Exabyte Mammoth-2 Tape Drive

Fibre Channel Interface Supplement

Exabyte®

1003790-001

Copyright

Disclaimer

Exabyte Corporation makes no representation or warranties with respect to the contents of this document and specifically disclaims any implied warranties of merchantability or fitness for any particular purpose. Further, Exabyte Corporation reserves the right to revise this publication without obligation to notify any person or organization of such revision or changes.

Trademark Notices

Exabyte, Exafacts, Exapak, Exa*soft*, Exatape, and Strategex are U.S. registered trademarks of Exabyte Corporation. Eliant, M2, MammothTape, NetStorM, SmartClean, and SupportSuite are trademarks of Exabyte Corporation. All other product names are trademarks or registered trademarks of their respective owners.

Revision History

Revision	Date	Description
000	April 2000	Preliminary release
001	October 2000	Update to include all M2 FC specifications

Note: The most current information about this product is available at Exabyte's World Wide Web site (www.exabyte.com).

Exabyte Corporation
1685 38th Street
Boulder, Colorado 80301
(303) 442-4333

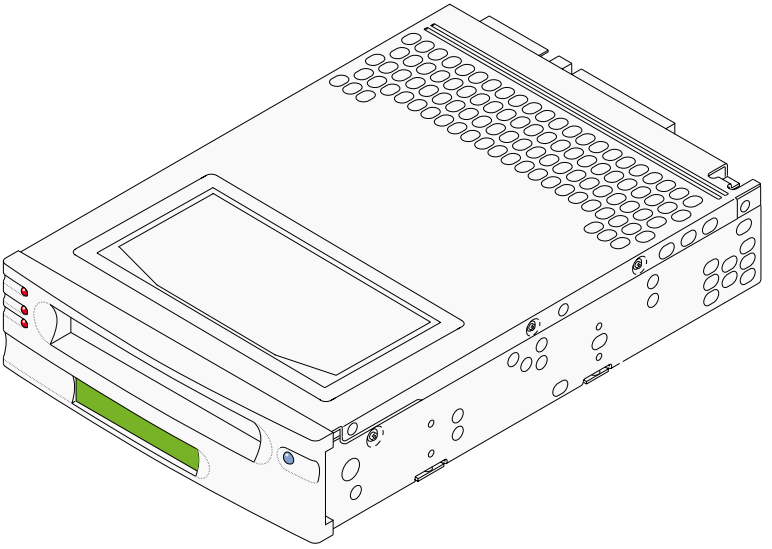
1003790-001

Contents

Notes

1 Introduction

The Exabyte® Mammoth-2 (M2™) tape drive with Fibre Channel, shown below, is a high-speed, high-capacity tape drive ideally suited to meet the demanding requirements of the network server industry and data-intensive applications. The Fibre Channel interface allows M2 to operate as an integral part of today's leading-edge storage area network (SAN) environments.



M2 with Fibre Channel versus M2 with SCSI

M2 with Fibre Channel is a MammothTape technology tape drive and, with the exception of the Fibre Channel interface, is identical to M2 with SCSI. The following table summarizes the major features that are unique to M2 with Fibre Channel.

Unique features of M2 with Fibre Channel...	Look here for more information....
Components ▪ A new Fibre Channel interface card replaces the primary SCSI interface card inside the tape drive. ▪ The internal tape drive has a native copper interface with a single 80-pin SCA-2 connector, which allows connection to two Fibre Channel loops. This connector also provides the power connection for the tape drive. ▪ The tabletop tape drive uses GBIC (gigabit interface converter) sockets on the back of the enclosure to provide connections to both Fibre Channel loops. ▪ Where appropriate, LCD messages have been added to reflect the use of a Fibre Channel interface instead of a SCSI interface.	"Components" on page 8 and "LCD Messages" on page 16
Cable and connector requirements ▪ The 80-pin SCA-2 connector on the internal tape drive must be connected to an interface board or system backplane that provides power, hardware address selection, and connections to the two Fibre Channel loop ports. ▪ The two GBIC sockets on the back of tabletop tape drive allow the use of any industry-standard GBIC socket to the appropriate Fibre Channel cable.	"Connecting to the Fibre Channel Network" on page 12
Power specifications The specifications for operating current and power consumption for M2 with Fibre Channel may be different from M2 with SCSI.	"Functional Specifications" on page 20

