DLT2000 Cartridge Tape Subsystem/ DLT2700 Mini-Library

DLT2000 Series Magnetic Tape Product Manual

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The following FCC Notice applies to the DLT2000 drive:

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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.

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Attention! Ceci est un produit de Classe A. Dans un environment domestique, ce produit risque de créer des interférences radioélectriques, il appartiendra alors à l'utilisateur de prendre les mesures spécifiques appropriées.

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Preface

To the Reader

This is the first edition of this manual. DIGITAL 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. DIGITAL 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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Attention: OEM Tape Products

Purpose

This manual introduces the DLT2000/DLT2700 Cartridge Tape Subsystem and describes operating procedures and code update.

Manual Structure

Chapter 1, Overview and Features of the DLT2000/DLT2700 Product, gives a product overview and lists the product features of the DLT2000 /DLT2700 tape subsystem.

Chapter 2, Installing and Configuring the DLT2000 Tabletop Drive, describes installing and configuring the DLT2000 tabletop tape drive.

Chapter 3, Configuring and Operating the DLT2000 Tape Drive, includes selecting density, configuration and other operation information for the tape drive, such as front panel indicators and contr ols, 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 DLT2700 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, Troubleshooting Guide for the DLT2700 Mini-Library, gives instructions on how to clear failures and describes the necessary conditions to ensure the loader OCP pushbuttons operate effectively.

Chapter 6, 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 7, DLT2000 SCSI Interface, details the SCSI protocol features of the DLT2000 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 DLT2000/DLT2700 product.

Appendix C, Sense Key Information, lists the sense key information for the DLT2000/DLT2700 product.

Intended Audience

This manual is intended for the subsystem or system integrator and users of the DLT2000 series tape cartridge product.

1

Overview and Features of the DLT2000/DLT2700 Product

1.1 In This Chapter

Chapter 1 includes the following main topics and sections:

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

1.2 Product Overview

The DLT2000/DLT2700 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 DLT2000 drive features a formatted capacity of 20 GB and a sustained user data transfer rate of 2.5 MB/s.

The DLT2000 is a 5-1/4 inch form factor, half-inch tape drive. The design includes a dual-channel read/write head, Digital Lempel-Ziv (DLZ) high-efficiency data compression, and tape mark directory to maximize data throughput and minimize data access time.

The DLT2700 is a tape mini-library that performs automatic tape operations. The DLT2700 includes the tape drive and a 7-cartridge SCSI-2 medium changer device (loader). The mini-library can provide unattended backup of 140 GB in less than 16 hours or up to 72 GB in an 8-hour shift.

The drive and mini-library are available in a rackmountable form factor. An optional tabletop enclosure for the drive or mini-library is available.

The DLT2000 and DLT2700 are available with single-ended or differential driver/receivers.

1.3 Fast Data Transfer Rate

Used for unattended backups or archiving, the DLT2000/DLT2700 allows you to back up a higher data capacity at a higher speed than earlier products. The DLT2000/DLT2700, when operating in noncompressed mode, has a maximum transfer rate of 1.25 MB/s. When operating in compressed mode, the maximum transfer rate is 2.5 MB/s write and 3 MB/s read.

1.4 High Capacity

The amount of data you can store on a tape cartridge can be 10.0 GB native capacity or 20.0 GB compressed, depending on whether you select compression mode. Built-in data compression increases cartridge capacity and drive transfer rate 2 to 2.5 times. You can select compression on the loader or drive front panel or from the host by using the SCSI MODE SELECT command.

1.5 Compaction

The compaction feature of the DLT2000 helps you store data efficiently. A read/write data cache of 2.0 MB allows working space for compaction and makes maximum use of available tape space.

1.6 Strong Media

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

Digital is committed to maintaining compatibility within the DLT family of tape drives. The DLT2000/DLT2700 tape products are the third generation of tape products started with the THZ01 and THZ02 drives.

The DLT2000/DLT2700 complies with the ANSI standard for SCSI-2. The tape media format follows ECMA approved and ANSI proposed standards.

You can select tape density on the loader or drive front panel or from the host by using the SCSI MODE SELECT command. The DLT2000/DLT2700 can write 2.6, 6.0, and 10.0 GB tape formats for 100% interchange compatibility with earlier DLT drives. On a write from BOT, the DLT2000/DLT2700

reformats the cartridge recorded at 2.6, 6.0, or 10.0 GB format to the new specified format.

1.8 Firmware Update Capability

The DLT2000 includes Flash EEPROM technology that allows easy on-site installation of microcode updates from tape.

1.9 Embedded Diagnostics

The DLT2000 has embedded diagnostic software that tells you when head cleaning is required, diagnostic results, and drive operating status. The drive has embedded data logging of errors for failure analysis.

2

Installing and Configuring the DLT2000 Tabletop Drive

2.1 In This Chapter

Chapter 2 includes the following main topics and sections:

Topic	Section
Prepare for the Installation	Section 2.2
Install the Subsystem	Section 2.3
Configure the DLT2000 Tabletop	Section 2.4
Connect the Cables	Section 2.5
Test the Installation	Section 2.6
DLT2000 Troubleshooting Chart	Section 2.7

2.2 Prepare for the Installation

This section describes how to prepare for installing the DLT2000 cartridge tape subsystem including:

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

2.2.1 Before You Start

Installing the DLT2000 tabletop cartridge tape subsystem 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 installation, see Table 2–4, DLT2000 Troubleshooting Chart.

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 DLT2000 tabletop subsystem.
3	Power off the system on which the DLT2000 is to be installed.

2.2.3 Site Setup

Place the DLT2000 on a flat, sturdy, level area such as a desk or tabletop—*not on the floor*.

2.2.4 Site Guidelines

Be sure to follow these guidelines for your DLT2000:

- Avoid a site that is dusty or humid.
- Allow enough space around the DLT2000 for ventilation and for easy access to the front and rear.

Figure 2–1 shows the DLT2000 front panel.

Figure 2–1 DLT2000 Front Panel

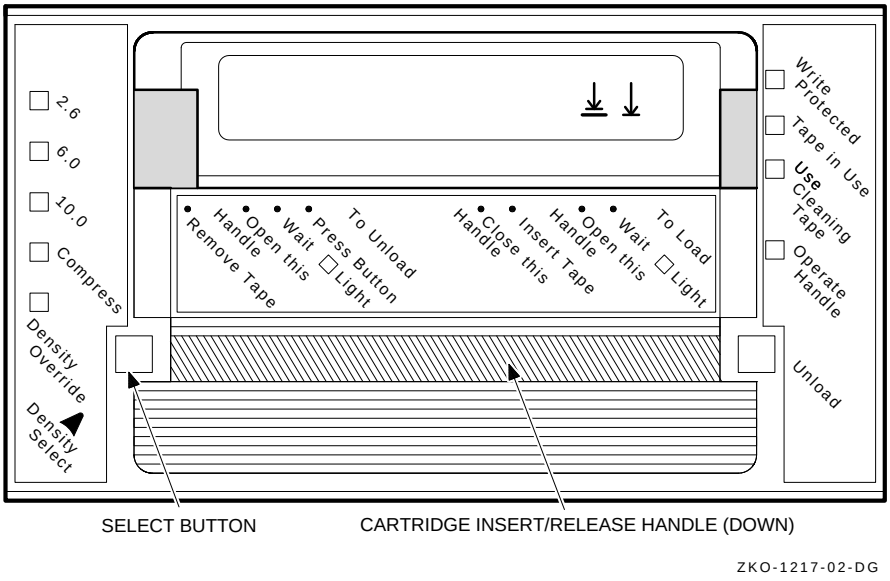
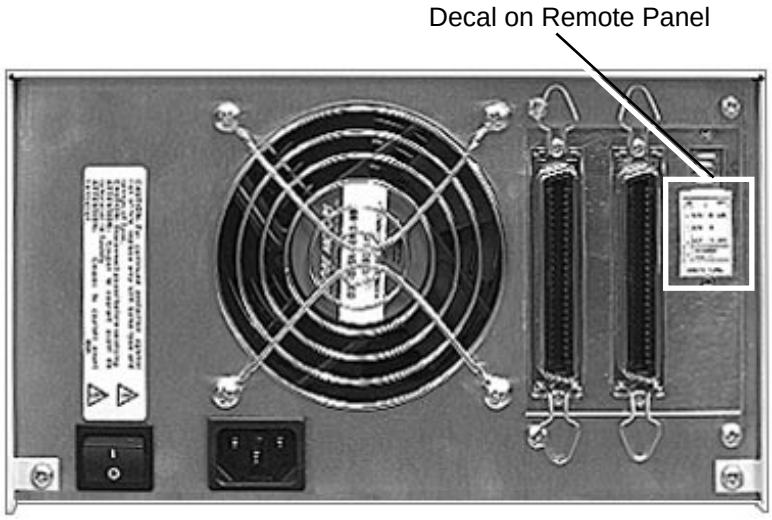


Figure 2–2 shows where the decal adheres on the rear of the DLT2000 drive.

Figure 2–2 DLT2000 Rear Panel



2.3 Install the Subsystem

To install the DLT2000:

Step	Action
1	Note the DLT2000 factory settings.
2	Review Section 2.4.1.
3	Configure the DLT2000 for your system:

If you need to. . .	See section. . .
Disable parity checking	Section 2.4.3
Change the SCSI ID	Section 2.4.4

Step	Action
4	Connect the cables.

2.4 Configure the DLT2000 Tabletop

This section describes how to configure the DLT2000 including:

Topic	Section
Configuration Guidelines	Section 2.4.1
Switchpack Location	Section 2.4.2
To Disable Parity Checking	Section 2.4.3
Changing the SCSI ID	Section 2.4.4

The DLT2000 is factory set to SCSI ID 0, unless otherwise specified. The drive is factory set for parity generation and checking is enabled.

2.4.1 Configuration Guidelines

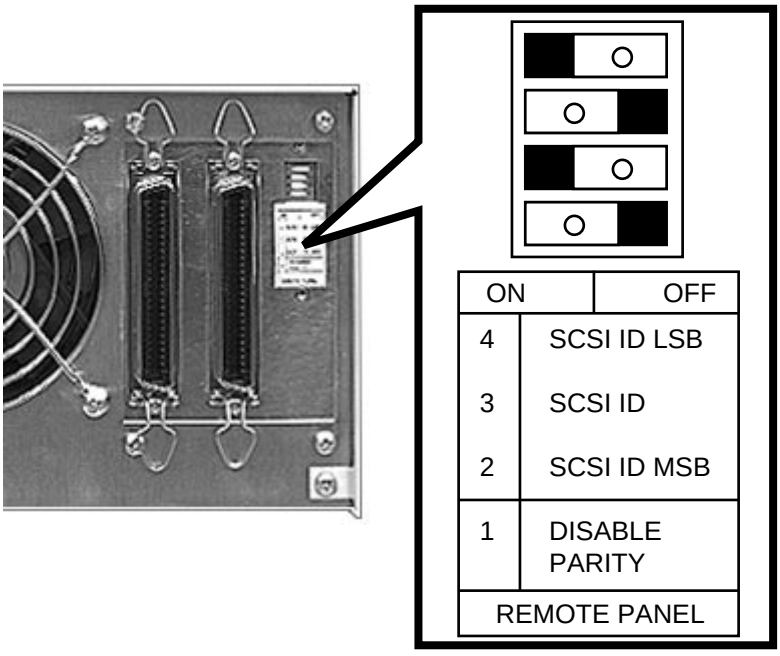
Your system uses the SCSI ID to identify, or address, the DLT2000. Follow these guidelines when configuring the DLT2000 for your system:

If you are installing the DLT2000 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 Switchpack Location

Figure 2–3 shows the location of the DISABLE PARITY and SCSI ID switchpack:

Figure 2–3 DISABLE PARITY and SCSI ID Switchpack



CAUTION

Never use a pencil to press the switches on the switchpack.

2.4.3 To Disable Parity Checking

If your host system does not generate SCSI bus parity, you can disable parity checking in the DLT2000 through a switch on the rear panel. Set the DISABLE PARITY switch to ON (Figure 2–3) by pressing down on the left side switch 1.

2.4.4 Changing the SCSI ID

You can change the SCSI ID through the SCSI ID switchpack on the rear panel (Figure 2–3):

To change the SCSI ID:

1. Look at the first column in Figure 2–4 and choose a SCSI ID.

Figure 2–4 SCSI ID Selection

SCSI ID	Switch 2	Switch 3	Switch 4
0	Off	Off	Off
1	Off	Off	On
2	Off	On	Off
3	Off	On	On
4	On	Off	Off
5	On	Off	On
6	On	On	Off
7	On	On	On

Switch 2 is the most significant bit (MSB) and switch 4 is the least significant bit (LSB).

2. Next to the SCSI ID you chose from Figure 2–4, look across at the switch 2, switch 3, and switch 4 columns. See what the setting should be for each switch at the chosen ID.

   For example, if you chose SCSI ID 3, then the setting for switch 2 is Off; switch 3 is On; and switch 4 is On.

If the switch setting should be:

- On, press in the left side of the switch on the rear of the DLT2000 (Figure 2–3).
- Off, press in the right side of the switch on the rear of the DLT2000 (Figure 2–3).

2.5 Connect the Cables

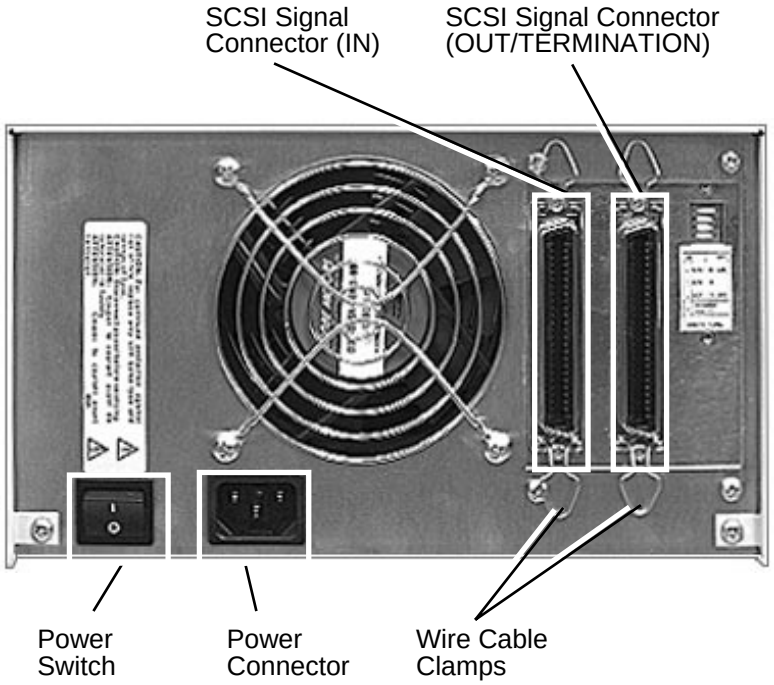
Section 2.5 includes the following topics:

Topic	Section
Examine the DLT2000 Rear Panel	Section 2.5.1
Connect the SCSI Signal Cable	Section 2.5.2
Terminate the SCSI Bus	Section 2.5.3
Connect the Power Cord	Section 2.5.4

2.5.1 Examine the DLT2000 Rear Panel

Examine the components on the DLT2000 rear panel to complete the physical installation (Figure 2–5).

Figure 2–5 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 DLT2000 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, another SCSI device.

See your system documentation for system SCSI connections.

2.5.3 Terminate the SCSI Bus

NOTE

The Small Computer System Interface (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 DLT2000 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 the rightmost SCSI signal connector on the DLT2000 rear panel. 2. Snap the wire cable clamps into place 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.

You can configure the DLT2000 to supply **TRM PWR** on the bus by adding a jumper to the pins labeled **TRM PWR** on the controller module.

2.5.4 Connect the Power Cord

To connect the power cord:

1. Be sure the DLT2000 power switch is set to 0.
2. Connect the power cord to the DLT2000 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)	Section 2.6.1
What to do after POST	Section 2.6.2

2.6.1 Run POST

To test the DLT2000 installation by running POST:

1. Turn on system power.
2. Set the power switch on the DLT2000 rear panel to on. POST runs automatically when you power on the DLT2000.
3. Observe the lights on the DLT2000 front panel. Ensure the 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 lights on the right front panel turn on sequentially from top to bottom. All lights stay on for a few seconds.
2	All lights 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 lights turn off. The yellow Tape in Use light blinks while the tape drive initializes.
4	After initialization, if no cartridge is loaded, the yellow Tape in Use light turns off, the green Operate Handle light 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 timeout 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 optional system tests. See Chapter 3 for operating the drive and selecting density.
All left- or right-side lights on the DLT2000 front panel blink only	POST failed. See Table 2–4, DLT2000 Troubleshooting Chart.

2.7 DLT2000 Troubleshooting Chart

If the DLT2000 fails during POST or operation, use Table 2–4 to determine the problem and the action to take.

Table 2–4 DLT2000 Troubleshooting Chart

If . . .	Then . . .	You should . . .
Your system does not recognize the DLT2000	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 DLT2000 is the last or only device on the bus, make sure the terminator is installed on the DLT2000.
		If the DLT2000 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.

(continued on next page)

Table 2–4 (Cont.) DLT2000 Troubleshooting Chart

If . . .	Then . . .	You should . . .
Your system does not recognize the DLT2000	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 DLT2000 does not power up	The DLT2000 has no power	Check the DLT2000 power cord connections with the DLT2000 power switch off
All right or all left side lights on the DLT2000 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 lights stop blinking and the drive tries to reinitialize. The lights turn on steadily again and go off if the test succeeds.
You are finding fatal or nonfatal errors for which you cannot determine the cause	The bus termination or SCSI signal cable connections might be incorrect	Make sure the SCSI bus is terminated.
	The ac power source grounding might be incorrect	Use an ac outlet for the DLT2000 on the same ac line powering the system.

After taking the action in Table 2–4, power on the the DLT2000 to rerun POST. If all right or left side lights blink again, you most likely have a hardware failure.

3

Configuring and Operating the DLT2000 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 drive.) Chapter 3 includes the following main topics and sections:

Topic	Section
Before You Install the DLT2000 Drive	Section 3.2
Overview of the Front Panel	Section 3.3
Selecting Density	Section 3.4
Description of Controls and Indicators	Section 3.5
Description of the Tape Cartridge	Section 3.6
Loading a Cartridge	Section 3.7
Using the CleaningTape III	Section 3.8
Unloading a Cartridge	Section 3.9
Preserving Cartridges	Section 3.10

3.2 Before You Install the DLT2000 Drive

Section 3.2 includes:

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

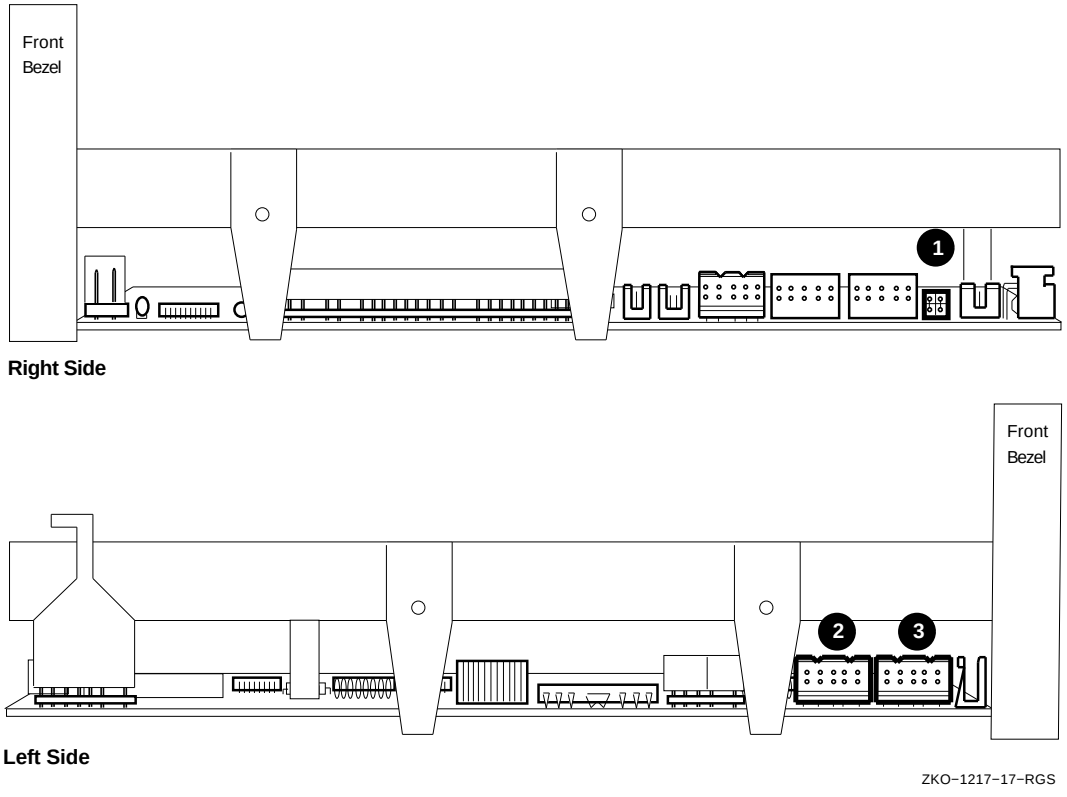
3.2.1 Disabling Parity Checking

If your host system does not generate SCSI bus parity, you can disable parity checking in the DLT2000 by adding a jumper to the SCSI ID connector on the left side of the DLT2000 drive controller board (Figure 3–1).

To disable parity:

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

Figure 3–1 DLT2000 Drive Connectors



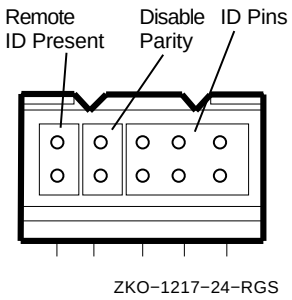
❶ TRM PWR/TRM ENB Connector

❷ SCSI ID Connector

❸ Loader Connector

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

Figure 3–2 SCSI ID Connector Pins

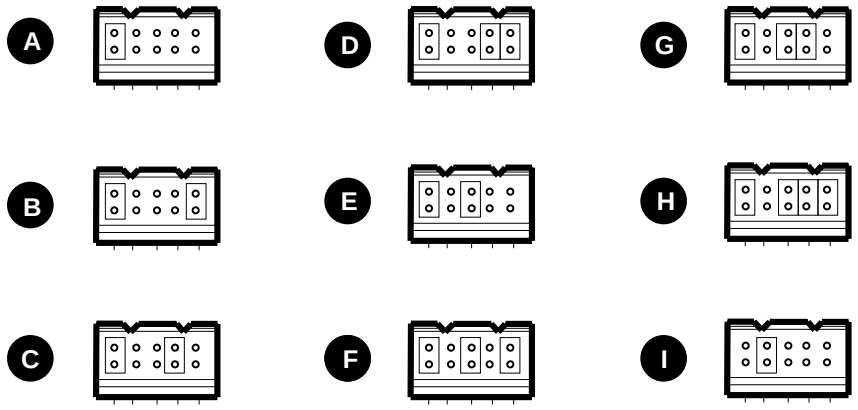


NOTE

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.

