. An Allocation Length of zero indicates that no Inquiry data is transferred. This condition is not considered an error. The drive will terminate the DATA IN phase when Allocation Length bytes have been transferred, or when all available Inquiry data has been transferred to the initiator, whichever is less.

8.4.4.1 Drive Inquiry Response

The DLT4000 drive passes back the following information in response to an INQUIRY command on the drive LUN:

			Bit					
	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	RMB	Device Type Modifier						
2	ISO Version		ECMA Version		ANSI-Approved Version			
3	Anec	TrmIOP	Reserved		Response Data Format			
4	Additional Length (33h)							
5	Reserved							
6	Rsvd	MChngr	Reserved					
7	RelAdr	WBus32	WBus16	Sync	Linked	RSVD	CmdQue	SftRe
8-15	Vendor ID = "Quantum "*							
16-31	Product ID = "DLT4000 "							
32-35	Product Revision Level = "hhss"							
36-55	Vendor Unique bytes							

Byte (label for rows)

*Applies to code version V25 and future updates, but does not apply to code version V20 or earlier code versions.

Figure 8-5 *INQUIRY Response Data*

Peripheral Qualifier

The tape drive returns one of the following values in this field:

- 000b - The indicated Peripheral Device Type is connected to the logical unit.

- 001b - The indicated Peripheral Device Type is not connected to the logical unit; however, the tape drive is capable of supporting the indicated Peripheral Device Type at the specified logical unit.

- 011b - The target is not capable of supporting a physical device on this logical unit. For this case, the Peripheral Device Type will be set to 1Fh.

Peripheral Device Type

On the tape drive LUN, this field is set to 01h, indicating a sequential access device. On the Medium Changer LUN, this field is set to 08h. All other LUNs will return 1FH.

Other Inquiry Data Fields

The rest of the fields in the Inquiry Response are used as follows:

- Byte 1:

    RMB - The Removable Medium bit is one.

    Device-Type Modifier - Set to 0.

- Byte 2:

    IOS Version - Set to 0

    ECMA Version - Set to 0

    ANSI Approved Version - Set to 02h, indicating compliance with SCSI-2

- Byte 3:

    ANEC - Set to 0 (Asynchronous Event Notification not supported)

    TrmIOP - Set to 1 (TERMINATE I/O PROCESS message supported)

    Response Data Format - Set to 2 (Inquiry Data in SCSI-2 format)

- Byte 4:

    Additional Length - The tape drive sets this field to indicate the number of additional bytes of INQUIRY Response Data available

- Byte 6: All bits set to zero, except:

    MChngr - Set to 1 if an integrated Media Loader is present and EEROM parameter EnbIngMedChgr is set to 1. This SCSI-3 bit indicates that the Read Element Status and Move Medium commands can be issued to the drive LUN (0). By default, this bit is off on the DLT4000 products.

- Byte 7: All bits set to zero, except:

    Sync - Set to 1 (synchronous data transfer supported)

    Linked - Set to 1 (linked commands supported)
- Vendor Identification - See figure 8-6

- Product Identification - See figure 8-6

_____**NOTE** _____

If a media loader is attached to the tape drive, the Product ID will indicate "DLT4500" or "DLT4700" instead of "DLT4000" for 5 and 7 cartridges loader, respectively.

_____

Product Revision Level
This field contains four bytes of ASCII data, which define the product's software Revision Levels. The first tow bytes are the version number of servo code. in the DLT4000 products, this firmware is located in a PROM and is not field updateable. The second two bytes are the version number of the SCSI/read/write code. When a firmware update is performed on the DLT4000 drive , this part of the Revision Level field will change appropriately.

Vendor Specific
Vendor Specific - See next section.

8.4.4.2 Vendor Unique Inquiry Data

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

Bit

36	Product Family	Released Firmware
37	Firmware Major Version #	
38	Firmware Minor Version #	
39	EEPROM Format Major Version #	
40	EEPROM Format Minor Version #	
41	Firmware Personality	
42	Firmware Sub-personality	
43	Tape Directory Format Version #	
44	Controller Hardware Version #	
45	Drive EEPROM Version #	
46	Drive Hardware Version #	
47	Media Loader Firmware Version #	
48	Media Loader Hardware Version #	
49	Media Loader Mechanical Version #	
50	Media Loader Present flag	
51	Library Present flag	
52-55	Module Revision	

Byte (label to left of Byte column 44 area)

Figure 8-6 *INQUIRY Vendor Unique Bytes Definition*

Vendor Specific Inquiry Bytes

To more precisely identify the product and the installed firmware, additional information is available.

Product Family

Use Table 8-3 to determine what Product Family Bit value represents.

Table 8-3 *Product Family Bit Values*

Product Family Bit	Drive Density
0	Not Specified
1	2.6 GB
2	6.0 GB
3	10.0/20.0 GB
5	20.0/40.0 GB
6	15.0/30.0 GB

Released Flag

This flag differentiates between released and test versions of firmware. One indicates released code (Vxxx) or field test code (Txxx). Released code has no Minor FW Version number (byte 38 is 0). Field Test and engineering versions of code have non-zero Minor FW Version numbers for tracking purposes.

Various Version Numbers

In binary, not ASCII.

Firmware Personality

Numeric indicator of firmware personality. Set to 4.

Firmware Sub-Personality

Further differentiates product versions, currently set to a 1.

Loader Present

Nonzero if a media loader is present.

Library Present

Nonzero if a library is attached.

Module Revisions

A four byte ASCII string represents the revision of the hardware module.

8.4.4.3 Vital Product Data Pages

The following figures show the information in the supported Vital Product Data Pages.

	Bit							
	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (00h)							
2	Reserved							
3	Page Length (3 more bytes)							
4	00h - (this page)							
5	80h - Unit Serial Number page							
6	C0h - Firmware Build Info page (VU)							

(Byte)

Figure 8-7 *Supported Vital Product Data Pages*

	Bit							
	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (80h)							
2	Reserved							
3	Page Length (0Ah)							
4 - 13	Serial Number							

(Byte)

Figure 8-8 *Unit Serial Number page*

Serial Number

The serial number is the serial number of the printed circuit card mounted on the bottom of the DLT4000 drive. It can be found on the bar code label. The serial number is returned in ASCII.

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

Byte (label at left of rows 1)

Figure 8-9 *Firmware Build Information page - VU*

The checksums are binary, and are for positive Firmware and EEPROM identification.

Firmware Build Date is an ASCII string in the DD-Mmm-YYYY HH:MM::SS format.

8.4.4.4 Media Loader Inquiry Response

The DLT4000 controller generates INQUIRY Data on the Medium Changer LUN that is very similar to that of the tape drive LUN. The key differences are:

- Peripheral Device Type is set to "8" for SCSI-2 Medium Changer

- Product ID bytes are set to DLT4700 for a 7 cartridge loader.

8.4.5 LOAD-UNLOAD (1Bh)

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

Figure 8-10 *LOAD-UNLOAD CDB*

LOAD-UNLOAD tells the target to load or unload the media in the tape cartridge. If no cartridge is in the drive, both LOAD and UNLOAD will return a CHECK CONDITION status with a NOT READY sense key set. If the drive has received an UNLOAD command with the Immed bit set and then receives another command which would involve tape motion or TEST UNIT READY, the drive will return a CHECK CONDITION status with a NOT READY sense key set.

Operation of the Unload version of this command will be different if a media loader is present.

Two modes of operation are possible when a media loader is attached. If none of the media loader specific commands has been issued, then the device will operate in the sequential mode of operation. Once a media loader specific command has been issued, the sequential mode of operation is disabled and the UNLOAD command becomes a no-op.

If the device is still in the default sequential mode of operation and an UNLOAD command is received by the subsystem, the current cartridge will be unloaded and automatically moved to the magazine slot from which it originated. Then, the cartridge from the next slot in the magazine, if not empty, is automatically moved from the magazine into the drive, loaded, and made ready. If the next magazine slot is empty, no CHECK CONDITION status is created.

When the cartridge is unloaded into magazine slot 6 (the last one), the subsystem does not cycle back to slot 0. This prevents accidental overwriting of data when using the subsystem in sequential auto-loading mode. The next cartridge must be selected and loaded manually, or with a SCSI Move Medium command.

EEROM parameters ENALDRAUTOLD and DISLDRAUTOLDMC can be modified to enable/disable the sequential loading feature (Table 8-4).

A media loader does not affect the device's processing of the LOAD flavor of the LOAD-UNLOAD command.

The command specific bits are used as follows:

- Immed - If this bit is set, status is returned as soon as the operation is started. Otherwise, the status is returned after the operation has completed.

- Re-Ten - Re-tension operations are not needed on the DLT4000 drive, so this bit is ignored (that is, good status, if the bit is set).

- Load - When a cartridge is inserted, the media is automatically loaded and positioned by the drive at BOM. Logically, the drive will be positioned at the beginning of Partition 0.

  If the Load bit is set, and the media is already loaded, no action is taken. If the media was unloaded but the cartridge was not removed, a Load will cause it to be loaded to BOP again and made ready.

  If the Load bit is zero and media is loaded, the drive writes any buffered data and filemarks to the tape and rewinds the tape to BOM and unloads the media into the DLT4000 cartridge. The green Operate Handle light turns on and the cartridge can be removed from the drive. If the media is already unloaded, no action is taken.

- EOT - This bit is ignored by the DLT4000 drive, unless both the EOT and Load bits are both set, then the drive returns CHECK CONDITION, ILLEGAL REQUEST.

8.4.6 LOCATE (2Bh)

Byte	Bit	7	6	5	4	3	2	1	0
	0	Operation Code (2Bh)							
	1	Logical Unit Number			Reserved		BT	CP	Imm
	2	(MSB)							
	3	Reserved							
	4								
	5								
	6								(LSB)
	7	Reserved							
	8	Partition							
	9	Unused		Reserved				Flag	Link
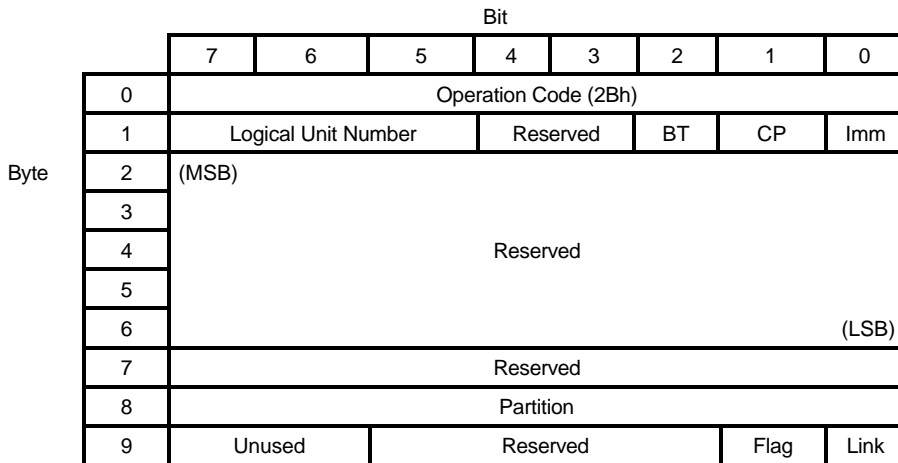
Figure 8-11 *LOCATE CDB*

The LOCATE command is used to do high-speed positioning to the specified block address. Average positioning time is about 45 seconds; maximum time is under 90 seconds.

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

- BT - The Block Type bit indicates how the Block Address field is interpreted. For the DLT4000 products, SCSI Logical Block addresses are always returned, that is, setting the BT bit does not affect the values returned. The first recorded object (block or filemark) is at address zero, and Block Addresses count both data blocks and filemarks.

- CP - Since multiple partitions are not supported this bit must be zero.

- Imm - If set, STATUS is returned when the command has been started.

Block Address

The Block Address field defines the SCSI Logical Block Address to which the media will be positioned. These addresses start at zero, and include data blocks and filemarks, so they could also be considered an object address.

8.4.7 LOG SELECT (4Ch)

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

Figure 8-12 *LOG SELECT CDB*

LOG SELECT allows the host to manage statistical information maintained by the device about its own hardware or the installed media. The description should be read in conjunction with the description of the LOG SENSE command which follows it, to provide the reader with information about log page format, parameters, and supported pages. The command specific bits are used as follows:

- PCR - If Parameter Code Reset bit is set to 1 and parameter list length is 0, all accumulated values of page code 2, 3, and 32 are set to zero and all threshold values are set to default. If PCR is set to 1 and the Parameter List Length Field is not zero, the command will be terminated with a CHECK CONDITION Status, with Sense Key of ILLEGAL REQUEST, and ASC of INVALID FIELD IN CDB.

- SP - The Save Page bit is not supported and must be set to zero. If the SP bit is set, the command will be terminated with CHECK CONDITION Status, with Sense Key of ILLEGAL REQUEST, and ASC of INVALID FIELD IN CDB.

- PC - The Page Control field defines the type of parameter values to be selected:

PC	Type of Parameter Values
00b	Threshold Values
01b	Cumulative Values
10b	Default Threshold Values
11b	Default Cumulative Values

Figure 8-13 *LOG Page Control Definitions*

All types of parameter values are changeable through Log Select.

When the PC field is set to 00b or 01b and the Parameter List Length is zero, the command is terminated with a CHECK CONDITION Status, with Sense Key of ILLEGAL REQUEST, and ASC of INVALID FIELD IN CDB. This is because modification of Current Threshold Values and Current Cumulative Values is not supported.

When the PC field is set to 10b and the Parameter List Length field is 0 then all Current Threshold Values will be reset to the Default Threshold Values. This is equivalent to no change as Threshold Values cannot be modified.

When the PC field is set to 11b and the Parameter List Length field is 0 then all Current Cumulative Values will be reset to the Default Cumulative Values. This is equivalent to clearing all log pages which can be cleared.

Parameter List Length

This field specifies the length in bytes of the LOG SELECT parameter list to be transferred from the initiator to the target during the DATA OUT phase. A parameter list length of zero indicates that no data is to be transferred. This condition is not considered an error (see the description of Parameter Code Reset and Page Control fields in this section).

Error Detection Summary in LOG SELECT CDB

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

- If PCR bit is set to 1 and parameter list length is not zero

- If SP bit is set 1

- A parameter list length that would cause a parameter within a valid page to be truncated or otherwise incompletely initialized.

8.4.7.1 Operation of LOG SELECT

The purpose of the LOG SELECT command is to allow the initiator to modify and initialize parameters within the logs supported by the device.

There are two ways to initialize the log parameters. First, set the PCR bit in the LOG SELECT CDB; this clears all parameters. Secondly, individual pages can be cleared by specifying the log page and the parameter value as the log parameters. The following pages can be cleared in this manner.

Page Code	Page Description
02b	Write Error Counter Page
03b	Read Error Counter Page
32b	Compression ratio page

Figure 8-14 *Clearable Log Pages*

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

LOG SELECT PAGE FORMAT

Each Log page will begin 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, will be 8 bytes. The parameter block for code 05h will be 12 bytes.

Log Page Header

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

Log Parameters

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

Figure 8-15 *Read/Write Error Log Select Page Format*

Page Code

The Page Code specifies what Log Page this LOG SELECT command is for.

Page Length

The Page Length specifies the total number of bytes contained in this log page, not including the four bytes of the header.

Parameter Code

Parameter codes supported for the read/write error counter pages are described in Figure 8-16.

Parameter Control Bytes

Byte 2 of Log parameter block in Figure 8-15 is referred to as the parameter control byte.

- DU–Disable Update: DU bit is not defined for LOG SELECT and the target ignores any value.

- DS and TSD–Saving parameters is not supported; they both should be set to 1. If the DS and/or TSD are set to zero, the command is terminated with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN PARAMETER LIST.

- ETC–Enable Threshold Comparison: When set to 1, the drive will perform a comparison with threshold values once the cumulative value is updated. Comparison criteria is defined in TMC. If the comparison is met and the RLEC bit of MODE SELECT/SENSE Control Page is set to 1, then a UNIT ATTENTION *is* generated for all initiators. The additional sense code is set to LOG EXCEPTION and the additional sense code qualifier is set to THRESHOLD CONDITION MET. If the RLEC bit is zero and the comparison is met, then UNIT ATTENTION *is not* generated.

- TMC–Threshold Met Criteria: See Figure 8-23 for the list of criteria. Once the specified criteria in this field is met and the ETC bit is 1 and the RLEC bit in MODE SENSE/SELECT Control Page is set to 1, then UNIT ATTENTION is generated for all initiators.

- LP–List Parameter: This bit should always be set to 0 to indicate parameter codes are treated as data counters.

Parameter Length

This field specifies the number of bytes of the parameter value.

Parameter Value

This field is the actual value of this log parameter.

Parameter Code	Description
00h	Errors corrected with substantial delays
01h	Errors corrected with possible delays
02h	Total rewrites or rereads
03h	Total errors corrected
04h	Total times correction algorithm processed
05h	Total bytes processed
06h	Tortal uncorrected errors
8000h	Vendor Unique

Figure 8-16 *Parameter Codes Supported*

Parameter codes 00h, 01h, and 04h will always return a value of zero.

_____ **NOTE** _____

Parameter value for code 05h will be 8 bytes; the parameter length will be set to 8.

_____

Error Detection Summary in Log Select Pages

The host should issue a LOG SENSE command to initialize host software which allows:

- Correct determination of the pages the drive uses

- Determination of the parameter codes and length of each parameter

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

- If a page header is received with unsupported page codes

- Incorrect log page length is specified in the page header

- An illegal parameter code within a valid page code

- Parameter codes for a supported page are not sent in ascending order

- LP bit is set to 1 in the parameter control byte

- DS bit is set to zero in the parameter control byte

- TSD bit is set to zero in the parameter control byte

8.4.8 LOG SENSE (4Dh)

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

Figure 8-17 *LOG SENSED CDB*

LOG SENSE allows the host to retrieve statistical information maintained by the device about its own hardware or the installed media. It is a complementary command to LOG SELECT.

PPC

The Parameter Pointer Control bit must be zero. A Parameter Pointer Control bit of zero indicates that the parameter data requested from the device will start with the parameter code specified in the Parameter Pointer field and return the number of bytes specified in the Allocation Length field in ascending order of parameter codes from the specified log page. A PPC bit of zero and a Parameter Point field of zero causes all available parameter data for that page code to be returned to the initiator.

_____**NOTE** _____

The current implementation of the Read/Write Compression Page does not support a parameter pointer other than zero.
_____

If PPC bit is set or the Parameter Pointer is larger than the highest numbered parameter on the page, then the target will terminate the command with 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 target does not support a parameter code within this page then it will not return any data associated with this parameter.

SP

Saving log parameters is not supported and is always zero.

If the SP bit is set, the command is terminated with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and an additional sense code of INVALID FIELD IN CDB.

PC

The Page Control field defines the type of parameter values to be returned:

PC	Type of Parameter Values
00b	Threshold Values
01b	Cumulative Values
10b	Default Threshold Values
11b	Default Cumulative Values

Figure 8-18 *LOG Page Control Definitions*

The Default Threshold Values are the maximum values that each parameter can attain.

The Current Cumulative Values are the values computed since the last reset of the device (either by power-cycling, BUS DEVICE RESET, or SCSI RESET).

The Default Cumulative Values are the values to which each parameter gets initialized on a reset condition as described previously. Default values are zero.

By default Current threshold values = Default threshold values.

_____ **NOTE** _____

All types of Parameter values are changeable through LOG SELECT.
_____

Page Code

The Page Code field identifies which log page is being requested by the initiator. If the page is not supported then the command terminates with a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and an additional sense code of INVALID FIELD IN CDB. Supported pages are as follows:

Page Code	Page Description
00h	List of Supported Pages Page
02h	Write Error Counter Page
03h	Read Error Counter Page
07h	Last n Errors Events Page
32h	Compression ratio page

Figure 8-19 *LOG SENSE Pages Supported*

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 field contains 3, then only parameters 3, 4, and 5 are returned to the initiator. Similarly, if a page supports parameters 1, 3, and 6, and the Parameter Pointer field contains 2, then only parameters 3 and 6 are returned to the initiator.

If Parameter Pointer is larger than the highest numbered parameter on the page, then the target will terminate the command with CHECK CONDITION status. The sense key is set to ILLEGAL REQUEST and the additional sense code is set to INVALID FIELD IN CDB.

_____**NOTE**_____

Parameters within a page are always returned in ascending order according to parameter code.

_____

Allocation Length

The Allocation Length field is used to inform the target how much space the initiator has allocated for data. There must be sufficient space allocated for all the requested data, otherwise the command will terminate with a CHECK CONDITION Status with Sense Key of ILLEGAL REQUEST, and ASC of INVALID FIELD IN CDB.

Error Detection Summary in LOG SENSE CDB

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

- If a page is not supported

- If the parameter pointer is larger than the highest numbered parameter on the page

- If SP bit is set to 1

- If the Allocation Length is smaller than the data being returned by target

8.4.8.1 Supported Pages Log Page (Page 0)

When page 0 is requested, the 4-byte page header is returned followed by the pages supported in ascending order, one byte for each.

	Bit							
	7	6	5	4	3	2	1	0
0	Reserved			Page Code (00h)				
1	Reserved							
2	(MSB)	Page Length (05H)						
3								(LSB)
4	00h							
5	02h							
6	03h							
7	07h							
8	32h							

Byte

Figure 8-20 *Supported Pages Page Format*

8.4.8.2 Read/Write Error Log Page (Page 2 and 3)

Each Log page will begin with a 4-byte header followed by n number of log parameter blocks, each block of 8 bytes except for parameter code 5h.

The log parameter block for the Parameter total bytes processed (5h) will be 12 bytes, since the parameter value is 8 bytes long.

Log Page Header

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

Log Parameters

		7	6	5	4	3	2	1	0
	0	(MSB)		Parameter Code					
	1								(LSB)
	2	DU	DS	TSD	ETC	TMC		Rsvd	LP
	3	Parameter Length							
Byte	4	(MSB)							
	—	Parameter Value							
	—								
	11								(LSB)
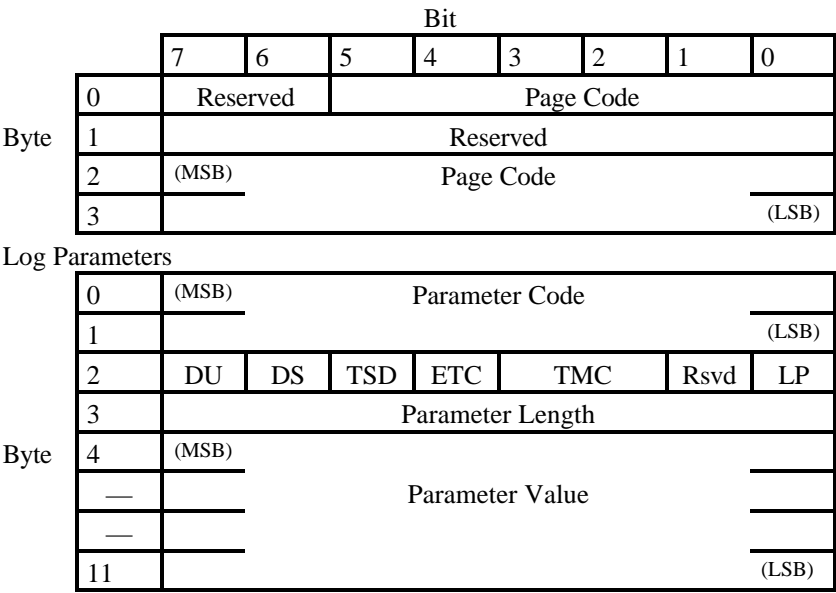
Figure 8-21 *Read/Write Error Log SENSE Page Format*

Page Code

The Page Code echoes the page code that was specific in the LOG SENSE CDB.

Page Length

The Page Length specifies the total number of bytes contained in this log page, not including the four bytes of the heads.

For example, if PPC bit is zero and parameter pointer is zero then target will return 4 bytes of page header with page length of 44h followed by 8 bytes of parameter value data for each parameter code except for parameter code 5h. For 5h, it will return 12 bytes.

So, for Parameter code 0h, 1h, 2h, 3h, 4h, 6h, and 8000h, each page will be 8 bytes. For parameter code 5h, page will be 12 bytes.

Parameter Code

The following parameter codes are supported for the read/write error counter pages.