Figure 3–3 Jumper Positions



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.

3.2.2 Changing the SCSI ID

The drive is shipped with SCSI ID 0, 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. For example, if you choose SCSI ID 1, place the jumpers in the same positions as those in letter B.

3.2.3 Setting the TRM ENB/TRM PWR Jumpers

NOTE

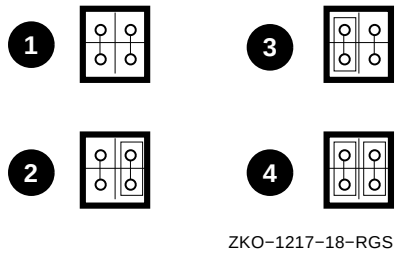
The Small Computer System Interface (SCSI) bus must be terminated at both ends, and at least one device must supply terminator power.

The DLT2000 controller module has active terminators. You can configure the DLT2000 drive to supply termination power and termination on the bus.

To supply terminator power and provide termination for the SCSI bus:

1. Use Figure 3–1, number ❶, to locate the TRM PWR/TRM ENB connector on the drive.
2. Place jumpers in the positions shown in Figure 3–4, number ❹.

Figure 3–4 Jumper Settings for the TRM PWR/TRM ENB Connector

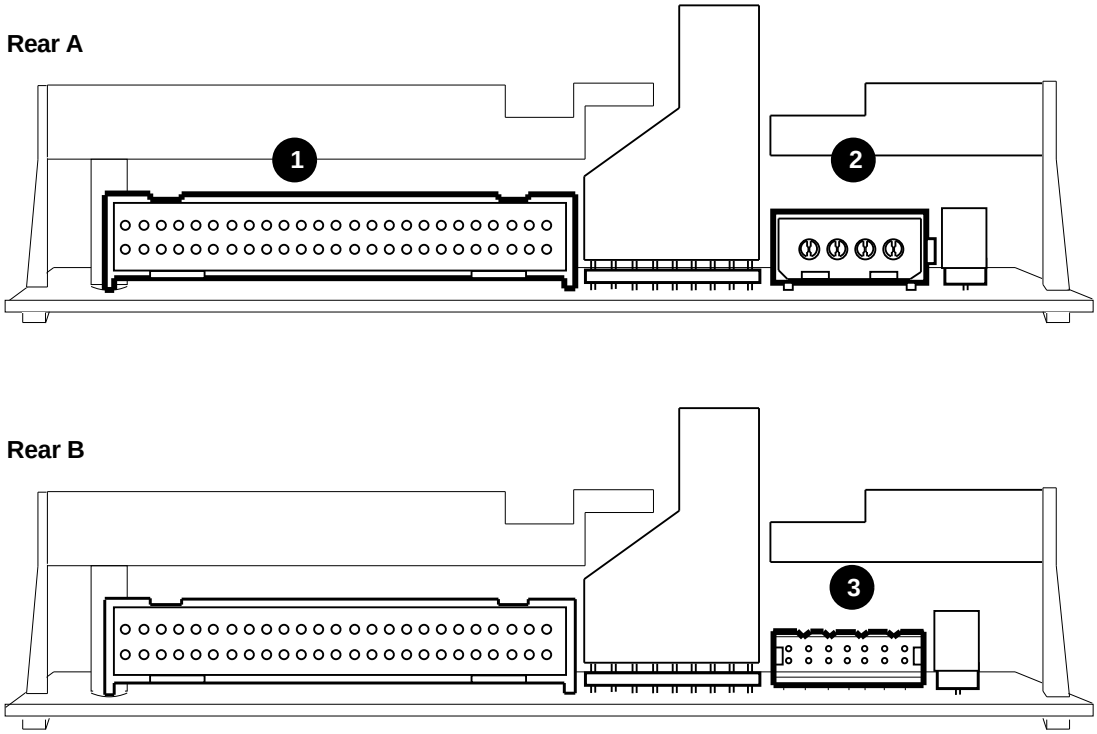


❶ No Term Power/Disable Active Termination	❸ Term Power/Disable Active Termination
❷ No Term Power/Enable Active Termination	❹ Term Power/Enable Active Termination

3.2.4 Locating the SCSI and Power Connectors

To install the DLT2000 drive, note the location of the rear connectors (Figure 3–5).

Figure 3–5 DLT2000 Rear Connectors



❶ SCSI Connector	❷ Power connector ❸ Power connector (StorageWorks option)

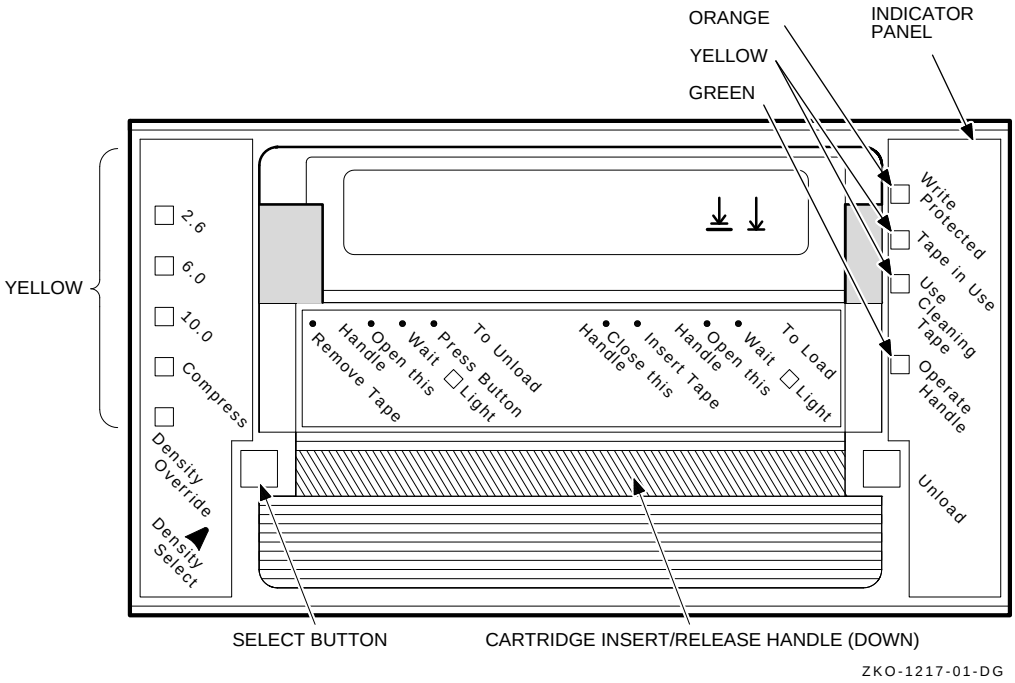
3.3 Overview of the Front Panel

The DLT2000 has the following indicators and controls for operating the drive (Figure 3–6):

Indicators (Left Side of Drive)	Indicators (Right Side of Drive)
Density light 2.6	Write Protected light
Density light 6.0	Tape in Use light
Density light 10.0	Use Cleaning Tape light
Compress light	Operate Handle light
Density Override light	Beeper (audible) not visible
Controls	
Density Select button	Unload button
Cartridge insert/release handle	

Figure 3–6 shows the DLT2000 indicators and controls.

Figure 3–6 DLT2000 Indicators



For details on controls, indicators, and operation, see the sections after Section 3.4 in this chapter.

3.4 Selecting Density

Section 3.4 describes the drive's density select features.

CAUTION

If you reuse a prerecorded tape 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

You 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, 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 10.0 and Compress (assuming the Density Select button or the host selection was not used.)

How to Select Density

To select density with the DLT2000:

1. Load the tape into the drive. The yellow Tape in Use light blinks while the tape loads and calibrates.
2. After calibration completes, Tape in Use remains lit.
3. The light shows the tape's prerecorded density, such as 2.6 or 6.0.
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 loaded a tape with a prerecorded 2.6 density and you use the Density Select button to select 10.0 density, the following should happen:

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

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

- The 2.6 light turns off
- 10.0 lights steady
- Density Override remains lit

Table 3–1 shows the results of density selection.

Table 3–1 Results of Density Selection

If . . .	Then . . .
You did not use the Density Select button	The lights show the actual density when the tape is reading and writing. The lights are on steady and Density Override is off.
You use the Density Select button, and if the actual tape density is the same as the density you selected	The actual density and Density Override light. For example, if the actual tape density is 10.0 and the selected tape density is 10.0, then the indicator next to 10.0 lights.

(continued on next page)

Table 3–1 (Cont.) Results of Density Selection

If . . .	Then . . .
You used the Density Select button, and if the actual tape density differs from the density selected	1. The light with the actual density is on steady 2. The light with the selected density blinks 3. Density Override lights steady For example, if the actual tape density is 10.0 and the selected density is 6.0, 10.0 lights steady, 6.0 blinks, and Density Override lights steady.

To select density over the SCSI bus:

1. Do a SCSI MODE SELECT with the density you want. For more details, see Chapter 7.
2. Write data to the tape from BOT.

3.5 Description of Controls and Indicators

Section 3.5 includes the following sections:

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

3.5.2 Unload Button

The Unload button is used primarily to indicate that the user wants to unload the tape. When the user pushes Unload, the DLT2000 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. Depending on tape position, an unload operation may take from 10 seconds to 4 minutes.

If the drive is in error state (all right side lights 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 light 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

When you turn on system power, the drive performs the POST. The sequence of events is:

Stage	What Happens
1	The lights on the right front panel turn on sequentially from top to bottom. All lights stay on for a few seconds.
2	The lights 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 lights turn off. The yellow Tape in Use light blinks while the tape drive initializes.

<table>
<tr><th>Stage</th><th>What Happens</th></tr>
<tr><td>4</td><td>After initialization, the drive is in one of the following four states:
<table>
<tr><th>Drive State</th><th>Indicator Displays and Actions</th></tr>
<tr><td>a. No cartridge is present</td><td>1. The yellow Tape In Use light turns off
2. The green Operate Handle light turns on
3. The handle is unlatched
4. The drive beeps momentarily
You can now raise the handle and insert a cartridge.</td></tr>
<tr><td>b. A cartridge is present and the handle is down</td><td>The drive loads the cartridge. When the yellow Tape In Use light stops blinking and stays on, the tape's actual density lights. For example, if the actual tape density is 2.6, then the light 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.)</td></tr>
<tr><td>c. A cartridge is present, but the handle is up (not recommended)</td><td>The yellow Tape In Use light turns off. The green Operate Handle light flashes. When you lower the handle, the cartridge loads.</td></tr>
<tr><td>d. The drive detects an error condition</td><td>Then all right or left side lights 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 lights stop blinking and the drive tries to reinitialize. The lights turn on steadily again and turn off if the test succeeds.</td></tr>
</table></td></tr>
</table>

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 timeout 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
Light (Right Front Panel)			
Write Protected	Orange	On Off	Tape is write-protected. Tape is write-enabled.
Tape in Use	Yellow	Blinking On	Tape is moving. 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.
All four right side lights or all left side lights	–	On	POST is starting.
		Blinking	An error has occurred. See Table 2–4, DLT2000 Troubleshooting Chart.

(continued on next page)

Table 3–2 (Cont.) Determining the Drive's Operating Condition

Label	Color	State	Operating Condition
Light (Left Front Panel)			
2.6	Yellow	On	Tape is recorded in 2.6 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 format.
		Blinking	Tape is recorded in another density. You selected this density for a write from BOT.
10.0	Yellow	On (default)	Tape is recorded in 10.0 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 density only.)
		Off	Compression mode is disabled.
Density Override	Yellow	On	You selected a density from the front panel.
		Off (default)	Density will 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 tape cartridge is a 4-inch, gray, plastic cartridge containing 1100 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):

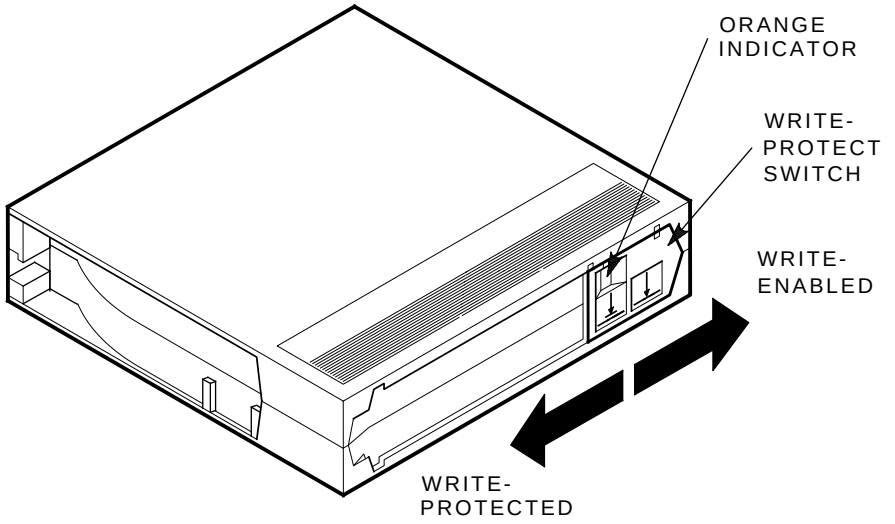
- Left, so the cartridge is write-protected
- Right, so the cartridge is write-enabled

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) lets you know that 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 :

Figure 3–7 Tape Cartridge



3.6.2 Data Protection

If you move the cartridge write-protect switch 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 light is on	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 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

Directions for loading a cartridge into and unloading a cartridge from the drive are printed on the front of the drive.

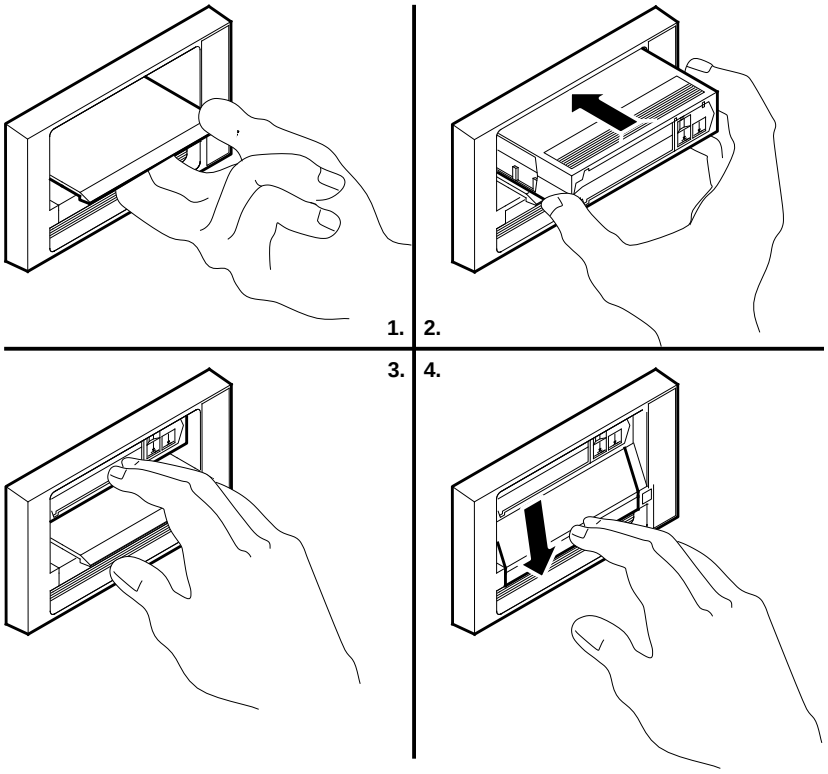
The following are more detailed steps for loading a cartridge (Figure 3–8):

1. When the green light is on steady, pull the cartridge insert/release handle open.
2. Insert the cartridge.
3. Push the cartridge into the drive.
4. Push the handle closed.

The green light turns off and the yellow light blinks to show the tape is loading. When the tape is at the BOT marker, the yellow light 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 light is on steady, the tape is ready to use. When the tape is being read, written, or rewound, Tape in Use blinks.

Use Table 3–5 to determine what is happening during cartridge use:

Table 3–5 What is Happening During Cartridge Use (Right Side Lights)

If . . .	It means . . .
The yellow light 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 light blinks irregularly	A read or write is in progress.
The yellow light blinks regularly	Tape is loading, unloading, or rewinding.
The green light turns on and the beeper sounds	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 lights blink	An error has occurred during operation. See Table 2–4, DLT2000 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 lights (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 is complete, the beeper sounds for you to remove the cleaning cartridge.

(continued on next page)

Table 3–6 (Cont.) When to Use the Cleaning Cartridge

If . . .	It means . . .	And you should . . .
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 lights after you clean the drive head	Your data cartridge may be causing the problem	Try another data cartridge.
4. Use Cleaning Tape lights 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

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

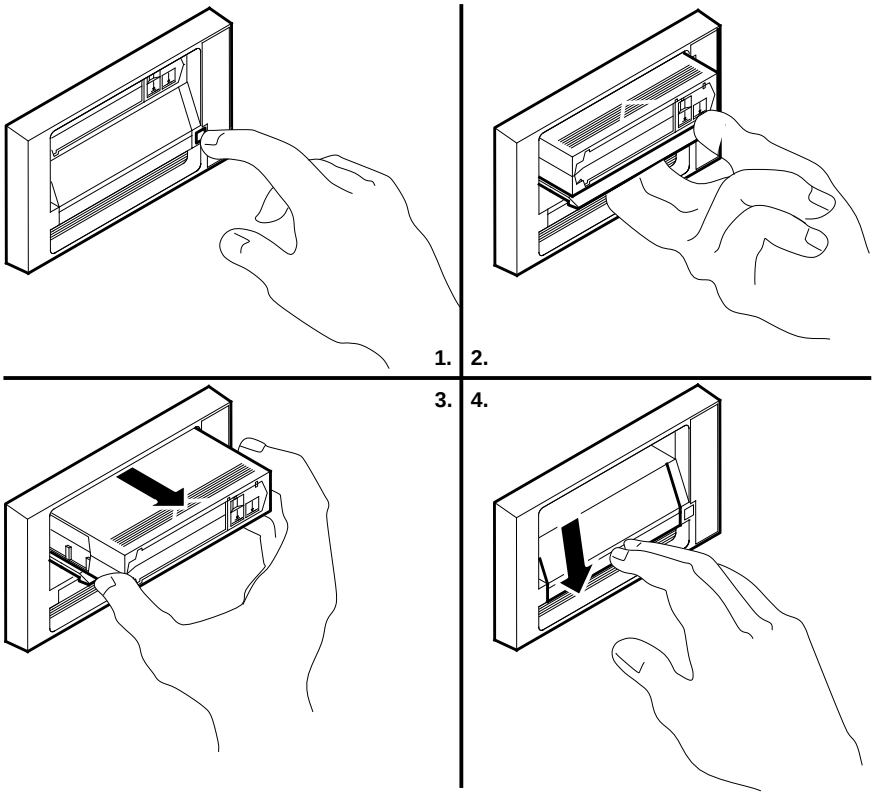
1. Press the Unload button (or issue the appropriate system software command). The yellow Tape in Use light blinks as the tape rewinds.
2. When the green light turns on (the beeper also sounds), pull the cartridge insert/release handle open to eject the cartridge.
3. Remove the cartridge.
4. Push the handle closed.

CAUTIONS

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.

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 the following 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.

4

Configuring and Operating the DLT2700 Mini-Library

4.1 In This Chapter

Chapter 4 includes the following main topics and sections:

Topic	Section
Introduction to the Media Loader	Section 4.2
Mode Select Key	Section 4.4
Selecting Density	Section 4.5
Operator Control Panel (OCP)	Section 4.6
Configure the DLT2700	Section 4.3
Power-On Process	Section 4.7
Slot Select, Load/Unload, and Eject Button Functions	Section 4.8
Magazine	Section 4.9

4.2 Introduction to the Mini-Library

The mini-library option includes a DLT2000 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:

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

4.3 Configure the DLT2700

This section describes how to configure the DLT2700 including:

Topic	Section
Configuration Guidelines	Section 4.3.1
Switchpack Location	Section 4.3.2
Disable Parity Checking	Section 4.3.3
Change the SCSI ID	Section 4.3.4

The DLT2700 is factory set to SCSI ID 0 unless otherwise specified.

If your system generates parity, the DLT2700 can check for correct parity on the SCSI bus.

4.3.1 Configuration Guidelines

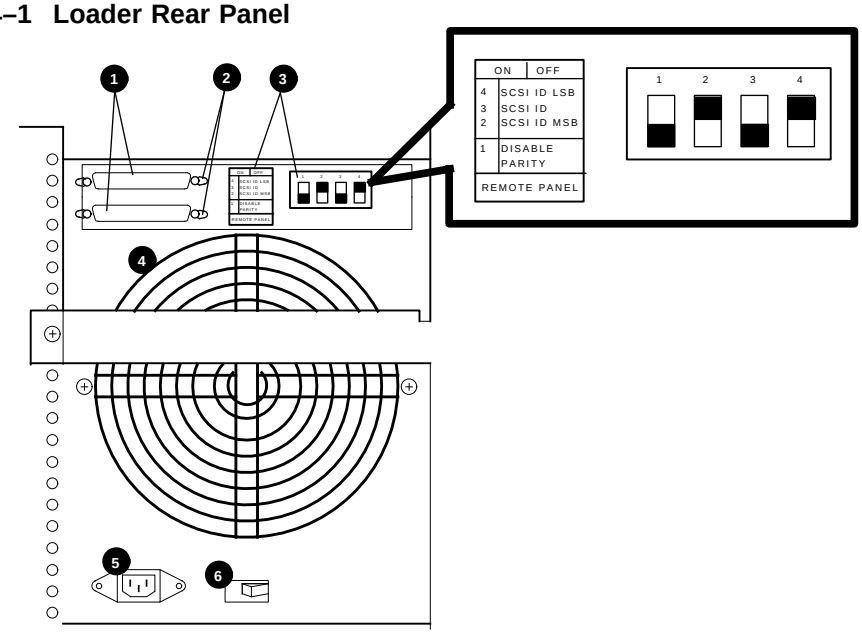
Your system uses the SCSI ID to identify, or address, the DLT2700. Follow these guidelines when configuring the DLT2700 for your system:

If you install the DLT2700 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.

4.3.2 Switchpack Location

Figure 4–1 shows the location of the DISABLE PARITY and SCSI ID switchpack.

Figure 4–1 Loader Rear Panel



❶ SCSI Connectors	❷ Wire Cable Clamps	❸ Decal and SCSI ID Switchpack
	❹ Fan	
❺ Power Connector	❻ Power Switch	

CAUTION

Never use a pencil to press the switches on the switchpack.

4.3.3 Disable Parity Checking

If your system does not generate parity, you can disable parity on the DLT2700 by repositioning the switches on the loader rear panel. Set the DISABLE PARITY switch to ON (Figure 4–1) by pressing in the upper side of switch 1.