Parameter Code	Description
00h	Errors corrected with substantial delays
01h	Errors corrected with possible delays
02h	Total rewrites or rereads
03h	Total errors corrected
04h	Total times correction algorithm processed
05h	Total bytes processed
06h	Tortal uncorrected errors
8000h	Vendor Unique

Figure 8-22 *Parameter Codes Supported*

Parameter codes 00h, 01h, and 04h will always return a value of zero.

DU, DS, TSD, ETC, TMC, and LP are collectively referred to as parameter control byte.

- DU–Disable Update: A zero value indicates that target updates all log parameter values. A value of 1 indicates that target will not update the log parameter values except in response to LOG SELECT. This bit is set by the drive when accumulated values reach maximum. This is also returned set if the host set the bit in the last LOG SELECT command. The default is zero.

_____ **NOTE** _____

For parameter types other than threshold and cumulative values, this bit is always zero.

- DS–Disable Save: Saving parameters is not supported; this bit will always be set to 1.

- TSD–Target Save Disable: Saving parameters is not supported; this bit will always be set to 1.

- ETC–Enable Threshold Comparison: ETC of 1 indicates that comparison to threshold is performed. ETC of zero indicates that this comparison is not performed. This bit is set to 1 by MODE SELECT. Default is zero.

- TMC–Threshold Met Criteria: This field is valid only if host sets ETC to 1. It determines the basis for comparison and is specified by host by LOG SELECT. If the result of comparison is true (cumulative = threshold) and MODE SELECT/SENSE control mode page RLEC bit is set 1, then a unit attention is generated for all initiators. The sense key will be set to UNIT ATTENTION, ASC

will be set to LOG EXCEPTION and ASCQ will be set to THRESHOLD CONDITION MET. If the RLEC bit in control mode page is zero then, UNIT ATTENTION will not be generated.

_____**NOTE** _____

This comparison is performed in real time. Therefore, you do not need to issue a Log Sense command to get the check condition. Once ETC is selected, RLEC bit in Control mode page, the check condition will be issued based on the criteria defined in the TMC bits if the criteria is met in Real time. Check condition will not identify for which parameter code the criteria is met. The user will need to issue Log Sense to read the counters to see for which parameter code criteria is met.

_____

Parameter Code	Basis of Comparison
00b	Every update of the cumulative value
01b	Cumulative value equal to threshold value
10b	Cumulative value not equal to threshold value
11b	Cumulative value greater than threshold value

Figure 8-23 *Threshold Met Criteria*

- LP–List Parameter: This bit will always be set to zero as we treat the parameter codes as data counter. When the data counter reaches its defined maximum value, it is not increment and DU bit is set to 1. If the data counter is at or reaches its maximum value during the execution of a command, the drive will complete the command. If the RLEC bit of CONTROL MODE PAGE is 1, the drive then will issue the status of CHECK CONDITION and set the sense key to RECOVERED ERROR with additional sense code set to LOG COUNTER AT MAXIMUM.

Parameter Length

This field specifies the number of bytes of the parameter value.

Parameter Value

This field is the actual value of this log parameter

8.4.8.3 Last n Error Events Page (07h)

This page returns one parameter at a time that consists of the ASCII text for the specified event log. The Parameter Number field in the CDB specifies the log event to return. The log events EEROM are numbered 0 to 255, after which the number wraps back to 0, and only a limited number of events are stored at a given time (up to 14). The log event returned is the one whose parameter code is equal to, or the first one greater than, the Parameter Number specified in the CDB.

Parameter Code

Parameter code values are assigned from 0 to 27, where 0 would be the oldest event stored, and the highest parameter code returned would be the most recent event.

Hex ASCII String

The text of the parameter includes a "Packet #", which is a value from 0 to 255. This internal number is assigned when the packet is written into EEROM. Zero is normally the oldest packet, but packet numbers can wrap around from 255 to 0. For a detailed description of the packet string, see Appendix D.

	Bit							
	7	6	5	4	3	2	1	0
4	(MSB)			Parameter Code				
5								(LSB)
6	DU	DS	TSD	ETC	TMC		0	LP
7				Parameter Length				
8	(MSB)							
—				Hex ASCII string for Event n				
—								
n								(LSB)

Byte (label for rows 4–n)
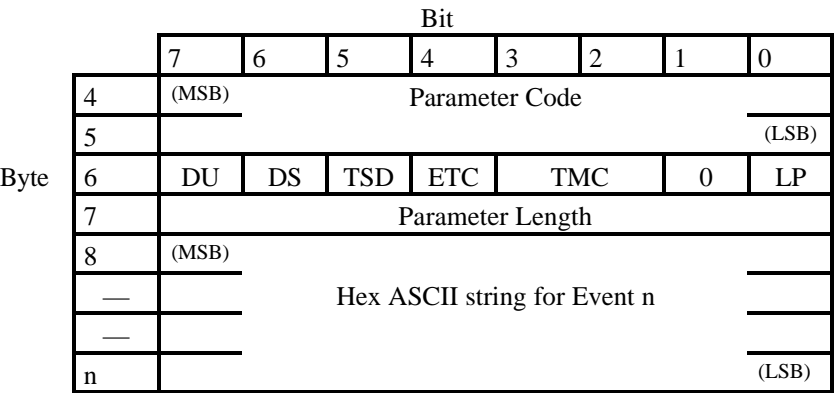
Figure 8-24 *Last n Error Events Page*

8.4.8.4 Read/Write Compression Ratio Page Format (32h)

The Read/Write Compression Ratio page begins with a 4-byte header followed by the log parameter blocks of 6 or 8 bytes, depending on the parameter code selected.

Parameter Codes

The following parameter codes are supported for the Read/Write Compression Ratio page.

Parameter Code	Description
00h	Read Compression Ratio $\times$ 100
01h	Write Compression Ratio $\times$ 100
02h	MBytes Transferred to Host
03h	Bytes Transferred to Host
04h	MBytes Read from Tape
05h	Bytes Read from Tape
06h	MBytes Transferred from Host
07h	Bytes Transferred from Host
08h	MBytes Written to Tape
09h	Bytes Written to Tape

Figure 8-25 *Parameter Codes Supported*

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

Byte

Figure 8-26 *Read/Write Compression Ratio Page Header*

Additional Length

The additional length field specifies the number of bytes available and depends on the parameters requested

Parameter Block for Parameter Codes 00 and 01

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

Figure 8-27 *Read/Write Compression Ratio LOG SENSE Page Format*

Parameter Control Byte

- DU–Disable Update: This bit is always zero.

- DS–Disable Save: Saving parameters is not supported; this bit will always be set to 1.

- TSD–Target Save Disable: Saving parameters is not supported; this bit will always be set to 1.

- ETC–Enable Threshold Comparison: Threshold checking is not supported on this page; this bit is always a zero.

- TMC–Threshold Met Criteria: Always a zero.

- LP–List Parameter: This bit will always be set to zero, as we treat the parameter codes as data counter.

Compression Ratio

The compression ratio is reported as the actual compression ratio times 100.

Parameter Block for Parameter Codes 02 through 09

<table>
<tr><td></td><td></td><td colspan="8" align="center">Bit</td></tr>
<tr><td></td><td></td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td rowspan="8" align="center">Byte</td><td>0</td><td>(MSB)</td><td colspan="7" align="center">Parameter Code</td></tr>
<tr><td>1</td><td colspan="8" align="right">(LSB)</td></tr>
<tr><td>2</td><td>DU</td><td>DS</td><td>TSD</td><td>ETC</td><td colspan="2" align="center">TMC</td><td>Rsvd</td><td>LP</td></tr>
<tr><td>3</td><td colspan="8" align="center">04h</td></tr>
<tr><td>4</td><td>(MSB)</td><td colspan="7"></td></tr>
<tr><td>5</td><td colspan="8" align="center">Counter Value</td></tr>
<tr><td>6</td><td colspan="8"></td></tr>
<tr><td>7</td><td colspan="8" align="right">(LSB)</td></tr>
</table>

Figure 8-28 *Read/Write Bytes Transferred LOG SENSE Page Format*

Parameter Control Byte

- DU–Disable Update: This bit is always zero.

- DS–Disable Save: Saving parameters is not supported; this bit will always be set to 1.

- TSD–Target Save Disable: Saving parameters is not supported; this bit will always be set to 1.

- ETC–Enable Threshold Comparison: Threshold checking is not supported on this page; this bit is always a zero.

- TMC–Threshold Met Criteria: Always a zero.

- LP–List Parameter: This bit will always be set to zero as we treat the parameter codes as data counter.

Counter Value

These parameter codes provide a count of the number of bytes transferred since the current tape cartridge was inserted or since the last time the counters were reset via a MODE SELECT command.

Parameter codes 02 and 03 report the counts of bytes transferred from the tape drive to the initiator. Parameter code 02 reports the number of full megabytes transferred. Parameter code 03 reports the number of bytes less than a full megabyte that has been transferred. Multiplying the counter returned for parameter 02 by 1,048,576 and then adding the counter value returned for parameter 03 will give the actual total bytes transferred to the initiator.

Parameter codes 04 and 05 report the counts of bytes transferred from the tape to the buffer. Parameter code 04 reports the number of full megabytes transferred. Parameter code 05 reports the number of bytes less than a full megabyte that has been transferred. Multiplying the counter returned for parameter 04 by 1,048,576 and then adding the counter value returned for parameter 05 will give the actual total bytes transferred from tape to buffer.

Parameter codes 06 and 07 report the counts of bytes transferred from the initiator to the buffer. Parameter code 06 reports the number of full megabytes transferred. Parameter code 07 reports the number of bytes less than a full megabyte that has been transferred. Multiplying the counter returned for parameter 06 by 1,048,576 and then adding the counter value returned for parameter 07 will give the actual total bytes transferred from the initiator to the buffer.

Parameter codes 08 and 09 report the counts of bytes written to the tape. Parameter code 08 reports the number of full megabytes transferred. Parameter code 09 reports the number of bytes less than a full megabyte that has been transferred. Multiplying the counter returned for parameter 08 by 1,048,576 and then adding the counter value returned for parameter 09 will give the actual total bytes written to the tape.

8.4.9 MODE SELECT (15h)

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

Figure 8-29 *MODE SELECT CDB*

MODE SELECT enables the host to configure the device. Implementing MODE SELECT and MODE SENSE requires a certain amount of handshaking between the host and the drive. Before configuring the drive, the host should issue a MODE SENSE to get the current configuration and determine what parameters are configurable. The host interprets this information and may then issue MODE SELECT to set the drive to the host's preferred configuration.

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

PF

The Page Format bit indicates that the data sent by the host after the MODE SELECT header and block descriptors complies with the definition of pages in the SCSI-2 specification. The SCSI-1 format will not be implemented, so this bit is required to be set. It is an ILLEGAL REQUEST to have page parameters while the PF bit is off.

SP

This bit must be zero. The save Parameters bit instructs the drive to save all savable pages. This is not supported.

PARAMETER LIST LENGTH

This specifies the length in bytes of the MODE SELECT parameter list that is transferred during the DATA OUT phase. A zero Parameter List Length indicates that no data is transferred.

8.4.9.1 MODE SELECT Parameter List

The MODE SELECT parameter list shown below, contains a 4-byte header, followed by one 8-byte block descriptor.

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

Block Descriptor

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

Page Descriptors

	0	PS (0)	0	Page Code					
	1	Additional Page Length							
	2	Page Defined or Vendor-Unique Parameter List							

Figure 8-30 *MODE SELECT Parameter List*

Media Type

This field is ignored by MODE SELECT command.

Buffered Mode

The drive will implement Immediate Reporting on WRITE commands through Buffered mode.

If the field is zero, then the drive does not report a GOOD status on WRITE commands until the data blocks are actually written to tape. If the Buffered Mode field is one, then the drive reports GOOD status on WRITE commands as soon as the data block has been transferred to the buffer. This is the default configuration for the drive.

When Buffered mode is not used, the tape drive will suffer a significant degradation in performance, and maybe capacity as well, depending on tape format, block size and

compression. If writing 2.6 or 6.0 GByte formats, if the block size is a multiple of 4 Kbytes, there is no capacity loss. When using the 10 GByte or 20 GByte format, if compression is disabled and the block size is a multiple of 8 Kbytes, there is no capacity loss.

When using the 10/20 GByte format and compression enabled, not having buffered mode enabled will cause some capacity loss, depending on compression ratios. This is because the block packing feature is essentially disabled by turning off buffered mode.

If this field is greater than 1, the command will be rejected with a Check Condition, with a Sense Key of ILLEGAL REQUEST.

Speed

The tape drive supports only one speed, the default speed.

Block Descriptor Length

This specifies the length in bytes of all the block descriptors. Since the drive only allows one block descriptor, this value must be 8 or 0. Any other value causes a CHECK CONDITION status with an ILLEGAL REQUEST sense key to be returned.

Density Code

This field should match the current density of the media, or will be set to zero if the density is unknown.

00h - use default density

0Ah - 6667 bpi MFM serial cart. tape X3B5/86-199 (Read only)

16h - 10000 bpi MFM serial cart tape X3.193-1990 (Read only)

17h - 42500 bpi MFM serial cart tape X3B5/91-174 - 2.6 GB

18h - (Same as 17h but with 56 track pairs vs. 24) - 6.0 GB

19h - 62500 bpi, 64 track pairs, serial cart tape - 10/15 GB

1Ah - 81633 bpi, 64 track pairs, serial cart tape - 20/30 GB

7Fh - No change from previous density (NOP)

80h - 62500 bpi, 64 track pairs, serial cart tape-10/15 GB (without compression)

81h - 62500 bpi, 64 track pairs, serial cart tape-20/30 GB (with compression)

82h – 81633 bpi, 64 track pairs, serial cart tape - 20 GB (without compression)

83h – 81633 bpi, 64 track pairs, serial cart tape - 40 GB (with compression)

Number of Blocks

This MODE SENSE field will be sent as zero, indicating that all of the remaining logical blocks on the tape will have the medium characteristics specified by the block descriptor.

Block Length

This specifies the length in bytes of each logical block transferred over the SCSI bus. A block length of zero indicates that the length is variable (specified in the I/O command). Any other value indicates the number of bytes per block to use for read, write and verify type 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.

8.4.9.2 MODE SELECT Pages

Following the Block Descriptor are the MODE SELECT pages, which set the device parameters. Each page has a 2-byte header which identifies the page code and indicates the number of bytes in that page.

The supported Page Codes are as follows:

Page Code	Description	Sense/Select
01h	Error Recovery Page	Both
02h	Disconnect/Reconnect	Both
0Ah	Control Mode Page	Both
0Fh	Data Compression Page	Both
10h	Device Configuration	Both
11h	Medium Partition	Both
3Eh	EEPROM Parameter	Both

Figure 8-31 *MODE SELECT Pages Supported*

PS Bit

For the MODE SELECT command this bit is reserved. For the MODE SENSE command, a Parameters Savable (PS) bit of one indicates that the page can be saved in nonvolatile memory by the drive. If the PS bit is zero, the supported parameters cannot be saved. (Savable pages are not supported.)

Additional Page Length

This indicates the number of bytes in that page. However, the value does not include bytes 0 and 1. The length is returned on MODE SENSE and must subsequently be set to the same value when performing MODE SELECT. If the page length does not match that expected by the drive, a CHECK CONDITION status is returned with the sense key set to ILLEGAL REQUEST.

The drive also returns a CHECK CONDITION status with an ILLEGAL REQUEST sense key if the host sends an unsupported Page Code, or a Page field with values not supported or changeable. In this case, no parameters will be changed by the command.

8.4.9.3 Read/Write Error Recovery Page (01h)

The drive supports the Error Recovery Page which has the following format:

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

Figure 8-32 *Error Recovery Page Format*

In this page, only the Post Error (PER) flag parameter is changeable. If PER is set, Check Conditions will be created, with Sense Key of Recovered Error, and VU Sense Data detailing the cause. Normally, these events should be rare, and only occur if the recovered write or read retry rates reach excessive levels.

Option Flags

- TB - The Transfer Block (when not fully recovered) function is not supported.

- EER - The Enable Early Recovery function is always enabled.

- PER - The Post Error bit turns on reporting of Check Condition to report recovered read/write errors. The default setting of this bit is zero.

- DTE - The Disable Transfer on Error feature is not supported so this bit must be zero.

- DCR - The Disable ECC Correction bit feature is not supported so this bit must be zero.

Read Retry Count

This field reports the maximum number of rereads that are done before declaring an unrecoverable error.

Write Retry Count

This field reports the maximum number of overwrite retries that will be performed before declaring an unrecoverable error.

8.4.9.4 Disconnect/Reconnect Page (02h)

The drive supports the Disconnect/Reconnect Page which has the following format:

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

Figure 8-33 *Disconnect/Reconnect Page Format*

In this page, only the Maximum Burst Size parameter is changeable.

The following parameters in this page are supported:

Maximum Burst Size
This value specifies the maximum amount of data that will be transferred without disconnecting. A value of zero sets no limit. This value is in units of 512 bytes. For example, a value of 8 means 4k bytes. Values that are not multiples of 8 are rounded up to the closest multiple of 8.

Data Transfer Disconnect Control (DTDC)
The DTDC field defines further restrictions on when a disconnect is permitted.

DTDC	Description
00b	Data transfer disconnect control is not used. Disconnect is controlled by the other fields in this page
01b	A target does not attempt to disconnect once the data transfer of a command has started until all data the command is to transfer has been transferred.
10b	Reserved
11b	A target does not attempt to disconnect once the data transfer of a command has started, until the command is complete.

Figure 8-34 *Data Transfer Disconnect Control*

If DTDC is non-zero and the maximum burst size is non-zero, the DLT4000 drive returns CHECK CONDITION status. The sense key is set to ILLEGAL REQUEST and the additional sense code set to ILLEGAL FIELD IN PARAMETER LIST.

8.4.9.5 Control Mode Page (0Ah)

The control mode page provides controls over several features such as tagged queuing, extended contingent allegiance, asynchronous event notification, and error logging.

	Bit							
	7	6	5	4	3	2	1	0
0	RSVD		Page Code					
1	Page Length							
2	RSVD							RLEC
3	Queue Algorithm Modifer				Reserved		QErr	DQue
4	EECA	Reserved				RAENP	UAAENP	EAENP
5	Reserved							
6	(MSB)							
7	Ready AEN Holdoff Period							(LSB)

(Byte labels shown at left; Bit label shown at top)

Figure 8-35 *Control Mode Page (0Ah)*

A report log exception condition (RLEC) bit of one specifies the target reports log exception conditions. An RLEC bit of zero specifies the target is not reporting log exception conditions.

Page Code
The Page Code identifies the type of MODE SELECT page being transferred. This is the Control Mode Page. The valid value for Page Code is 0Ah.

Page Length
The Page Length indicates the number of bytes in the Control Mode Page that follow this byte. The valid value for this byte is 06h.

RLEC
The RLEC bit works with the READ/WRITE Error Log Sense Page. Refer to the previous section Read/Write Error Log SENSE Page Format (Page 2 and 3) under the TMC bit description.

The RLEC bit indicates whether the DLT4000 drive should return Check Condition status with the sense key set to Unit Attention (6h) when one of its write and read error counters of the log pages reaches a specified threshold as follows: (See LOG SELECT command section on how to change the threshold.)

0 - Do not return Unit Attention when a threshold condition is met

1 - Return Unit Attention when a threshold condition is met

Queue Algorithm Modifier

This field must be 0.

QErr (Queue Error)

This bit must be 0.

DQue (Disable Queuing)

This bit must be 0.

EECA (Enable Extended Contingent Allegiance)

The DLT4000 drive does not support extended contingent allegiance, so this bit must be 0.

RAENP (Ready AEN Permission)

The DLT4000 drive does not support asynchronous event notification (AEN), so this bit must be 0.

UAAENP (Unit Attention AEN Permission)

The DLT4000 drive does not support asynchronous event notification, so this bit must be 0.

Ready AEN Holdoff Period

The DLT4000 drive does not support asynchronous event notification, so this field must be 0.

8.4.9.6 Data Compression Page (0Fh)

The Data Compression Page specifies parameters for the control of data compression. This page allows you to turn DLT4000 drive compressed format on and off independently of the tape's position and allows you to enable or disable decompression of DLT4000 drive compressed data during write operations.

	Bit							
	7	6	5	4	3	2	1	0
0	RSVD		Page Code					
1	Page Length							
2	DCE	DCC	Reserved					
3	DDE	RED		Reserved				
4	(MSB)							
7	Compression Algorithm							(LSB)
8	(MSB)							
11	Decompression Algorithm							(LSB)
12	(MSB)							
15	Reserved							(LSB)

Byte (label on left side of table)

Figure 8-36 *Data Compression Page (0Fh)*

Page Code
The Page Code identifies the type of MODE SELECT page being transferred. This is the Data Compression Page. The valid value for the Page Code is 0Fh.

Page Length
The Page Length indicates the number of bytes in the Data Compression Page that follow this byte. The valid value for this byte is 0Eh.

DCE (Data Compression Enable)
The Data Compression Enable bit specifies whether the DLT4000 drive should enable or disable data compression. When the DCE bit is 1, the DLT4000 drive starts in compressed format.

DCC (Data Compression Capable)
The Data Compression Capable bit is used by the MODE SENSE command to indicate that the DLT4000 drive supports data compression.

DDE (Data Decompression Enable)

When the DLT4000 drive reads compressed data from tape, it automatically decompresses the data before sending it to the initiator. Data compression is always enabled, so this bit must be set to 1 (enable data decompression).

RED (Report Exception on Decompression)

The DLT4000 drive does not report exceptions on decompression (boundaries between compressed and uncompressed data). The RED field must be 00h.

Compression Algorithm

The Compression Algorithm field indicates which compression algorithm the DLT4000 drive will use to process data from the initiator when the DCE bit (byte 02, bit 7) is 1. The only value currently supported for this field is 10h.

_____ **NOTE** _____

Specifying a value other than 10h for this field causes the DLT4000 drive to return Check Condition status with the sense key set to Illegal Request (5h). However, if EEROM parameter EnaRepDecomp is set, the parameter in this field is ignored and not Check Condition status is returned.

_____

Decompression Algorithm

The Decompression Algorithm field indicates which decompression algorithm the DLT4000 drive will use when decompressing data encountered on the tape. The only value currently supported for this field is 10h.

_____ **NOTE** _____

Specifying a value other than 10h for this field causes the DLT4000 drive to return Check Condition status with the sense key set to Illegal Request (5h).

_____

8.4.9.7 Device Configuration Page (10h)

The drive supports the Device Configuration Page which has the following format:

	Bit							
	7	6	5	4	3	2	1	0
0	PS(0)	0	Page Code (10h)					
1	Additional Page Length (0Eh)							
2	Res	CAP	CAF	Active Format				
3	Active Partition							
4	Write Buffer Full Ratio							
5	Read Buffer Full Ratio							
6	(MSB)							
7	Write Delay Time							(LSB)
8	DBR	BIS	RSmk	AVC	SOCF		RBO	REW
9	Gap Size							
10	EOD Defined			EEG	SEW	Reserved		
11	(MSB)							
12	Buffer Size at Early Warning (optional)							
13								(LSB)
14	Select Data Compression Algorithm							
15	Reserved							

Byte

Figure 8-37 *Device Configuration Page Format*

In this page, only the Write Delay Time and Select Data Compression Algorithm parameters are changeable.

PS
Must be zero.

CAP, CAF, Active Format
These fields are not supported and must be zero on MODE SELECT.

Active Partition

Only partition 0 is supported. Setting this field to any other value will be rejected by the drive with a CHECK CONDITION status and the ILLEGAL REQUEST sense key set.

Write Buffer Full Ratio and Read Buffer Empty Ratio

These indicate how full/empty the buffer memory should be before restarting the writing/reading of the media. The DLT4000 drive will set these fields to zero (unused) because it uses an automatic, adaptive mechanism to dynamically adjust its Full/Empty ratios according to the average data rates over the SCSI bus.

Write Delay Time

This indicates the maximum time that the drive will wait with a partially full buffer before forcing the data to tape (100 ms increments). The buffer Full/Empty ratio, which is dynamic, can cause data to be written sooner than the Write Delay time would indicate. The Write Delay Time defaults to 200 (C8h). This causes the buffer to be flushed in 20 seconds. Maximum value is 6500 (1964h) and the minimum is 15 (0Fh). This represents delays from almost 11 minutes down to 1.5 seconds.

Values between 0 and 15, on a MODE SELECT, are rounded down to 0. This causes the data to go straight to the media without delay.

Byte 8:

DBR - set to 0 (data buffer recovery not supported)

BIS - set to 1 (Block Identifiers Supported in media format)

RSmk - set to 0 (Setmarks not supported)

AVC - set to 0

SOCF - set to 0

RBO - set to 0

REW - set to 0 (Do not report Early Warning EOM on reads)

Gap Size

This field is not used and is set to zero.

EOD Defined

This field is set to 00h; any other value will be rejected by the drive.

EEG

The Enable EOD Generation bit is set to indicate that the drive will generate an EOD. The drive generates an EOD mark before any change of direction following a write-type operation. This bit is ignored on MODE SELECT.

SEW and Buffer Size At Early Warning

The Synchronize at Early Warning bit is set to 1. Buffer Size at EW is not supported and must be zero.

Select Data Compression Algorithm

One enables data compression; a zero disables it.

The front panel setting will override what is specified in the MODE SELECT, but no error will result. If the front panel is returned to automatic mode, the value from the last MODE SELECT command will determine whether compression will be used or not.

8.4.9.8 Medium Partition Page (11h)

The drive supports the Medium Partitions Parameter Page, which has the following format:

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

Figure 8-38 *Medium Partition Page Format*

Maximum Additional Partitions

No additional partitions are supported, this field must be zero.

Additional Partitions Defined

The field specifies the number of additional partitions to be defined for the tape based on the settings of the SDP and IDP bits. The maximum allowed is the value returned in the Maximum Additional Partitions field. Since only one partition is supported, this field must be zero.

Option Flags

FDP - Fixed Data Partitions bit must be zero.

SDP - Select Data Partitions bit must be zero.

IDP - Initiator Defined Partitions bit must be zero.

PSUM - Partition Size Unit of Measure field must be zero.

Medium Format Recognition

This field is only valid on a MODE SENSE and is set to 01h indicating that automatic Format Recognition is supported.

8.4.9.9 EEROM Vendor Unique Page (3Eh)

The drive supports a vendor unique page, which you can use to modify savable parameters. Only one savable parameter may be changed per Mode Select command. It has the following format:

0	PS(0)		0	Page Code
1	Additional Page Length			
2	ASCII String of parameter name and value			

Figure 8-39 *EEROM Vendor Unique Page Format*

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 will be interpreted as indicated in the following table. The parameter name may be in upper- or lowercase.

Table 8-4 *EEROM Vendor Unique Page Parameters*

Name	Value Rep.	Default	Length (Bytes)	Usage
VENDORID	ASCII	QUANTUM	8	Vendor Identification field in Inquiry Data
PRODUCTID	ASCII	DLT4000	16	Product Identification field in Inquiry Data
FORCEDENSITY[2]	ASCII Decimal	0	1	0=automatic[1], 1=DLT260, 2=DLT600, 3=DLT2000xt, 4=DLT4000
FORCECOMP	ASCII Binary	0	1	0=automatic[1], 1=Always compress unless front panel selection disables it
DEFAULTCOMPON	ASCII Binary	1	1	0=Compression defaulted off on powerup/reset, 1=Compression defaulted to on, on powerup/reset
DEFFIXEDBLKLEN	ASCII Decimal	0	8	Default fixed block size
ENBINQMEDCHGR	ASCII Binary	0	1	0=disable media changer bit, 1=enable media changer bit in byte 6 of inquiry data
LOADERLUN	ASCII Decimal	1	1	1-7 = LUN to report media loader device on
REWINDONRESET	ASCII Binary	1	1	0=Do not rewind on Bus Reset or BDR msg (Caution: May have partial block data written to the tape, if reset happens during writing.) 1=Rewind the media to BOT on reset.
ENALDRAUTOLD	ASCII Binary	1	1	To turn on/off sequential loading with loader.
DISLDRAUTOLDMC	ASCII Binary	1	1	To partially disable sequential loading with loader if any media loader command has been received.
ENAPARERRRETRY	ASCII Binary	0	1	To turn on/off parity error retry feature.
ENAMODEPG22	ASCII Binary	0	1	To enable vendor unique Data Compression (Status Mode Page).

[1]Parameter is not forced to a special format, which is decided by the parameters selected in MODE SELECT.

[2]Applied to DLTtape III tape for DLT260 format, DLT600 format and DLT2000xt format. Applied to DLTtape IV tape for DLT4000 format

Table 8-4 EEROM Vendor Unique Page Parameters (cont'd)

Name	Value Rep.	Default	Skip Default[1]	Usage
NODISCONFXDBLK	ASCII Binary	1	0	To turn on/off feature of not to disconnect on every fixed block data transfer.
PROTECTDIRONWP	ASCII Binary	0	0	To protect tape directory if the cartridge write-protect switch is in write protect position.
ENACLNGLTRPT	ASCII Binary	1	0	To report error status if cleaning light is on.
LONGXPORTPAGE	ASCII Binary	1	0	To report 18 or 6 bytes medium transport element status descriptor if parameter is on or off.
FORCEEEREBUILD	ASCII Binary	0	0	To force all the EEROM parameters reset to default, if set
SCSIINQVS	ASCII Binary	0	0	To return vendor unique inquiry string, if set
DEFSEW	ASCII Binary	1	0	To set default SEW parameter
ENAINITSYNCNEG	ASCII Binary	0	0	To enable target initiated synchronous negotiation, if set.
REPORTRCVDPERRS	ASCII Binary	1	0	To report recovered error if parity error has been retried successfully, if set.
ENATHIRDPTYDENS	ASCII Binary	1	0	To make non-DLT density code act as the default density (same as density code 0), if set.
FORCEREADSILI	ASCII Binary	0	0	To make variable Read command handled as if the SILI bit is set, if set.
CACHETMS	ASCII Decimal	0	0	0,1=Don't cache filemarks unless Imm bit is 1; 2=Cache if not 2 in a row unless Imm bit is 1; 3=Always cache filemarks
LDRCYCLERESET	ASCII Binary	0	0	To cause the first cartridge to be loaded if unloading the last cartridge when the loader product is operated in sequential mode ,if set.
ENAREPDECOMP	ASCII Binary	0	0	If set and the drive is on Read mode, the decompression algorithm field in Data Compression mode page will be set if the last block requested by the host was decompressed, otherwise it is cleared.
SCSIRESRELNOP	ASCII Binary	0	0	SCSI Reserve/Release Unit commands are NOP, if set.

Table 8-4 *EEROM Vendor Unique Page Parameters (cont'd)*

Name	Value Rep.	Default	Length (Bytes)	Usage
DISUNBUFMODE	ASCII Binary	0	0	The drive disables unbuffered mode, i.e. it ignores the Mode Select "buffered mode" selection to turn off buffered mode, if set.
NODEFERRCVDERR	ASCII Binary	0	1	The drive reports deferred recovered error as current recovered error, is set
SCSIBUSDMATIMER	ASCII Decimal	2	1	The amount of seconds the drive times out waiting for ACK once DMA transfer started. When set to 0, the timer is set to infinite.
SCSIRESELRETRIES	ASCII Decimal	10	1	The number of reselection retries the drive made before giving u[. Each reselection retry occurred every 1 second. When set to 0, the drive does infinite reselection retries.
SCSIRDYEARLY	ASCII Binary	0	1	The drive report Ready status earlier, if set.
REPORTRCVRDERR	ASCII Binary	0	1	This parameter set the default value of PER bit of Read/Write Error Recovery Mode page (01h).
NORDYUAONUNLD	ASCII Binary	0	1	When set, Not Ready to Ready unit attention will be removed from the unit attention queue upon a successful unload.
REDUNDANCYMODE	ASCII Decimal	1	1	Set the value of the allowed maximum marginal channel (0-3 allowed).
REPBUSYINPROG	ASCII Binary	0	1	When set, report busy status if the drive is in the progress of becoming ready.

This is an example of an EEROM vendor unique page that will modify the VENDORID parameter to "XXXYY."

0	0	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			"Y" (59H)
14			"Y" (59H)
15			"Y" (59H)
16			<LF> (0AH) or (00H)

Figure 8-40 *EEROM Vendor Unique Page Example 1*

This is an example of an EEROM vendor unique page that will modify the FORCEDENSITY parameter to 1.

0	0	0	Page Code (3EH)
1			Page Length (0FH)
2			"F" (46H)
3			"O" (4FH)
4			"R" (52H)
5			"C" (43H)
6			"E" (45H)
7			"D" (44H)
8			"E" (45H)
9			"N" (4EH)
10			"S " (53H)
11			"I" (49H)
12			"T" (54H)
13			"Y" (59H)
14			" " (20H)
15			"1" (31H)
16			<LF> (0AH) or (00H)

Figure 8-41 *EEROM Vendor Unique Page Example 2*

8.4.9.10 MODE SELECT Changeable Parameters

The following table lists the changeable mode parameters and their minimum and maximum values allowed. See the previous definitions for the units that are used. Parameter rounding is supported for all parameters except the block descriptor length.

Table 8-5 *Changeable Mode Parameters*

Page: Parameter	Default	Minimum	Maximum
Header: Buffered Mode, Device Specific Byte	1	0	1
Block Descriptor Length	08h	00h	08h
Block Descriptor: Block Length			
2.6 GB and 6.0 GB mode	0	0	40000h
10.0 GB, 15.0 GB, 20.0 GB, 30.0 GB and 40.0 GB mode	0	0	FFFFFFh
Read-Write Error Recovery (01h): PER Bit	0	0	1
Control Mode (0Ah): RLEC	0	0	1
Data Compression (0Fh): DCE	1	0	1
Disconnect-Reconnect (02h): Maximum Burst Size	0080h	0000h	FFFFh
Disconnect-Reconnect (02h): DTDC	0	0	3
Device Configuration (10h): Write Delay Time	C8h	Fh	1964h
Device Configuration (10h): SEW	1	0	1
Device Configuration (10h): Select Data Compression Algorithm	1	0	1

8.4.10 MODE SENSE (1Ah /5Ah)

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

Bit

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

Figure 8-42 MODE SENSE CDB (6)

The DLT4000 products also support the 10 byte MODE SENSE, which is required to request the VU EEROM Parameter page because of the large amount of data that needs to be passed back. MODE SENSE (10) can be used to retrieve the other pages as well. Note that MODE SENSE (10) returns a different format of Descriptor data.

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

(Byte — row labels for column at left)
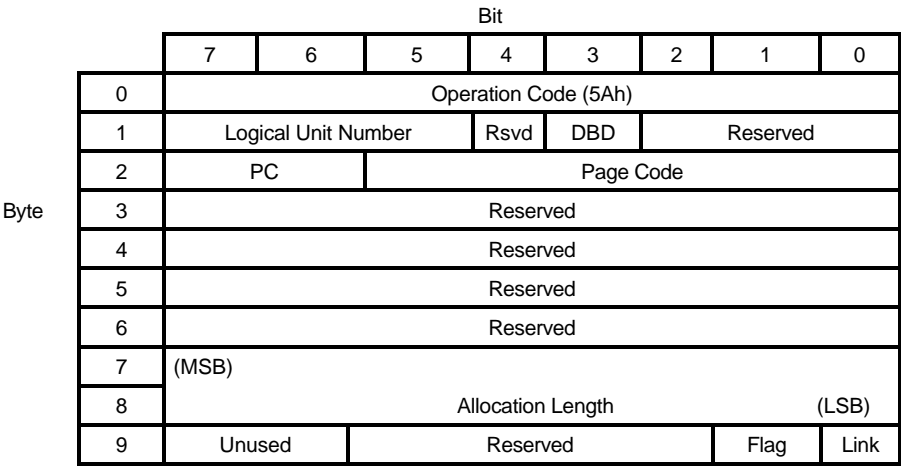
Figure 8-43 *MODE SENSE CDB (10)*

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

DBD

If the Disable Block Descriptors bit is zero, the device returns the Block Descriptor Data. If set, then the Block Descriptor information is not returned.

PC

The Page Control field indicates the type of page parameter values to be returned to the host as shown in the following table:

PC	Description
0 0	Report Current Values
0 1	Report Changeable Values
1 0	Report Default Values
1 1	Report Save Values

Figure 8-44 *MODE SENSE Page Control Definition*

The Additional Page Length field of each page returned by the drive indicates the number of bytes supported for that page.

Page Code

This allows the host to select any specific page, or all the pages supported by the drive.

Allocation Length

The Allocation Length field specifies the number of bytes that the host has allocated for returned MODE SENSE data. An Allocation Length of zero means that the drive will return no MODE SENSE data. This is not considered an error and GOOD status is returned.

8.4.10.1 MODE SENSE Parameter List

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

	Bit							
	7	6	5	4	3	2	1	0
Byte 0	Sense Data Length							
1	Media Type							
2	WP	Buffered Mode			Speed (0)			
3	Block Descriptor Length (08h)							

Figure 8-45 *MODE SENSE (6) Data Header*

The MODE SENSE (10) data contains an 8-byte header followed by one 8-byte block descriptor, followed by zero or more variable length pages. The MODE SENSE (10) data header format is as follows:

	Bit							
	7	6	5	4	3	2	1	0
Byte 0	(MSB)							
1	Mode Sense Data Length							(LSB)
2	Media Type							
3	WP	Buffered Mode			Speed (0)			
4	Reserved							
5	Reserved							
6	(MSB)							
7	Block Descriptor Length (8)							(LSB)

Figure 8-46 *MODE SENSE (10) Data Header*

Bit							
7	6	5	4	3	2	1	0

Byte

0	Density Code
1	(MSB)
2	Number of Blocks (000000h)
3	(LSB)
4	Reserved
5	(MSB)
6	Block Length
7	(LSB)
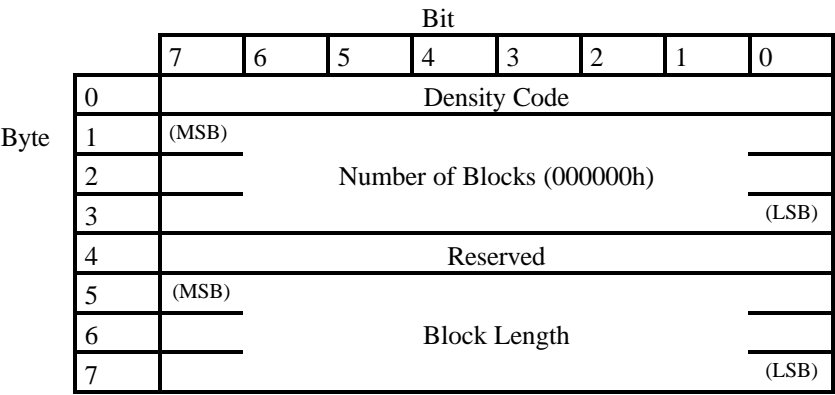
Figure 8-47 *MODE SENSE Block Descriptor*

Bit							
7	6	5	4	3	2	1	0

Byte

0	PS	0	Page Code
1	Additional Page Length
2	Page Defined or Vendor-Unique Parameter Bytes
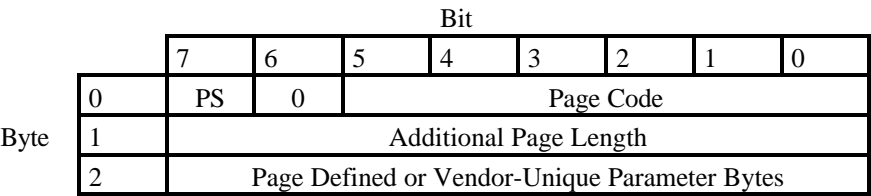
Figure 8-48 *MODE SENSE Page Descriptor*

Data Length

The Sense Data Length specifies the length in bytes of the following MODE SENSE data that is available to be transferred during DATA IN phase. The Sense Data Length does not include itself.

Media Type

The media type determined by the drive is as follows:

00h: Unknown or media not present

81h: Cleaning Tape

82h: DLTtape I or DLTtape II

83h: DLTtape III

84h: DLTtape IIIxt

85h: DLTtape IV

WP

A Write-Protected bit of zero indicates that the tape is write-enabled. A Write-Protected bit of one indicates that the tape is write-protected.

Buffered Mode

The drive implements Immediate Reporting on WRITE commands through Buffered mode.

If the field is zero, then the drive does not report a GOOD status on WRITE commands until the data blocks are actually written to tape. If the Buffered Mode field is one, then the drive reports GOOD status on WRITE commands as soon as the data block has been transferred to the buffer. This is the default configuration for the drive. If Buffered mode is not used, the tape drive will suffer a significant degradation in performance, but not capacity.

Speed

The tape drive supports only one speed, the default speed.

Block Descriptor Length

This specifies the length in bytes of all the block descriptors. Since the drive only allows one block descriptor, this value will be 8.

Density Code

This field matches the current density of the media, or zero if the density is unknown.

00h – use default density

0Ah – 6667 bpi MFM serial cart. tape X3B5/86-199 (read only)

16h – 10000 bpi MFM serial cart tape X3.193-1990 (read only)

17h – 42500 bpi MFM serial cart tape X3B5/91-174 - 2.6 GB

18h – (Same as 17h but with 56 track pairs vs. 24) - 6.0 GB

19h – 62500 bpi, 64 track pairs, serial cart tape - 10 GB

1Ah – 81633 bpi, 64 track pairs, serial cart tape - 20 GB

80h – 62500 bpi, 64 track pairs, serial cart tape - 10/15 GB (without compression)

81h – 62500 bpi, 64 track pairs, serial cart tape - 20/40 GB (with compression)

82h – 81633 bpi, 64 track pairs, serial cart tape - 20 GB (without compression)

83h – 81633 bpi, 64 track pairs, serial cart tape - 40 GB (with compression)

Number of Blocks

This field will be sent as zero, indicating that all of the remaining logical blocks on the tape will have the medium characteristics specified by the block descriptor.

Block Length

This specifies the length in bytes of each logical block transferred over the SCSI bus. A block length of zero indicates that the length is variable (as specified in the I/O command). Any other value indicates the number of bytes per block that will be used for read, write, and verify type commands that specify a "Fixed" bit of 1 (fixed block mode).

8. .10 2 MODE SENSE Pages

parameters. Each page has a 2-byte header which identifies the page code and indicates the number of bytes in that page.

Page Code	Description	
00h	No Requested Page	Sense
01h	Error Recovery Page	Both
02h	Disconnect/Reconnect	Both
0Ah	Control Mode Page	Both
0Fh	Data Compression Page	Both
10h	Device Configuration	Both
11h	Medium Partition	Both
3Eh	EEPROM parameter	Both
3Fh	All Pages (Except EEPROM)	Sense

Figure 8-49 *MODE SENSE Pages Supported*

PS Bit
A Parameters Savable (PS) bit of one indicates that the page can be saved in nonvolatile memory by the drive. If the PS bit is zero, the supported parameters cannot be saved. (Savable pages are not supported.)

Additional Page Length
This indicates the number of bytes in that page. However, the value does not include bytes 0 and 1. The length is returned on MODE SENSE and must subsequently be set to the same value when performing MODE SELECT.

.4 10. Read/Write Error Recovery Page (01h)

The drive will support the Error Recovery Page, which has the following format:

	7	6		4	3		1	0
0	PS	0	Page Code (01h)					
1	Additional Page Length (0Ah)							
2	Rsvd	Rsvd	TB	Rsvd	EER	PER	DTE	DCR
3	Read Retry Count							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Write Retry Count							
9	Reserved							
10	Reserved							
11	Reserved							

(Byte)

Figure 8-50 *Error Recovery Page Format*

Option Flags

- TB–The Transfer Block (when not fully recovered) function is not supported.

- EER–The Enable Early Recovery function is always enabled.

- PER–The Post Error bit turns on reporting of Check Condition to report recovered read/write errors. The default setting of this bit is off.

- DTE–The Disable Transfer on Error feature is not supported so this bit will be zero.

- DCR–The Disable ECC Correction bit feature is not supported so this bit will be zero.

Read Retry Count

This field reports the maximum number of rereads that are done before declaring an unrecoverable error.

Write Retry Count

This field reports the maximum number of overwrite retries that will be performed before declaring an unrecoverable error.

8. .10 4 Disconnect/Reconnect Page (02h)

The drive will support the Disconnect/Reconnect Page which has the following format:

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

Figure 8-51 *Disconnect/Reconnect Page Format*

The following parameters in this page are supported:

Maximum Burst Size

This value specifies the maximum amount of data that will be transferred without disconnecting. A value of zero sets no limit. This value is in units of 512 bytes. For example, a value of 8 means 4K bytes. Values that are not multiples of 8 are rounded up to the closest multiple of 8.

Data Transfer Disconnect Control (DTDC)

This value specifies the restriction when a disconnect is permitted.

8.4.10.5 Control Mode Page (0Ah)

The Control Mode Page allows you to determine whether the DLT4000 drive will
return Check Condition status when one of its write and read error counters reaches a
specified threshold.

		Bit							
		7	6	5	4	3	2	1	0
	0	RSVD			Page Code				
	1	Page Length							
	2	RSVD							RLEC
Byte	3	Queue Algorithm Modifier				Reserved		QErr	DQue
	4	EECA	Reserved				RAENP	UAAENP	EAENP
	5	Reserved							
	6	(MSB)							
	7	Ready AEN Holdoff Period							(LSB)

Figure 8-52 *Control Mode Page (0Ah)*

Page Code

The Page Code identifies the type of MODE SENSE page being transferred. The value
returned for the Page Code is 0Ah (Control Mode Page).

Page Length

The Page Length indicates the number of bytes in the Control Mode Page that follow
this byte. The value returned for this byte is 06h.

RLEC (Report Log Exception Condition)

The RLEC bit indicates whether the DLT4000 drive should return Check Condition
status with the sense key set to Unit Attention (6h) when one of its write and read
error counters reaches a specified threshold, as follows:

   0 - Do not return Unit Attention when a threshold condition is met

   1 - Return Unit Attention when a threshold condition is met

Queue Algorithm Modifier

The value returned for this field is 0.

QErr (Queue Error)

The value returned for this field is 0.

DQue (Disable Queuing)

The value returned for this field is 0.

EECA (Enable Extended Contingent Allegiance)

returned for this field is 0.

RAENP (Ready AEN Permission)

value returned for this field is 0.

UAAENP (Unit Attention AEN Permission)

returned for this field is 0.

Ready AEN Holdoff Period

returned for this field is 0.

8 4. .6

The Data Compression Page specifies parameters for the control of data compression.

			6	5		3	2		0
	0	PS	RSVD		Page Code				
	1	Page Length							
	2	DCE	DCC		Reserved				
Byte	3	DDE	RED			Reserved			
	4	(MSB)							
	7				Compression Algorithm				(LSB)
	8	(MSB)							
	11				Decompression Algorithm				(LSB)
	12	(MSB)							
	15				Reserved				(LSB)

Bit (column header above table)

Figure 8-53 *Data Compression Page (0Fh)*

PS (Parameters Savable)

The Parameters Savable bit indicates if the MODE SENSE parameter data contained in this page is savable. The DLT4000 drive does not support this feature. The value returned for this bit is 0.

Page Code

The Page Code identifies the type of MODE SENSE data being transferred. The value returned for this field is 0Fh (Data Compression Page).

Page Length

The Page Length indicates the number of Data Compression Page bytes that follow this byte. The value returned for this byte is 0Eh.

DCE (Data Compression Enable)

value returned for this bit depends on the current write density of the DLT4000 drive as follows:

　　1 - Data compression is enabled.

DCC (Data Compression Capable)

compression as follows:

　　0 - The device does not support data compressi

　　1 - The device supports data compression and will process any data sent to it by the initiator according to the setting of the DCE bit (byte 02, bit 7)

returned for this bit is 1.

DDE (Data Decompression Enable)

or disabled as follows:

　　0 - Data decompression is disabled.

When the DLT4000 drive reads compressed data from tape, it automatically decompresses the data before sending it to the initiator. Therefore, the value returned

RED (Report Exception on Decompression)

The DLT4000 drive does not report exceptions on decompression (boundaries between

Compression Algorithm

The value returned for the Compression Algorithm field is 10h. This indicates

Decompression Algorithm

The value returned for the Decompression Algorithm field is 10h. This indicates

parameter EnaRepDCcomp is set, zero value will be reported if the last block read is not decompressed.