4.3.4 Change the SCSI ID

To change the SCSI ID via the rear panel:

1. Look at the first column in Figure 4–2, choose a SCSI ID, and set the switches as indicated.

Figure 4–2 SCSI ID Selection

SCSI ID	Switch 2	Switch 3	Switch 4
0	Off	Off	Off
1	Off	Off	On
2	Off	On	Off
3	Off	On	On
4	On	Off	Off
5	On	Off	On
6	On	On	Off
7	On	On	On

Switch 2 is the most significant bit (MSB) and switch 4 is the least significant bit (LSB).

If the switch setting should be:

- On, press in the upper side of the switch on the rear of the loader (Figure 4–1).
- Off, press in the lower side of the switch on the rear of the loader (Figure 4–1).

4.4 Mode Select Key

The Mode Select key (Figure 4–3), 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

4.4.1 OCP Disabled Mode

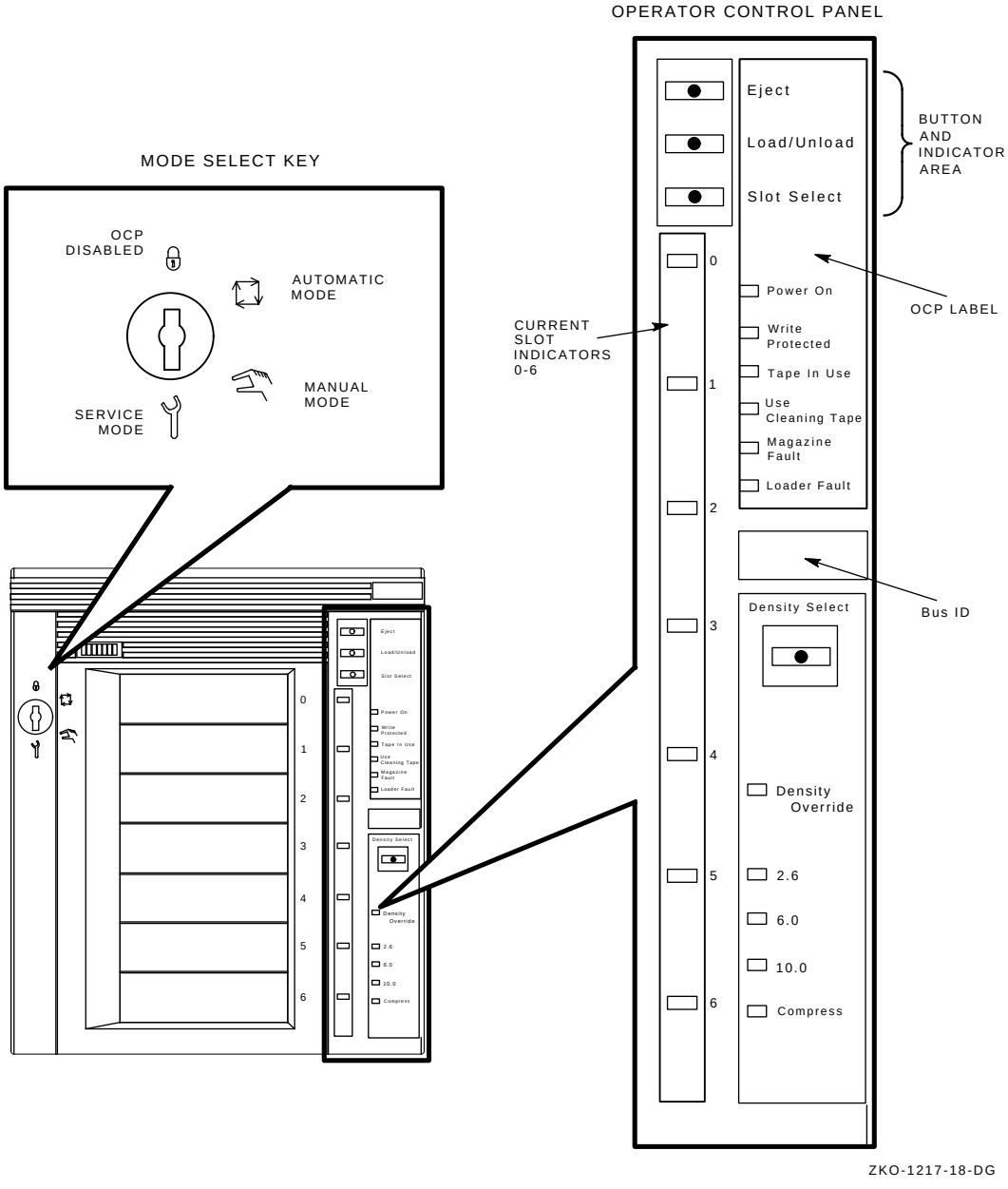
When the magazine is inserted into the receiver and the receiver is closed, the loader transfer assembly scans the magazine. The first cartridge in the magazine automatically loads into the drive.

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 DLT2700 subsystem into the enclosure and lock the receiver, set the Mode Select key to OCP Disabled. The OCP pushbuttons are disabled.

Figure 4–3 DLT2700 Operator Control Panel



4.4.2 Automatic Mode

This is the default or normal mode of the DLT2700 subsystem. It allows the DLT2700 to load and unload cartridges as needed during backup procedures.

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 DLT2700 subsystem into its normal operating position in the enclosure, but leave the receiver unlocked, set the Mode Select key to Automatic mode. The receiver can be opened and all OCP pushbuttons are enabled.

4.4.3 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.

To lock the DLT2700 subsystem into the enclosure, set the Mode Select key to Manual mode. The receiver is unlocked and can be opened and all OCP pushbuttons are on.

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.

4.4.4 Service Mode

Service mode allows for servicing procedures. For details on controls, indicators, and operation, see the sections after Section 4.5 in this chapter.

4.5 Selecting Density

Section 4.5 describes the loader's density select feature.

Ways of Selecting Density

You 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, tape density may be changed by:
   - The Density Select button. Density Select always overrides a host selection.
   - A programmable host selection via your operating system. (The Density Override light is off, indicating automatic or host density selection.)
   - Native default density 10.0 and Compress (assuming 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 DLT2700:

1. Press the Load/Unload button to load the cartridge into the drive. The yellow Tape in Use light blinks while the tape loads and calibrates.
2. After calibration completes, Tape in Use remains lit.
3. The light shows the tape's prerecorded density, such as 2.6 or 6.0.
4. You 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 density selection
   - Eject the magazine from the loader

Density Select Example

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

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

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

- 2.6 turns off

- 10.0 lights steady
- Density Override remains lit

Table 4–1 shows the results of density selection.

Table 4–1 Results of Density Selection

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

To select density over the SCSI bus:

1. Do a SCSI MODE SELECT with the density you want. For more details, see Chapter 7.
2. Write data to the tape from BOT.

4.6 Operator Control Panel

The DLT2700 operator control panel (OCP) has 4 pushbuttons and 22 indicators used with the Mode Select key (Table 4–2). See Section 4.4 for information on the Mode Select key and its functions. See Section 4.8 for more details on button and indicator operations.

Table 4–2 lists each button/indicator and its function.

Table 4–2 DLT2700 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	You can press the Eject button to unload cartridges from the drive to the magazine and open the receiver. Lights 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 subsystem 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 indicator	Green	The DLT2700 is in a known good power state (ac and dc voltages are within tolerance).

(continued on next page)

Table 4–2 (Cont.) DLT2700 Operator Control Panel

Button/Indicator	Color	Function
Write Protected indicator	Orange	When on, indicates that 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—tape is rewinding • Rapid blinking—tape is reading or writing • On steady—a cartridge is in the drive and the tape is not moving • Off—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 (Sections 5.5.1 and Section 5.5.2).
Density Select	Green	You can choose a density on the OCP

(continued on next page)

Table 4–2 (Cont.) DLT2700 Operator Control Panel

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 will 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 format. • Blinking—tape is recorded in another density. You selected this density for a write from BOT.
6.0	Yellow	Indicates tape drive activity as follows: • On steady—tape is recorded in 6.0 format. • Blinking—tape is recorded in another density. You selected this density for a write from BOT.
10.0	Yellow	Indicates tape drive activity as follows: • On steady—tape is recorded in 10.0 format. • Blinking—tape is recorded in another density. You selected this density for a write from BOT.

(continued on next page)

Table 4–2 (Cont.) DLT2700 Operator Control Panel

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

4.7 Power-On Process

CAUTION

Before turning on power, verify the DLT2700 is set (see voltage label on mini-library rear panel) for the available ac supply voltage.

Table 4–3 explains what happens during each phase of the DLT2700 operation.

Table 4–3 Loader Power-On Self-Test

Phase	What Happens
1	When you power on the DLT2700, the Loader Fault and Power On lights on the loader OCP are on.
2	One second later, all lights are on. Within 15 seconds, POST of the loader mechanics completes. • If the Magazine Fault and Loader Fault lights turn off, loader POST **succeeded**. • If the Magazine Fault and Loader Fault lights stay on, loader POST **failed**.
3	A few seconds later, the drive controller resets the loader.

(continued on next page)

Table 4–3 (Cont.) Loader Power-On Self-Test

Phase	What Happens	
4	Loader POST starts again.	
	If . . .	**Then POST . . .**
	The Magazine Fault and Loader Fault lights turn off and shortly after all lights except Power On turn off	**Passed**
	The Magazine Fault and Loader Fault lights stay on	**Failed**

NOTE

If the Magazine Fault or Loader Fault lights remains on, POST detected an error. See Chapter 5 for error conditions.

5	The elevator scans the magazine to determine which slots contain cartridges.
6	If the subsystem magazine has a cartridge in slot 0, and no cartridge is in the drive, these lights should be on: • Power On • Eject • Load/Unload • Slot Select • Slot 0

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

Slot Select, Load/Unload, Eject, and Density Select are OCP pushbuttons. They contain a green light and are operable only when their corresponding lights are on.

NOTE

Load/Unload button has three functions:

- Load
- Unload
- Reset

If a loader fault occurred and the Loader Fault light is on, press Load/Unload to reset the DLT2700.

4.8.1 Selecting a Cartridge

To select a cartridge: press the Slot Select button to advance the slot indicator light to the next available slot. After a successful initialization, the DLT2700 automatically selects slot 0 and the Slot Select button becomes active. The Load/Unload and Eject lights remain on during slot selection.

4.8.2 Loading the Cartridge

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

Table 4–4 Load/Unload Functions

Stage	What Happens
1	The Select Slot, Load/Unload, and Eject lights turn off, and the elevator moves to the selected slot, indicated by the light.
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 lights remain off until the tape loads to the BOT.
5	After the cartridge is loaded into the drive, the Eject and Load/Unload lights turn on, and the corresponding buttons are enabled. The Slot Select light remains off.

4.8.3 Unloading the Cartridge

CAUTION

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

NOTE

The Load/Unload light 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 light 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 lights turn on once the cartridge is returned to the magazine.
The Loader Fault light is on, showing a malfunction	Press the Load/Unload button to reset the subsystem and try to clear the error.

4.8.4 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 lights are on before any operation begins.	Press the Eject button to turn off all lights. The elevator then returns to its home position and the receiver opens.

When . . .	Then . . .	You should . . .
A cartridge is in the drive	The Eject and Load /Unload lights are on before the operation begins	Press the Eject button to turn off both lights 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 lights turn back on when the scan completes.

4.9 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.

4.9.1 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 4–5). Each slot is numbered – to ensure you insert the cartridge correctly into 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 toward you (Figure 4–4).
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 light is not visible)
Write-protect the tape	Slide the switch to the left (orange light is visible)

3. Push the cartridge (Figure 4–5) into the slot until it stops and you hear a click. A small metal tab holds the cartridge in place.

Figure 4–4 Write-Protect Switch on a Cartridge

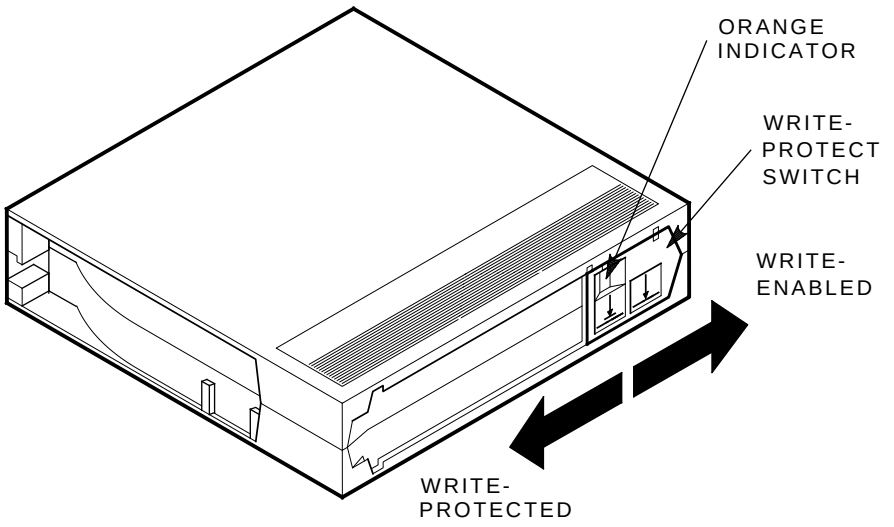
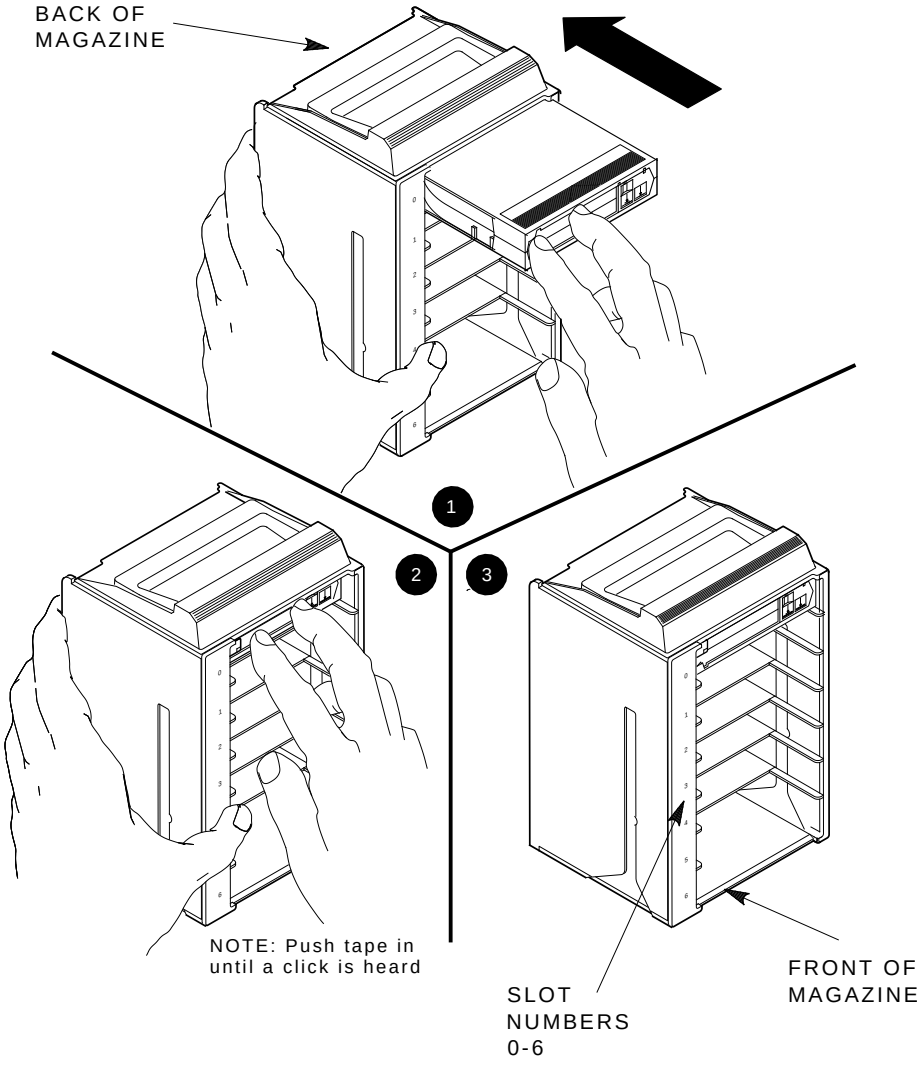


Figure 4–5 Inserting a Cartridge into the Magazine



4.9.2 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 4–6) 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. This can cause cartridge jams in the DLT2700 subsystem. Use the space on the front of the cartridge for labels.

4.9.3 Removing the Magazine from the Receiver

To remove the magazine from the receiver, first ensure:

1. The Power On light is on (Figure 4–3).
2. The Eject light is on. (It must be on before you can press the Eject button.)

Then:

1. Press the Eject button (Figure 4–3) 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 4–7), and gently pull it forward to access the magazine.
3. Grasp the magazine's handle only to lift the magazine out of the receiver.

4.9.4 Installing the Magazine into the Receiver

To install the magazine into the receiver:

1. Slide the magazine down into the receiver (Figure 4–7) 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 DLT2700 subsystem before proceeding.

Figure 4–6 Removing a Cartridge from the Front of the Magazine

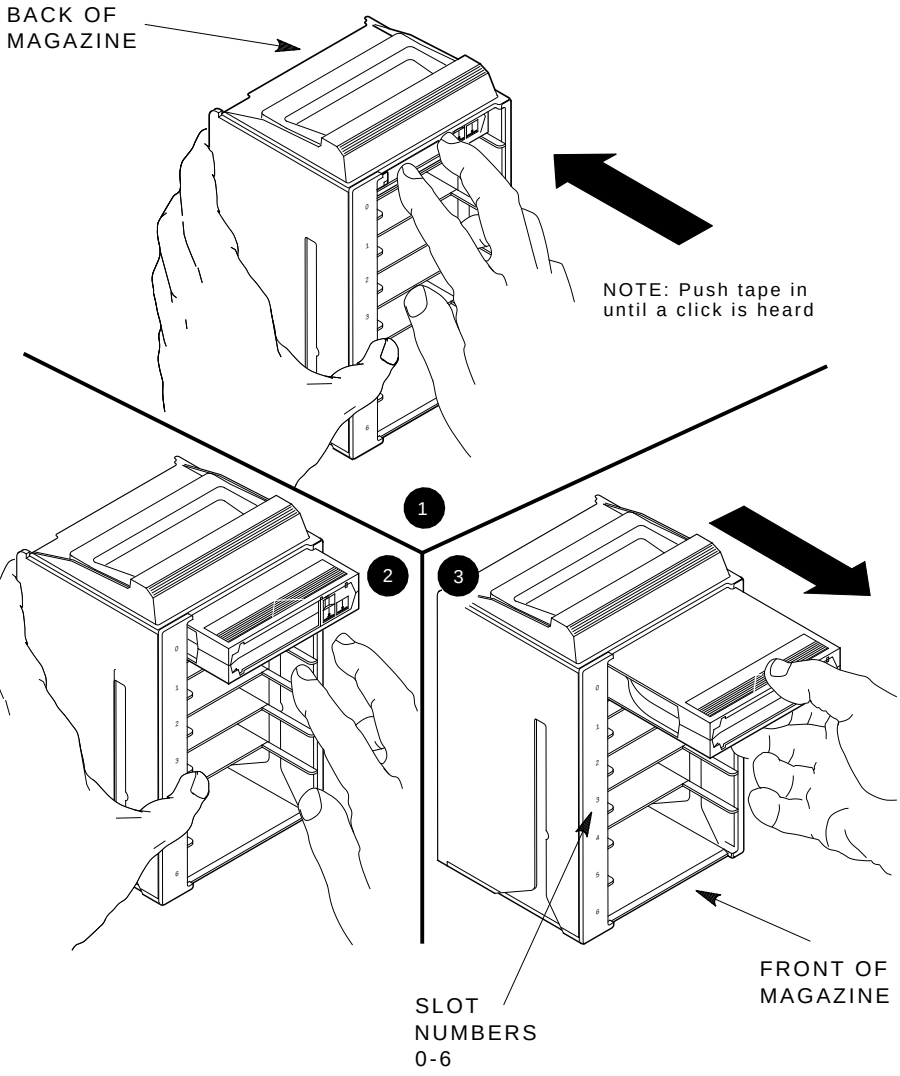
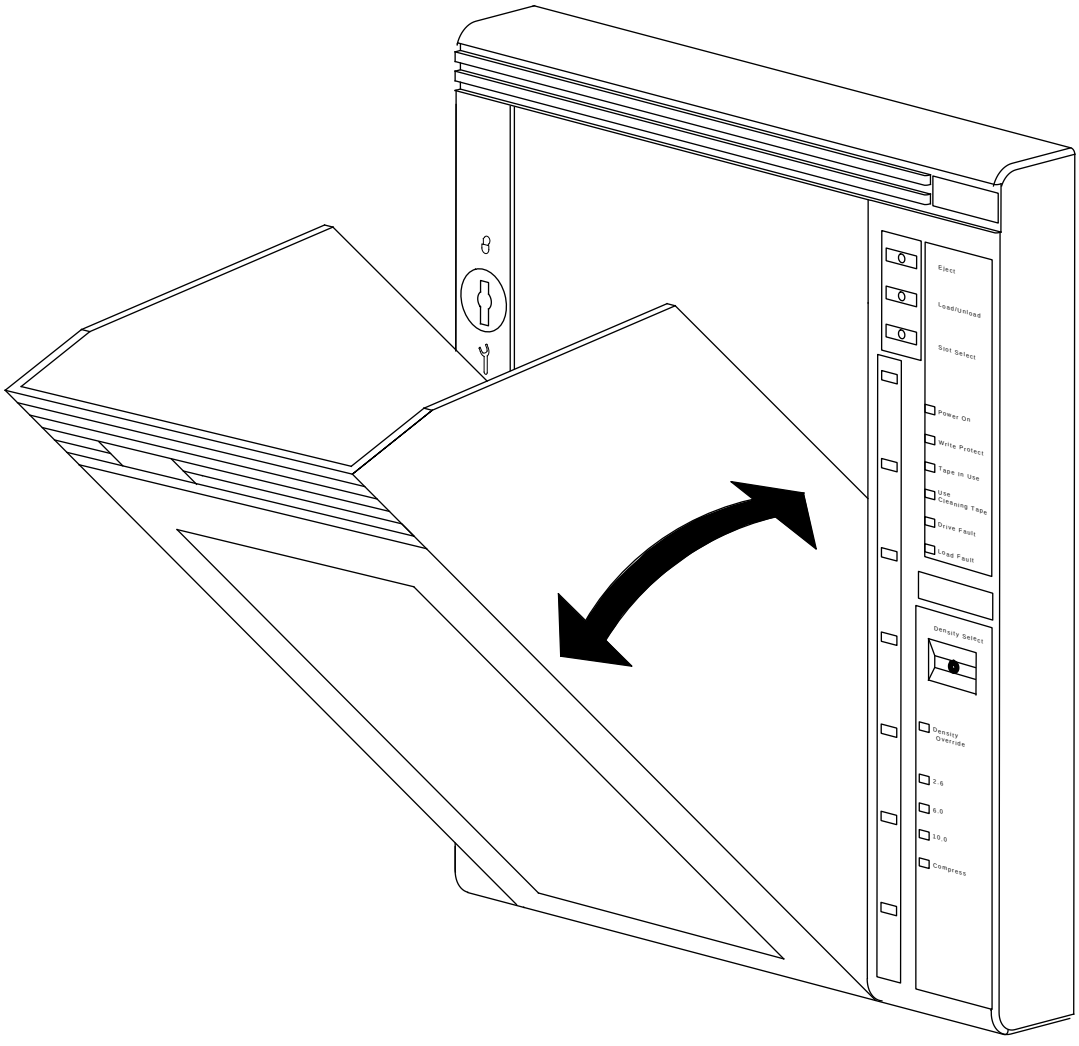


Figure 4–7 Receiver Opened



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5

Troubleshooting Guide for the DLT2700 Mini-Library

5.1 In This Chapter

Chapter 5 includes the following main topics and sections:

Topic	Section
Conditions Necessary for Button Operation	Section 5.2
Backup Operation Failure	Section 5.3
Avoiding Basic Problems	Section 5.4
Error Conditions	Section 5.5
Power Problems	Section 5.6

5.2 Conditions Necessary for Button Operation

Be sure to review information in the previous chapters to ensure that you are correctly operating the DLT2700 mini-library.