8.4.10.7 Device Configuration Page (10h)

The drive supports the Device Configuration Page which has the following format:

		Bit							
	7	6	5	4	3	2	1	0
0	PS	0	Page Code (10h)					
1	Additional Page Length (0Eh)							
2	Res	CAP	CAF	Active Format				
3	Active Partition							
4	Write Buffer Full Ratio							
5	Read Buffer Full Ratio							
6	(MSB)							
7	Write Delay Time							(LSB)
8	DBR	BIS	RSmk	AVC	SOCF		RBO	REW
9	Gap Size							
10	EOD Defined			EEG	SEW	Reserved		
11	(MSB)							
12	Buffer Size at Early Warning (optional)							
13								(LSB)
14	Select Data Compression Algorithm							
15	Reserved							

Byte is labelled along the left side (rows 0–15).

Figure 8-54 *Device Configuration Page Format*

PS

Saving parameters is not supported and will be zero.

CAP, CAF, Active Format

These fields are not supported and will be zero.

Active Partition

Only partition 0 is supported.

These indicate how full/empty the buffer memory should be before restarting the writing/reading of the media. The DLT4000 drive will set these fields to zero (unused)

ratios according to the average data rates over the SCSI bus.

Write Delay Time

before forcing the data to tape (100 ms increments). Note that the buffer full/empty ratio, which is dynamic, can cause data to be written sooner than the Write Delay time

be flushed in 20 seconds. Maximum value is 6500 (1964h) and the minimum is 15 (Fh). This represents delays from almost 11 minutes down to 1.5 seconds.

DBR–set to 0 (Data buffer recovery not supported)

BIS–set to 1 (Block Identifiers Supported in media format)

AVC–set to 0

SOCF–set to 0

REW–set to 0 (Do not report Early Warning EOM on reads)

This field is not used and is set to zero.

EOD Defined

EEG

The Enable EOD Generation bit is set to indicate that the drive will generate an EOD.

type operation.

SEW and Buffer Size at Early Warning

supported and will be zero.

Select Data Compression Algorithm

8.4.10.8 Medium Partition Page (11h)

The drive supports the Medium Partitions Parameter Page, which has the following format:

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

Figure 8-55 *Medium Partition Page Format*

Maximum Additional Partitions

No additional partitions are supported; this field will be zero.

Additional Partitions Defined

The field specifies the number of additional partitions to be defined for the tape based on the settings of the SDP and IDP bits. The maximum allowed is the value returned in the Maximum Additional Partitions field. Since only one partition is supported, this field will be zero.

Option Flags

FDP–The Fixed Data Partitions bit will be zero.

SDP–The Select Data Partitions bit will be zero.

IDP–The Initiator Defined Partitions bit will be zero.

PSUM–The Partition Size Unit of Measure field will be zero.

Medium Format Recognition

This field is set to 01h indicating that automatic Format Recognition is supported.

8. .10 9 EEROM Vendor Unique Page (3Eh)

parameters that are settable through MODE SELECT EEROM vendor unique page
are returned.

NOTE _____

MODE SENSE (6) to retrieve EEROM parameters

_____

Because of the length of the EEROM parameter, a 10-byte MODE SENSE command
is required to retrieve the parameters. If a 6-byte MODE SENSE command is used to

"Send a 10-byte MODE SENSE command to get the Parameter List."

The data returned by the 10-byte MODE SENSE command for the EEROM page is in

The data in the page descriptor is organized in the form of a parameter header
followed by the actual parameters value. The parameter header is as follows:

	Current	Default		Maximum
--------		--------	-----------	

Name refers to the parameter name, for example, PRODUCTID or
DEFFAULTCOMPON.

decimal data type if not specified.

Current/Default/ Minimum/Maximum specifies the

8.4.11 PREVENT/ALLOW MEDIUM REMOVAL (1Eh)

	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (1Eh)							
	Logical Unit Number			Reserved				
	Reserved							
	Reserved							
4								Prevent
5			Reserved				Flag	

Byte is labeled to the left of the table.
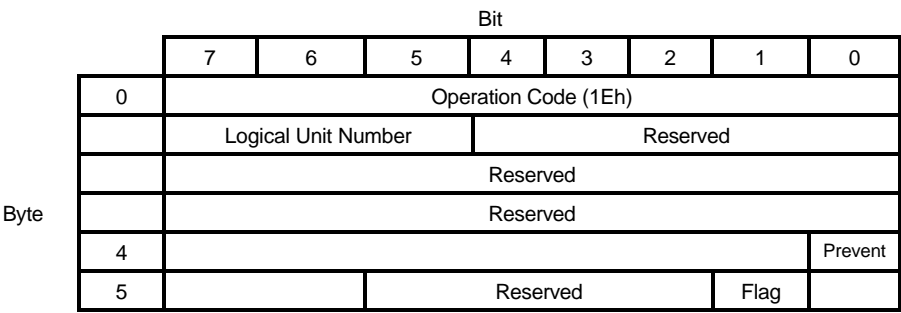
Figure 8 56

This command enables or disables the unloading of the tape cartridge.

If this bit is set, the Unload button on the drive front panel is effectively disabled, and the UNLOAD command will not unload the media or the cartridge. The

When the Prevent bit is set to zero, then the Prevent state corresponding to that initiator is cleared. Only when all initiators have cleared their Prevent state are the

reset, or Bus Device Reset message, the Prevent Medium Removal function is cleared.

If a Media Loader is present, the Move Medium command will not be allowed to

8.4.12 READ (08h)

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

Figure 8 57 *READ CDB*

the drive.

Fixed

or variable-length blocks are to be transferred.

If the Fixed bit is set to zero, a Variable Block mode is requested. A single block is

initiator has allocated for the returned data.

If the Fixed bit is set to one, the Transfer Length specifies the number of blocks to be

in Fixed Block mode.

When the Transfer Length is zero, no data is transferred and the current position on

A successful READ with the Fixed bit set to one transfers (current block
length)×(Transfer Length) bytes of data to the host. Upon termination of READ, the

Suppress Incorrect Length Indicator (SILI)

If the SILI bit is one and the fixed bit is one, the target terminates the command with

additional sense code of INVALID FIELD in CDB.

If the SILI bit is not set and the actual block length is different from the specified

Incorrect Length Indicator (ILI) bit and Valid bit will be set to one. The Sense Key

field will be set to NO SENSE. The Information Bytes will be set to the difference (residue) between the requested transfer length and the actual block length, or in Fixed Blocked Mode, the difference (residue) between the requested number of blocks and the actual number of blocks read. No more than transfer length bytes are transferred to the initiator and the tape is logically positioned after the block (EOM side).

Filemark, End-of-Data and End-Of-Medium/partition Handling

If the drive reads a Filemark, it will return a CHECK CONDITION status. Within the Sense data, the Filemark and Valid bits are set and the Sense Key field is set to NO SENSE. The Information fields contain the residue count. The Additional Sense Code and Additional Sense Code Qualifier fields are set to Filemark Detected. Upon termination, the media will be logically positioned after the Filemark (EOM side).

If the drive detects EOD during the READ, the drive will return a CHECK CONDITION status. Within the Sense data, the Valid bit is set and the Sense Key field is set to BLANK CHECK. The EOM bit may be set if the drive determines that the tape is positioned past the PSEN marker. The information fields contain the residue count. The Additional Sense Code and Additional Sense Code Qualifier fields are set. Upon termination, the media will be physically positioned before EOD and after the last block on tape.

The meaning of EOM is different for a read than for a write type of command. EOM is only reported when the physical EOM/P is encountered. The drive returns a CHECK CONDITION status. The EOM and Valid bits are set and the Sense Key is set to MEDIUM ERROR. The information fields contain the residue count and the Additional Sense Code and Additional Sense Code Qualifier fields are set to EOM/P Detected. The tape is physically positioned at EOM/P.

If any READ command cannot be completed successfully the drive returns a CHECK CONDITION status. Further commands should attempt to move past the error and complete successfully.

.4 13 READ BLOCK LIMITS (05h)

Byte	Bit	6	5		3	2		0
	0	Operation Code (05h)						
	1	Logical Unit Number		Reserved				
	2	Reserved						
	3	Reserved						
	4	Reserved						
	5	Unused		Reserved			Flag	Link

Figure 8-58 *READ BLOCK LIMITS CDB*

READ BLOCK LIMITS tells the drive to return its limits for block length. The READ BLOCK LIMITS data shown below is sent during the DATA IN phase of the command. The command does not reflect the currently selected block size, only the available limits. MODE SENSE returns the current block size.

Byte	Bit	7	6	5	4	3	2	1	0
	0	Reserved							
	1	(MSB)							
	2	Maximum Block Length							
	3								(LSB)
	4	(MSB)							
	5	Minimum Block Length (0001h)							(LSB)

Figure 8-59 *READ BLOCK LIMITS Data*

Maximum Block Length

This field indicates the maximum block size. The device supports a maximum block length of 16,777,215 bytes (16 MB-1) for the 10 GB or 20 GB format. A maximum block length of 256 K bytes is supported for 2.6 GB or 6.0 GB formats.

Minimum Block Size

This field indicates the minimum block size. The device supports a minimum block length of 1 byte.

8 4. READ BUFFER (3Ch)

Byte		7	6		4	3		1	0
	0	Operation Code (3Ch)							
	1	Logical Unit Number			Reserved			Mode	
	2	Buffer ID							
	3	Reserved							
	4	Reserved							
	5	Unused			Reserved			Flag	Link

Figure 8-60 *READ BUFFER CDB*

READ BUFFER is used in conjunction with WRITE BUFFER as a diagnostic function for testing the drive's data buffer and the SCSI bus integrity.

Mode

The drive supports the following values within the field. If any nonsupported value is set, the drive terminates the command with a CHECK CONDITION status and an ILLEGAL REQUEST sense key set.

Mode	Description
000b	Combined Header and Data
010b	Data
011b	Descriptor

Figure 8-61 *READ BUFFER Modes Supported*

Buffer ID & Offset

The drive only supports a single Buffer ID field of zero, and offsetting of data is not supported. If these fields are nonzero, the drive returns a CHECK CONDITION status with an ILLEGAL REQUEST sense key set.

Allocation Length

The Allocation Length specifies the maximum number of bytes that the initiator has allocated for returned data.

8.4.14.1 Combined Header and Data Mode

In this mode, the drive returns a 4-byte header followed by the data bytes. The drive terminates the DATA IN phase when Allocation Length bytes of header and data have been transferred, or when all available data has been transferred to the initiator, whichever is less. The 4-byte READ BUFFER header is followed by data bytes from the target data buffer. The header has the following format:

	Bit							
	7	6	5	4	3	2	1	0
0	Reserved							
1	(MSB)							
2	Available Length							
3								(LSB)

Byte is the row label for bytes 1–3.

Figure 8-62 *READ BUFFER Data Head*

Available Length

The Available Length field specifies the total number of data bytes available in the target's buffer. This number is not reduced to reflect the allocation length, nor is it reduced to reflect the actual number of bytes written using the WRITE BUFFER command. Following the READ BUFFER header, the target will transfer data from its data buffer.

8.4.14.2 Data Mode

In this mode, the DATA IN phase only contains buffer data.

8.4.14.3 Descriptor Mode

In this mode, a maximum of four bytes of READ BUFFER descriptor information are returned. The drive returns the descriptor information for the buffer specified by the Buffer ID. In this mode, the drive does not reject the valid Buffer IDs with a CHECK CONDITION status, but returns all zeros in the READ BUFFER descriptor.

The Offset Boundary is 12 (0Ch), indicating buffer offsets should be integral multiples of 4K.

		Bit						
	7	6	5	4	3	2	1	0
0	Offset Boundary (0Ch)							
1	(MSB)							
	Buffer Capacity							
3								
								(LSB)
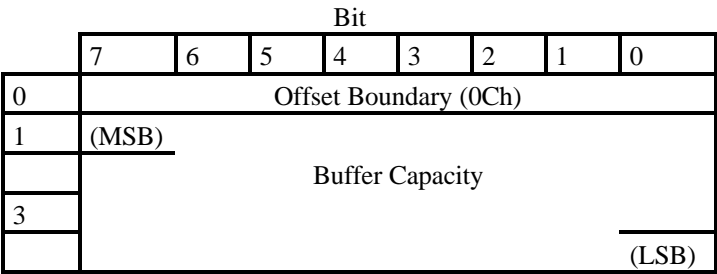
Figure **-63** *READ BUFFER Descriptor*

8.4.15 READ POSITION (34h)

					Bit				
		7	6	5	4	3	2	1	0
		Operation Code (34h)							
	1					Reserved			BT
		Reserved							
Byte		Reserved							
	4								
	5	Reserved							
		Reserved							
	7								
	8	Reserved							
		Unused		Reserved					Link

Figure -64 *READ POSITION CDB*

Block Address. The LOCATE command uses this identifier to position back to this same logical position, in a high performance fashion.

The Block Type bit indicates how the position is interpreted. Since this device uses the same logical block address whether this bit is set or not, the setting of BT is ignored.

_____ **NOTE**

   The drive returns CHECK CONDITION with the Unit Not Ready Sense
   Key with the Read Position command if the media is not ready to be

_____

8.4.15.1 READ POSITION Data Format

		Bit							
	7	6	5	4	3	2	1	0
	BOP	EOP				BPU	Reserved	
	Partition Number								
2									
3									
4	(MSB)								
6	First Block Location								
								(LSB)	
8									
9									
10									
11								(LSB)	
	Reserved								
13									
14	Number of Block in Buffer								
								(LSB)	
16									
17									
18									
19								(LSB)	

Byte

8- *READ POSITION Data Format*

The BOP and EOP bits will be set as appropriate. The Block Position Unknown (BPU)

the block address values returned.

First Block Location

The block address associated with the current logical position; the next block to be transferred between the target and initiator if a READ or WRITE command is issued.

Last Block Location

The block address associated with the current physical position; the next block to be transferred to the media and from the target's buffer. If the buffer is empty, or has only a partial block, the same value as First Block Location will be reported. The first block or filemark written onto the media is at address zero.

Number of Blocks in Buffer

The number of data blocks in the target's buffer.

Number of Bytes in Buffer

The number of data bytes in the buffer that have not been written to the medium.

.4 16 RECEIVE DIAGNOSTICS RESULTS (1Ch)

Byte	Bit 7		5	4		2	1	
0	Operation Code (1Ch)							
1	Logical Unit Number			Reserved				
2	Reserved							
3	(MSB)							
4	Allocation Length							(LSB)
5	Unused		Reserved				Flag	Link

Figure 8-66 *RECEIVE DIAGNOSTICS RESULTS CDB*

RECEIVE DIAGNOSTIC RESULTS tells the drive to send analysis data to the initiator after completion of a SEND DIAGNOSTIC command. The following data will be returned by this command. A REQUEST SENSE command should be issued to obtain more detailed information following a check condition on a SEND DIAGNOSTIC command.

Byte	Bit 7	6	5	4	3	2	1	0
0	Controller Present Flag							
1	Controller Error Flag							
2	Drive Present Flag							
3	Drive Error Flag							
4	Media Loader Present Flag							
5	Media Loader Error Flag							

Figure 8-67 *Receive Diagnostic Result Data Format*

This information simply indicates which of the main components of the subsystem has failed testing.

.4 17 RELEASE UNIT (17h)

Byte		6	5		3	2		0
				Bit				
0	Operation Code (17h)							
1	Logical Unit Number			3rdPty	Third Party Device ID			Rsvd
2	Reserved							
3	Reserved							
4	Reserved							
5	Unused			Reserved			Flag	Link

Figure 8-68 *RELEASE UNIT CDB*

RELEASE UNIT releases the drive if it is currently reserved by the requesting initiator.

It is not an error to attempt to release the drive if it is not currently reserved by the requesting initiator. However, if it reserved by another initiator, the drive is not released.

3rdPty
The third-party release option for RELEASE UNIT allows an initiator to release a logical unit that was previously reserved using the third-party reservation option. If the third-party (3rdPty) bit is zero, then the third-party release option is not requested. If the 3rdPty bit is one, the drive is released if it was originally reserved by the same initiator using the third-party reservation option, and if the device is the same SCSI device that was specified in the third-party device ID field.

8.4.17.1 Medium Changer Considerations

The optional Element reservation feature defined for Medium Changer devices in SCSI-2 is not supported, so the RELEASE command is defined the same as for the tape drive: Only the whole loader unit can be released. Reserve/release of the Loader and Drive LUNs are handled independently.

8.4.18 REQUEST SENSE (03h)

Bit

Byte		7	6	5	4	3	2	1	0
	0	Operation Code (03h)							
		Logical Unit Number			Reserved				
		Reserved							
		Reserved							
	4								
	5	Unused						Flag	Link

8- *REQUEST SENSE CDB*

REQUEST SENSE tells the target to transfer sense data to the initiator.

The sense data is valid for a CHECK CONDITION or RESERVATION CONFLICT

target until retrieved by the REQUEST SENSE command, or until the receipt of any other command from the same initiator.

the appropriate values in the EOM, Sense Key, Additional Sense Code, and Additional Sense Code Qualifier. The positional information provided reflects the

(nondiagnostic) data still in its buffer as well as the data on tape.

REQUEST SENSE does not cause the drive to flush its buffered data to tape.

precede the REQUEST SENSE with a WRITE FILEMARKS with length 0 (Immed =0) command, which forces the drive to flush any currently buffered data to tape. A

the drive to the initiator.

Allocation Length

The drive terminates the transfer when Allocation Length bytes have been transferred or when all available sense data has been transferred to the host, whichever is less.

8.4.18.1 Sense Information Format

Bit

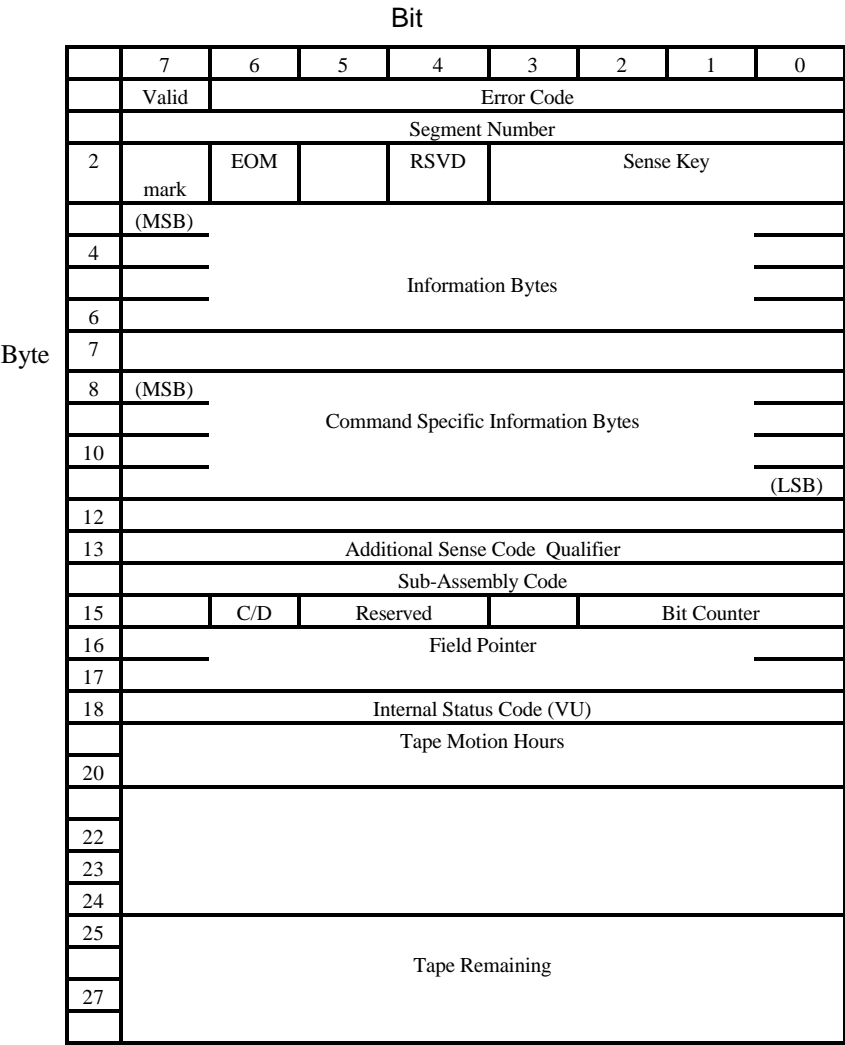| Byte	7	6	5	4	3	2	1	0
	Valid	Error Code						
	Segment Number						
2	mark	EOM		RSVD		Sense Key		
4	(MSB)							
6				Information Bytes				
7								
8	(MSB)			Command Specific Information Bytes				
10								
								(LSB)
12								
13				Additional Sense Code Qualifier				
				Sub-Assembly Code				
15		C/D	Reserved			Bit Counter		
16				Field Pointer				
17								
18				Internal Status Code (VU)				
20				Tape Motion Hours				
22								
23								
24								
25				Tape Remaining				
27								

Figure 8 70

Valid

defined in the SCSI specification.

Error-Code

A value of 70h indicates a current error – the report is associated with the most recently received command.

A value of 71h indicates a deferred error – the report is associated with a previous command and not as a result of the current command.

No other values will be returned.

Segment Number

This byte is always zero.

Filemark

This bit indicates that the current command has read a Filemark.

EOM

This bit indicates that an End-of Medium condition (End of Partition or Beginning of Partition) exists. The warning is also given by setting the Sense Key to NO SENSE and the Additional Sense Code Qualifier to End of Partition or Beginning of Partition.

For write-type operations, the drive returns a CHECK CONDITION on any operation which occurs after detection of the Early Warning EOP marker. The EOM and Additional Sense Code fields will be set. For read-type operations, the drive does not return a CHECK CONDITION until the drive encounters the physical EOP.

ILI

The Incorrect Length Indicator bit indicates that the requested logical block length did not match the logical block length of the data on the tape. Only Read or Verify may cause this bit to be set.

Sense Key

In most cases, Additional Sense Code and/or Qualifier information is available. See the tables later in this section.

Information Bytes

These bytes contain the differences (residue) of the requested length minus the actual length in bytes, blocks, or Filemarks, as determined by the command. Negative values are indicated by two's complement notation. The bytes are valid for all read, write, space, and verify tape commands for which a CHECK CONDITION status has been generated. The information bytes are zero for MODE SELECT/SENSE, INQUIRY, READ BLOCK LIMITS, and TEST UNIT READY.

Additional Sense Length

of the command descriptor block is too small to transfer all of the additional sense bytes, the Additional Sense Length is not adjusted to reflect the truncation.

Command Specific Bytes are handled as device specific and can be logged by the operating system on error conditions. On media errors, this usually contains the

Additional Sense Code (ASC) and ASC Qualifier

These two bytes provide additional information about the Sense Key and cause of the

Sub-Assembly Code

Unused at present, returned as 0.

C/D - When set, indicates that the illegal parameter is in the CDB. A C/D of zero indicates that the illegal parameter is in the Parameter List from the initiator.

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.

multi-byte field, the most significant byte is indicated.

Internal Status Code

Tape Motion Hours

Report the number of tape motion hours, that is, the head wear hours. Format is

Power On Hours

Report the total hours the drive power has been on. Format is represented in a hex

Tape Remaining

Report the amount of tape remained in 4096 bytes block.

Table 8-6 *Sense Keys Used*

Sense Key	Description
0h	No Sense. Check the Filemark/EOM/ILI bits and the ASC/Q bytes.
1h	Parameters on a Mode Select, or to report that R/W error rates are reaching subsystem specification limits for optimal operation. without any unrecovered errors for a long period of time.
2h	Media might not be present in the drive, or may be in the process of loading or calibrating. Medium Error. An unrecoverable write, read, or positioning error has occurred. Detailed device specific information may be
4h	Hardware Error. The Additional Sense Code/Qualifier fields may
5h	Illegal Request. The CDB or supplied parameter data had an 17.
6h	the media asynchronously becomes ready to this initiator, if another initiator changes Mode Parameters, and if the firmware is
7h	Data Protected. The current media is write-protected. This can be media is not DLTtape III, DLTtape IIIxt or DLTtape IV.
8h	

Table 8-6 *Sense Keys Used (Cont'd)*

Sense Key	Description
Bh	Command Aborted. Generated when a command has been aborted by the tape device for some reason. Check the ASC/Q bytes.
Dh	Volume Overflow. Physical end of media has been reached during writing. The initiator ignored the EOM condition and continued writing.
Eh	Miscompare. A compare error occurred during reading by the self-tests invoked during execution of a Send Diagnostic.

Table 8-7 *Additional Sense Codes/Qualifiers Used*

ASC	ASCQ	Description
00h		No Additional Sense Code
	00h	No additional sense qualifier
	01h	Unexpected FM Encountered
	02h	End of Medium Encountered
	03h	SetMark Encountered
	04h	Beginning of Medium Encountered
	05h	EOD Encountered
04h		Unit not ready
	00h	Cause nonreportable
	01h	Calibration in process
	02h	Load command needed
	03h	Manual Intervention needed
08h	00h	LUN Communications Failure
	01h	LUN Communications Time-out
0Ah	00h	Error Log Overflow
0Ch	00h	Write Error

Table 8-7 *Additional Sense Codes/Qualifiers Used (Cont'd)*

ASC	ASCQ	Description
11h	00h	Unrecovered Read Error
	08h	Incomplete Block Read
14h	00h	Recorded Entity Not Found
15h	01h	Mech Position Error
	02h	Detected by Read of Media
1Ah	00h	Parameter List Length Error
20h	00h	Illegal opcode
21h	01h*	Invalid Element Address
24h	00h	Invalid CDB field
	81h	Invalid mode on write buffer
	82h	Media in drive
	84h	Insufficient resources
	86h	Invalid offset
	87h	Invalid size
	89h	Image data over limit
	8Bh	Image/personality is bad
	8Ch	Not immediate command
	8Dh	Bad drive/servo image EDC
	8Eh	Invalid personality for CUP
	8Fh	Bad controller image EDC
25h	00h	Illegal LUN
26h		Parameter list error
	00h	Invalid Field
	01h	Parameter not supported
	02h	Parameter Value Invalid

Table 8-7 *Additional Sense Codes/Qualifiers Used (Cont'd)*

ASC	ASCQ	Description
27h	00h	Write protected
	80h	Hardware write protect
	82h	Data safety write protect
28h	00h	Not ready to read
29h	00h	Reset occurred
2Ah	01h	Mode parameters changed
	02h	Log parameters changed
2Fh	00h	Commands Cleared by another Initiator
30h	00h	Cannot read medium
37h	00h	Rounded Parameter
39h	00h	Saving Parameters Not Supported
3Ah	00h	Media Not Present
	80h	VU Cartridge Missing
3Bh	00h	Sequential Positioning Error
	08h	Reposition Error
	0Dh*	Media Destination Element Full
	0Eh*	Media Source Element Empty
3Dh	00h	Invalid Bits in ID Msg

* = Medium Changer specific commands

Table 8-7 *Additional Sense Codes/Qualifiers Used (Cont'd)*

ASC	ASCQ	Description
3Fh	01h	Microcode has been changed
40h	80h	ROM EDC failure
	81h	RAM failure
	82h	Bad Drive status
	83h	Loader diags failed
	84h	Reportable POST failure
43h	00h	Message error
44h	00h	Internal Target Failure
	80h	Unexpected Selection Interrupt
	82h	Command complete sequence failure
	83h	SCSI chip Gross Error
	84h	Unexplained Residue in TC Registers
	85h	Immediate data transfer time-out
	86h	Insufficient CDB bytes
	87h	Disconnect/SDP sequence failed
	88h	Bus DMA Transfer Time-out
	C1h	EEPROM copy 1 area bad
	C2h	EEPROM copy 2 area bad
	C3h	Both EEPROM copies bad
45h	00h	Select/Reselect Failure
47h	00h	SCSI Parity Error
48h	00h	IDE Message received
49h	00h	Invalid Message Error
4Eh	00h	Overlapped Commands attempted
51h	00h	Erase failure

Table 8-7 *Additional Sense Codes/Qualifiers Used (Cont'd)*

ASC	ASCQ	Description
53h	00h	Media Load/Eject failure
	01h	Unload Tape failure
	02h	Media Removal Prevented
5Ah	01h	Operator Media Removal Request
5Bh	01h	Threshold Condition Met
	02h	Log Counter at Maximum
80h	00h	Calibration Error
	01h	Cleaning Required
	02h	Cleaning Requested
81h	00h	Directory Read Error
82h	00h	Not allowed if not at BOT

8.4.19 RESERVE UNIT (16h)

Bit

Byte	7	6	5	4	3	2	1	0
0	Operation Code (16h)							
1	Logical Unit Number			3rdPty	Third-Party Device ID			RSVD
2	Reserved							
3	Reserved							
4	Reserved							
5	Unused		Reserved				Flag	Link

Figure 8-71 *RESERVE UNIT CDB*

RESERVE UNIT reserves the specified drive for exclusive use by the requesting initiator or for another specified SCSI device. The reservation remains in effect until one of the following conditions is met:

- The initiator that made the reservation sends another RESERVE UNIT command.

- The drive is released by RELEASE UNIT from the same initiator.

- A BUS DEVICE RESET message is received from any initiator.

- A hard reset occurs.

The occurrence of the last two conditions is indicated by the drive returning a CHECK CONDITION status with a sense key of UNIT ATTENTION on the next command following the condition. It is not an error to issue RESERVE UNIT to a drive that is currently reserved to the requesting initiator.

If the logical unit has previously been reserved by another initiator, the target returns a RESERVATION CONFLICT status.

If, after honoring the reservation, any other initiator attempts to perform any command except INQUIRY, REQUEST SENSE, or RELEASE UNIT, the command is rejected with a RESERVATION CONFLICT status. A RELEASE UNIT command issued by another initiator is ignored by that reserved logical unit.

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.

If the third-party (3rdPty) bit is zero, then the third-party reservation option is not requested. If the 3rdPty bit is one, RESERVE UNIT reserves the logical unit for the

SCSI device specified in the Third-Party Device ID field. The drive preserves the reservation until any one of the four conditions mentioned above occurs. The drive ignores any attempt made by any other initiator to release the reservation and returns a GOOD status.

An initiator that holds a current reservation may modify that reservation (for example, to switch third-parties) by issuing another RESERVE UNIT to the drive.

8.4.19.1 Medium Changer Considerations

The optional Element reservation feature defined for Medium Changer devices in SCSI-2 is not supported, so the RESERVE command is defined the same as for the tape drive: Only the whole loader unit can be reserved. This is separate from a reservation of the tape drive.

The RESERVE/RELEASE commands operate on a LUN basis; so the Medium Changer and Tape Drive are generally handled as different devices. But in the case of a reserved drive LUN, a MOVE MEDIUM command issued to the loader LUN can **not** insert/remove a cartridge on the drive, unless the drive is reserved by the same initiator.

8.4.20 REWIND (01h)

	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (01h)							
1	Logical Unit Number			Reserved				Immed
2	Reserved							
3	Reserved							
4	Reserved							
5	Unused			Reserved			Flag	Link

Byte (label for rows 0–5)

Figure 8-72 *REWIND CDB*

REWIND tells the drive to position the tape at the beginning of the currently active partition. Before rewinding, the drive writes any write data that is buffered to the tape, and appends an EOD marker.

Immed

If the Immed (Immediate) bit is set, the drive first writes any remaining buffered data to tape followed by an EOD marker. It then returns status to the host before beginning the actual rewind operation. If the Immed bit is not set, status will be returned after the rewind has completed.

8.4.21 SEND DIAGNOSTIC (1Dh)

Bit

Byte		7	6	5	4	3	2	1	0
	0	Operation Code (1Dh)							
	1	Logical Unit Number			PF	Rsvd	Selftst	Dev OfL	UnitOFl
	2	Reserved							
	3	(MSB)							
	4	Parameter List Length							(LSB)
	5	Unused		Reserved				Flag	Link

Figure 8-73 *SEND DIAGNOSTIC CDB*

SEND DIAGNOSTIC tells the drive to perform its diagnostic tests.

The Page Format field is not supported and must be zero.

Two separate types of unit resident tests can be accessed:

- Electronics Self-Test - (Level 1 test) To invoke the diagnostic, a good portion of the controller hardware and software must be functioning properly. This is the premise this test is based on: that full power-up testing is not necessary. Therefore, this test does an extension of the power-up self tests. The code ROM EDC is verified, two queues used by much of the controller software is checked by dequeuing and enqueuing items.

  The Send Diagnostic when there is a loader attached, a software reset is performed on it. This test does not attempt to write or read data to or from media. This test has an execution time of approximately 60 seconds which includes the reset.
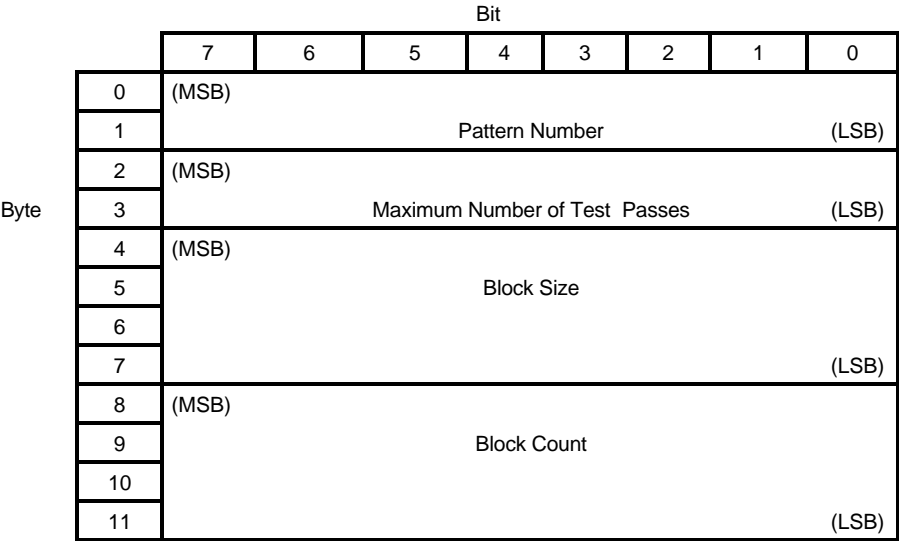
  This test is specified by setting just the Self-Test bit (DevOfL, and UnitOfL both zero).

- Write/Read Functionality Test - (Level 2 test). The default version of this test does the following:

  - Writes 500 32 KB records on track 0.

  - Rewinds the tape.

  - Reads the records.

  - Positions to the beginning of track 1.

  - Writes 500 32 KB records on track 1.

  - Repositions to the beginning of track 1.

  - Reads the records.

  - Rewinds the tape. The execution time for the test is 6 minutes, if calibration is not required. This test is specified by setting the Self-Test and UnitOfL bits, and zeroing the DevOfL bit. This test can accept a parameter list specifying test variables, as shown in the next table.

    If a parameter list is specified, all parameters must be filled in and the parameter list length should be set to 12. If these requirements are not met, an ILLEGAL REQUEST will be returned. The Self-Test bit should be zero.

Table 8-8 *Send Diagnostics Parameters*

Selftest	DevOfL	UnitOfL	Selftest Action
0	0	0	Illegal combination
0	0	1	Self-Test 2 with default parameters
0	1	0	Illegal combination
0	1	1	Self-Test 2 with default parameters
1	0	0	Self-Test 1 with default parameters
1	0	1	Self-Test 2 with default parameters
1	1	0	Self-Test 1 with default parameters
1	1	1	Self-Test 2 with default parameters

	Bit							
	7	6	5	4	3	2	1	0
0	(MSB)							
1				Pattern Number				(LSB)
2	(MSB)							
3				Maximum Number of Test Passes				(LSB)
4	(MSB)							
5				Block Size				
6								
7								(LSB)
8	(MSB)							
9				Block Count				
10								
11								(LSB)

Byte

Figure 8-74 *SEND DIAGNOSTIC Parameter List Format*

Table 8-9 *Definition of Pattern Numbers*

Pattern	Name	Data in Hex
0	Rotate	(Rotate through the other 9 patterns, change for each tape file)
1	All 0's	00 00 00 00 00
2	2F	FF FF FF FF FF
3	Alternating 1's and 0's	55 5A AA A5 55 5A AA A5
4	Marching 1	01 02 04 08 10 20 40 80
5	Marching 0	FE FD FB F7 EF DF BF 7F
6	MW	0E 0E 0E 0E 0E 0E 0E 0E
7	MFM	DE AD DE AD DE AD DE AD
8	1F	AA AA AA AA AA AA AA AA
9	Random Data	

If the Max Number of Passes is zero, this indicates to loop forever. A BUS Reset or a selection from the host sending an Abort or a Bus Device Reset message will terminate testing.

If the Block Size field is set to zero, random block sizes will be used.

The Block Count field specifies how many blocks to write/read starting first on track 0, then again on track 1. So if the Block Size and Count fields result in 3 tracks worth of data, the test will:

- Write tracks 0, 1, 2

- Rewind, read, and verify 0, 1, 2

- Write 3 tracks starting with 1: 1, 2, 3 and then rewind to the beginning of track 1 and do the read/verify pass. If Block Count is set to zero, data will be written until EOT is reached each time, so almost 4 complete passes over the tape would result.

_____**NOTE** _____

Because of data generation and verification, this test only streams the tape for short periods of time. Therefore, if Block Count is set very high, this test can take many minutes or even many hours to complete.

_____

If the specified test passes, a GOOD STATUS is returned. Otherwise, a Check Condition is generated, and the Sense Data will contain information about the failure.

Table 8-10 *Sense Keys Used*

Sense Key	Description
3h	Medium Error. A positioning error has occurred where the returned position does not match the expected.
4h	Hardware Error. The Additional Sense Code/Qualifier fields will provide more specific information.
5h	ILLEGAL REQUEST. Illegal bit settings in the SEND DIAGNOSTIC command.
Eh	Miscompare. A compare error occurred during a read.

Table 8-11 *Additional Sense Codes*

Additional Sense Code	Additional Sense Qualifier	Description
15h	2h	A positioning error has occurred where the returned position does not match the expected.
40h	80h	Level 1 ROM test failed.
40h	81h	Level 1 RAM test failed.
40h	82h	Level 1 test failed. Bad Drive status.
40h	83h	Level 1 test failed. Loader Reset failed.

8.4.22 SPACE (11h)

	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (11h)							
1	Logical Unit Number			Reserved			Code	
2	(MSB)							
3	Count							
4								(LSB)
5	Unused			Reserved			Flag	Link

Byte (labels column 0–5)
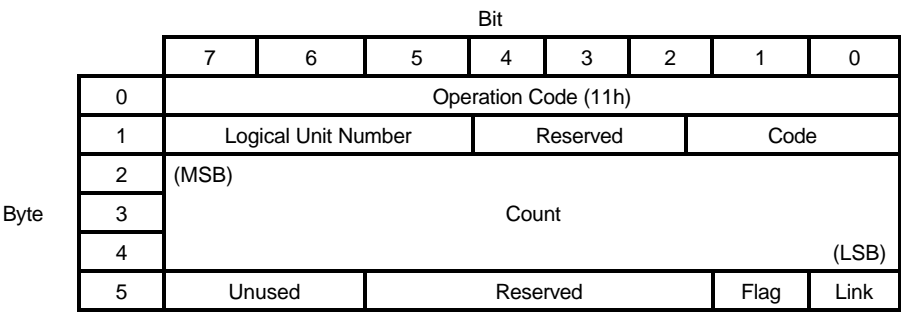
Figure 8-75 *SPACE CDB*

SPACE provides a variety of positioning functions that are determined by Code and Count fields in the Command Descriptor Block. Both forward (toward EOM/P) and reverse (toward BOM/P) positioning are provided.

Code

The code is defined as follows:

Space Code	Space by:
000b	Blocks
001b	Filemarks
010b	Sequential Filemarks
011b	End-of-Data

Figure 8-76 *SPACE Code Definition*

For 2.6 and 6.0 GB format, the drive supports count values 0, 1, and 2 only. For 10.0 GB format, compress or noncompress, the count value can be from 0 to FFFFFFh.

Count

When spacing over blocks or marks, the Count field is interpreted as follows:

- A positive value N causes forward movement over N blocks or marks. The tape is logically positioned after the Nth block or mark on the EOM/P side.

- A zero value causes no change in the logical position.

- A negative value -N (two's complement notation) causes reverse movement over N blocks or marks. The tape is logically positioned on the BOM/P side of the Nth block or mark.

- When spacing to EOD, the Count field is ignored. Forward movement occurs until the drive encounters EOD. The position is such that a subsequent WRITE command would append data after the last object that has been written to tape before EOD.

When executing SPACE, the drive implements the following hierarchy:

- Blocks - lowest

- Filemarks

- EOD

- BOM/P or EOM/P - highest

Therefore, SPACE N blocks will halt with GOOD status after the Nth block, or with CHECK CONDITION status on any occurrence of Filemark, EOD, BOM/P, or EOM/P. A space N Filemarks will halt on the Nth Filemark or on any occurrence of EOD, BOM/P, or EOM/P, and so on.

Depending on the size of blocks, read ahead data in the buffer allows some spacing requests to be satisfied without tape movement.

8.4.23 TEST UNIT READY (00h)

Bit

Byte	7	6	5	4	3	2	1	0
0	Operation Code (00h)							
1	Logical Unit Number			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							
5	Unused			Reserved			Flag	Link

Figure 8-77 *TEST UNIT READY CDB*

TEST UNIT READY checks if the drive unit is ready for commands involving tape movement. If the drive has a tape loaded, the command returns a GOOD status. Otherwise, CHECK CONDITION is reported.

It is possible to get multiple check conditions on a TEST UNIT READY command because of power cycle, code update, and tape loaded.

8.4.23.1 Medium Changer Considerations

When directed at the Media Loader LUN, this command will return Check Condition, Sense Key, or Not Ready if:

- The Mode Select key switch is in the Service mode, and there is no 24V signal (usually means the loader assembly has been moved out of its sleeve enough to trip the 24V interlock.)

8.4.24 VERIFY (13h)

		Bit						
	7	6	5	4	3	2	1	0
0	Operation Code (13h)							
1	Logical Unit Number			Reserved		Immed	BC	Fixed
2	(MSB)							
3	Verification Length							
4								(LSB)
5	Unused		Reserved				Flag	Link

(Byte labeled to the left of bytes 2–4)

Figure 8-78 VERIFY CDB

VERIFY verifies one or more blocks beginning with the next block on the tape. Both CRC and EDCs are validated.

Immed

If this bit is set, the Verify command will complete before any media movement is done (that is, when processing has been initiated).

BC

This bit selects a CRC/ECC verification or a byte-by-byte compare. If the BC bit is cleared, the device is instructed to perform an internal CRC/ECC check of the data.

If this bit is set, the command will be rejected.

Fixed

This bit operates in the same fashion as with the READ command.

8.4.25 WRITE (0Ah)

Bit

Byte	7	6	5	4	3	2	1	0
0	Operation Code (0Ah)							
1	Logical Unit Number			Reserved				Fixed
2	(MSB)							
3	Transfer Length							
4								(LSB)
5	Unused			Reserved			Flag	Link
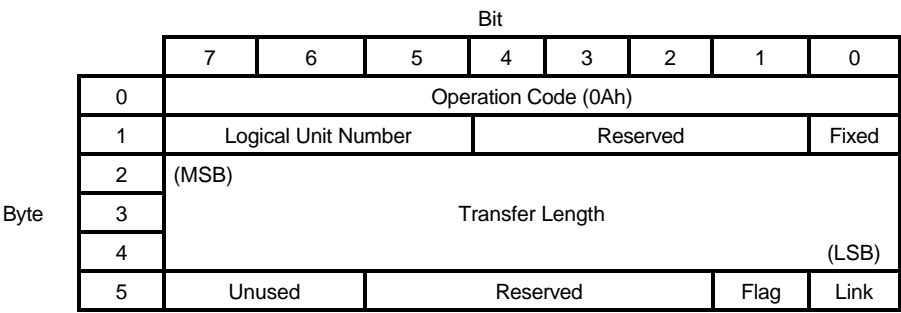
Figure 8-79 *WRITE CDB*

WRITE transfers one or more blocks from the host to the current logical position. When in Buffered Mode (see MODE SELECT), the tape drive reports a GOOD status on WRITE commands as soon as this data block has been transferred to the data buffer.

The drive flushes the write buffer to tape under the following conditions:

- The write hold-off time limit is exceeded. (See MODE SELECT command.)

- Receipt of the following nonwrite commands:

  LOAD-UNLOAD

  REWIND

  ERASE

  LOCATE

  MOVE MEDIUM

  PREVENT/ALLOW MEDIUM REMOVAL that clears a prevent state

- A Write Filemarks command with the immediate bit cleared.

- A SCSI Reset or Bus Device Reset a reset message is received

If Buffered Mode is not selected, the buffer will flush after every write-type command. Buffered Mode can be configured through MODE SELECT, and if it is not used, the tape drive suffers a significant degradation in performance with respect to transfer rate and therefore, loss of streaming.

Fixed

The fixed bit specifies both the meaning of the Transfer Length field and whether fixed-length or variable-length blocks are to be transferred. If the Fixed bit is set to zero, Variable Block mode is selected. A single block is transferred from the initiator and is written to the logical unit beginning at the current logical tape position. Upon successful termination, the tape is logically positioned after this block (EOM/P side). The Transfer Length specifies the number of bytes that the drive handshakes out from the initiator.

If the Fixed bit is set to one, the Transfer Length field specifies the number of blocks to be transferred to the host beginning at the current tape position. This form of WRITE is valid only if the logical unit is currently operating in Fixed Block mode, in other words, when it has been instructed to use fixed-length blocks with MODE SELECT. The current block length is the block length defined in the MODE SELECT command. Upon termination, the tape is logically positioned after these blocks.

Transfer Length

This field contains the length of the data transfer in bytes or blocks, depending on whether Fixed or Variable block mode is selected.

If the Transfer Length is zero, no data is transferred and the current position on the logical unit is not changed.

Exception Conditions

If EOT is detected while writing, the drive will finish writing any buffered data. The command terminates with CHECK CONDITION status. Within the Sense data, the EOM bit is set, the Sense Key field is set to NO SENSE, and the Additional Sense Code and Additional Sense Code Qualifier fields are set to EOM/P detected. The drive attempts to complete any subsequent writes, returning a CHECK CONDITION status in each case.

If the drive encounters the physical EOM when attempting write, CHECK CONDITION status is returned. Within the Sense data, the EOM and Valid bits are set, and the Sense Key field is set to VOLUME OVERFLOW. The Information fields contain the residue count and the Additional Sense Code and Additional Sense Code Qualifier fields are set to EOM/P Detected. The tape is physically positioned at EOM/P.
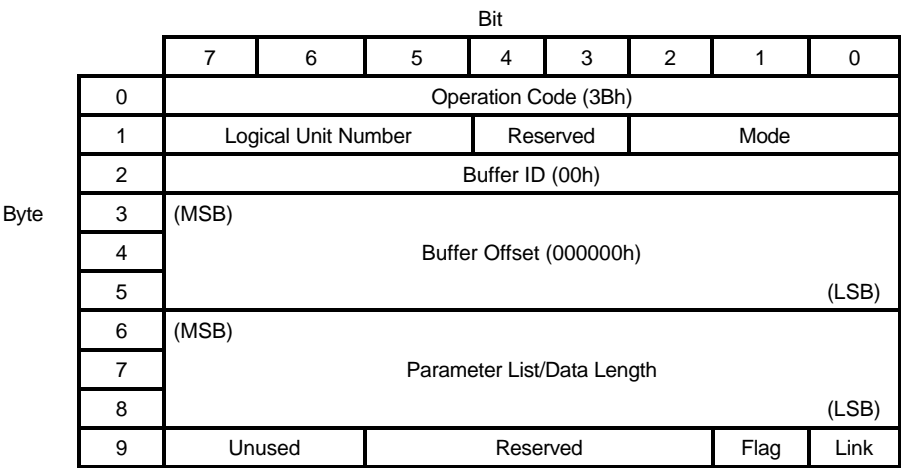
8.4.26 WRITE BUFFER (3Bh)

	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (3Bh)							
1	Logical Unit Number			Reserved		Mode		
2	Buffer ID (00h)							
3	(MSB)							
4	Buffer Offset (000000h)							
5								(LSB)
6	(MSB)							
7	Parameter List/Data Length							
8								(LSB)
9	Unused		Reserved				Flag	Link

Byte (row labels)

Figure 8-80 *WRITE BUFFER CDB*

WRITE BUFFER is used with READ BUFFER as a diagnostic function for testing the device data buffer, DMA engine, SCSI bus interface hardware, and SCSI bus integrity. It is also used for downloading and updating controller microcode (firmware).