Before pressing the Slot Select, Load/Unload, or Eject button on the DLT2700 OCP, check the conditions in Table 5–1 and ensure the:

- Power On light is on
- Receiver is closed
- Mode Select key is *not* set to OCP Disabled

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

NOTE

Do not press the Load/Unload button to abort any function of the DLT2700 subsystem. Type Ctrl/Y or Ctrl/C instead.

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Section 4.8 has more information on DLT2700 OCP buttons and functions.

Table 5–1 DLT2700 OCP Button Conditions

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

5.3 Backup Operation Failure

Some manual operations, if not performed correctly, may cause backup operations to fail during BACKUP:

- Loading write-protected CompacTape III cartridges when executing write operations
- Selecting the incorrect cartridge slot from which to initialize operations

5.4 Avoiding Basic Problems

Follow these guidelines when operating the DLT2700 subsystem to avoid basic problems:

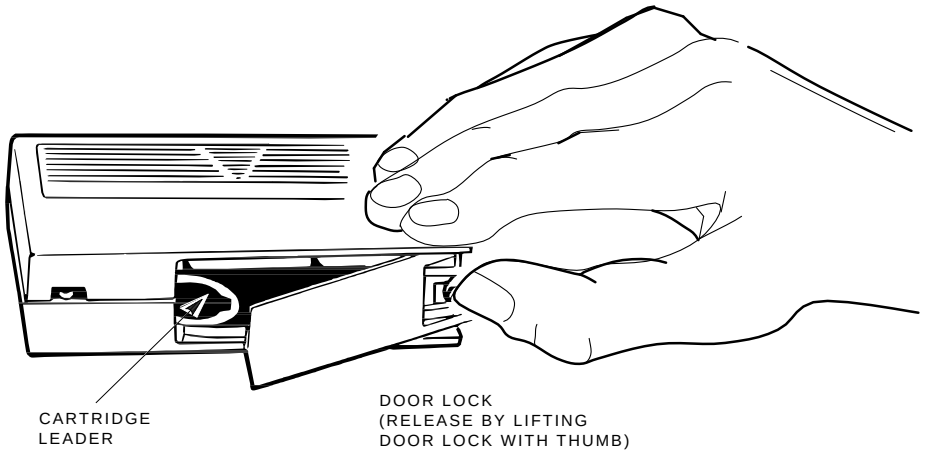
- Use CompacTape III cartridges.
- Check the tape leader in the cartridge by lifting the cartridge latch that opens the door to expose the leader. Be sure the leader is positioned as shown in Figure 5–1.

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.

Figure 5–1 Opening the Cartridge Door to Check Tape Leader



5.5 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 light is on. If you cannot resolve the fault, call your Multivendor Customer Services representative.
- **Loader Fault** — This condition most likely requires service from a Multivendor Customer Services representative. It is indicated when the Loader Fault light is on.

5.5.1 Magazine Fault Description (Cases)

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

1. A cartridge was removed from the magazine incorrectly.
2. A cartridge was manually unloaded from the drive.
3. A cartridge that was loaded into the 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, requiring service intervention. This cannot occur under normal operation.

When these conditions are present, the Magazine Fault light 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.

5.5.1.1 Detecting Cases 1, 2, and 3

You can tell these cases have occurred when the Magazine Fault light and slot lights 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 cartridge insertion/removal procedure (Section 4.9.1 and Section 4.9.2) to clear a magazine fault caused by cases 1, 2, and 3.

To clear the 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 the normal cartridge insertion /removal procedure. 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 removed and reinserted into the magazine. To clear this, simply close the receiver.

5.5.1.2 Detecting Case 4

You can tell this case has occurred when the Magazine Fault light and slot lights 0 and 6 are on. This is the only time slot lights 0 and 6 are on for a magazine fault. Only service personnel can resolve this condition by performing the following procedure:

1. Press the Eject button to open the receiver.
2. Close the receiver to clear the Fault light
3. Press the Load/Unload button; the cartridge unloads, but is not removed from the drive. The Magazine Fault light 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 lights in all error conditions to indicate that 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.

5.5.2 Loader Fault Description

A loader fault indicates the DLT2700 detected a fatal error in either the loader transfer assembly or the tape drive. In some loader transfer assembly errors, the subsystem retries the error three times before indicating failure. All loader faults cause the Loader Fault light 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 lights:

- Slots 4 and 0—a controller module
- Slots 5 and 0—a loader transfer assembly
- Slots 6 and 0—drive

NOTE

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

5.5.2.1 Clearing a Loader Fault

When a loader fault occurs, the Load/Unload and Eject lights are on. When you press the Load/Unload button, the DLT2700 attempts to clear the error. When you press Eject, the receiver opens to let you access the magazine.

5.6 Power Problems

If the Power On light is not on, or your system does not recognize the DLT2700 subsystem:

- Ensure power plug is secure.
- Verify with your system manager that the subsystem configuration is correct.

If power problems still exist, call your service representative.

6

Firmware Update (From Tape)

6.1 In This Chapter

Chapter 6 includes the following main topics and sections:

Topic	Section
DLT2000 Firmware Update Overview	Section 6.2
Creating a "Firmware Update Tape"	Section 6.3
Firmware Update Procedure	Section 6.4

6.2 DLT2000 Firmware Update Overview

In the DLT2000 cartridge tape subsystem family, the subsystem can automatically update the controller board 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 loads a tape that includes the DLT2000 firmware image file.

The subsystem automatically reads and verifies the tape information as a valid DLT2000 firmware image. If the image data passes all verifications, it is installed into the controller's nonvolatile code memory.

This chapter details the firmware update procedure.

6.2.1 Before Performing the Procedure

Before performing 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 performing a firmware update, take reasonable precautions to prevent a powerfail.

6.2.1.1 Updating Firmware on a Standalone System

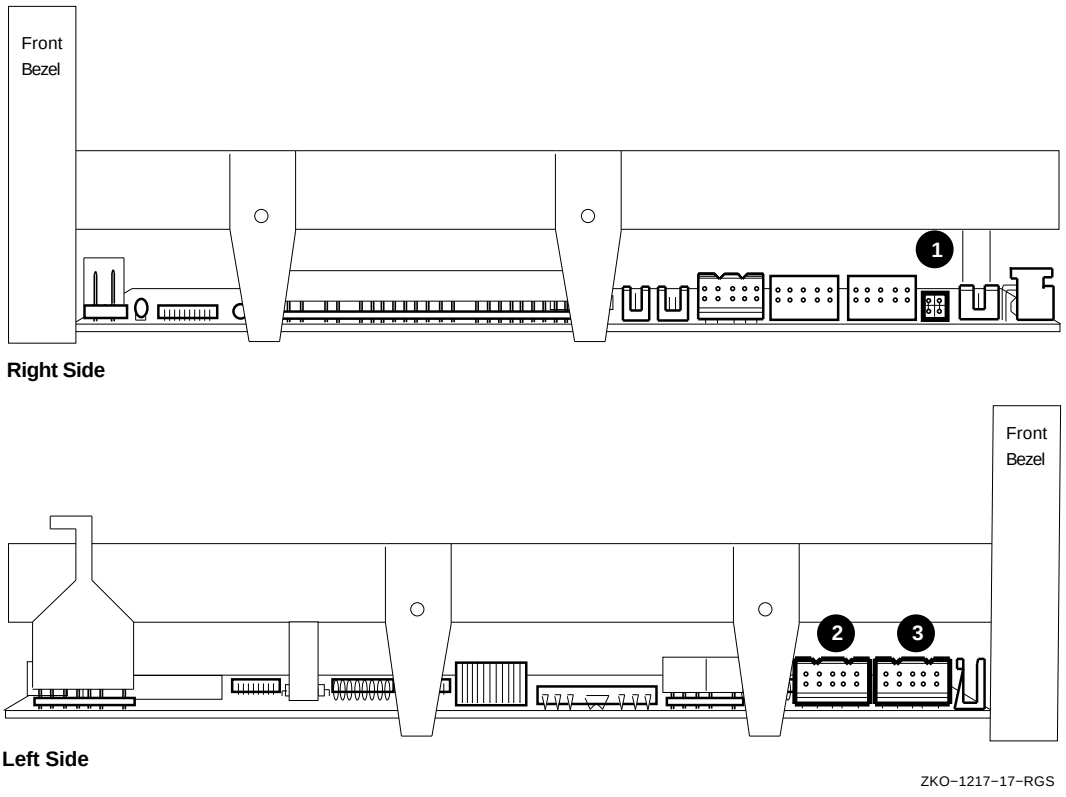
You can update the subsystem, even when the subsystem is not attached to a SCSI bus, that is a standalone system. However, to do an update, the Power-On Self-Test (POST) must pass first, and to pass, POST needs a properly terminated bus.

The DLT2000 controller module has active terminators. Note the jumper covering the two pins labeled on the etch: **TRM PWR/TRM ENB**.

To perform a firmware update on a standalone system:

1. Find the TRM PWR/TRM ENB connector on the DLT2000 drive by using (Figure 6–1, number ❶).

Figure 6–1 DLT2000 Subsystem Connectors



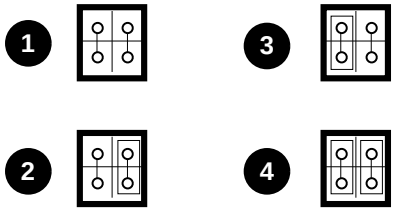
❶ TRM PWR/TRM ENB connector

❷ SCSI ID connector

❸ Loader connector

2. Ensure the TRM PWR/TRM ENB jumpers are in position (Figure 6–2, number ❹).

Figure 6–2 Jumper Settings for the TRM PWR/TRM ENB Connector



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❶ No Term Power/Disable Active Termination	❸ Term Power/Disable Active Termination
❷ No Term Power/Enable Active Termination	❹ Term Power/Enable Active Termination

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

6.3 Creating a "Firmware Update Tape"

To perform the firmware update, you must have a CompacTape cartridge with a copy of the firmware image. The image must be byte written onto the tape in 4K block format. The image must be "copied" onto the tape instead of using the backup utility.

6.4 Firmware Update Procedure

Section 6.4 describes the procedure for updating the firmware (code) of the DLT2000 subsystem controller module. 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 7 for details.

Firmware updates are supported on the DLT2000 with and without the media loader. The steps for performing the update are similiar for each. To update the firmware with the:

- Drive only configuration, see Section 6.4.1
- Drive and loader configuration, see Section 6.4.2

6.4.1 Updating the Firmware on DLT2000 (Drive Only Configuration)

1. Get or make a CompacTape with the firmware image of the desired revision level copied to it.
2. Put the DLT2000 subsystem into firmware update mode. To do this:
   a. Remove any cartridge that is in the target DLT2000 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 light blinks. This means the DLT2000 subsystem has recognized your request for firmware update mode and is waiting for the sequence to complete.

      If Write Protect does not blink, check that:

      1. POST passed
      2. The drive is unloaded
      3. The drive handle is in the down position

   c. Then, release the Unload button and press it again within 4 seconds. The second press should take less than 1 second.
   d. Tape in Use and Write Protect blink, showing the tape subsystem recognizes that firmware update mode was selected.
   e. If selecting the firmware update mode is not successful (for example, because pressing the button the second time takes longer than one second) Write Protect 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 select firmware update mode, insert a cartridge into the drive, which:
   a. Temporarily turns off the Tape in Use and Write Protect lights.

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 DLT2000 firmware image

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

4. If the drive code is up-to-date, the drive code does not go through an update.
5. If the drive code is *not* up-to-date, the drive code goes through an update, taking 2 to 3 minutes.
6. While the drive code goes through the update, the Write Protect and Tape in Use lights flash alternately.
7. When the drive code update completes, the drive resets and goes through POST. The process waits until the tape is reloaded at BOT.
8. 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 lights flash again during the controller firmware update.

6.4.1.1 Interpreting the Results

Two possible results can occur:

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

  On the DLT2000, 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 it depends on why the update failed:

  1. Power failure
  2. Bad image on the tape

3. Broken flash EEPROMs

Table 6–1 gives additional details:

Table 6–1 Results of Firmware 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.
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 lights do not blink. The drive resets and the tape stays loaded to signal that the firmware update was unsuccessful.
The tape contains a valid image, but for some reason 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.

CAUTION

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

6.4.2 Updating the Firmware on the DLT2700 (Drive and Loader Configuration)

1. Get or make a CompacTape with the firmware image of the desired revision level copied to it.
2. Put the DLT2700 subsystem into firmware update mode. To do this:
   a. Remove any magazine in the DLT2700 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 OCP and hold the button (about 6 seconds) until Write Protect blinks. This means the DLT2700 recognizes your request for firmware update mode and is waiting for completion of the sequence.

      If Write Protect 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. Tape in Use and Write Protect blink, showing the subsystem recognizes that firmware update mode has been selected.
   f. If selecting firmware update mode is not successful (for example, not pushing the Unload button properly the second time), Write Protect should stop blinking within several seconds. Try the procedure again.
3. Once you select firmware update mode, press the OCP EJECT button twice to open the receiver door. Write Protect and Tape In Use stop blinking, even though the subsystem is still in Update mode.
4. Place a magazine with the Firmware Update Tape in the first slot into 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 select 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 DLT2700 firmware image

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

   d. If the drive code is up-to-date, it does not go through an update.
   e. If the drive code is *not* up-to-date, it goes through an update, taking 2 to 3 minutes.
   f. While the drive code goes through the update, Write Protect and Tape in Use flash alternately.
   g. When the drive code update is complete, the drive resets and goes through POST. The process waits until the tape is reloaded at 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 6 other cartridges are present, the scan takes an extra minute or more.

6.4.2.1 Interpreting the Results

Two possible results can occur:

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

  On the DLT2700, 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 it depends on why the update failed:

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

Table 6–2 gives additional details:

Table 6–2 Results

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 subsystem 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. This can damage the controller.

7

DLT2000 SCSI Interface

7.1 Overview

This chapter details the SCSI Protocol features the DLT2000 product implements.

The following sections do not fully reiterate the ANSI SCSI specification, but describe which commands, messages, and options are supported, and what the error recovery procedures are.

7.2 General SCSI Bus Operation

7.2.1 Data Transfer

The DLT2000 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 2, 3, or 4 for details.

The DLT2000 supports a maximum block size of 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.

7.2.2 Initiator/Target Operation

The DLT2000 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

7.2.3 SCSI IDs And Logical Unit Numbers (LUNs)

The DLT2000 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 1 to 7. Refer to Section 7.4.9.8.

Unsupported LUNs shall be treated as follows: If the LUN specified in the IDENTIFY message is invalid, the DLT2000 shall accept the Command Descriptor Block (CDB). There are three cases of what happens next:

1. If the command is INQUIRY, the target shall return 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 shall return sense data. The sense key shall be ILLEGAL REQUEST, with an additional sense code of INVALID Logical Unit Number.
3. For any other command, the target shall terminate the command with CHECK CONDITION status, and generate the above Sense Data.

7.2.4 Unit Attention Condition

Queued Unit Attentions are implemented on this device, and are maintained separately for each valid LUN for each Initiator. Unit Attentions will be created in the following circumstances:

Power on
BUS Reset
Bus Device Reset message
When the media may have changed asynchronously
Another initiator changed the Mode Parameters
A firmware (microcode) update has completed

Two queued Unit Attentions are not unusual. For example, if a unit is powered up and 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 clear Unit Attentions queued for it, at some point the tape device will stop generating 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 command since the transition to ready is synchronous.

7.2.5 Behavior Around Power-On and SCSI Bus Reset

- All device SCSI lines shall go to high impedance when the DLT2000 is powered off.
- The DLT2000 will not generate any spurious signals on the SCSI bus at power-on.
- Within 5 seconds of power on, and within 250 milliseconds (typically under 4 ms) after a Bus Reset, the DLT2000 will respond to SCSI bus selections and return appropriate, normal, responses. Tape motion commands will be returned with Check Condition status, Sense Key Not Ready, until the media has been made ready.
- The Hard Bus Reset option is implemented.
- The media is rewound to BOP.

The DLT2000 will be able to recognize multiple bus resets in succession and bus resets of arbitrarily long duration. It will recover within the time limits specified above, following the last bus reset.

7.2.6 Data Cache and Tape Write Interaction

The DLT2000 contains a data cache that buffers blocks (records) until they are written. This section defines specific times that blocks shall be written to 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.

The write data cache shall be 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" shall be automatically written to media.
- When a nonwrite type media access command is received (for example, SPACE, READ, UNLOAD, . . .)

7.2.7 Other SCSI Functionality

1. Linked commands are supported.
2. Untagged queuing is supported
3. The DLT2000 does not use the Wide-SCSI data path.

7.2.8 Bus Phases

The DLT2000 conforms to the bus state transition table shown in the SCSI-2 standard, "Phase Sequences." The information in the following sections also applies.

7.2.9 ATTENTION Signal Response

The DLT2000 will respond to an ATN condition at least at every phase transition, as long as the initiator sets the ATN bit before the target deasserts the REQ for the last byte of the previous phase. Generally ATN will be recognized immediately by the DLT2000 and it will change the bus phase to Message Out.

7.2.10 STATUS phase

The DLT2000 will enter the status phase just once per command, unless a retry is requested by the initiator. The only exception is during error cases when the device goes immediately to bus free, as defined in the SCSI-2 standard (Section 6.3 of rev 10c).

Status bytes the tape drive returns are:

- GOOD (00): This status indicates the drive successfully completed the command.
- CHECK CONDITION (02): A contingent allegiance condition occurred. The REQUEST SENSE command should be sent following this status to determine the nature of the event.
- BUSY (08): The target is busy. This status is returned whenever the device is unable to accept a command from an otherwise acceptable initiator. The initiator should reissue the command at a later time.
- INTERMEDIATE GOOD (10h): This status is returned instead of GOOD status for commands issued with the LINK bit set. Following the return of this status, the drive will proceed to the COMMAND phase for the transfer of the next linked command.

- RESERVATION CONFLICT (18h): This status is returned by the drive whenever a SCSI device attempts to access the drive when it has been reserved for another initiator with a RESERVE UNIT command.
- COMMAND TERMINATED (22h): This is the status returned for a command that was terminated by a TERMINATE I/O PROCESS message. This status also indicates that a contingent allegiance condition has occurred.
- QUEUE FULL (28h): This status is returned when a QUEUE TAG type message is received and the command queue is full. The command received is discarded.

NOTE

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

In the not ready state, the initiator cannot perform any operation which would cause tape motion (write, read, verify, space). These commands will return a CHECK CONDITION status with a DRIVE NOT READY sense key. The initiator may, however, execute commands that do not require access to the media 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.

7.3 SCSI Message System

The message system allows communication between an initiator and a target for the purpose of physical path management.

To support certain SCSI-1 initiators, an Identify message is not required by the DLT2000. If a message is sent by the initiator after the SELECTION phase, it should be an IDENTIFY, ABORT, or BUS DEVICE RESET message. If the DLT2000 receives any other message in this case, it will go directly to BUS FREE phase.

The following messages are supported:

Table 7–1 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->FF	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.

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 aborts the command currently being executed and proceeds to the BUS FREE state. The drive then executes a hard reset which leaves it as if a Bus Reset had occurred. All data in the write buffer is lost.

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.

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 the 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 microseconds 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:

Figure 7–1 Extended Message Format

Byte 0	Extended Message Identifier − 01h
Byte 1	Extended Message Length
Byte 2	Extended Message Code
Byte 3	Extended Message additional parameters

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
02h - Reserved
03h - WIDE DATA TRANSFER REQUEST (not supported)
04h-7Fh - Reserved
80-FFh - Vendor Unique

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 DLT2000 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 shall be to switch to the MESSAGE IN phase and resend 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 to be 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.

The tape drive accepts this message if in the initiator mode (while performing a COPY command). 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. DLT2000 will *not* initiate the Synchronous Data Transfer Request message, but relies on the Initiator to do so. The SDTR message has the following format:

Figure 7–2 SDTR Extended Message 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)

7.4 Tape Drive SCSI Commands

7.4.1 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.

7.4.2 Summary of Supported Sequential-Access Device Commands

The following table shows what SCSI commands are supported by the DLT2000 tape drive.

Table 7–2 DLT2000 Supported SCSI Commands

Opcode	Command	Section
19	ERASE	Section 7.4.3
12	INQUIRY	Section 7.4.4
1B	LOAD-UNLOAD	Section 7.4.5
2B	LOCATE	Section 7.4.6
4C	LOG SELECT	Section 7.4.7
4D	LOG SENSE	Section 7.4.8
15	MODE SELECT	Section 7.4.9
1A	MODE SENSE	Section 7.4.10
1E	PREVENT/ALLOW MEDIUM REMOVAL	Section 7.4.11
08	READ	Section 7.4.12
05	READ BLOCK LIMITS	Section 7.4.13
3C	READ BUFFER	Section 7.4.14
34	READ POSITION	Section 7.4.15
1C	RECEIVE DIAG RESULTS	Section 7.4.16
17	RELEASE UNIT	Section 7.4.17
03	REQUEST SENSE	Section 7.4.18
16	RESERVE UNIT	Section 7.4.19
01	REWIND	Section 7.4.20
1D	SEND DIAGNOSTIC	Section 7.4.21
11	SPACE	Section 7.4.22
00	TEST UNIT READY	Section 7.4.23
13	VERIFY	Section 7.4.24
0A	WRITE	Section 7.4.25
3B	WRITE BUFFER	Section 7.4.26
10	WRITE FILEMARK	Section 7.4.27

7.4.3 ERASE 19h

Figure 7–3 ERASE CDB

Byte	Bit 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

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

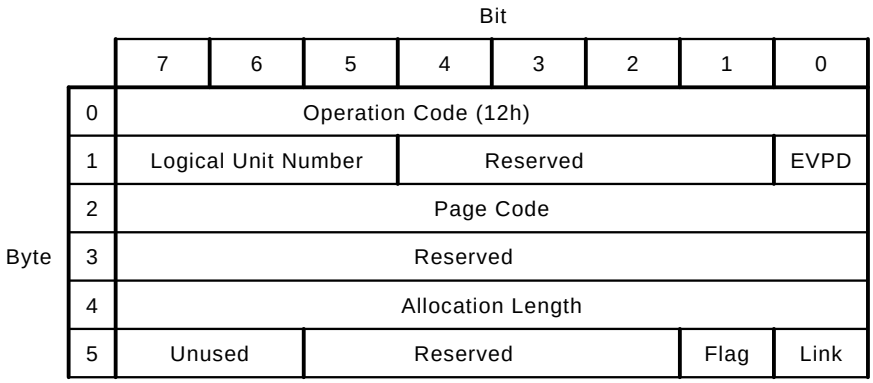
The Long bit controls the distance to be erased. If the bit is set, filler and EOD blocks will be written if needed, and then the entire rest of the tape will be erased.