Mode

The drive supports the following values within the field. If any other value is set, the drive terminates the command with a CHECK CONDITION status and an ILLEGAL REQUEST sense key set.

Mode	Description
000b	Write combined header and data
010b	Write data
100b	Download Microcode
101b	Download Microcode and Save

Figure 8-81 *WRITE BUFFER Modes Supported*

For all modes, only a Buffer ID of zero is supported. If the Buffer ID field is nonzero, the command will be rejected. The target detects and rejects commands that would overrun the buffer.

8.4.26.1 Header and Data Mode

The data to be transferred is preceded by a 4-byte header consisting entirely of reserved bytes. This header is discarded (not stored into the buffer). The buffer offset field must be zero for this mode.

8.4.26.2 Write Data

Similar to mode 000b, except there is no header in the data passed to the target. The Buffer Offset must be zero. Potential buffer overruns are detected and the command is rejected.

8.4.26.3 Download Microcode

Using buffer offsets, the host can download the firmware image into the target's buffer in pieces. These commands do not cause the new image to become active. A Download and Save mode Write Buffer command must be issued.

The tape drive must be empty to allow downloading of an image. This is to safeguard against accidentally starting a firmware update. If a cartridge is loaded when all or part of a firmware image has been downloaded, another WRITE BUFFER with Download mode will be rejected. Overlapping or nonconsecutive downloading of the image data is not supported. The firmware image must be downloaded in integral multiples of 4K bytes.

Any error on a Write Buffer command causes any downloaded image data to be discarded, and the download must be restarted from the beginning.

8.4.26.4 Download Microcode and Save

This mode can be used to download and save the entire image at once, or to download the image data and save it, or to cause a save operation after all the image data has been downloaded using the Download only mode. This mode of the command causes the image data to be verified and the Flash EEPROM firmware area to be updated. During the reprogramming, the Write Protect and Drive Activity LEDS on the drive's front panel will blink.

_____**CAUTION**_____

During the actual reprogramming of the FLASH memory chips, if any
type of powerfail occurs, or if the reprogramming fails part way through,
the subsystem will be unusable, and the controller board will need to be
replaced.

_____

When the Save operation is successfully completed, the firmware restarts itself,
causing POST to be rerun, and two Unit Attention conditions are generated: power-up
reset, and operating code has changed.

8.4.27 WRITE FILEMARKS (10h)

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (10h)							
1	Logical Unit Number			Reserved			WSmk	Immed
2	(MSB)							
3	Number of Filemarks							
4								(LSB)
5	Unused		Reserved				Flag	Link
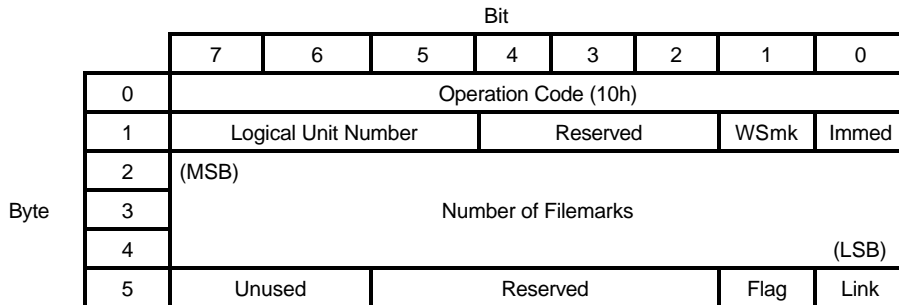
Figure 8-82 *WRITE FILEMARKS CDB*

WRITE FILEMARKS causes the specified number of Filemarks to be written beginning at the current logical position on tape. If the Immed bit is not set, any data or Filemarks in the write cache buffer are written to tape.

WSmk

If this bit is set, the tape drive writes a save-set mark to tape instead of a Filemark. Since Setmarks are not supported by the DLT4000 drive, this field must be zero.

Immed

If this bit is set, the drive returns status as soon as the command descriptor block has been validated, unless the filemark count is zero, or greater than 1 (since both cause the write buffer to be flushed to media). An Immed bit of zero indicates the status will not be returned until the operation is complete.

Number of Filemarks

This is the number of consecutive marks to be written to tape. A value of zero is not considered an error and GOOD status is returned.

This command may be used to force the drive to write any buffered write data to the tape. If the drive is in Buffered mode, and WRITE FILEMARKS is received, the requested Filemarks are appended to the data, and the write buffer is flushed to tape. A zero value in the Number of Filemarks field indicates that no Filemarks are to be written to the tape, but still flushes any write data to tape.

If EOT is detected while writing Filemarks, the drive finishes writing any buffered data and terminates with CHECK CONDITION status. Within the Sense data, the EOM bit is set, the Sense Key field is set to NO SENSE and the Additional Sense Code and Additional Sense Code Qualifier fields are set to EOM/P detected. The drive will attempt to complete any subsequent WRITE FILEMARKS, returning a CHECK

CONDITION status in each case. If the drive encounters the physical EOM when attempting a WRITE FILEMARKS, CHECK CONDITION status is returned.

8.5 Supported SCSI-2 Medium Changer Device Commands

On the Medium Changer LUN, only commands defined for this device type are allowed. The following commands are implemented:

Table 8-12 *SCSI-2 Medium Changer Commands*

Opcode	Command	Section
07*	INITIALIZE ELEMENT STATUS	8.5.1
12	INQUIRY	8.4.4
15+	MODE SELECT	8.5.2
1A+	MODE SENSE	8.5.2
A5*	MOVE MEDIUM	8.5.3
3C	READ BUFFER	8.4.14
B8*	READ ELEMENT STATUS	8.5.4
1C	RECEIVE DIAG RESULTS	8.4.16
17	RELEASE	8.4.17
03	REQUEST SENSE	8.4.18
16	RESERVE	8.4.19
1D	SEND DIAGNOSTIC	8.4.21
00	TEST UNIT READY	8.4.23
3B	WRITE BUFFER	8.4.26

* = Medium Changer specific commands

+ = Commands with significant Medium Changer specific content

The Inquiry, Send Diagnostic, Receive Diagnostic Results, Read/Write Buffer, and Request Sense commands are documented in the preceding sections.

The rest of this chapter covers Medium Changer unique commands.

8.5.1 INITIALIZE ELEMENT STATUS (07h)

Bit

	7	6	5	4	3	2	1	0
0	Operation Code (07h)							
1	Logical Unit Number			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							
5	Unused		Reserved				Flag	Link

Byte (label for rows)

Figure 8-83 *Initialize Element Status CDB*

This command causes the medium changer to initialize the element status.

8.5.2 MODE SENSE/SELECT (1Ah/15h)

All three pages that are specific to Medium Changers are supported.

8.5.2.1 Device Capabilities Page (1Fh)

The drive supports the Device Capabilities Page which has the following format:

	Bit							
	7	6	5	4	3	2	1	0
0	PS	0	Page Code (1Fh)					
1	Additional Page Length (0Eh)							
2	Reserved				StorDT	StorI/E	StorST	StorMT
3	Reserved							
4	Reserved				MT➜DT	MT➜I/E	MT➜ST	MT➜MT
5	Reserved				ST➜DT	ST➜I/E	ST➜ST	ST➜MT
6	Reserved				IE➜DT	IE➜I/E	IE➜ST	IE➜MT
7	Reserved				DT➜DT	DT➜I/E	DT➜ST	DT➜MT
8	Reserved							
9	Reserved							
10	Reserved							
11	Reserved							
12	Reserved				MT<>DT	MT<>I/E	MT<>ST	MT<>MT
13	Reserved				ST<>DT	ST<>I/E	ST<>ST	ST<>MT
14	Reserved				IE<>DT	IE<>I/E	IE<> T	IE<>MT
15	Reserved				DT<>DT	DT<>I/E	DT<>ST	DT<>MT

(Byte labels to left of rows 0–15)

Figure 8-84 *Device Capabilities Page Format*

Bit Field Values

- Elements that can store media: StorDT, StorST

- Valid Source->Destination pairs: ST->DT, DT->ST

All the "MT->XX" and the "XX->MT" entries are zero, since the loader will not accept a Medium Transport element address as a source or destination.

All the "IE->XX" and the "XX->IE" entries are zero since there is no Import/Export element.

Bytes 12 through 15 are all zero as the medium changer does not support the exchange medium command.

The medium changer does not support "ST->ST" or "DT->DT".

8.5.2.2 Element Address Assignment Page (1Dh)

The drive supports the Element Address Assignment Page which has the following format:

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	PS	0	Page Code (1Dh)					
1	Length (12h)							
2	(MSB)	1st Medium Transport Element Address (01h)						
3								(LSB)
4	(MSB)	Number of Medium Transport Elements (1)						
5								(LSB)
6	(MSB)	1st Storage Element Address (100h)						
7								(LSB)
8	(MSB)	Number of Storage Elements						
9								(LSB)
10	(MSB)	1st Import/Export Elements (0)						
11								(LSB)
12	(MSB)	Number of Import/Export Elements						
13								(LSB)
14	(MSB)	1st Data Transfer Element Address (10)h						
15								(LSB)
16	(MSB)	Number of Data Transfer Elements (01)						
17								(LSB)
18	Reserved							
19	Reserved							

Figure 8-85 *Element Address Assignment Page Format*

Medium Changer Element Address assignment is as follows:

Table 8-13 *Medium Changer Element Addresses*

Address	Comments
0	Default Medium Transport Element
1	Medium Transport Element
2-0Fh	Reserved
10h	Data Transfer Element (tape drive)
11h-0FFh	Reserved
100h	Medium Storage Element (Magazine slot 0)
101h	Medium Storage Element (Magazine slot 1)
102h	Medium Storage Element (Magazine slot 2)
103h	Medium Storage Element (Magazine slot 3)
104h	Medium Storage Element (Magazine slot 4)
105h	Medium Storage Element (Magazine slot 5)
106h	Medium Storage Element (Magazine slot 6)
107h-0FFFFh	Reserved

8.5.2.3 Transport Geometry Parameters Page (1Eh)

The drive supports the Transport Geometry Page which has the following format:

	Bit							
	7	6	5	4	3	2	1	0
0	PS	0	Page Code (1Eh)					
1	Additional Page Length (02h)							
2	Reserved							Rotate
3	Member Number in Transport Element Set (0)							

Figure 8-86 *Transport Geometry Page Format*

Rotation of media is not appropriate for this type of Loader, so the Rotate bit is zero.

There is only one Medium Transport Element, so there is only one set, with one member.

8.5.3 MOVE MEDIUM (A5h)

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (A5h)							
1	Logical Unit Number			Reserved				
2	(MSB) Transport element Address							
3								(LSB)
4	(MSB) Source Address							
5								(LSB)
6	(MSB) Destination Address							
7								(LSB)
8	Reserved							
9	Reserved							
10	Reserved							
11	Unused		Reserved				Flag	Link
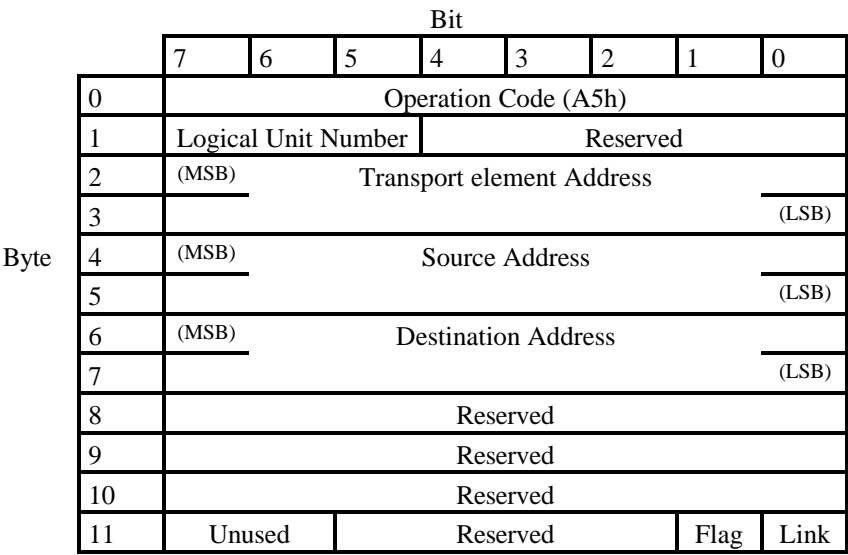
Figure 8-87 *MOVE MEDIUM CDB*

The Move Medium command is used to move cartridges from the tape drive to the magazine slot it came from, or from any magazine slot to the tape drive.

The Transport Element Address field must be zero or one.

8.5.4 READ ELEMENT STATUS (B8h)

Bit

Byte	7	6	5	4	3	2	1	0
0	Operation Code (B8h)							
1	Logical Unit Number			VolTag	Element type Code			
2	(MSB)		Starting Element Address					
3								(LSB)
4	(MSB)		Number of Elements					
5								(LSB)
6	Reserved							
7	(MSB)							
8	Allocation Length							
9								(LSB)
10	Reserved							
11	Unused		Reserved				Flag	Link

Figure 8-88 *READ ELEMENT STATUS CDB*

Code	Description
0h	All element types reported (valid in CDB only)
1h	Medium Transport Element
2h	Storage Element (magazine slot)
3h	Import Export Element (not supported)
4h	Data Transfer Element (tape drive)
5 - Fh	reserved

Figure 8-89 *Element Type Code Definitions*

The format of Element Status data is defined in the SCSI-2 specification. The following sections show the information returned for the medium changer. The Element Status data is made up of a header, and one or more Status Pages (for each element type). The Status Pages are made up of a header and one or more element descriptors (one for each element address). The data shown assumes the CDB was specified in such a way that all descriptors for a given element type would be returned.

The Primary and Alternate Volume Tag functions are not supported, so the flags indicating these functions in the Element Status Pages (below) are always set to zero.

8.5.4.1 Element Status Data Header

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

Figure 8-90 *Element Status Data Header*

8.5.4.2 Medium Transport Element Status Page

Bit

Byte		7	6	5	4	3	2	1	0
	0	Element Type Code (1h = Medium Transport)							
	1	PVolTag	AVolTag	Reserved					
	2	(MSB)							
	3	Transport Element Descriptor Length							(LSB)
	4	Reserved							
	5	(MSB)							
	6	Byte Count of Descriptor Data Available							
	7								(LSB)

Descriptor

Byte		7	6	5	4	3	2	1	0
	8	(MSB)							
	9	Transport Element Address (01h)							(LSB)
	10	Reserved					Except	Rsv'd	Full
	11	Reserved							
	12	Additional Sense Code							
	13	Additional Sense Code Qualifier							
	14	Reserved							
	15	Reserved							
	16	Reserved							
	17	SValid	Invert	Reserved					
	18	(MSB)							
	19	Source Element Address							(LSB)
	20	Reserved							
	21	Reserved							
	22	Reserved							
	23	Reserved							
	24	Density Code of Media (= 0 if empty) VU							
	25	Unused (VU)							

Figure 8-91 *Medium Transport Element Status Page*

There is only one Medium Transport element, which can be addressed explicitly as element address 1, or implicitly as address 0.

PvolTag and AVolTag are always zero.

8.5.4.3 Storage Element Status Page

		Bit							
		7	6	5	4	3	2	1	0
	0	Element Type Code (2h = Storage Transport)							
	1	PVolTag	AVolTag	Reserved					
	2	(MSB)							
	3	Storage Element Descriptor Length							(LSB)
Byte	4	Reserved							
	5	(MSB)							
	6	Byte Count of Descriptor Data Available							
	7								(LSB)

Descriptor

	8	(MSB)							
	9	First Storage Element Address Reported							(LSB)
	10	Reserved			Access	Except	Rsv'd		Full
	11	Reserved							
	12	Additional Sense Code							
	13	Additional Sense Code Qualifier							
	14	Reserved							
Byte	15	Reserved							
	16	Reserved							
	17	SValid	Invert	Reserved					
	18	(MSB)							
	19	Source Element Address							(LSB)
	20	Reserved							
	21	Reserved							
	22	Reserved							
	23	Reserved							
	24	Density Code of Media (= 0 if empty) (VU)							
	25	Unused (VU)							
	26 to n	Descriptors for other Storage Elements							

Figure 8-92 *Storage Element Status Page*

There are up to seven Storage Elements, corresponding to the number of slots in a magazine.

PvolTag and AVolTag are always zero.

Access is always 1, and Full is set to 1 if a media cartridge is in the corresponding magazine slot. Exception will be set to 1 if the magazine slot indicates a cartridge has been removed, but is not in the Medium Transport or Data Transfer elements. The Source Element Address will always be set to this element's address.

8.5.4.4 Data Transfer Element Status Page

	Bit							
	7	6	5	4	3	2	1	0
0	Element Type Code (4h = Data Transport)							
1	PVolTag	AVolTag	Reserved					
2	(MSB)	Data Transfer Element Descriptor						
3								(LSB)
4	Reserved							
5	(MSB)							
6	Byte Count of Descriptor Data Available							
7								(LSB)

Byte (label for rows 0–7)

Descriptor

	7	6	5	4	3	2	1	0
8	(MSB)	Data Transfer Element Address (10h)						
9								(LSB)
10	Reserved				Access	Except	Rsvd	Full
11	Reserved							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	NotBus	Rsvd	IDValid	LUValid	Rsvd	Logical Unit Number		
15	SCSI Bus Address (same as tape drive's)							
16	Reserved							
17	SValid	Invert	Reserved					
18	(MSB)	Source Element Address						
19								(LSB)
20	Reserved							
21	Reserved							
22	Reserved							
23	Reserved							
24	Density Code of Media (= 0 if empty) (VU)							
25	Unused (VU)							

Byte (label for rows 8–25)

Figure 8-93 *Data Transfer Element Status Page*

PvolTag and AVolTag are always zero.

Access is always set, and Full is set if a cartridge is in the tape drive.

IDValid and LUValid are always set, drive LUN is 0. The SCSI Bus Address field is the same as the tape drive's controller.

SValid is set if there is a cartridge in the drive, and Source Element Address will indicate which magazine slot it came from.

Appendix A

Technical Specifications

A.1 In This Appendix

Appendix A contains specifications for the DLT4000 tape drive, DLT4500 mini-library and the DLT4700 mini-library including:

Topic	Section
Drive and Mini-library Physical Descriptions	A.2
• DLT4000 Drive/Table Top	A.2.1
• DLT4500 Mini-library	A.2.2
• DLT4700 Mini-library	A.2.3
Functional Specifications	A.3
• DLT4000 Drive	A.3.1
Identifying the Correct AC Power Cord	A.4
Tape Drive Mounting Holes	A.5
Performance Specifications	A.6
Environmental Specifications	A.7
Vibration and Shock Specifications	A.8
Electromagnetic Interference (EMI) Susceptibility	A.9
Regulatory Requirements	A.10
Drive Reliability Factors	A.11

A.2 Drive and Mini-library Physical Descriptions

A.2.1 DLT4000 Drive Physical specifications

Table A-1 lists the key physical specifications of the DLT4000 tape drive.

Table A-1 *DLT4000 Physical Specifications*

Description	Drive 5 1/4 inch FH (modified depth)	Table Top
Height	82.5 mm (3.235 in) without bezel 86.3 mm (3.4 in) with bezel	146.6 mm (5.77 in)
Width	144.8 mm (5.7 in) behind bezel 148.3 mm (5.84 in) with bezel	235 mm (9.25 in)
Length	228.6 mm (9.0 in) measured from back of front bezel 243.8 mm (9.6 in) including the bezel	332 mm (13.08 in)
Weight	2.9 kg (6 lb)	6.63 kg (14 lb, 9 oz)
Shipping Weight	3.86 kg (8 lb, 8 oz) depending on configuration	10.01 kg (22 lb, 0.4 oz) depending on configuration
Environmental temperature		
Operating	10°C to 40°C (50°F to 104°F)	10°C to 40°C (50°F to 104°F)
Nonoperating	-40°C to 66°C (-40°F to 150.8°F)	-40°C to 66°C (-40°F to 150.8°F)
Humidity		
Operating	20% to 80% noncondensing	20% to 80% noncondensing
Nonoperating	10% to 95%	10% to 95%
Certifications		
EMI	Meets CEmark Class A, VCCi Class 1, CISPR 22 Class A, FCC Class A devices	Meets CEmark Class B, VCCi Class 2, CISPR 22 Class B, FCC Class B devices
Safety	Meets UL, CSA, TUV, "BG" MARK and IEC standards	Meets UL, CSA, TUV, "BG" MARK and IEC standards
Operating Air Velocity	125 LFM average air velocity measured directly in front of the bezel	125 LFM average air velocity measured directly in front of the bezel

Table A-1 *DLT4000 Physical Specifications (cont'd)*

Description	Drive 5 1/4 inch FH (modified depth)	Table Top
Electrical rating (Auto ranging)	(See Below)	100 to 240 V ac,
	D.C.	A.C.
Power Requirements Power Consumption	25 W steady state/27 W, maximum	50W, maximum
+5(±5%)* Volt Bus	2.0 A steady state/2.5 A maximum	N/A
+12(±5%)* Volt Bus	0.8 A steady state/1.5 A maximum	N/A
Communication interface	SCSI-2 bus 8 bits (single-ended or differential) with a separate SCSI LUN ID for the mini-library and tape drive.	SCSI-2 bus 8 bits (single-ended or differential) with a separate SCSI LUN ID for the mini-library and tape drive.
MTBF	80,000 hours	80,000 hours

*Voltage measured at the power bus connector pins.

A.2.2 DLT4500 Mini-library Physical specifications

Table A-2 lists the key physical specifications for the DLT4500 mini-library.

Table A-2 *DLT4500 Mini-Library Physical Specifications*

Description	Rack Mount	Table Top
Height	295 mm (11.6 in)	300 mm (11.8 in)
Width	414 mm (16.3 in)	414 mm (16.3 in)
Length*	259 mm (10.2 in)	267 mm (10.5 in)
Weight	12 kg (27 lb)	15.9 kg (35 lb)
Environmental temperature		
Operating	10°C to 40°C (50°F to 104°F)	10°C to 40°C (50°F to 104°F)
Nonoperating	-40°C to 66°C (-40°F to 150.8°F)	-40°C to 66°C (-40°F to 150.8°F)
Humidity		
Operating	20% to 80% noncondensing	20% to 80% noncondensing
Nonoperating	10% to 95%	10% to 95%
Certifications		
EMI	Meets CEmark Class A, VCCi Class 1, CISPR 22 Class A, FCC Class A devices	Meets CEmark Class A, VCCi Class 1, CISPR 22 Class A, FCC Class A devices
Safety	Meets UL, CSA, TUV, "BG" MARK and IEC standards	Meets UL, CSA, TUV, "BG" MARK and IEC standards
Maximum number of cartridges	5	5
Electrical rating (Auto ranging)	100 to 240 V ac	100 to 240 V ac,
AC power requirements	45 W, maximum	45 W, maximum
Communication interface	SCSI-2 bus 8 bits (single-ended or differential) with a separate SCSI LUN ID for the mini-library and tape drive.	SCSI-2 bus 8 bits (single-ended or differential) with a separate SCSI LUN ID for the mini-library and tape drive.
Cycle time	20 s, maximum	20 s, maximum

*Cable length not included.

A.2.3 DLT4700 Mini-library Physical specifications

Table A-3 lists the key physical specifications for the DLT4700 mini-library.

Table A-3 *DLT4700 Mini-Library Physical Specifications*

Description	Rack Mount	Table Top
Height	26.47 cm (10.42 in)	27.25 cm (10.73 in)
Width	22.20 cm (8.74 in)	22.54 cm (8.875 in)
Length*	68.5 cm (27.0 in)	68.5 cm (27.0 in)
Weight	24.95 kg (55 lb)	29.54 kg (65 lb)
Environmental temperature		
Operating	10°C to 40°C (50°F to 104°F)	10°C to 40°C (50°F to 104°F)
Nonoperating	-40°C to 66°C (-40°F to 150.8°F)	-40°C to 66°C (-40°F to 150.8°F)
Humidity		
Operating	20% to 80% noncondensing	20% to 80% noncondensing
Nonoperating	10% to 95%	10% to 95%
Certifications		
EMI	Meets CEmark Class A, VCCi Class 1, CISPR 22 Class A, FCC Class A devices	Meets CEmark Class A, VCCi Class 1, CISPR 22 Class A, FCC Class A devices
Safety	Meets UL, CSA, TUV, "BG" MARK and IEC standards	Meets UL, CSA, TUV, "BG" MARK and IEC standards
Maximum number of cartridges	7	7
Electrical rating	100 to 120/220 to 240 V ac, 2/1 A Voltage Selection Switch	100 to 120/220 to 240 V ac, 2/1 A Voltage Selection Switch
AC power requirements	82 W, typical 113 W, maximum	82 W, typical 113 W, maximum
Communication interface	SCSI-2 bus 8 bits (single-ended or differential),SCSI-2 bus	SCSI-2 bus 8 bits (single-ended or differential),SCSI-2 bus
Cycle time	50 s, maximum	50 s, maximum

*Cable length not included.

A.3 Drive Functional Specifications

A.3.1 DLT4000 Drive Functional Specifications

Table A-4 lists the key functional specifications of the DLT4000 tape drive.

Table A-4 *DLT4000 Functional Specifications*

Functional	Specifications
DLTtape IV	
Capacity/formatted native	20.0 GB user data
Capacity/formatted compressed 2:1[1]	40.0 GB user data
DLTtape IIIxt Cartridge	
Capacity/formatted native	15.0 GB user data
Capacity/formatted compressed 2:1[1]	35.0 GB user data
DLTtape III	
Capacity/formatted native	10.0 GB user data
Capacity/formatted compressed 2:1[1]	20.0 GB user data
Interface	8 bit SCSI-2, single ended or differential
Drive Type	DLT, streaming, 10.0/15.0/20.0 GB-16 bit, single end or differential
Recording Type	2-7 RLL code with DLT2000, DLT2000xt and DLT4000 format, MFM with 2.6 GB/6.0 GB DLT260 and DLT600 format
Form Factor	5-¼ inch, F.H. modified depth
Transfer Rate, Raw Native	2.5 MBytes/second[2]
Transfer Rate, User Native Uncompressed	1.5 MBytes/second
Transfer Rate, User Compressed[1]	More than 3.0 MB/second maximum write, 10 MBburst mode
	More than 2.5MB/second maximum read, 10 MBburst mode
Error Rate (Recoverable)	Read recoverable error rate: $1.0X10^9$
	Write recoverable error rate: $1.0X10^6$

Table A-4 *DLT4000 Functional Specifications (cont'd)*

Functional	Specifications
Error Rate (Unrecoverable)	Read interchange recoverable error rate
	Read unrecoverable error rate
Tracks	128 tracks; 64 pairs
Linear Bit Density	81,600 bpi/per track

[1] Nominal compression ratio. Actual compression is data dependent.

[2] Included format data, user data, post amble, and so forth for extended tape.

A.4 Identifying the Correct AC Power Cord

_____ **WARNING** _____

Do not attempt to modify or use an external 100 - 115 VAC power
cord for 220 - 240 VAC input power. Modifying the power cord can
cause personal injury and severe equipment damage.

_____

An AC power cord was supplied with your unit. Carefully inspect it and make sure
that it is the correct one for your country or region based on the criteria listed below. If
you feel the supplied AC power cord is not correct, contact your authorized Quantum
service representative.

The AC power cord used with this equipment must meet the following criteria:

1. UL and CSA Certified cordage rated for use at 250 VAC with a current rating
    that is at least 125% of the current rating of the product. In Europe, the cordage
    must have the <HAR> mark.

2. The AC plug must be terminated in a grounding-type male plug designed for use
    in your country. It must also have marks showing certification by an agency
    acceptable in the country.

3. The connector at the product end must be an IEC type CEE-22 female connector.

4. The cord must be no longer than 14.5 feet (4.5 meters).

_____**NOTE** _____

The power cord should be a minimum of 18/3 AWG, 60°C, Type SJT
or SVT.

_____

Figure A-1 shows the different AC power cord plug configurations for 115V and 220V/240V usage.
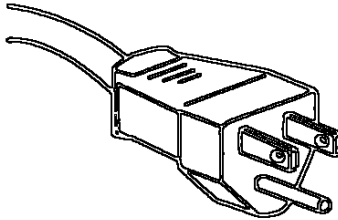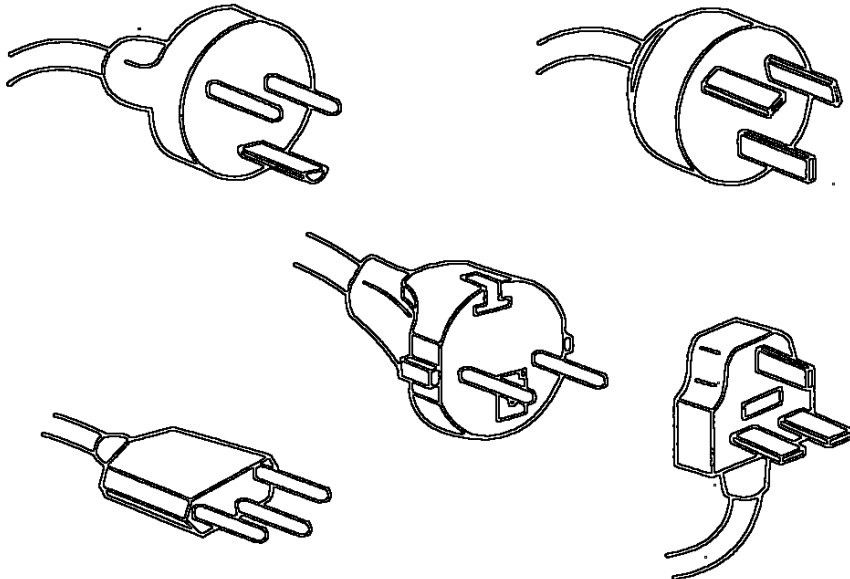
Figure A-1 *Power Cords*

A.5 DLT4000 Tape Drive Mounting Hole Descriptions

Figure A-2 shows the mounting holes and dimensions in a top view of the DLT4000 drive.
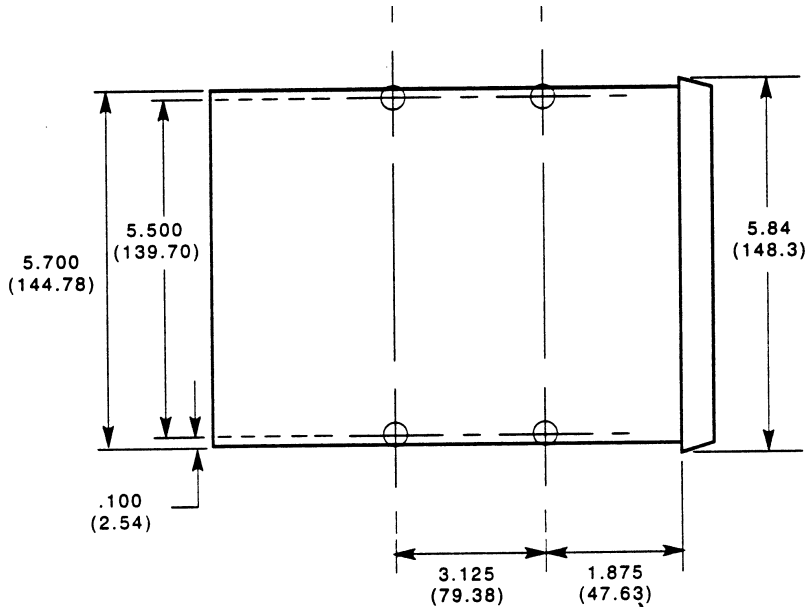
Figure A-2 *Mounting Hole Dimensions (Top View)*

Tape drive width and height are standard 5-1/4 inch disk drive form factor measurements. Both dimensions hold tolerances of ± 0.020 inches. Depth dimensions have tolerances of +00, -0.040 in.

Figure A-3 shows the mounting holes and dimensions in a side view of the DLT4000 drive.

```
                    9.600
                  (243.84)

                    9.000
                  (228.60)

                         .25
8X 6-32UNC-2B   (6.4) FULL THREAD

3.250                                        3.40
(82.55)                                      (86.4)

.820
(20.83)

              3.125      1.875
             (79.38)    (47.63)
```
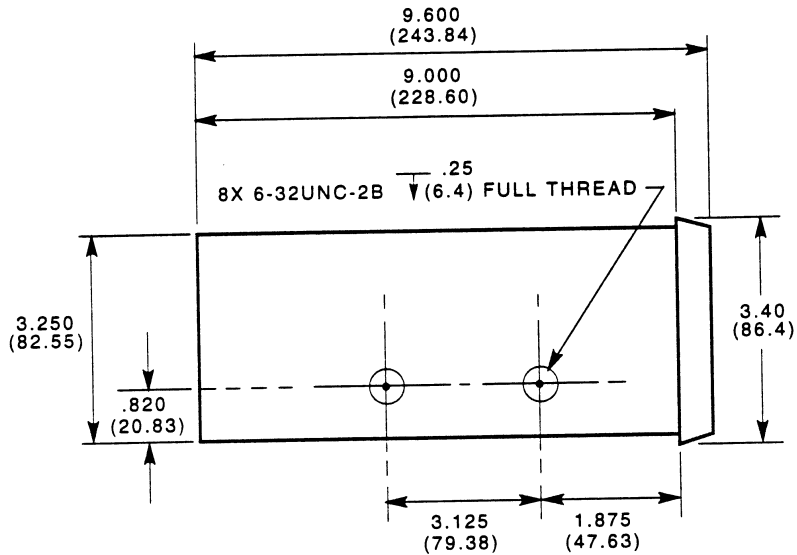
Figure A-3 *Mounting Hole Dimensions (Side View)*

A.6 Performance Specifications

Section A.6 describes performance specifications including:

Topic	Section
Nominal Tape Tension	A.6.1
DLT4000 Media Loader Timing Characteristics	A.6.2
DLT4500 Media Loader Timing Characteristics	A.6.3
DLT4700 Media Loader Timing Characteristics	A.6.4

A.6.1 Nominal Tape Tension

Nominal tape tension is:

3.0 ± 1 oz when stationary

4.7 ± 1 oz at operating speed

A.6.2 DLT4000 Timing Characteristics

Table A-5 lists timing characteristics of the DLT4000 tape drive:

Table A-5 *DLT4000 Timing Characteristics*

Read/Write Tape Speed	98 in/sec
Rewind Tape Speed	150 in/sec search
Linear Search Tape Speed	150 in/sec search
Average rewind time	70 sec
Maximum rewind time	140 sec
Average access time (from BOT)	45 sec
Maximum access time (from BOT)	90 sec
Load to BOT—previously written	48 sec; if using a blank tape, time is slightly longer.
Unload from BOT	17 sec

A.6.3 DLT4500 Media Loader Timing Characteristics

Table A-6 lists timing characteristics of the DLT4500 media loader.

Table A-6 *DLT4500 Media Loader Timing Characteristics*

Nominal magazine scan	12 sec
Move cartridge slot to drive	27 sec
Move cartridge drive to slot	12 sec
Error recovery	51 sec
Load media on to drive & ready for I/O processing	48.0 sec
Unload media from drive to cartridge (from BOT)	17.0 sec

A.6.4 DLT4700 Media Loader Timing Characteristics

Table A-7 lists timing characteristics of the DLT4700 media loader.

Table A-7 *DLT4700 Media Loader Timing Characteristics*

Nominal magazine scan	12 sec
Move cartridge slot to drive	27 sec
Move cartridge drive to slot	25 sec
Error recovery	30 sec
Load media on to drive & ready for I/O processing	48.0 sec
Unload media from drive to cartridge (from BOT)	17.0 sec

A.7 Environmental Specifications

Section A.7 describes environmental specifications including:

Topic	Section
Temperature and Humidity	A.7.1
Altitude	A.7.2

The tape drive conforms to an environment that includes general offices and workspaces with:

- Conditioned and marginally-conditioned areas with central or remote air-conditioning
- Complete temperature and humidity controls
- Moderate control tolerances
- Systems capable of maintaining comfort levels (for example, typical offices and general work areas)
- Marginal heating or cooling apparatus
- No humidity conditioning
- Uncontrolled tolerances
- Systems inadequate to maintain constant comfort levels (for example, marginal offices and work spaces)

A.7.1 Temperature and Humidity

Table A-8 lists the operating temperature and humidity ranges.

Table A-8 *Operating Ranges*

Dry Bulb Temperature Range	10 to 40°C
Wet Bulb Temperature	25°C
Temperature Gradient	11°C/h (across the range)
Temperature Shock	10°C (over two minutes)
Relative Humidity	20 to 80% noncondensing
Humidity Gradient	10%/h

Table A-9 lists the power-on ranges.

Table A-9 *Power-on Ranges—No Tape Loaded (Unpacked - 24 hours)*

Dry Bulb Temperature Range	10 to 40°C
Wet Bulb Temperature	25°C
Temperature gradient	15°C/h (across the range)
Temperature shock	15°C (over two minutes)
Relative humidity	10 to 90%
Humidity gradient	10%/h

Table A-10 lists the storage ranges.

Table A-10 *Storage Ranges (Unpacked or Packed)*

Dry Bulb Temperature Range	-40 to 66°C
Wet Bulb Temperature	46°C
Temperature gradient	20°C/h with 5° margin (across the range)
Temperature shock	15°C with 5° margin (over two minutes)
Relative humidity	10 to 95% noncondensing
Humidity gradient	10%/h

Table A-11 lists the shipment ranges:

Table A-11 *Shipment Ranges*

Dry Bulb Temperature Range	-40 to 66°C
Wet Bulb Temperature	46°C
Temperature gradient	25°C/h with 5° margin (across the range)
Temperature shock	15°C with 5° margin (over two minutes)
Relative humidity	10 to 95% noncondensing
Humidity gradient	10%/h

A.7.2 Altitude

The tape drive operates in normal pressures from -500 to 30,000 feet.

A.8 Vibration and Shock Specifications

Section A.8 describes environmental specifications:

Topic	Section
Operating Vibration and Shock	A.8.1
Nonoperating Vibration and Shock	A.8.2

A.8.1 Operating Vibration and Shock

Table A-12 lists operating vibration specifications and Table A-13 and Table A-14 lists operating shock specifications.

Table A-12 *Operating Vibration Specifications*

Vibration type	Sine	Sweep
Frequency range	5–500–5 Hz	Upward and downward sweep
Acceleration level	0.25 G	Between 22 and 500 Hz
	0.010" DA	Between 5 and 22 Hz (crossover)
Application	X, Y, and Z axes	Sweep rate; 1 octave per minute
Overstress		
Vibration type	Sine	Sweep
Frequency range	1–500–10 Hz	Upward and downward sweep
Acceleration level	0.50 G	Between 26.1 and 500 Hz
	0.010" DA	Between 5 and 26.1 Hz (crossover)
Application	Vertical axis (top/bottom)	Sweep rate; 1 octave per minute

Table A-13 *Operating Shock Specifications, All Products*

Pulse shape	1/2 sine pulse
Peak acceleration	10 G
Duration	10 ms
Application	X, Y, and Z axes, once in each axis

Table A-14 *Operating Shock Specifications, Table Top and Drive*

Pulse shape	1/2 sine pulse
Peak acceleration	5 G
Duration	11 ms
Application	10 G each direction of each axis, 35 sec between shocks, 60 shocks total

A.8.2 Nonoperating Shock and Vibration

Table A-15 lists Nonoperating shock (bench handling) specifications for the tabletop product without its shipping packaging.

Table A-15 *Nonoperating Shock "Overstress" (Bench Handling - Unpackaged) Specifications*

Test Type	Bench handling; pivot drop
Description	Pivot edge to a height of 4 in above table and release
Application	Four shocks total; once each edge

Tables A-16, A-17, A-18 A-19, A-20, and A-21 list Nonoperating vibration and Nonoperating shock specifications for the product in its shipping packaging.

Table A-16 *Nonoperating (Packaged) Vibration Specifications*

Vibration type	Random vibration	
Frequency range	5 to 300 Hz, vertical (z); 5 to 200 Hz horizontal (x and y)	
Vibration levels	1.19 GRMS overall in vertical (z) axis	
	0.698 GRMS overall in horizontal (x and y) axes	
PSD envelope (vertical)	5 to 10 Hz	0.003 G^2/Hz @ 5, to 0.020 @ 10
	10 to 50 Hz	Flat @ 0.020 G^2/Hz
	50 to 300 Hz	0.020 G^2/Hz @ 50 w/ 8 db/oct rolloff
PSD envelope (horizontal)	5 to 10 Hz	0.0011 G^2/Hz @ 5, to 0.007 @ 10
	10 to 50 Hz	Flat @ 0.007 G^2/Hz
	50 to 200 Hz	0.007 G^2/Hz @ 50 w/ 8 db/oct rolloff
Application	X, Y, and Z axes	One hour, each axis (3 hours total)

Table A-17 *Nonoperating (Packaged) Repetitive Shock Specifications*

Excitation type	Synchronous vertical motion; 1 inch excursion
Shock (bounce) cycles	14,200 total
Application	Half cycles each in x and y orientations; 7100 cycles in the x orientation, 7100 cycles in the y orientation

Table A-18 *Nonoperating (Packaged) Shock (Drop) Specifications* All Products

Test type	Drop shock
Drop height	30 in - items < 20.9 lbs
	24 in - 21 < items < 40.9 lbs
	18 in - 41 < items < 60.9 lbs
	12 in - 61 < items < 100 lbs
Application	10 drops total; 1 each side, 3 edges, 1 corner

Table A-19 *Nonoperating (Packaged) Shock (Drop) Specifications, Table Top and Drive*

Test type	Drop shock
Drop height	42 in - items < 20.0 lbs
	36 in - 20.0 < items < 40.0 lbs
Application	16 drops total

Table A-20 Nonoperating (Unpackaged) Vibration Specifications

Vibration type	Sine	Sweep
Frequency range	1$-$500–10 Hz	Upward and downward sweep
Acceleration level	1 G	10-500-10 Hz
Application	X, Y, and Z axes	Sweep rate; 1/2 octave per minute
Vibration type	Random	Sweep
Frequency range	5$-$500 Hz	Upward and downward sweep
Acceleration level	2 G	
PSD envelope		0.008 G^2/Hz.
Application	X, Y, and Z axes	Sweep rate: 60 min/axis

Table A-21 *Nonoperating (Unpackaged) Shock Specifications*
Nonoperating (Unpackaged)

Pulse shape	Square wave
Peak acceleration	40 G, 180 in/sec velocity changing
Duration	10 ms
Application	X, Y, and Z axes, twice in each axis, total of 6 shocks
Pulse shape	1/2 sine pulse
Peak acceleration	140 G
Duration	2 ms
Application	X, Y, and Z axes, twice in each axis, total of 6 shocks

A.9 Electromagnetic Interference (EMI) Susceptibility

Section A.9 describes environmental specifications including:

Topic	Section
Electromagnetic Emissions	A.9.1
Conducted Emissions	A.9.2
Radiated Emissions	A.9.3
Magnetic Radiated Susceptibility	A.9.4
Radiated Susceptibility	A.9.5
Conducted Susceptibility	A.9.6
ESD Failure Level Limits	A.9.7
Acoustic Noise Emissions	A.9.8

A.9.1 Electromagnetic Emissions

Electromagnetic emissions include:

- CSA 108.8

- EEC Directive 89/336

EN55022 and National standards are based on:

- BS6527   (UK)

- NEN55022   (Netherlands)

- VDE 0871 Class B   (Germany)

- CE Mark

- Cispr22 Class B:

    ♦ FCC Rules Part 15B

    ♦ Class B certified

A.9.2 Conducted Emissions

Limits for Class B equipment are in the frequency range from 0.15 to 30 MHz. The limit decreases linearly with the logarithm of the frequency in the range from 0.15 to 0.50 MHz.

Table A-22 list the conducted emission limits.

Table A-22 *Conducted Emissions*

Frequency Range (MHz)	Limits dB	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46
0.50 to 5	56	46
5 to 30	60	50

*The limit decreases with the logarithm of the frequency.

A.9.3 Radiated Emissions

Limits of radiated interference field strength, in the frequency range from 30 MHz to 30 GHz at a test distance of 3 and 10 meters, for Class B equipment are:

Table A-23 *Radiated Emissions, 30 MHz to 30 GHz*

Frequency range (MHz)	Quasi-peak limit dB (μV/m)	
	@ 10 m	@ 3 m
30 to 230	30	40
230 to 1000	37	46
Above 1000	N/A	54

A.9.4 Magnetic Radiated Susceptibility

Table A-24 lists the magnetic radiated susceptibility limits.

Table A-24 *Low Frequency, Magnetic Fields, 10 to 3000 KHz*

100 dB (pt) @ 10 KHz declining to 80 dB (pt) @ 1 MHz	No errors, no screen distortion

A.9.5 Radiated Susceptibility

Table A-25 lists the radiated susceptibility limits:

Table A-25 *High Frequency, Electric Fields, 1 to 1000 MHz*

3 V/m (rms) 80% modulated 1 KHz	No errors, no screen distortion
	S/W recoverable errors
	No hardware failure

A.9.6 Conducted Susceptibility

The transient voltage is the actual peak voltage above the normal ac voltage from the power source.

Table A-26 lists the voltage limits for power and data cables:

Table A-26 *Fast Transient (Bursts) for Power and Data Cables*

2 kV	S/W recoverable errors
	No hardware failures

Table A-27 lists power cable voltage limits:

Table A-27 *High Energy Transient Voltage for Power Cables*

1.2 kV	No errors
2.5 kV	S/W recoverable errors
	No hardware failure

_____ **NOTE** _____

Maximum energy in a single pulse from the transient generator must be limited to 2.5 W.

_____

Table A-28 lists the low-level conducted interference voltage limits:

Table A-28 *Low-level Conducted Interference*

3 V(rms) 80% modulated 1 KHz	No errors
	S/W recoverable errors
	No hardware failure

A.9.7 ESD Failure Level Limits

Table A-29 lists the ESD failure level limits for normal operator access areas.

Table A-29 *ESD Failure Level Limits*

Failure Type	Equipment	Failure Level	Allowable Errors
Hard	Office	1 to 12 kV	No operator intervention (soft recoverable allowed)
Hardware	Office	Up to 15 kV	No component damage - operator intervention allowed (soft/hard errors allowed)

A.9.8 Acoustic Noise Emissions

The following lists the acoustic noise emission levels:

Table A-30 *Acoustic Noise Emissions, Nominal*

Noise Power Emission Level (LNPEc)				
Mode	DLT4000 Drive	DLT4000 Tabletop	DLT4500 Loader	DLT4700 Loader
Idle	N/A	4.6 bels	4.3 bels	5.1 bels
Streaming	N/A	5.1 bels	4.9 bels	5.2 bels

Sound Pressure Level (LPAc)				
Mode	DLT4000 Drive	DLT4000 Tabletop	DLT4500 Loader	DLT4700 Loader
Idle	N/A	30.0 dB	36.0 dB	34.0 dB
Streaming	N/A	41.0 dB	40.0 dB	35.0 dB

Table A-30 *Acoustic Noise Declaration for German Noise Declaration Law* *(*Cont'd)

Schallemissionswerte - Werteangaben nach ISO 9296 und ISO 7779/DIN EN27779:				
	Schalleistungspegel LwAd, B		Schalldruckpegel LpAm, dBA (Zuschauerpositionen)	
Gerät	Leerlauf	Betrieb	Leerlauf	Betrieb
TH5xx		5,5		45
TH5Bx	5,2	5,3	39	40
TH5Ex	5,5	5,6	33	33
TH5Fx	5,5	5,6	33	33
TH5Hx	4,8	5,3	35	40

Table A-30 *Acoustic Noise Declaration for German Noise Declaration Law* Cont'd

Generic Product Option Numbers	Description
TH5xx	DLT4000 drive
TH5Bx	DLT4000 table top drive
TH5Ex	DLT4700 cartridge rackmount loader
TH5Fx	DLT4700 cartridge table top loader
TH5Hx	DLT4500 cartridge table top loader

A.10 Regulatory Requirements

Regulatory requirements include:

- Safety

- Electromagnetic emissions

A.10.1 Safety Requirements

Safety requirements include:

- UL1950 - Information Technology Including Electrical Business Equipment

- CSA C22.2 #220 - Information Technology Including Electrical Business Equipment

- TUV EN60950/IEC 950 - Information Technology Including Electrical Business Equipment

A.10.2 Electromagnetic Emission Requirements

Electromagnetic emission requirements include:

- FCC, Part 15, Class A, Class B

- EN55022/B

- EN55082/B

- CISPR22/ Class A and B

- VCCi/ Class 1 and 2

- CEmark Class A and B

A.11 Drive Reliability Factors

Table A-31 lists the reliability factors:

Table A-31 *Reliability Factors*

Design life	Seven years	Design life statistics provide the point at which statistical failure rate begins to rise.
Head life	10,000 tape motion hours	Continuous operation.
MTBF	80,000 hours	Quantum Corporation does not warrant that predicted MTBF is representative of any particular unit installed for customer use. Actual figures vary from unit to unit. (The MTBF figure is measured at 100% duty cycle, excluding the head life.)
Tape life	500,000 passes	

A.12 DLTtape Recording Media Specifications

Table A-32 lists the media characteristics:

Table A-32 *DLTtape Recording Media Specifications*

DLTtape III	
Description	**Quantity**
Width	0.5 in metal particle
Length	1200 ft
Cartridge Dimensions	4.1 in x 4.1 in x 1.0 in
Shelf Life	30 years min. @ 20°C & 40% RH (non-condensing)
Usage	500,000 passes

DLTtape IIIxt Media	
Description	**Quantity**
Width	0.5 in metal particle
Length	1800 ft
Cartridge Dimensions	4.1 in x 4.1 in x 1.0 in
Shelf Life	30 years min. @ 20°C & 40% RH (non-condensing)
Usage	500,000 passes

DLTtape IV	
Description	**Quantity**
Width	0.5 in metal particle
Length	1800 ft
Cartridge Dimensions	4.1 in x 4.1 in x 1.0 in
Shelf Life	30 years min. @ 20°C & 40% RH (non-condensing)
Usage	500,000 passes

Appendix B

Definition of Vendor Unique Sense Data Information

B.1 In This Appendix

Appendix B lists the internal status codes with their descriptions.