NOTE

This command is a NOP on the DLT2000 unless the Long bit is set.

7.4.4 INQUIRY 12h

Figure 7–4 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 DLT2000 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 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.

7.4.4.1 Drive Inquiry Response

The DLT2000 passes back the following information in response to an INQUIRY command on the drive LUN.

Figure 7–5 INQUIRY Response Data

	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	AENC	TrmIOP	Reserved		Response Data Format			
4	Additional Length (33h)							
5	Reserved							
6	Reserved							
7	RelAdr	WBus32	WBus16	Sync	Linked	Rsrved	CmdQue	SftRe
08−15	Vendor ID = "DEC "							
16−31	Product ID = "DLT2000 (C) DEC"							
32−35	Product Revision Level = "hhss"							
36−55	Vendor Unique bytes							

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.

RMB

The Removable Medium bit is one.

Device-Type Modifier

The Device-Type Modifier is set to 0

ISO Version

The ISO Version is set to 0.

ECMA Version

The ECMA Version is set to 0

ANSI Approved Version

The ANSI Approved Version is set to 2, indicating compliance with SCSI-2.

AENC

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

TrmIOP

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

Response Data Format

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

Additional Length

Additional Length—The tape drive sets this field to indicate the number of additional bytes of INQUIRY Response Data available. This value is not adjusted to reflect the actual number of bytes which will be transferred (possibly determined by the Allocation Length specified by the initiator).

Sync

Sync - Set to 1 (synchronous data transfers supported)

Linked

Linked - Set to 1 (linked commands supported)

Vendor Identification

Vendor Identification—see Figure 7–6

Product Identification

Product Identification—see figure.

NOTE

If a Media Loader is attached to the tape drive , the Product ID will indicate "DLT2700" instead of "DLT2000."

Product Revision Level

Product Revision Level—This field contains four bytes of ASCII data, which define the product's software Revision Levels. The first two bytes are the servo firmware version #, the second two bytes are the read/write firmware version #. When a firmware update is performed on the DLT2000, this part of the Revision Level field will change appropriately.

Vendor Specific

Vendor Specific—(see below)

Figure 7–6 INQUIRY Vendor Unique Bytes Definition

36	Released SCSI (controller) 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 | 55	VU−reserved

Vendor Specific Inquiry Bytes

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

Released Flag

This flag differentiates between released and test versions of firmware. A 1 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 nonzero Minor FW Version numbers for tracking purposes.

Various Version Numbers

In binary, not ASCII (see figure).

Firmware Personality

Numeric indicator of firmware personality. Set to 4.

Sub-Personality

Further differentiates product versions, currently set to a 1.

Loader Present

Nonzero if a Media Loader is present.

7.4.4.2 Vital Product Data pages

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

Figure 7–7 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)							

Figure 7–8 Unit Serial Number Page

	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							

Serial Number

The serial number is the serial number of the printed circuit card mounted on the bottom of the DLT2000. It can be found on the bar code label. The serial number is returned in ASCII.

Figure 7–9 Firmware Build Information page - VU

	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 Checksum							
8–11	Read/Write Firmware Checksum							
12–35	Read/Write Firmware Build Date							

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.

7.4.4.3 Media Loader Inquiry Response

The DLT2000 controller generates INQUIRY Data on the Medium Changer LUN that is very similar to 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 "TZ Media Changer"

7.4.5 LOAD-UNLOAD 1Bh

Figure 7–10 LOAD-UNLOAD CDB

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

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.

There are two possible modes of operation possible when a media loader is attached. If none of the media loader specific commands have 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 it originated from. 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.

If 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 an SCSI Move Medium command.

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:

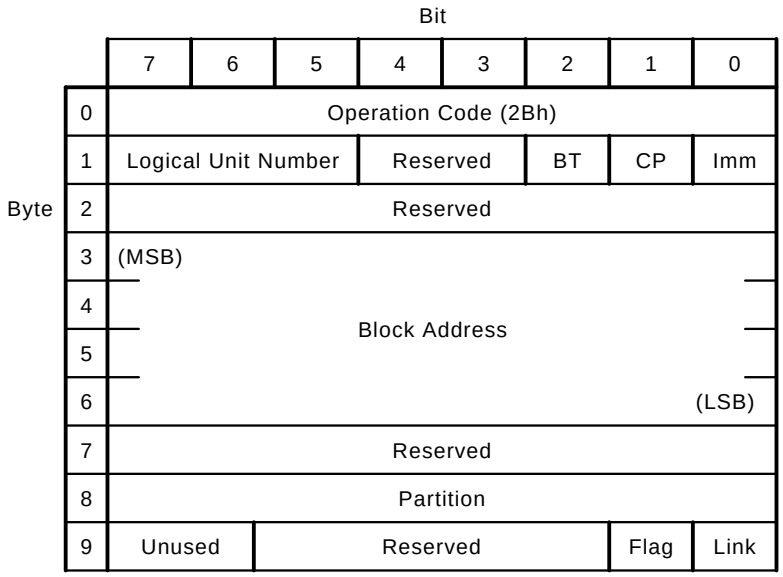
- Immed—If this bit is set, status is returned as soon as the operation is started. Otherwise, the status is returned after the operation has completed.
- Re-Ten—Re-tension operations are not needed on the DLT2000, so this bit is ignored.
- Load—When a cartridge is inserted, the media is automatically 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 an filemarks to the tape and rewinds the tape to BOM and unloads the media into the DLT2000 cartridge. The "Operate Handle" green LED lights 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 DLT2000, unless both the EOT and Load bits are both set, then the drive returns CHECK CONDITION, ILLEGAL REQUEST.

7.4.6 LOCATE 2Bh

Figure 7–11 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 DLT2000 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 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.

7.4.7 LOG SELECT 4Ch

Figure 7–12 LOG SELECT CDB

Byte	Bit 7	6	5	4	3	2	1	0
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) Parameter List Length							
8	(LSB)							
9	Unused			Reserved			Flag	Link

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:

Figure 7–13 LOG Page Control Definitions

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

All types of parameter values all changeable through Log Select.

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 above).

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.

7.4.7.1 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.

To achieve this, during the DATA OUT phase the initiator must send the log page header of the page to be cleared, with the Page Length field set to 0. The following pages can be cleared in this manner:

Figure 7–14 Clearable Log Pages

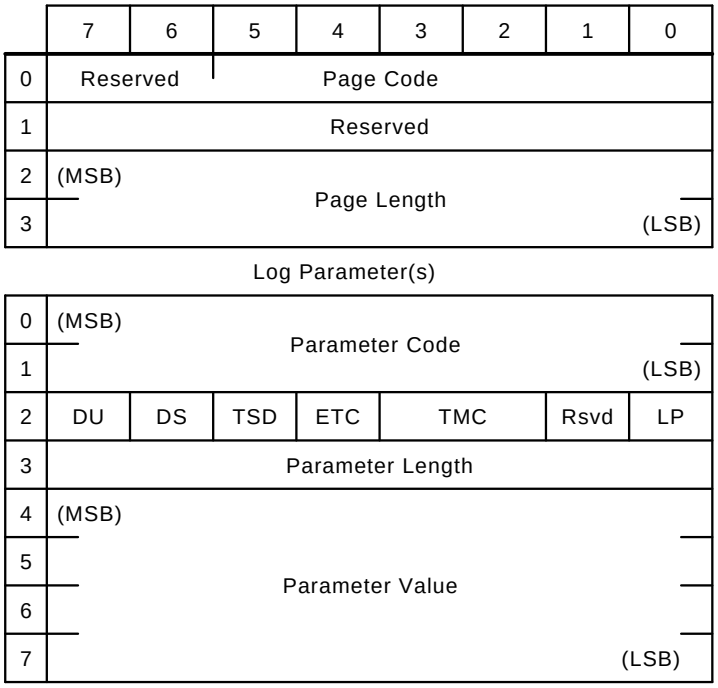
Page Code	Page Description
02h	Write Error Counter Page
03h	Read Error Counter Page
32h	Compression ratio page

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 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.

Figure 7–15 Read/Write Error Log Select Page Format



Parameter Code

The following parameter codes are supported for the read/write error counter pages.

Figure 7–16 Parameter Codes Supported

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	Total uncorrected errors
8000h	Vendor Unique

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

Note

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

Byte 2 of Log parameter block in Figure 7–15 is referred to as parameter control byte.

- DU—Disable Update—not defined for LOG SELECT and target shall ignore 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 1, Drive shall perform a comparison with threshold values once the cumulative value is updated. Comparison criteria is defined in TMC. If the comparison is met and RLEC bit of MODE SELECT/SENSE Control Page is set 1 then a UNIT ATTENTION IS generated for all initiators. The additional sense code set to LOG EXCEPTION and the additional sense code qualifier set to THRESHOLD CONDITION MET. If RLEC bit is zero and comparison is met then UNIT ATTENTION IS NOT generated.

- TMC—Threshold Met Criteria: See Figure 7–23 for the list of criteria. Once the specified criteria in this field is met and ETC bit is 1 and RLEC bit in MODE SENSE/SELECT Control Page is set 1 then UNIT ATTENTION is generated for all initiators.
- LP—List Parameter: This bit should always be set to 0 to indicate that parameter codes are treated as data counters.

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

7.4.8 LOG SENSE 4Dh

Figure 7–17 LOG SENSED CDB

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) Parameter Pointer							
6	(LSB)							
7	(MSB) Allocation Length							
8	(LSB)							
9	Unused		Reserved				Flag	Link

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 PPC 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 shall be 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.

Figure 7–18 LOG Page Control Definitions

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

The Default Threshold Values are the maximum values that each parameter can attain.

The Current Cumulative Values are the values computed since the last reset of the device (either 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 above. 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.

Figure 7–19 LOG SENSE Pages Supported

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

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

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.

7.4.8.1 Supported Pages Page Format

When page 0 is requested, the 4 byte page header is returned followed by the pages supported in ascending order, one byte for each.

Figure 7–20 Supported Pages Page Format

	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							

7.4.8.2 Read/Write Error Log SENSE Page format (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.

Figure 7–21 Read/Write Error Log SENSE Page Format

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

Log Parameter(s)

	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 | | | 11	(MSB) Parameter Value							
	(LSB)							

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, 8000h each page will be of 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.

Figure 7–22 Parameter codes Supported

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	Total uncorrected errors
8000h	Vendor Unique

DU, DS, TSD, ETC, TMC, and LP are collectively referred to as parameter control byte.

- DU—Disable Update: A zero value indicates that target shall update 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 reaches its maximum. This is also returned set if the host set the bit in 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; therefore this bit will always be set to 1.
- TSD—Target Save Disable: Saving parameters is not supported; therefore 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 1 by MODE SELECT. Default is zero.

- TMC—Threshold Met Criteria: This field is valid only if the host sets ETC to 1. It determines the basis for comparison and is specified by the 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, a user does 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 upon 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.

Figure 7–23 Threshold Met Criteria

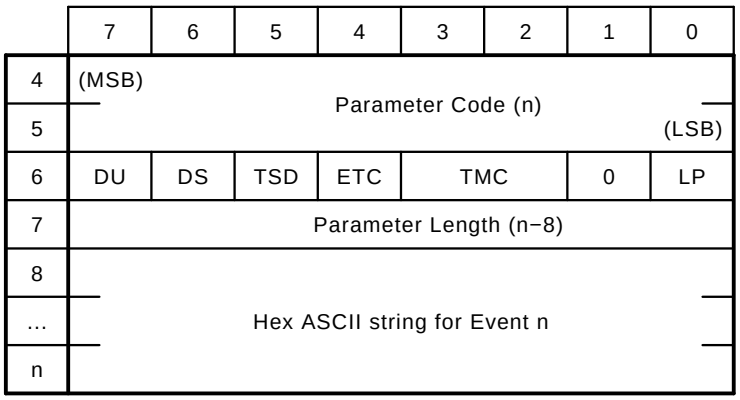
Code	Basis of Comparison
00b	Every update of the cumulative value
01b	Cumulative value equal to threshold value
10b	Cumulative value not equal to threshold value
11b	Cumulative value greater than threshold value

- 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 shall not increment and DU bit shall be 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.

7.4.8.3 Last n Error Events Page

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 in the 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 number is equal to, or the first one greater than, the Parameter Number specified in the CDB.

Figure 7–24 Last n Error Events Page



7.4.8.4 Read/Write Compression Ratio Log SENSE Page format

The Read/Write Compression Ratio page begins with a 4-byte header followed by the log parameter blocks of either 6 or 8 bytes, depending on the parameter code selected.

Parameter Codes

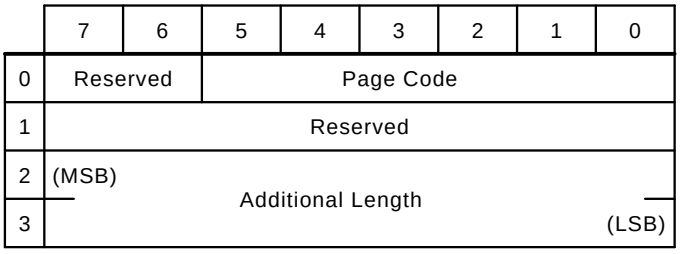
The following parameter codes are supported for the Read/Write Compression Ratio page.

Figure 7–25 Parameter Codes Supported

Parameter Code	Description
00h	Read Compression Ratio x 100
01h	Write Compression Ratio x 100
02h	MBytes Transfered to Host
03h	Bytes Transfered to Host
04h	MBytes Read From Tape
05h	Bytes Read From Tape
06h	MBytes Transfered From Host
07h	Bytes Transfered From Host
08h	MBytes Written to Tape
09h	Bytes Written to Tape

Read/Write Compression Ratio Page Header

Figure 7–26 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

Figure 7–27 Read/Write Compression Ratio LOG SENSE Page Format

	7	6	5	4	3	2	1	0
0	(MSB)							
1	Parameter Code							(LSB)
2	DU	DS	TSD	ETC	TMC		Rsvd	LP
3	02h							
4	(MSB)							
5	Compression Ratio x 100							(LSB)

Parameter Control Byte

- DU—Disable Update: This bit is always zero.
- DS—Disable Save: Saving parameters is not supported; therefore this bit will always be set to 1.
- TSD—Target Save Disable: Saving parameters is not supported; therefore this bit will always be set to 1.
- ETC—Enable Threshold Comparison: Threshold checking is not supported on this page, therefore 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

Figure 7–28 Read/Write Bytes Transfered LOG SENSE Page Format

	7	6	5	4	3	2	1	0
0	(MSB)							
1	Parameter Code							(LSB)
2	DU	DS	TSD	ETC	TMC		Rsvd	LP
3	04h							
4	(MSB)							
5								
6	Counter Value							
7								(LSB)

Parameter Control Byte

- DU—Disable Update: This bit is always zero.
- DS—Disable Save: Saving parameters is not supported; therefore this bit will always be set to 1.
- TSD—Target Save Disable: Saving parameters is not supported; therefore this bit will always be set to 1.
- ETC—Enable Threshold Comparison: Threshold checking is not supported on this page, therefore 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.

7.4.9 MODE SELECT 15h

Figure 7–29 MODE SELECT CDB

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

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.

SP

This bit must be zero. The Save Parameters bit instructs the drive to save all savable pages. This is not supported.

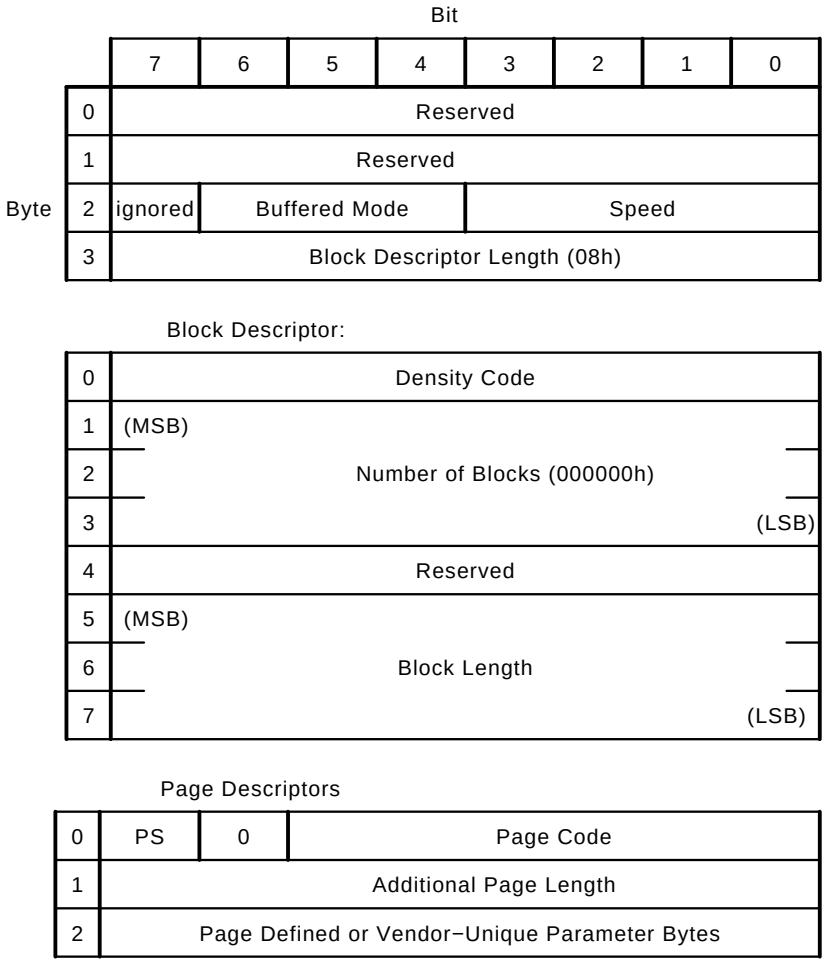
PARAMETER LIST LENGTH

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.

7.4.9.1 MODE SELECT Parameter List

The MODE SELECT parameter list shown below, contains a 4-byte header, followed by one 8-byte block descriptor.

Figure 7–30 MODE SELECT Parameter List



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.

If 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 GB formats, if the block size is a multible of 4 Kbytes, there is no capacity loss. When using the 10 GB format, if compression is disabled and the block size is a multible of 8 Kbytes, there is no capacity loss. When using the 10 GB format and compression enabled, not having buffered mode enabled will cause some capacity loss, depending upon 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 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 it 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 GB

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 (fixed block mode) which also causes the transfer length in the CDB to be defined as a block count.

7.4.9.2 MODE SELECT Pages

Following the Block Descriptor are the MODE SELECT pages, which set the device parameters. Each page has a 2-byte header that identifies the page code and indicates the number of bytes in that page.

The Page Codes supported are as follows:

Figure 7–31 MODE SELECT Pages Supported

Page Code	Description	Sense/ Select
00h	No requested page	Sense
0Ah	Control mode page	both
10h	Device Configuration	both
02h	Disconnect/Reconnect	both
01h	Error Recovery Page	both
11h	Medium partition Parameters	both
3Eh	EEPROM Parameter Select	Select
3Fh	All pages	Sense

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. (Saveable 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 that are not supported or not changeable. In this case, no parameters will be changed by the command.

7.4.9.3 Control Mode Page

The control mode page (Figure 7–32) provides controls over several features such as tagged queuing, extended contingent allegiance, asynchronous event notification, and error logging.

Figure 7–32 Control Mode Page

	7	6	5	4	3	2	1	0
0	RSVD		Page Code					
1	Page Length							
2	RSVD							RLEC
3	Queue Algorithm Modifier				Reserved		QErr	DQue
4	EECA	Reserved				RAENP	UAAENP	EAENP
5	Reserved							
6	(MSB) Ready AEN Holdoff Period							
7	(LSB)							

A report log exception condition (RLEC) bit of one specifies the target shall report log exception conditions. A RLEC bit of zero specifies the target shall not report 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 indicates whether the DLT2000 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 DLT2000 does not support the Simple Queue Tag message, so this field must be 0.

Byte 03, Bit 1—QErr (Queue Error)

The DLT2000 does not support the Simple Queue Tag message, so this bit must be 0.

Byte 03, Bit 0—DQue (Disable Queuing)

The DLT2000 does not support the Simple Queue Tag message, so this bit must be 1.

Byte 04, Bit 7—EECA (Enable Extended Contingent Allegiance)

The DLT2000 does not support extended contingent allegiance, so this bit must be 0.

Byte 04, Bit 2—RAENP (Ready AEN Permission)

The DLT2000 does not support asynchronous event notification (AEN), so this bit must be 0.

Byte 04, Bit 1—UAAENP (Unit Attention AEN Permission)

The DLT2000 does not support asynchronous event notification, so this bit must be 0.

Byte 05 and 06—Ready AEN Holdoff Period

The DLT2000 does not support asynchronous event notification, so this field must be 0.

7.4.9.4 Device Configuration Page (10h)

The drive supports the Device Configuration Page which has the following format:

Figure 7–33 Device Configuration Page Format

Byte	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 Empty Ratio							
6	(MSB) Write Delay Time							
7	(LSB							
8	DBR	BIS	RSmk	AVC	SOCF		RBO	REW
9	Gap Size							
10	EOD Defined			EEG	SEW	Reserv ed		
11	(MSB) Buffer Size at Early Warning (optional)							
12								
13	(LSB)							
14	Select Data Compression Algorithm							
15	Reserved							

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. DLT2000 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 50 (32h). This causes the buffer to be flushed in 5 seconds. Maximum value is 6500 (1964h) and the minimum is 10 (0Ah). This represents delays from almost 11 minutes down to 1 second.

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 and Buffer Size at EW fields are not supported and must be zero.

Select Data Compression Algorithm

A one enables data compression, a zero disables it.

The front panel setting will overrride 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.

7.4.9.5 Disconnect/Reconnect Page (02h)

The drive shall support the Disconnect/Reconnect Page which has the following format:

Figure 7–34 Disconnect/Reconnect Page Format

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

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)

This option is not supported, so this field should be zero.

7.4.9.6 Medium Partition Page (11h)

The drive supports the Medium Partitions Parameter Page, which has the following format.

Figure 7–35 Medium Partition Page Format

Byte	Bit 7	6	5	4	3	2	1	0
0	PS	0	PageCode(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							

In this page, no parameters are changeable.

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.