B.2 Internal Status Code

The internal status code is located at byte offset 18 of the request sense data and may be available after certain types of failures.

_____ **NOTE** _____

This byte has two formats: a byte code, and a bit flags format. The bit flags format is used when there is no internal status code to report, and can be distinguished by bit 7 being set.

_____

Table B-1 *Internal Status Code*

Dec	Hex	Description
0	0	No meaning
1	1	Reed-Solomon Error Correction Code recovery
2	2	Read or write block retry (soft retry)
3	3	Reposition command aborted
4	4	Controller has stopped reading
5	5	No control or data buffers available
6	6	Target delivered in read ahead
7	7	Logical EOT encountered, 2 file marks
8	8	Command connection dropped

Table B-1 *Internal Status Code (cont'd)*

Dec	Hex	Description
9	9	Cleared from queue
10	0A	Missing data block—read only
11	0B	Gap within object (missing blocks in record)
12	0C	Record on tape larger than requested
13	0D	Compare error
14	0E	Successive blocks missing across objects
15	0F	Drive state not valid for command
16	10	Drive error
17	11	Drive communication timeout error
18	12	Drive unloaded
19	13	Unable to write - no CRC
20	14	Block to append to not found
21	15	Data synchronization error (read after write not happening)
22	16	Missing block(s) in current entity
23	17	Drive hardware write protected
24	18	Reposition-target not found
25	19	Long gap encountered (blank tape or no data encountered)
26	1A	End of data or filler block encountered
27	1B	File mark encountered
28	1C	EDC error found by GPSP3 - FECC RAM bad
29	1D	Beginning of medium encountered
30	1E	EDC error
31	1F	Hard write error - GPSP3 Underrun
32	20	Hard write error - Read Sync Timeout
33	21	Hard write error - Overshoot Append
34	22	Hard write error - CRC error
35	23	EDC error found by GPSP3 - FECC RAM ok
36	24	Timeout on command to medium changer
37	25	Medium changer UART error (overrun)
38	26	Medium changer response length error
39	27	Medium changer detected error

Table B-1 *Internal Status Code (cont'd)*

Dec	Hex	Description
40	28	Invalid source slot
41	29	Invalid destination slot
42	2A	Source slot empty
43	2B	Destination slot full
44	2C	Medium changer motion error
45	2D	Medium changer/drive interface error
46	2E	Medium changer/slot interface error
47	2F	Medium changer mechanical error
48	30	Medium changer hardware error
49	31	Medium changer controller error
50	32	Unrecognized medium changer subcommand
51	33	Medium changer fatal error
52	34	Medium changer is in manual mode
53	35	68020 detected communication error w/ Servo area
54	36	68020 detected drive command timeout
55	37	Calibration failure
56	38	Bad tape format

Table B-2 *Internal Status Bit* Flags

Bit No.	Description
0	If set, cleaning light is on, otherwise it is off
1-2	Tape directory status: • 0 Good status • 1 Unknown status • 2 Directory partially bad • 3 Directory bad
3-6	Reserved
7	If set, the internal status byte (18) is in Bit Flags format; otherwise, it is a code.

Appendix C

Sense Key Information

C.1 In This Appendix

Appendix C lists the sense key information.

- No Sense (0):

    00 01 Unexpected FM encountered

    00 02 EOM encountered

    00 04 BOM encountered

- Recovered Error (1):

    0A 00 Error Log Overflow

    37 00 Rounded Parameter

    3B 08 Repositioning error

    44 C1 Internal Target failure, EEROM copy 1 area bad

    44 C2 Internal Target failure, EEROM copy 2 area bad

    44 C3 Internal Target failure, EEROM both copy areas bad

    47 00 SCSI Parity Error

    48 00 IDE Message Received

    51 00 Erase failure

    53 01 Unload tape failure

    5B 02 Log Counter at Maximum

    80 02 Cleaning Requested

- Not Ready (2):

    04 00 Unit Not Ready, Cause nonreportable

    04 01 Unit Not Ready, Calibration in process

---

04 02 Unit Not Ready, Load command needed

04 03 Unit Not Ready, Manual Intervention needed

3A 00 Medium Not Present

3A 80 Medium Not Present, Cartridge Missing

5A 01 Operator Media Removal Request

- Medium Error (3):

  04 02 Unit Not Ready, Load command needed

  0C 00 Write Error

  11 00 Unrecovered Read Error

  11 08 Unrecovered Read Error, Incomplete block read

  14 00 Recorded Entity Not Found

  15 02 Position error detected by read of medium

  30 00 Can't Read Medium

  3B 00 Sequential positioning error

  3B 08 Repositioning error

  51 00 Erase Failure

  80 00 Calibration Error

  80 01 Cleaning Required

  81 00 Directory Read Error

- Hardware Error (4):

  08 00 LUN Communication Failure

  08 01 LUN Communication Timeout Failure

  15 01 Random Mechanical Positioning Error

  21 01 Invalid Element Address

  3B 08 Repositioning error

  3B 0D Media Destination Element Full

  3B 0E Media Source Element Empty

  40 80 Diagnostic/POST failure, ROM EDC failure

  40 81 Diagnostic/POST failure, RAM failure

40 82 Diagnostic/POST failure, bad drive status

40 83 Diagnostic/POST failure, loader diags failure

40 84 Diagnostic/POST failure, POST soft failure

44 00 Internal Target Failure

44 80 Unexpected selection interrupt

44 83 SCSI chip gross error

44 84 Unexplained residue in TC registers

44 85 Immediate data transfer timeout

44 86 Insufficient CDB bytes

44 87 Disconnect/SDP sequence failed

44 88 Bus DMA transfer timeout

48 00 IDE Message received

47 00 SCSI Parity Error

51 00 Erase Failure

53 00 Media Load/Eject Failure

53 01 Unload tape failure

- Illegal Request (5):

1A 00 Parameter List Length Error

20 00 Illegal Opcode

21 01 Invalid Element Address

24 00 Invalid CDB Field

24 81 Invalid mode on write buffer

24 82 Media in drive

24 84 Insufficient resources

24 86 Invalid offset

24 87 Invalid size

24 89 Image data over limit

24 8B Image/personality is bad

24 8C Not immediate command

24 8D Bad drive/server image EDC

24 8E Invalid personality for code update

24 8F Bad controller image EDC

25 00 Illegal LUN

26 00 Parameter List Error, invalid field

26 01 Parameter List Error, parameter not supported

26 02 Parameter List Error, parameter value invalid

39 00 Saving parameters not supported

3B 0D Media Destination Element Full

3B 0E Media Source Element Empty

3D 00 Invalid Bits in ID Message

53 02 Media Removal Prevented

82 00 Not allowed if not at BOT

- Unit Attention (6):

  28 00 Not Ready To Ready Transition

  29 00 Reset occurred

  2A 01 Mode Parameters changed

  2A 02 Log Parameters changed

  3F 01 Microcode has been changed

  5B 01 Log Threshold condition met

- Data Protected (7):

  27 80 Hardware Write Protect

  27 82 Data Safety Write Protect

- Blank Check (8):

  00 05 EOD Encountered

- Command Aborted (Bh):

  43 00 Message error

  44 82 Command Complete sequence failure

  45 00 Select/Reselect Failure

47 00 SCSI parity error

48 00 IDE Message received

49 00 Invalid Message Error

4E 00 Overlapped commands attempted

- Volume Overflow (Dh):

  no additional sense code

- Miscompare (Eh):

  no additional sense code

_____ **NOTE** _____

The Filemark/EOM/ILI bits may be set even though
ASC/ASCQ = 00 00:

_____

(1) FM, EOM, ILI bit may be set with no sense key (0) and ASC/ASCQ = 00 00

(2) FM, EOM, ILI bit may be set with recovered error (1) and ASC/ASCQ = 00 00

(3) FM, EOM, ILI bit may be set with medium error (3) and ASC/ASCQ = 00 00

(4) EOM bit is set at Volume Overflow (Dh) and ASC/ASCQ = 00 00

(5) FM (byte 2, bit 7), EOM (byte 2, bit 6), and ILI (byte 2, bit 5) are fields in request
data. (See figure on REQUEST SENSE Data.)

Appendix D

EEROM Resident Bugcheck and Event Logs

D.1 EEROM Packets (Last n Error Events)

The DLT4000 products keep certain error and event logs in semi-permanent non-volatile memory (EEROM) on the ECM. There is room for a total of 14 such information packets in EEROM, each consisting of 98 bytes (96 data bytes plus 2 control bytes) of information. Packets can be written for many different reasons, and several packet types exist, but each must conform to the standard EEROM LOG packet envelope as shown in Figure D-1.

The information logs are maintained as a circular buffer; a new entry will overwrite the oldest existing entry. At any point in time, the most recent 14 logs are kept.

The EEROM information packets can be retrieved by Log Sense command with page code 07h ((Last n Error Events page).

The packet type field defines the content as well as the format of the data portion of the packet (refer to Table D-1). These packet types are further delineated in the sections that follow. Please note that the byte offsets in the structure layout diagrams that follow are referenced relative to the beginning of the 98 byte EEROM Log envelope.
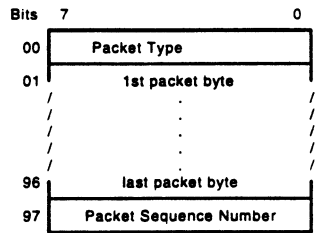
Figure D-1 *EEROM Log Area Layout*

Table D-1 *EEROM LOG Packet Types*

Packet Type	Purpose
0	Packet Empty
1	Bugcheck - Fatal System Crash
2	PO/ST (power on/self test) Failure
3	EVENT LOG - Generic event informational (non-fatal) data
4	CUP - Code Update Status Packet
5	Manufacturing DIAG results packet

D.2 Bugcheck Packets

Bugchecks occur because of some kind of software detected fatal failure. For example, a hardware failure, or an internal system consistancy failure might cause a bugcheck. These events cause Bugcheck packets to be written into EEROM. Refer to Figure D-2 for the detailed packet layout. The most important information is the error code. The more common ones are listed in Table D-2. A full listing is not given here because most are not meaningful without a detailed knowledge of the firmware design. Analysis of the other informtion saved in an EEROM Bugcheck log entry also requires in-dpth internal firmware knowledge to interpret and attempt to determine if the cause was external (e.g. a bad SCSI bus cable, improper termination, etc.), an ECM or drive fault, or a firmware bug.

```
Bits  7                        0
01 ┌─────────────────┐   49 ┌──────────────────────┐
02 │    Up-Time      │      │  68020 A0–A7 Registers │
03 │    Stamp        │      /         .            /
04 │                 │      /         .            /
   ├─────────────────┤   83 /         .            /
05 │                 │   80 ├──────────────────────┤
06 │   POH/PC Time   │   81 │                      │
07 │   Stamp         │   82 │   System Context     │
08 │                 │   83 │                      │
   ├─────────────────┤   84 ├──────────────────────┤
09 │   Error Code    │   85 │                      │
10 │                 │   86 │  ISR Return Address  │
   ├─────────────────┤   87 │                      │
11 │ 68020 Status Register │ 88 ├──────────────────────┤
12 │                 │   89 │                      │
   ├─────────────────┤   90 │  68020 MSP Register  │
13 │                 │   91 │                      │
14 │ 68020 PC Register │  92 ├──────────────────────┤
15 │                 │   93 │   SW Major Revision  │
16 │                 │      ├──────────────────────┤
   ├─────────────────┤   94 │   SW Minor Revision  │
17 │ 68020 D0–D7 Registers │ ├──────────────────────┤
   /         .       /   95 │   Day Count          │
   /         .       /   96 │                      │
48 └─────────────────┘      └──────────────────────┘
```
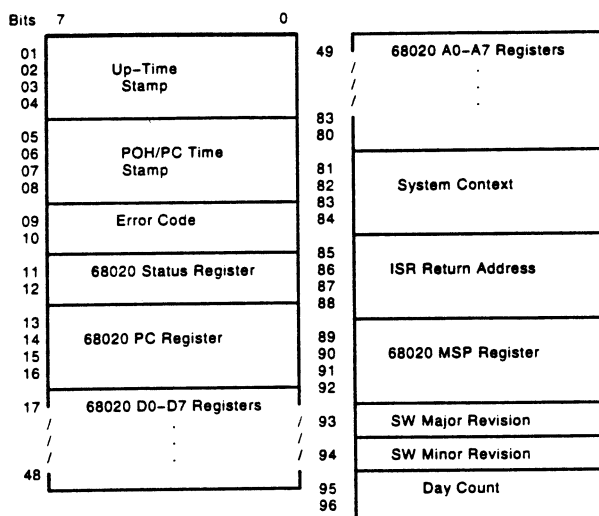
Figure D-2 *Bugcheck LOG Packet Layout*

Table D-2 *Bugcheck Error Codes*

Bugcheck Code	Meaning and Possible Cause
E204	Unexpected Timer2 Interrupt- possible ECM fault
EE01	Spurious Non-Maskable Interrupt- possible ECM fault
EE02	Spurious 8254 Timer Interrupt- possible ECM fault
EE03	Spurious Level 5 interrupt (GPSP)- possible ECM fault
EE04	Spurious Drive Comm Interrupt- possible ECM fault
EE05	Spurious Loader Comm Interrupt- possible ECM fault
EE06	Spurious Diag Comm Interrupt- possible ECM fault
EE08	Watch Dog Expiration- SCSI bus may have lost termination, or ECM is constantly receiving non-tape commands.
EE09	Spurious Power Fail Signal received- possible power supply fault
EE0D	Spurious Level 6 interrupt (GPSP)- possible ECM fault
F202	Loader time out-possible media loader fault

D.3 PO/ST failure packets

PO/ST failure packets are stored whenever the Power-On /Self-Test logic detects a failure of any kind. Each failure is encoded as a 4-byte vector. In some cases, multiple vectors may be stored, as shown in Figure D-3.

Bits 7   0

```
01
02   POH/PC Time Stamp
03
04

05
06   POST Last Fail Vector
07
08

09
10   Secondary POST Vector
11
12

13
14   Tertiary POST Vector
15
16

17        reserved
              .
              .
              .
96
```
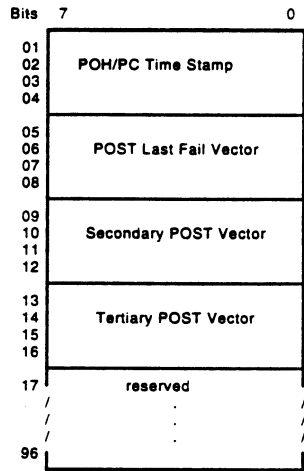
Figure D-3 *POST LOG Packet Layout*

D.4 Event Log packets

Event logs are non fatal and can occur to log error or informative information regarding significant events. The general envelope for these packets is shown in Figure D-4. Refer to Table D-3 for a list of the existing error codes, as well as where to refer for additional information.
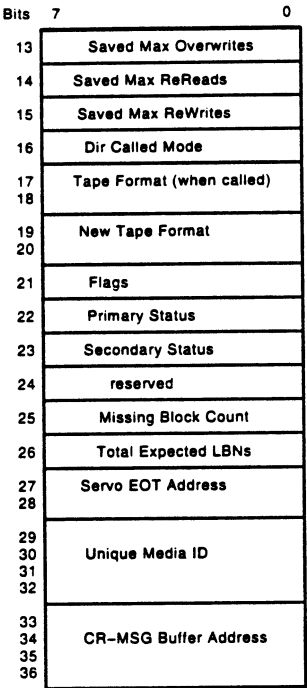
Figure D-4 *EVENT LOG Packet Layout*

Table D-3 *Event Log Codes*

Event Log Code	Meaning
0xA400	Hard Read Error Log
0xA401	Hard Write Error Log
0xA402	Drive Error Log
0xA403	Loader Error Log
0xA407	Directory Read Fail
0xA408	Directory Write Fail

D.4.1 Directory Failure Event Logs

These event logs are written when a directory read or write

request fails for any reason. Refer to Figure D-5 and the sections that follow.

Bits	7	0
13	Saved Max Overwrites	
14	Saved Max ReReads	
15	Saved Max ReWrites	
16	Dir Called Mode	
17 18	Tape Format (when called)	
19 20	New Tape Format	
21	Flags	
22	Primary Status	
23	Secondary Status	
24	reserved	
25	Missing Block Count	
26	Total Expected LBNs	
27 28	Servo EOT Address	
29 30 31 32	Unique Media ID	
33 34 35 36	CR–MSG Buffer Address	
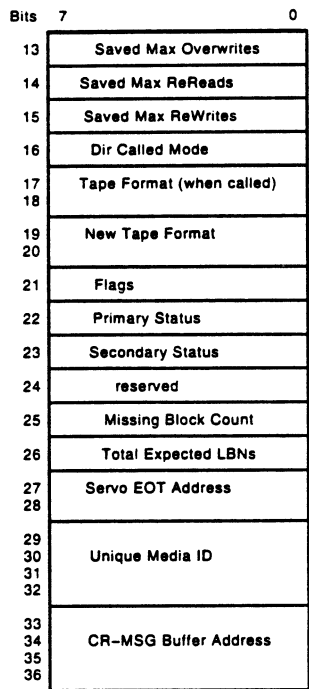
Figure D-5 *Directory Failure Event Logs*

Saved Overwrites/ReReads/ReWrites

These are fields are used as temporaries and have no use in interpreting these packets.

Dir Called Mode

A code which specifies the original reason for the directory call. A value of 1 indicates a directory READ (on load); a value of 2 indicates a directory WRITE (on UNLOAD); a value of 3 indicates a directory WRITE (on WRITE from BOT).

Tape Format (Called/New)

These fields contain the TMSCP values for the tape format both prior to and after the directory operation.

Flags

A bit mapped field which provides additional status information. Refer to Table D-4.

Table D-4 *SET DIR_TAB "Directory Event Log Flags*

Bit Mask	Meaning
0x01	READ on Load operation complete
0x02	Inhibit further WRITEs unless WRITE from BOT
0x04	LBN 0 was found intact
0x08	Directory WRITE failed
0x10	Tape FORMAT Mismatch
0x20	Event Log Generated
0x40	Tape Format Unknown
0x80	Reserved

D.5 Primary Status/Secondary Status

Table D-5 *Directory Event Status*

Primary	Secondary	Meaning
0	0	Status Unknown
1	1	No Directory - 50/70 Format
1	10	Inconsistent Formats
1	11	Wrong Format
1	12	Reserved Field Validation Failed
1	20	Read Sync Time Out
1	21	No directory Blocks Read
1	22	Not all Directory Blocks Present
1	30	SyncLock Failure
1	31	Revision Level Mismatch
1	32	Directory Verify Failed
1	33	Directory Initialized (WRITE from BOT)
1	40	Empty Directory
2	41	Partial Directory
3	42	Complete_Directory

Missing Block Count

The number of missing directory LBNs.

Expected LBNs

The total number of directory LBNs expected.

Servo EOT Address

Servo version of tape length.

Unique Media ID

The Unique Media Identification number, stored on the media.

CR_MSG Address

The address of the CR-MSG request block from TDS.

D.6 Code Update (CUP) Status Packet

The CUP status packet is written after every code update attempt regardless of its status. Refer to Figure D-6 for the overall packet layout.

The "Old 68020" and "Old Servo" Sections contain informa- tion about the code images that exist in the Flash memories for those areas before the update is performed. The "New 68020" and "New Servo" sections contain information about the new images. The fields within these sections are self explanatory. Refer to Table D-6 and Table D-7 for a description of the statuses.
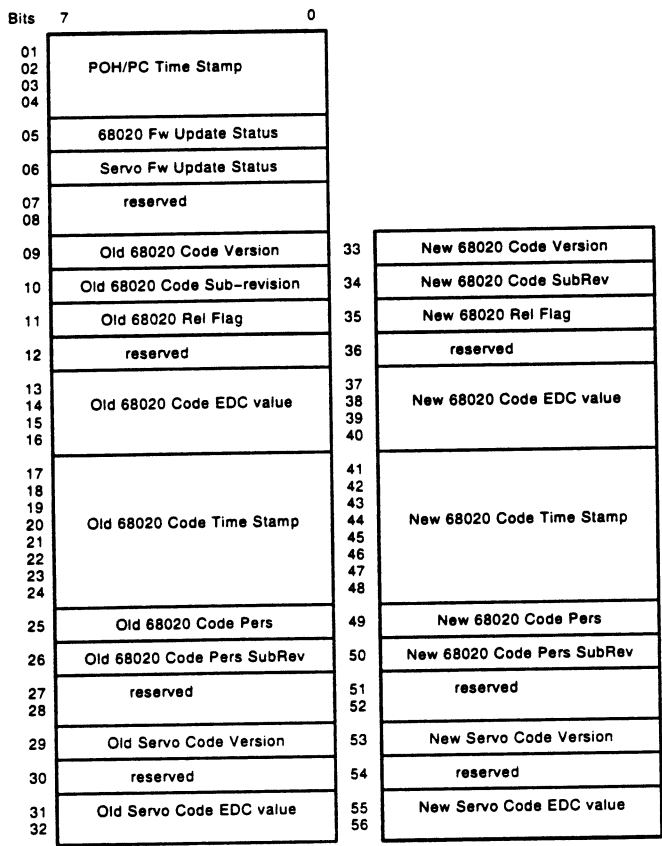
Figure D-6 *Code Update (CUP) LOG Packet Layout*

Table D-6 *68020 Code Update Status*

Status	Meaning
0	No Update Operation Performed
1	Code Update Operation Successful
50	Personality Lockout
51	Image EDC Check Failed
52	Bad Image
53	Write to FLASH Memory Failed
54	Erase of FLASH Memory Failed
55	FLASH Memory Clear (zero) Failed
56	Invalid Image Compressed)

Table D-7 *Servo Code Update Status*

Status	Meaning
0	No Update Operation Performed
1	Code Update Operation Successful
2	Servo Update Not Necessary
10	Servo Code Update Inhibited
20	Servo Image Validation Failed
21	Bad Initial Poll
22	Servo Family Mismatch
23	Servo FLASH Erase Failed
24	Erase Time Out
25	Image Transmit Failed
26	Bad Final Poll
27	Invalid Final Code Check
28	BOT Time Out
29	Invalid_Lamp_Status

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E