7.4.9.7 Read/Write Error Recovery Page (01h)

The drive shall support the Error Recovery Page which has the following format.

Figure 7–36 Error Recovery Page Format

Byte	Bit 7	6	5	4	3	2	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							

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.

7.4.9.8 EEROM Vendor Unique Page (3Eh)

The drive shall support a vendor unique page which may be used to modify savable parameters. This page is only supported with the Mode Select command. Only one savable parameter may be changed per mode select command. It has the following format:

Figure 7–37 EEROM Vendor Unique Page Format

0	PS	0	Page Code
1	Additional Page Length		
2	ASCII String of parameter name and value		

The ASCII string has a parameter name, followed by one or more space characters, a parameter value, and an ASCII line feed or null character. When the string is parsed the parameter value will be interpreted as indicated in the following table. The parameter name may be in upper- or lowercase.

Table 7–3 EEROM Vendor Unique Page Parameters

Name	Value Representation	Default	Usage
VENDORID	ASCII	DEC	Vendor Identification field in Inquiry Data
PRODUCTID	ASCII	DLT2000	Product Identification field in Inquiry Data
FORCEDENSITY	ASCII Decimal	0	0=automatic,1=THZ01,2=THZ02, 3=DLT2000
FORCECOMP	ASCII Decimal	0	0=automatic,1=Always compress unless front panel selection disables it
DEFAULTCOMPON	ASCII Decimal	1	0=Compression defaulted off on powerup/reset, 1=Compression defaulted to on, on powerup/reset
DEFFIXEDBLKLEN	ASCII Decimal	0	Default fixed block size
ENBINQMEDCHGR	ASCII Decimal	0	0=disable media changer bit,1=enable media changer bit in byte 6 of inquiry data
LOADERLUN	ASCII Decimal	1	1-7 = LUN to report media loader device on
REWINDONRESET	ASCII Decimal	0	0=Do not rewind on Bus Reset or BDR msg, 1=Rewind the media to BOT on reset events

This example of a EEROM vendor unique page will modify the VENDORID parameter to "XXXYY ."

Figure 7–38 EEROM Vendor Unique Page Example 1

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	"X" (58H)		
14	"Y" (59H)		
15	"Y" (59H)		
16	<LF> (0AH) or (00H)		

This example of an EEROM vendor unique page will modify the FORCEDENSITY parameter to 1.

Figure 7–39 EEROM Vendor Unique Page Example 2

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)		

7.4.9.9 MODE SELECT Changeable Parameters

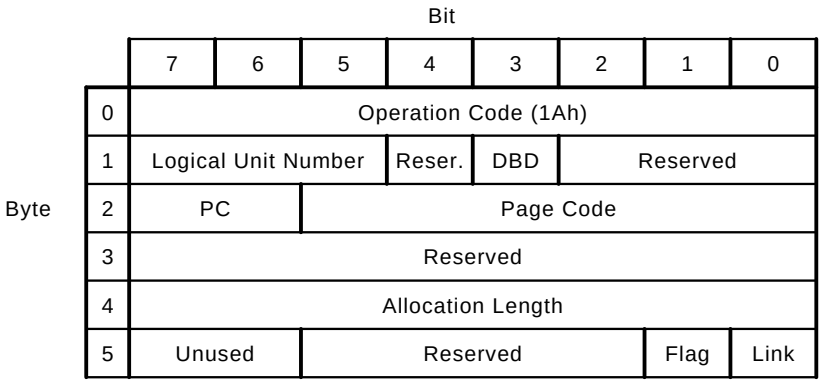
The following table lists the changeable mode parameters and their minimum and maximum values allowed. See the previous definitions for the units that are used. Parameter rounding is supported for all parameters except the block descriptor length.

Table 7–4 Changeble 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 and 20.0 GB mode	0	0	FFFFFFh
Read-Write Error Recovery: PER Bit	0	0	1
Control Mode: RLEC	0	0	1
Disconnect-Reconnect: Maximum Burst Size	0080h	0000h	FFFFh
Device Configuration: Write Delay Time	C8h	Fh	1964h
Device Configuration: Select Data Compression Algorithm	1	0	1

7.4.10 MODE SENSE 1Ah

Figure 7–40 MODE SENSE CDB



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:

Figure 7–41 MODE SENSE Page Control Definition

PC	Description
0 0	Report Current Values
0 1	Report Changeable Values
1 0	Report Default Values
1 1	Report Saved Values

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.

7.4.10.1 MODE SENSE Parameter List

The MODE SENSE 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:

Figure 7–42 MODE SENSE Data Header

		Bit							
		7	6	5	4	3	2	1	0
Byte	0	Sense Data Length							
	1	Reserved							
	2	WP	Buffered Mode			Speed (0h)			
	3	Block Descriptor Length (08h)							

Figure 7–43 MODE SENSE Block Descriptor

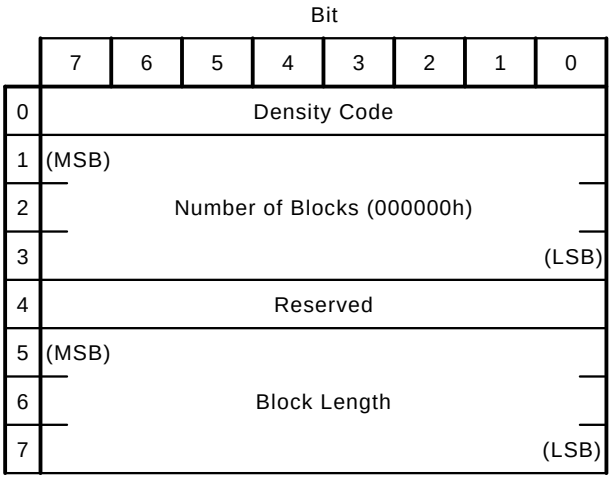
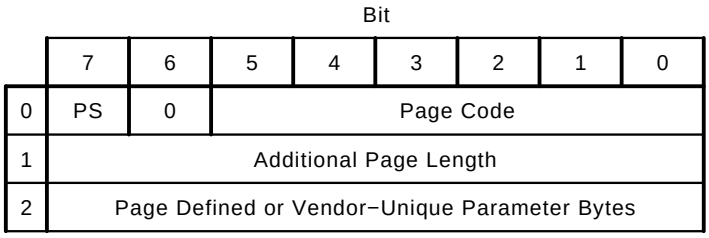


Figure 7–44 MODE SENSE Page Descriptor



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.

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 versus 24) - 6.0 GB
19h—62500 bpi, 64 track pairs, serial cart tape - 10 GB

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 (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).

7.4.10.2 MODE SENSE 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 Page Codes supported are as follows:

Figure 7–45 MODE SENSE Pages Supported

Page Code	Description	Sense/ Select
00h	No requested page	Sense
0Ah	Control mode page	both
10h	Device Configuration	both
02h	Disconnect/Reconnect	both
01h	Error Recovery Page	both
11h	Medium partition Parameters	both
3Eh	EEPROM Parameter Select	Select
3Fh	All pages	Sense

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. (Saveable 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.

7.4.10.3 Device Configuration Page (10h)

The drive shall support the Device Configuration Page which has the following format:

Figure 7–46 Device Configuration Page Format

Byte	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 Empty Ratio							
6	(MSB) Write Delay Time							
7	(LSB							
8	DBR	BIS	RSmk	AVC	SOCF		RBO	REW
9	Gap Size							
10	EOD Defined			EEG	SEW	Reserv ed		
11	(MSB) Buffer Size at Early Warning (optional)							
12								
13	(LSB)							
14	Select Data Compression Algorithm							
15	Reserved							

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.

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. DLT2000 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). Note that 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 (Fh). This represents delays from almost 11 minutes down to 1 second.

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.

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.

SEW and Buffer Size at Early Warning

The Synchronize at Early Warning bit and Buffer Size at EW fields are not supported and will be zero.

Select Data Compression Algorithm

A one enables data compression and a zero disables data compression.

7.4.10.4 Disconnect/Reconnect Page (02h)

The drive shall support the Disconnect/Reconnect Page which has the following format:

Figure 7–47 Disconnect/Reconnect Page Format

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

The following parameters in this page are supported:

Maximum Burst Size

This value specifies the maximum amount a 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 option is not supported, so this field will be zero.

7.4.10.5 Medium Partition Page (11h)

The drive supports the Medium Partitions Parameter Page, which has the following format:

Figure 7–48 Medium Partition Page Format

Byte	Bit 7	6	5	4	3	2	1	0
0	PS	0	PageCode(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							

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.

7.4.10.6 Read/Write Error Recovery Page (01h)

The drive shall support the Error Recovery Page which has the following format:

Figure 7–49 Error Recovery Page Format

Byte	Bit 7	6	5	4	3	2	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							

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

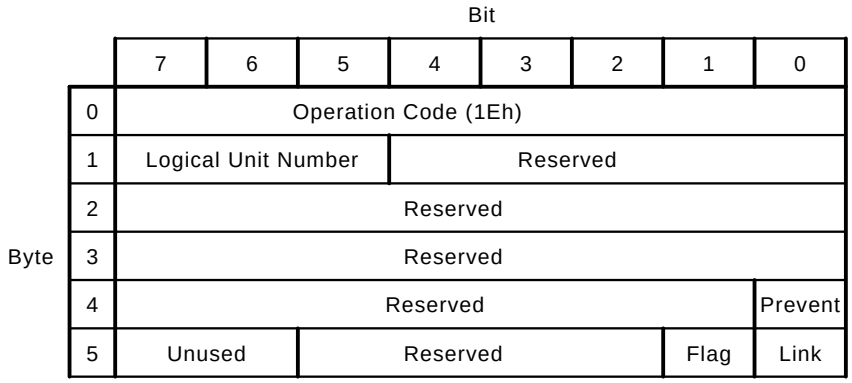
This field reports the maximum number of rereads that are done before declaring an unrecoverable error.

Write Retry Count

This field reports the maximum number of overwrite retries that will be performed before declaring an unrecoverable error.

7.4.11 PREVENT/ALLOW MEDIUM REMOVAL 1Eh

Figure 7–50 PREVENT/ALLOW MEDIUM REMOVAL CDB



This command enables or disables Unloading of the tape cartridge.

Prevent

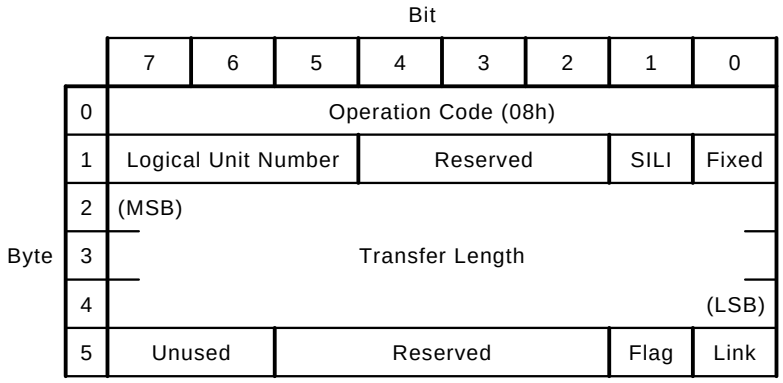
If this bit is set, the Unload button on the drive front panel is effectively disabled, and the UNLOAD command will not unload the media or the cartridge. The Prevent/Allow status in the device is maintained separately for each initiator.

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 Unload button and Unload commands reenabled. By default after power up, hard 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 remove a cartridge if PREVENT has been selected.

7.4.12 READ 08h

Figure 7–51 READ CDB



READ transfers one or more data blocks to the initiator starting with the next block on the drive.

Fixed

This bit specifies 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, a Variable Block mode is requested. A single block is transferred with the Transfer Length specifying the maximum number of bytes the initiator has allocated for the returned data.

If the Fixed bit is set to one, the Transfer Length specifies the number of blocks to be transferred to the initiator. This is valid only if the logical unit is currently operating in Fixed Block mode.

When the Transfer Length is zero, no data is transferred and the current position on the logical unit is not changed.

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 media is logically positioned after the last block transferred (EOM side).

SILI

If the Suppress Incorrect Length Indicator bit is set the target will not return CHECK CONDITION status if the only error is that the transfer length is not equal to the actual block length recorded on the media. All other error conditions are still reported.

If the SILI bit is not set and the actual block length is different from the specified transfer length, a CHECK CONDITION status is returned. Within the Sense data, the Incorrect Length Indicator (ILI) bit and Valid bit will be set to 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).

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 End of Data (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.

7.4.13 READ BLOCK LIMITS 05h

Figure 7–52 READ BLOCK LIMITS CDB

Byte	Bit 7	6	5	4	3	2	1	0
0	Operation Code (05h)							
1	Logical Unit Number			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							
5	Unused		Reserved				Flag	Link

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.

Figure 7–53 READ BLOCK LIMITS Data

Byte	Bit 7	6	5	4	3	2	1	0
0	Reserved							
1	(MSB)							
2	Maximum block length							
3								(LSB)
4	(MSB)	Minimum block length (0001h)						
5								(LSB)

Maximum block length

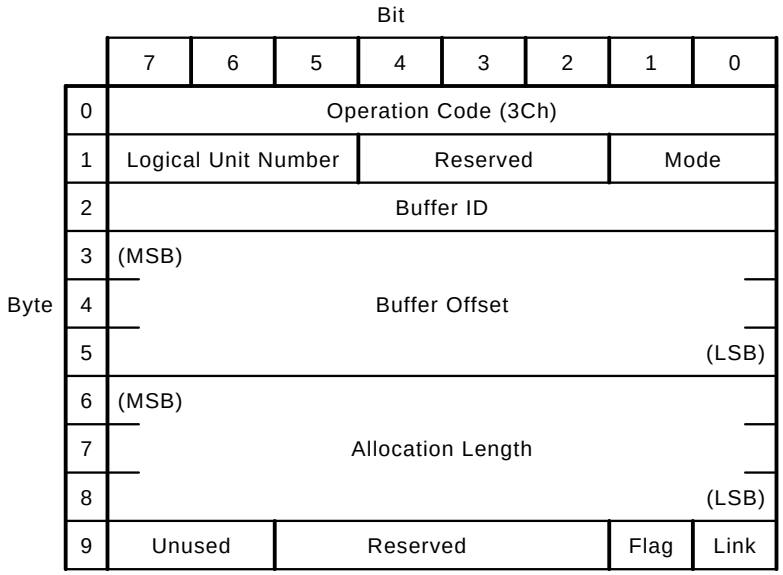
This field indicates the maximum block size. The device supports a maximum block length of 16,777,215 bytes (16 MB-1) for the 10 GB format. A maximum block length of 256k bytes is supportted for 2.6 GB or 6.0 GB formats.

Minimum block size

This field indicates the minimum block size. The device supports a minimum block length of 1 byte.

7.4.14 READ BUFFER 3Ch

Figure 7–54 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.

Figure 7–55 READ BUFFER Modes Supported

Mode	Description
000b	Combined Header and Data
010b	Data
011b	Descriptor

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.

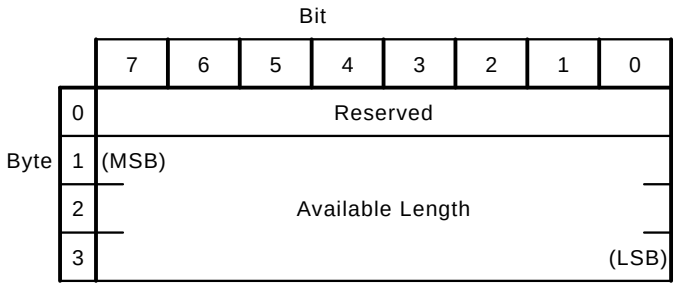
Allocation Length

The Allocation Length specifies the maximum number of bytes that the initiator has allocated for returned data.

7.4.14.1 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's data buffer. The header has the following format:

Figure 7–56 READ BUFFER Data Header



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.

7.4.14.2 Data Mode

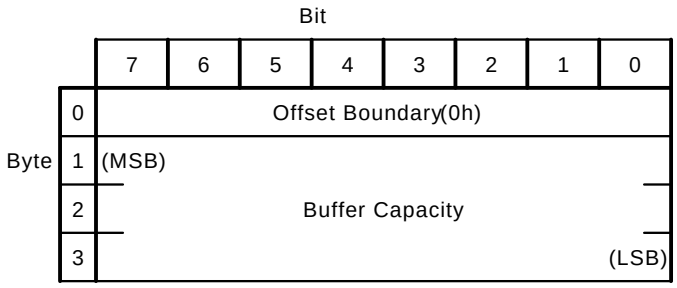
In this mode, the DATA IN phase only contains buffer data.

7.4.14.3 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.

Figure 7–57 READ BUFFER Descriptor



7.4.15 READ POSITION 34h

Figure 7–58 READ POSITION CDB

Byte	Bit 7	6	5	4	3	2	1	0
0	Operation Code (34h)							
1	Logical Unit Number			Reserved				BT
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Reserved							
9	Unused		Reserved				Flag	Link

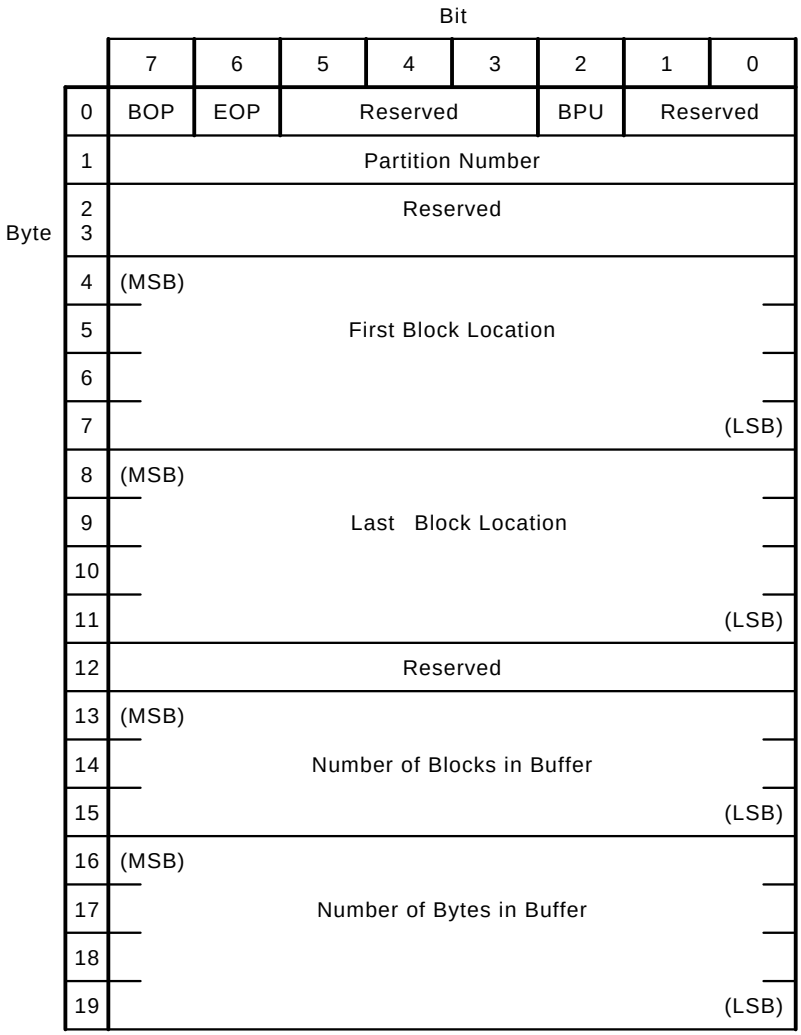
The READ POSITION command is used to read a position identifier, or SCSI Logical Block Address. The LOCATE command uses this identifier to position back to this same logical position, in a high performance fashion.

BT

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. The logical block address values include all recorded objects: blocks and filemarks.

7.4.15.1 READ POSITION Data Format

Figure 7–59 READ POSITION Data Format



The BOP and EOP bits will be set as appropriate. The Block Position Unknown (BPU) bit is never set since the setting of the BT bit in the Read Position CDB does not affect the block address values returned.

First Block Location

The block address associated with the current logical position; the next block to be transfered 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 transfered 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 and filemarks in the target's buffer.

Number of Bytes in Buffer – The number of data bytes and filemarks in the buffer that have not been written to the medium.

7.4.16 RECEIVE DIAGNOSTICS RESULTS 1Ch

Figure 7–60 RECEIVE DIAGNOSTICS RESULTS CDB

Byte	Bit 7	6	5	4	3	2	1	0
0	Operation Code (1Ch)							
1	Logical Unit Number			Reserved				
2	Reserved							
3	(MSB) Allocation Length							
4								(LSB)
5	Unused		Reserved				Flag	Link

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.

Figure 7–61 Receive Diagnostic Result Data Format

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							

This information simply indicates which of the main components of the subsystem has failed testing.

7.4.17 RELEASE UNIT 17h

Figure 7–62 RELEASE UNIT CDB

Byte	Bit 7	6	5	4	3	2	1	0
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

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 other 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.

7.4.17.1 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.

7.4.18 REQUEST SENSE 03h

Figure 7–63 REQUEST SENSE CDB

Byte	Bit 7	6	5	4	3	2	1	0
0	Operation Code (03h)							
1	Logical Unit Number			Reserved				
2	Reserved							
3	Reserved							
4	Allocation Length							
5	Unused		Reserved				Flag	Link

REQUEST SENSE tells the target to transfer sense data to the initiator.

The sense data is valid for a CHECK CONDITION or RESERVATION CONFLICT status returned on the previous command. The sense data bytes are preserved by the target until retrieved by the REQUEST SENSE command, or until the receipt of any other command from the same initiator.

If the drive receives an unsolicited REQUEST SENSE, then it returns Sense Data with the appropriate values in the EOM, Sense Key, Additional Sense Code, and Additional Sense Code Qualifier. The positional information provided reflects the logical position of the drive. The drive returns information based on 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. Therefore, if the host requires the exact physical positioning of the media, it should 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 subsequent REQUEST SENSE will return the actual physical (and logical) position of the drive to the initiator.

Allocation Length

The Allocation Length specifies the maximum number of sense bytes to be returned. 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.

7.4.18.1 Sense Information Format

Figure 7–64 REQUEST SENSE Data

Byte	Bit 7	6	5	4	3	2	1	0
0	Valid	Error Code						
1	Segment Number							
2	Filemrk	EOM	ILI	Reservd	Sense Key			
3	(MSB)							
4	Information Bytes							
5								
6								(LSB)
7	Additional Sense Length							
8	(MSB)							
9	Command Specific Information Bytes							
10								
11								(LSB)
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Sub−Assembly Code							
15	SKSV	C/D	Reserved		BPV	Bit Pointer		
16	(MSB)							
17	Field Pointer							(LSB)
18	Internal Status Code (VU)							

Valid

A Valid bit of one indicates that the information bytes contain valid information as 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 either bytes, blocks, 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

This specifies the number of additional sense bytes to follow. If the Allocation Length of the command descriptor block is too small to transfer all of the additional sense bytes, the Additional Sense Length is not adjusted to reflect the truncation.

Command Specific Information Bytes

Command Specific Bytes are handled as device specific and can be logged by the operating system on error conditions. On media errors, this usually contains the current SCSI Logical Block Address.

Additional Sense Code (ASC) and ASC Qualifier

These two bytes provide additional information about the Sense Key and cause of the CHECK CONDITION status. See the tables later in this section.

Sub-Assembly Code

Unused at present, returned as 0.

Field Pointer Bytes

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.

BPV—When the Bit Pointer Valid bit is set, it indicates that the Bit Pointer field is valid and designates which bit of the byte designated by the field pointer is in error. For a multi-bit field, it points to the most significant bit of the field.

Field Pointer—Indicates which byte of the CDB or Parameter List was in error. For a multi-byte field, the most significant byte is indicated.

Table 7–5 Sense Keys Used

Sense Key	Description
0h	No Sense. Check the Filemark/EOM/ILI bits and the ASC/Q bytes
1h	Recovered Error. This can be caused by rounding of Mode Parameters on a Mode Select, or to report that R/W error rates are reaching subsystem specification limits for optimal operation. However, the device may still be able to continue to function without any unrecovered errors for a long period of time.

(continued on next page)

Table 7–5 (Cont.) Sense Keys Used

Sense Key	Description
2h	Not Ready. The media is not ready for tape operation commands. Media might not be present in the drive, or may be in the process of loading or calibrating.
3h	Medium Error. An unrecoverable write, read, or positioning error has occurred. Detailed device specific information may be available.
4h	Hardware Error. The Additional Sense Code/Qualifier fields may provide more specific information.
5h	Illegal Request. The CDB or supplied parameter data had an unsupported or illegal operation specified. Check bytes 15, 16 and 17.
6h	Unit Attention. Unit Attentions are created after a device reset, if the media asynchronously becomes ready to this initiator, if another initiator changes Mode Parameters, and if the firmware is updated.
7h	Data Protected. The current media is write-protected. This can be due to the Write Protect switch on the cartridge, or if the media is not CompacTape-III(TM) type.
8h	Blank Check. An EOD or LongGap has been encountered.
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 7–6 Additional Sense Codes/Qualifiers Used

ASC	ASCQ	Description
00h		No Additional Sense Code
	00h	No additional sense qualifer
	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 non reportable
	01h	Calibration in process
	02h	Load command needed
	03h	Manual Intervention needed
08h	00h	LUN Communications Failure
	01h	LUN Communications Timeout
0Ah	00h	Error Log Overflow
0Ch	00h	Write Error
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 writebuffer
	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
25h	00h	Illegal LUN
26h		Parameter list error
	00h	Invalid Field
	01h	Parameter not supported
	02h	Parameter Value Invalid
27h	00h	Write protected

(continued on next page)

Table 7–6 (Cont.) Additional Sense Codes/Qualifiers Used

ASC	ASCQ	Description
	80h	hardware write protect
	82h	data safety write protect
28h	00h	Not ready to ready
29h	00h	Reset occurred
	01h	Mode paramters changed
	02h	Log paramters changed
2Fh	00h	Commands Cleared by another Initiator
30h	00h	Can't 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
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
	82h	Command Complete Sequence Failure
	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
53h	00h	Media Load/Eject failure
	01h	Unload Tape failure
	02h	Media Removal Prevented
5Ah	01h	Operator Media Removal Request

(continued on next page)

Table 7–6 (Cont.) Additional Sense Codes/Qualifiers Used

ASC	ASCQ	Description
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

* = Medium Changer specific commands

7.4.19 RESERVE UNIT 16h

Figure 7–65 RESERVE UNIT CDB

	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (16h)							
1	Logical Unit Number			3rdPty	Third−Party DeviceID			Rsrd
2	Reserved							
Byte 3	Reserved							
4	Reserved							
5	Unused		Reserved				Flag	Link

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.

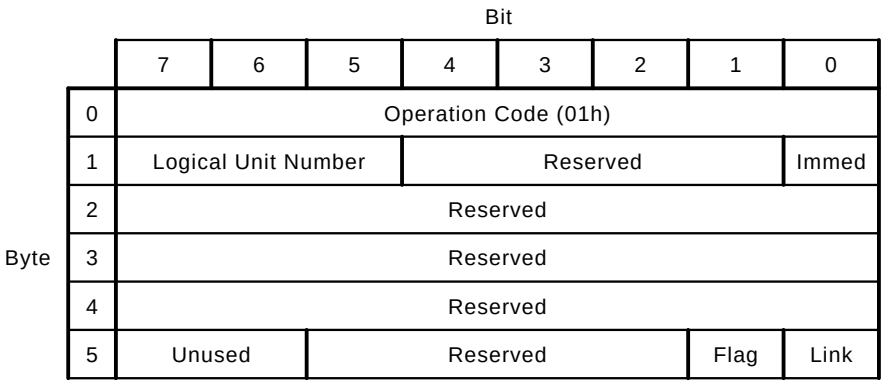
7.4.19.1 Medium Changer Considerations

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.

7.4.20 REWIND 01h

Figure 7–66 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.

7.4.21 SEND DIAGNOSTIC 1Dh

Figure 7–67 SEND DIAGNOSTIC CDB

Byte	Bit 7	6	5	4	3	2	1	0
0	Operation Code (1Dh)							
1	Logical Unit Number			PF	Rsv'd	Selftst	Dev OfL	UnitOfL
2	Reserved							
3	(MSB) Parameter List Length							
4								(LSB)
5	Unused			Reserved			Flag	Link

SEND DIAGNOSTIC tells the drive to perform diagnostic tests on itself.

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)—In order for the diagnostic to be invoked, 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. If there is a loader attached, a software reset is done on it. This test does not attempt to write or read data to or from media. When complete, any errors are posted in the extended Sense Data bytes. This test has an execution time of approximately 5 seconds.

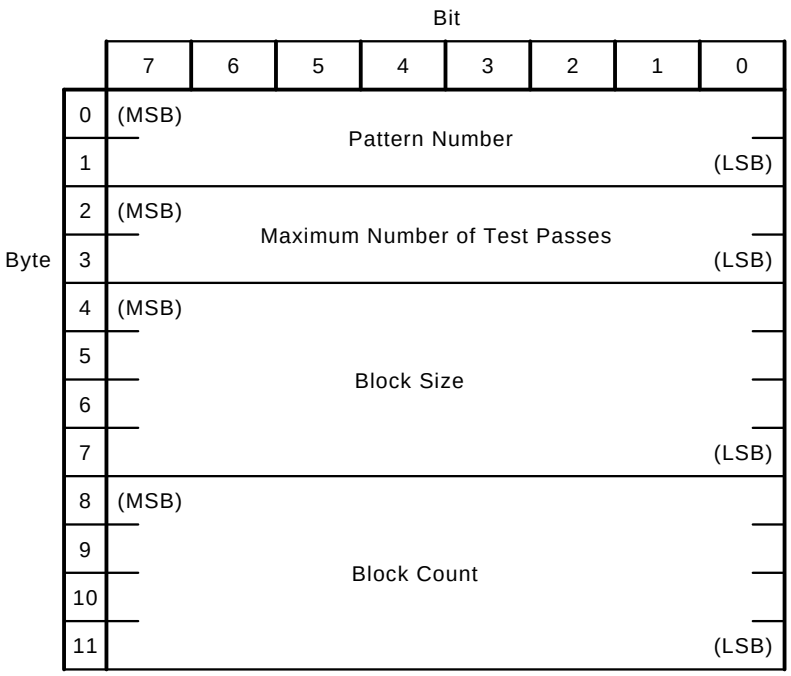
  This test is specified by setting just the Selftest bit (Dev OfL, and UnitOfL both zero).

- Write/Read Functionality Test—(Level 2 test) The default version of this test writes 100 32 KB records on the track, rewinds, and reads the records. The execution time for the test is less than one minute, if calibration is not required. This test is specified by setting the Selftest and UnitOfL bits, and zeroing the Dev OfL bit. This test can accept a parameter list specifying test vatiables, as shown below. If a parameter list is specified, the Sleftest bit should be zero.

Table 7–7 Send Diagnostics Parameters

Selftest	DevOfl	UnitOfl	Selftest Action
0	0	0	Illegal combination
0	0	1	Selfttest 2 with parameters
0	1	0	Illegal combination
0	1	1	Selfttest 1 with default parameters
1	0	0	Selfttest 1 with default parameters
1	0	1	Selfttest 2 with default parameters
1	1	0	Selfttest 1 with default parameters
1	1	1	Selfttest 2 with default parameters

Figure 7–68 SEND DIAGNOSTIC Parameter List Format



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 7–8 Sense Keys Used

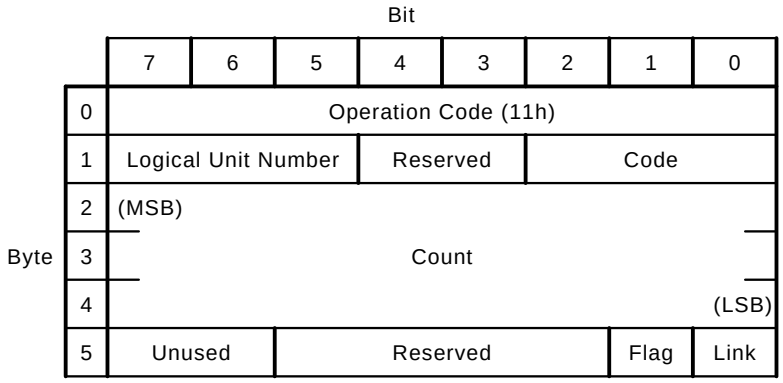
Sense Key	Description
3h	Medium Error. A positioning error has occurred where the returned position does not match the expected.
4h	Hardware Error. The Additional Sense Code/Qualifier fields will provide more specific information.
5h	Illegal Request. Illegal bit settings in the SEND DIAGNOSTIC command.
Eh	Miscompare. A compare error occurred during a read.

Table 7–9 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.

7.4.22 SPACE 11h

Figure 7–69 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:

Figure 7–70 SPACE Code Definition

Space Code	Space by:
000b	Blocks
001b	Filemarks
010b	Sequential Filemarks
011b	End−of−Data

Spacing by Sequential Filemarks is supported for count values of 0, 1, and 2 only.

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.

7.4.23 TEST UNIT READY 00h

Figure 7–71 TEST UNIT READY CDB

Byte	Bit 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

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.

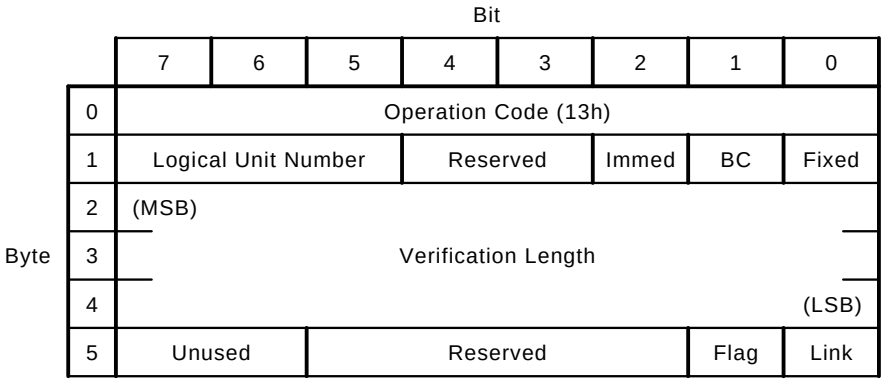
7.4.23.1 Medium Changer Considerations

When directed at the Media Loader LUN, this command will return Check Condition, Sense Key of Not Ready if:

- The key switch is in the Service position, and there is no 24 volt signal (usually means that the loader assembly has been moved out of its sleeve enough to trip the 24 volt interlock.)

7.4.24 VERIFY 13h

Figure 7–72 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 (when processing has been initiated).

BC

This bit selects an 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.

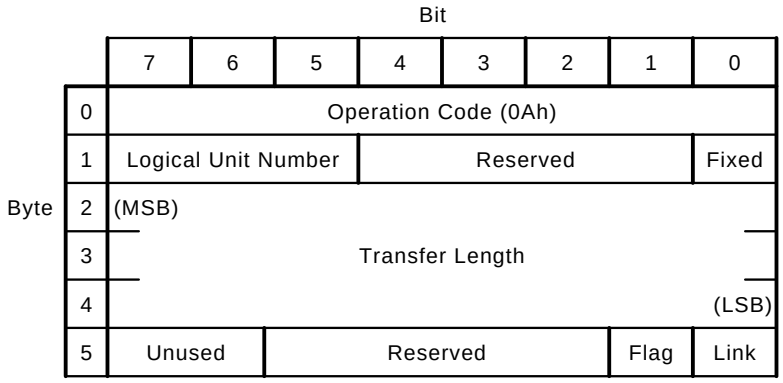
If this bit is set the command will be rejected.

Fixed

This bit operates in the same fashion as with the READ command.

7.4.25 WRITE 0Ah

Figure 7–73 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.

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.

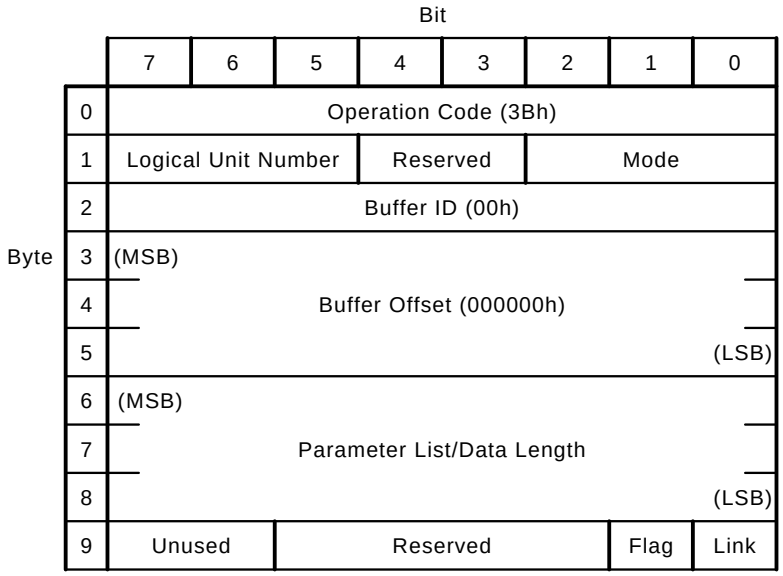
Exception Conditions

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 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.

7.4.26 WRITE BUFFER 3Bh

Figure 7–74 WRITE BUFFER CDB



WRITE BUFFER is used in conjunction with READ BUFFER as a diagnostic function for testing the device data buffer, DMA engine, SCSI Bus interface hardware, and the 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.

Figure 7–75 WRITE BUFFER Modes Supported

Mode	Description
000b	Write combined header and data
010b	Write data
100b	Download Microcode
101b	Download Microcode and Save

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.

7.4.26.1 Header and Data mode

Data to be transferred is preceded by a 4-byte header consisting entirely of reserved bytes. This header is discarded (not stored in the buffer). The buffer offset field must be zero for this mode.

7.4.26.2 Write Data

Similiar 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.

7.4.26.3 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 non-consecutive 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.

7.4.26.4 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 reprogramming, the Write Protect and Drive Activity LEDS on the drive's front panel will blink.

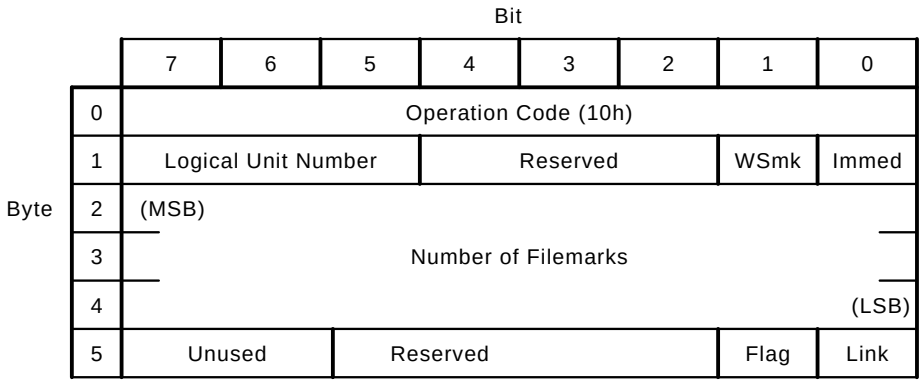
NOTE

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 successfully completes, the firmware restarts itself, causing POST to be rerun, and two Unit Attention conditions are generated: power-up reset, and operating code has changed.

7.4.27 WRITE FILEMARKS 10h

Figure 7–76 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 DLT2000, 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—see below.)

An Immed bit of zero indicates that 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.

7.5 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 7–10 SCSI-2 Medium Changer Commands

Opcode	Command	Section
07*	INITIALIZE ELEMENT STATUS	Section 7.5.1
12	INQUIRY	Section 7.4.4
15+	MODE SELECT	Section 7.5.3
1A+	MODE SENSE	Section 7.5.3
A5*	MOVE MEDIUM	Section 7.5.4
3C	READ BUFFER	Section 7.4.14
B8*	READ ELEMENT STATUS	Section 7.5.2
1C	RECEIVE DIAG RESULTS	Section 7.4.16
17	RELEASE	Section 7.4.17
03	REQUEST SENSE	Section 7.4.18
16	RESERVE	Section 7.4.19
1D	SEND DIAGNOSTIC	Section 7.4.21
00	TEST UNIT READY	Section 7.4.23
3B	WRITE BUFFER	Section 7.4.26

* = Medium Changer specific commands

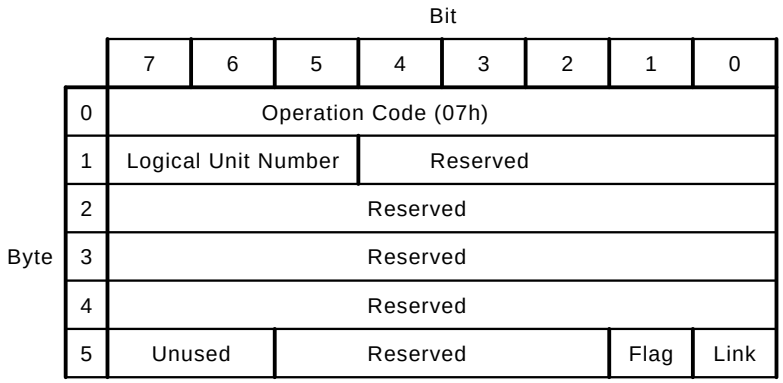
+ = Commands with significant Medium Changer specific content

The following information is covered in the preceding sections: The Inquiry, Send Diagnostic, Receive Diagnostic Results, Read/Write Buffer, and Request Sense commands and Loader specific details.

The rest of this chapter covers Medium Changer unique commands.

7.5.1 INITIALIZE ELEMENT STATUS 07h

Figure 7–77 Initialize Element Status CDB



This command causes the DLT2700 to initialize the element status.

7.5.2 READ ELEMENT STATUS B8h

Figure 7–78 READ ELEMENT STATUS CDB

	Bit 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) Allocation Length							
8								
9								(LSB)
10	Reserved							
11	Unused		Reserved				Flag	Link

Figure 7–79 Element Type Code Definitions

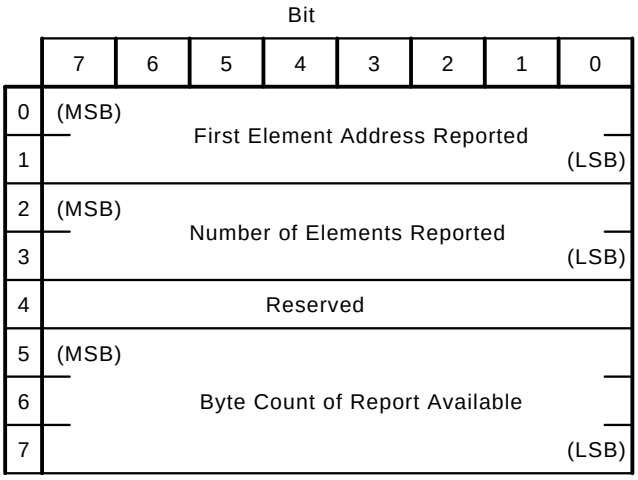
Code	Description
0h	All element types reported (valid in CDB only)
1h	Medium Transport Element
2h	Storage Element (magazine slot)
3h	Import Export Element (not supported)
4h	Data Transfer Element (tape drive)
5h–Fh	reserved

The format of Element Status data is defined in the SCSI-2 specification. The following sections show the information returned for the DLT2000. 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.

7.5.2.1 Element Status Data Header

Figure 7–80 Element Status Data Header



7.5.2.2 Medium Transport Element Status Page

Figure 7–81 Medium Transport Element Status Page

	Bit 7	6	5	4	3	2	1	0
0	Element Type Code (1 = Medium Transport)							
1	PVolTag	AVolTag	Reserved					
2	(MSB) Transport Element Descriptor Length (06h)							
3	(LSB)							
4	Reserved							
5	(MSB) Byte Count of Descriptor Data Available (06h)							
6								
7	(LSB)							
Descriptor:								
8	(MSB) Transport Element Address (1h)							
9	(LSB)							
10	Reserved					Except	rsvd	Full
11	Reserved							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Reserved							
15	Reserved							
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)							

There is only 1 Medium Transport element, which can be addressed explicitly as element address 1, or implicitly as address 0. PvolTag and AVolTag are always zero.

7.5.2.3 Storage Element Status Page

Figure 7–82 Storage Element Status Page

	Bit 7	6	5	4	3	2	1	0
0	Element Type Code (2h = Storage Element)							
1	PVolTag	AVolTag	Reserved					
2	(MSB) Storage Element Descriptor Length (12h)							
3	(LSB)							
4	Reserved							
5	(MSB) Byte Count of Descriptor Data Available							
6								
7	(LSB)							
Descriptor(s):								
8	(MSB) First Storage Element Address Reported							
9	(LSB)							
10	Reserved				Access	Except	rsvd	Full
11	Reserved							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Reserved							
15	Reserved							
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)							
25 to n	– descriptors for other Storage Elements reported							

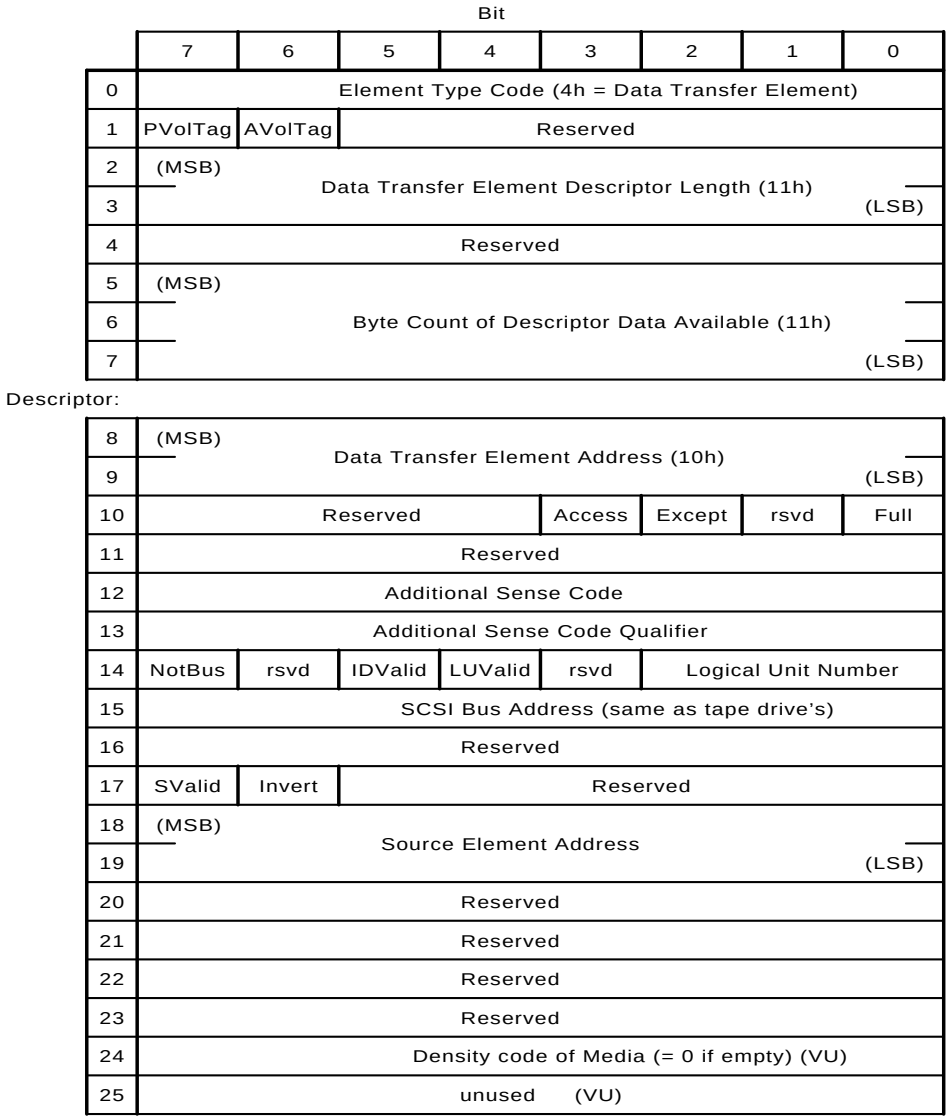
There are seven Storage Elements, corresponding to the seven slots in a magazine. PvolTag and AVolTag are always zero.

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.

7.5.2.4 Data Transfer Element Status Page

Figure 7–83 Data Transfer Element Status Page



PvolTag and AVolTag are always zero. Access is always set, Full is set if there is a cartridge 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.

7.5.3 MODE SENSE/SELECT

All three pages that are specific to Medium Changers are supported.

7.5.3.1 Device Capabilities Page

The drive shall support the Device Capabilities Page which has the following format:

Figure 7–84 Device Capabilities Page 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<>ST	IE<>MT
15	Reserved				DT<>DT	DT<>I/E	DT<>ST	DT<>MT

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 DLT2700 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 DLT2700 does not support the exchange medium command.

The DLT2700 does not support "ST->ST" or "DT->DT".

7.5.3.2 Element Address Assignment Page

The drive shall support the Element Address Assignment Page which has the following format:

Figure 7–85 Element Address Assignment Page Format

	Bit							
	7	6	5	4	3	2	1	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 (07)							
9	(LSB)							
10	(MSB) 1st Import/Export Element Address (00h)							
11	(LSB)							
12	(MSB) Number of Import/Export Elements (0)							
13	(LSB)							
14	(MSB) 1st Data Transfer Element Address (10h)							
15	(LSB)							
16	(MSB) Number of Data Transfer Elements (01)							
17	(LSB)							
18	Reserved							
19	Reserved							

Medium Changer Element Address assignment is as follows:

Table 7–11 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

7.5.3.3 Transport Geometry Parameters Page

The drive shall support the Transport Geometry Page which has the following format:

Figure 7–86 Transport Geometry Page 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)							

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.

7.5.4 MOVE MEDIUM A5h

Figure 7–87 MOVE MEDIUM CDB

	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							Invert
11	Unused		Reserved				Flag	Link

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.

A

Technical Specifications

A.1 In This Chapter

Appendix A contains specifications for the DLT2000 tape drive and DLT2700 mini-library including:

Topic	Section
Physical Description	Section A.2
Physical Dimensions	Section A.3
Performance Specifications	Section A.4
Environmental Specifications	Section A.5
Vibration and Shock Requirements	Section A.6
Electromagnetic Interference (EMI) Susceptibility	Section A.7
Regulatory Requirements	Section A.8
Drive Reliability Factors	Section A.9

A.2 Physical Description

Table A–1 lists the key physical and functional specifications of the DLT2000 tape drive.

Table A–1 DLT2000 Physical Specifications

Description	
Drive form factor	5-1/4 inch FH (modified depth)
Full height	
tabletop	5.72 in (145 mm)
drive	3.235 in
Mounting orientation	Horizontal Vertical - Rotated 90° counterclockwise from horizontal when facing front bezel
Width	
tabletop	9.25 in (235 mm)
drive	5.75 in (146 mm)
Depth	
tabletop	13.08 in (332 mm)
drive	9.00 in (228.6 mm) measured from back of front bezel 9.60 in (243.8 mm) including the bezel
Weight	
tabletop	15.00 lb 9 oz
drive	6.00 lb
Shipping weight	
tabletop	17.00 lb, depending on weight of manuals enclosed
drive	7.00 lb, depending on weight of manuals enclosed
MTBF	80,000 hrs
Functional Specifications	
Capacity/formatted native	10.0 GB (standard 1170 ft tape)
Capacity/formatted compressed 2:1[1]	20 GB (standard 1170 ft tape)
Interface	8 bit SCSI-2, single-ended or differential
Drive type	DLT, streaming
Recording type	2-7 RLL code with TZ87 format, MFM with 2.6 GB/6.0 GB format
Form factor	5-1/4 inch, FH modified depth
Transfer rate, raw native	1.71 MB/sec
Transfer rate, user native uncompressed	1.25 MB/sec
Transfer rate, user compressed[1]	More than 2.50 MB/sec maximum write More than 3.00 MB/second maximum read
Tracks	128; 64 pairs
Linear bit density	62,500 bpi/per track (standard 1200 ft tape)

[1] Nominal compression ratio. Actual compression is data dependent.

Tape drive conforms to DEC Standard 102 Class B.
Tape cartridge conforms to DEC Standard 102 Class B modified.

Table A–1 lists the key physical specifications of the DLT2700 mini-library.

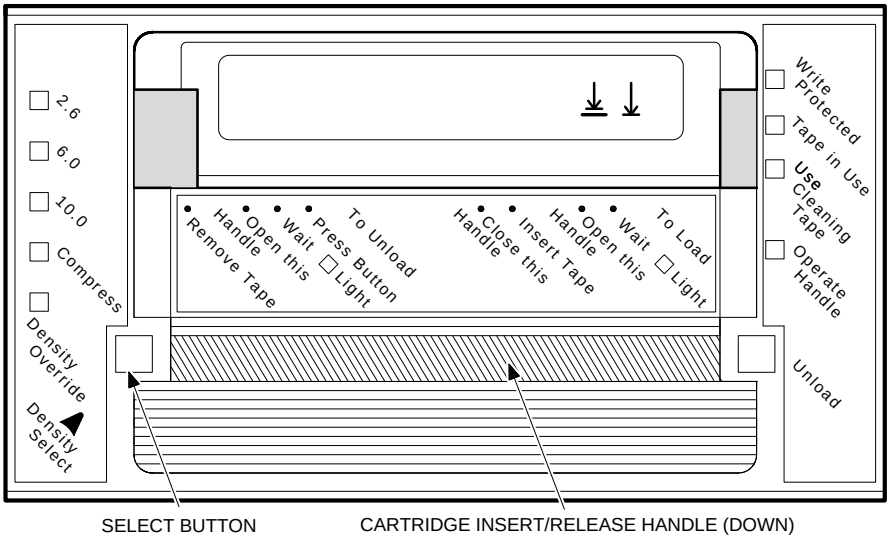
Table A–2 DLT2700 Magazine Tape Subsystem Specifications

Characteristic	Specifications
Height	26.47 cm (10.42 in)
Width	22.20 cm (8.74 in)
Length	64.77 cm (25.5 in)
Weight	24.95 kg (55 lb)
Noise level	62 dB
Environmental temperature	
Operating	10°C to 40°C (50°F to 104°F)
Nonoperating	–40°C to 66°C (–40°F to 150.8°F)
Humidity	
Operating	20% to 80% noncondensing
Nonoperating	10% to 95%
Certification	
EMI	Meets applicable FCC, VDE, and FTZ standards for Class A devices
Safety	Meets UL, CSA, TUV "BG" MARK and IEC standards
Maximum number of cartridges	7
Electrical rating	100 to 120/220 to 240 V ac 2/1 A
AC power consumption	110 W, typical 113 W, maximum
Communications interface	SCSI-2 bus (single-ended or differential)
Cycle time	50 s, maximum

A.2.1 Front Panel

Figure A–1 shows the front panel of the DLT2000 tape drive.

Figure A–1 DLT2000 Front View



ZKO-1217-02-DG

A.3 Physical Dimensions

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.

Table A–3 lists basic size, depth, mounting holes, and weight:

Table A–3 Tape Drive Specifications

Basic size	3.95 in high × 5.70 in wide × 9.00 in deep (from rear of bezel)
	(10.03 cm × 14.47 cm × 22.86 cm)
Bezel depth	0.60 in (1.52 cm)
Mounting holes	Standard for 5¼-in tape drives
Unpacking weight	
tabletop	15.00 lb, 9 oz
drive	6.00 lb
Packed weight	
tabletop	17.00 lb, depending on weight of manuals enclosed
drive	7.00 lb, depending on weight of manuals enclosed

Figure A–2 shows the mounting holes and dimensions in a top view of the DLT2000 tape drive.

Figure A–2 Mounting Hole Dimensions (Top View)

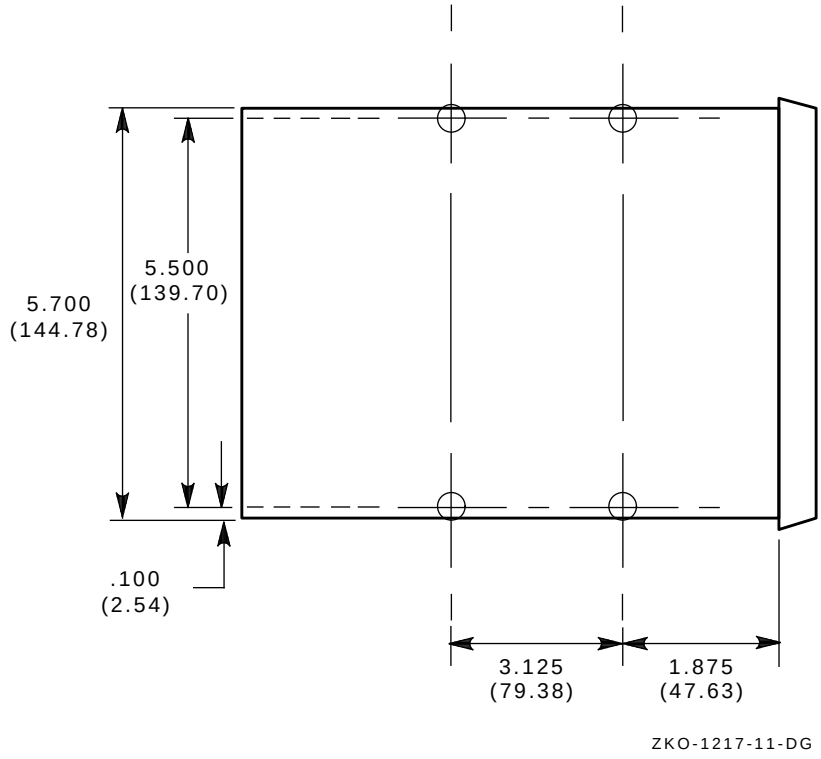
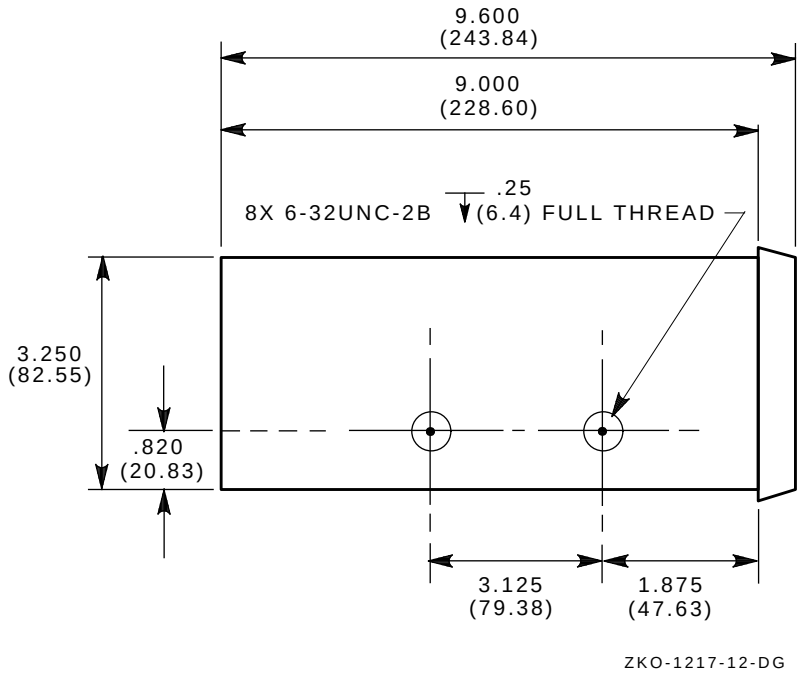


Figure A–3 shows the mounting holes and dimensions in a side view of the DLT2000 tape drive.

Figure A–3 Mounting Hole Dimensions (Side View)



A.4 Performance Specifications

Section A.4 describes performance specifications including:

Topic	Section
Nominal Tape Tension	Section A.4.1
Timing Characteristics	Section A.4.2
Media Loader Timing Characteristics	Section A.4.3
DLT2000 Power Requirements	Section A.4.4
DLT2000 Tabletop Power Requirements	Section A.4.5
DLT2700 Power Requirements	Section A.4.6

A.4.1 Nominal Tape Tension

Nominal tape tension is:

- 3.0 ± 1 oz when stationary
- 4.7 ± 1 oz at operating speed

A.4.2 DLT2000 Timing Characteristics

Table A–4 lists timing characteristics of the DLT2000 tape drive:

Table A–4 DLT2000 Timing Characteristics

Tape speed	110 in/sec read/write 150 in/sec search
Average rewind time	45 sec
Average access time (from BOT)	45 sec
Maximum access time (from BOT)	90 sec
Load to BOT—previously written	45 sec, if using a blank tape, time is slightly longer.
Unload from BOT	16 sec

A.4.3 DLT2700 Media Loader Timing Characteristics

Table A–5 lists timing characteristics of the DLT2700 media loader:

Table A–5 DLT2700 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

A.4.4 DLT2000 Power Requirements

The DLT2000 tape drive operates on +5 and +12 V dc power. The tape drive may also be mounted in a tabletop enclosure or media loader that operates from ac power.

Table A–6 lists the power requirements of the DLT2000.

Table A–6 DLT2000 Power Requirements (±5%)

Power	Steady State	Maximum
5 V	2.5 A	3.0 A
12 V	0.8 A	1.5 A
W	22 W	33 W

A.4.5 DLT2000 Tabletop Power Requirements

The power requirement of the drive when mounted in the tabletop enclosure is:

100–240 V ac
50/60 Hz
50 W

A.4.6 DLT2700 Power Requirements

The power requirement of the drive when mounted in the media loader is:

100–120, 220–240 V ac (selectable)
50/60 Hz
100 W

A.5 Environmental Specifications

Section A.5 describes environmental specifications including:

Topic	Section
Temperature and Humidity	Section A.5.1
Altitude	Section A.5.2
Electromagnetic Emissions	Section A.7.1
Conducted Emissions	Section A.7.2
Radiated Emissions	Section A.7.3
Magnetic Radiated Susceptibility	Section A.7.4
Radiated Susceptibility	Section A.7.5
Conducted Susceptibility	Section A.7.6
ESD Failure Level Limits	Section A.7.7
Acoustic Noise Emissions	Section A.7.8

The tape drive conforms to a modified Class B 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.5.1 Temperature and Humidity

Table A–7 lists the operating temperature and humidity ranges:

Table A–7 Operating Ranges

Dry bulb temperature	10° to 40°C
Wet bulb temperature	25°C
Temperature gradient	11°C/h (across the range)
Temperature shock	10°C (over two min)
Relative humidity	20% to 80% noncondensing
Humidity gradient	10%/h

Table A–8 lists the power-on ranges:

Table A–8 Power-on Ranges—No Tape Loaded (Unpacked—72 hours)

Dry bulb temperature	10° to 40°C
Wet bulb temperature	25°C
Temperature gradient	15°C/h (across the range)
Temperature shock	15°C (over two min)
Relative humidity	10% to 90%
Humidity gradient	10%/h

Table A–9 lists the storage ranges:

Table A–9 Storage Ranges (Unpacked or Packed)

Dry bulb temperature	-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 min)
Relative humidity	10% to 95% noncondensing
Humidity gradient	10%/h

Table A–10 lists the shipment ranges:

Table A–10 Shipment Ranges

Dry bulb temperature	-40°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 min)
Relative humidity	10% to 95% noncondensing
Humidity gradient	10%/h

A.5.2 Altitude

The tape drive operates in normal pressures from 60 to 8000 feet.

A.6 Vibration and Shock Requirements

Tables A–11 and A–12 list operating and nonoperating vibration requirements.

Table A–11 Operating Vibration Requirements (Within Spec—No Damage)

Frequency range	5–500–5 Hz
Peak acceleration	0.25 g
Waveshape	0.010 in double amplitude
Application	X, Y, Z axes—2 sweeps/axis

Table A–12 Nonoperating Vibration Requirements (Unpacked - No Damage)

Frequency range	10-50-300 Hz
Peak acceleration (Vertical)	0.029 g^2/Hz
Peak acceleration (Horizontal)	0.007 g^2/Hz
Waveshape	Random
Application	X, Y, Z axes - 2 sweeps/axis

Tables A–13 and A–14 list the operating and nonoperating shock requirements.

Table A–13 Operating Shock Requirements (Within Spec—No Damage)

Peak acceleration	10 Gs
Duration	10 ms
Waveshape	1/2 Sine pulses
Application	X, Y, Z axes - repeat 3 times

Table A–14 Nonoperating Shock Requirements (Packed—No damage)

Bench test	Four in freefall onto a wooden surface
Impacts	14,200 total
Duration	35 min
Displacement	1/16 in
Application	Stimulate package in normal shipping position

Table A–15 Vibration Requirements During Shipping

Frequency Range	5 to 300 Hz
Peak Acceleration	1.19 Grms
Waveshape	Random vibration
Power spectral density	.003 g^2/Hz @ 5 Hz
Power spectral density	.02 g^2/Hz @ 10 Hz

Table A–16 Physical Drop Test Requirements

Drop test distance	30 in

A.7 Electromagnetic Interference (EMI) Susceptibility

EMI susceptibility includes:

- Electromagnetic emissions
- Conducted emissions
- Radiated emissions
- Magnetic radiated susceptibility
- Radiated susceptibility

- Conducted susceptibility

A.7.1 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.7.2 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.

Frequency Range (MHz)		Limits dB
	Quasi-peak	Average
0.15 to 0.050	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.7.3 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:

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.7.4 Magnetic Radiated Susceptibility

Table A–17 lists the magnetic radiated susceptibility limits.

Table A–17 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.7.5 Radiated Susceptibility

Table A–18 lists the radiated susceptibility limits:

Table A–18 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.7.6 Conducted Susceptibility

The transient voltage is the actual peak voltage above the normal ac voltage from the power source.

Table A–19 lists the voltage limits for power and data cables:

Table A–19 Fast Transient (bursts) for Power and Data Cables

2 kV	S/W recoverable errors
	No hardware failures

Table A–20 lists power cable voltage limits:

Table A–20 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–21 lists the low-level conducted interference voltage limits:

Table A–21 Low-level Conducted Interference

3 V(rms) 80% modulated 1 kHz	No errors
	S/W recoverable errors
	No hardware failure

A.7.7 ESD Failure Level Limits

Table A–22 lists the ESD failure level limits for normal operator access areas.

Table A–22 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 (soft/hard errors allowed)

A.7.8 Acoustic Noise Emissions

The following lists the acoustic noise emission levels:

Table A–23 Acoustic Noise Emissions

Noise Power Emission Level (LNPEc)	
Tabletop	**Loader**
4.5 bels (idle mode)	5.1 bels (idle mode)
4.8 bels (streaming mode)	5.2 bels (streaming mode)

Sound Pressure Level (LPAc)	
Tabletop	**Loader**
36.0 dB (idle mode)	34.0 dB (idle mode)
43.0 dB (streaming mode)	35.0 dB (streaming mode)

A.8 Regulatory Requirements

Regulatory requirements include:

- Safety
- Electromagnetic emissions

A.8.1 Safety Requirements

Safety requirements include:

- UL1950 - Information Technology Including Electrical Business Equipment
- CSA C22.2 #220 - Information Technology Including Electrical Business Equipment
- TUV EN60950 - Information Technology Including Electrical Business Equipment

A.8.2 Electromagnetic Emission Requirements

Electromagnetic emission requirements include:

FCC, Part 15, Class B
EN55022/B
EN55082/B
CISPR22/B

A.9 Drive Reliability Factors

Table A–24 lists the reliability factors:

Table A–24 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 (average)	Head life may be less than listed if alternate sources for tape cartridges are used.
MTBF	80,000 hours	Digital Equipment Corporation does not warrant that predicted MTBF is representative of any particular unit installed for customer use. Actual figures vary from unit to unit.
Tape life	500,000 passes	

B

Definition of Vendor Unique Sense Data Information

B.1 In This Chapter

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

(continued on next page)

Table B–1 (Cont.) Internal Status Code

Dec	Hex	Description
7	7	Logical EOT encountered, 2 file marks
8	8	Command connection dropped
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
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

(continued on next page)

Table B–1 (Cont.) Internal Status Code

Dec	Hex	Description
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
1–6	Reserved
7	If set, the internal status byte (18) is in Bit Flags format; otherwise, it is a code.

C

Sense Key Information

C.1 In This Chapter

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
  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
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

- 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 maybe set even though ASC/ASCQ = 00 00:

(1) FM, EOM, ILI bit maybe set with no sense key (0) and ASC/ASCQ = 00 00
(2) FM, EOM, ILI bit maybe set with recovered error (1) and ASC/ASCQ = 00 00
(3) FM, EOM, ILI bit maybe set with medium error (3) and ASC/ASCQ = 00 00
(4) EOM bit is set at Volume Overflow (Dh) and ASC/ASCQ = 00 00

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