Unique features of M2 with Fibre Channel...	Look here for more information....
Fibre Channel interface The tape drive's Fibre Channel FC-2 Framing and Signaling protocol interface conforms to the Fibre Channel Arbitrated Loop standards (FC-AL-2) for both Private and Public loop and to the FC-TAPE specification.	"Fibre Channel Interface Overview" on page 25
SCSI protocol ▪ The 16-byte Product Identification returned in the Standard Inquiry Data is "Mammoth2" followed by 8 ASCII spaces. The 8-byte Submodel ID is reported in byte 36 of the Standard Inquiry Data. ▪ The tape drive reports its world-wide names through the INQUIRY command on the Device Identification Page (page code 83h). ▪ The Fibre Channel SCSI command layer is identical to the M2 with SCSI command layer. Additional pages have been added to the MODE SELECT and MODE SENSE commands to support the Fibre Channel transport.	"INQUIRY (12h)" on page 34 and "MODE SELECT (15h, 55h); MODE SENSE (1Ah, 5Ah)" on page 44

About This Supplement

This supplement provides functional and operational information about the M2 with Fibre Channel. It is intended as a supplement to the *Exabyte Mammoth-2 Product Specification*, *Exabyte Mammoth-2 Installation and Operation*, and *Exabyte Mammoth-2 SCSI Reference*. It provides information about integrating and using M2 in a Fibre Channel environment.

Conventions

This supplement uses the following conventions to highlight notes, important information, and cautions. Take special note of boxed text. Failure to follow cautions can result in equipment damage.

Note: Read *Notes* for additional information or suggestions about the topic or procedure being discussed.

➤ **Important** Read the information in *Important* notices to learn crucial information about the topic being discussed.

CAUTION

Read the information in *CAUTION* boxes to learn how to avoid damaging the tape drive or losing data.

Related Publications

Exabyte Mammoth-2 Tape Drive

- *Exabyte Mammoth-2 Tape Drive Product Specification*, 330874
- *Exabyte Mammoth-2 Tape Drive Installation and Operation*, 330875
- *Exabyte Mammoth-2 Tape Drive SCSI Reference*, 330876

Standards

- *ANSI Small Computer System Interface-2 (SCSI-2)*, X3.131 – 1994
- *Standard ECMA-293, 8 mm Wide Magnetic Tape Cartridge for Information Interchange – Helical Scan Recording – MammothTape-2 Format*, December 1999
- *TapeAlert Specification*, Version 2.0, November, 1997
- *ANSI Information Technology Fibre Channel Protocol for SCSI (FCP)*, X3.269-1996
- *Fibre Channel Protocol for SCSI, Second Revision 2* (FCP-2), T10/Project 1144-D/Rev 4, December 1999
- *ANSI Information Technology Fibre Channel Physical and Signaling Standard (FC-PH)*, X3.230-1994
- *ANSI Information Technology Fibre Channel 2nd Generation Physical and Signaling Standard (FC-PH-2)*, X3.303-1998
- *ANSI Information Technology Fibre Channel Arbitrated Loop (FC-AL)*, X3.272-1996
- *ANSI Information Technology Fibre Channel Arbitrated Loop (FC-AL-2)*, NCITS 332-1999
- *Information Technology Fibre Channel Fabric Loop Attachment (FC-FLA)*, T11/Project 1235-DT/Rev 2.7
- *Fibre Channel FC-Tape Standard*, T11/99 – 069v4, 1999
- *Fibre Channel Tape Connector Profile Using 80-pin SCA-2 Connector*, T11/99 – 234v2
- *Specification for 40-pin SCA-2 Connector w/Bidirectional ESI*, SFF-8067

- *Specification for 40-pin SCA-2 Connector w/Parallel Selection*, SFF-8045
- *SCA-2 Unshielded Connections*, EIA-700A0AE (SFF-8451)
- *Gigabit Interface Converter (GBIC)*, Small Form Factor, SFF-8053, Revision 5.*x*
- *Common FC-PH Feature Sets Profiles*, Fibre Channel Systems Initiative, FCSI-101-Rev. 3.1
- *SCSI Profile*, Fibre Channel System Initiative, FCSI-201-Rev. 2.2
- *FCSI IP Profile*, Fibre Channel System Initiative, FCSI-202-Rev. 2.1

2 Installation and Operation

This chapter provides the following information:

- Components unique to M2 with Fibre Channel.
- Installation and operation of the M2 with Fibre Channel tape drive, where it differs from M2 with SCSI. For detailed installation and operation instructions, refer to *Exabyte Mammoth-2 Installation and Operation*.
- Software compatibility.

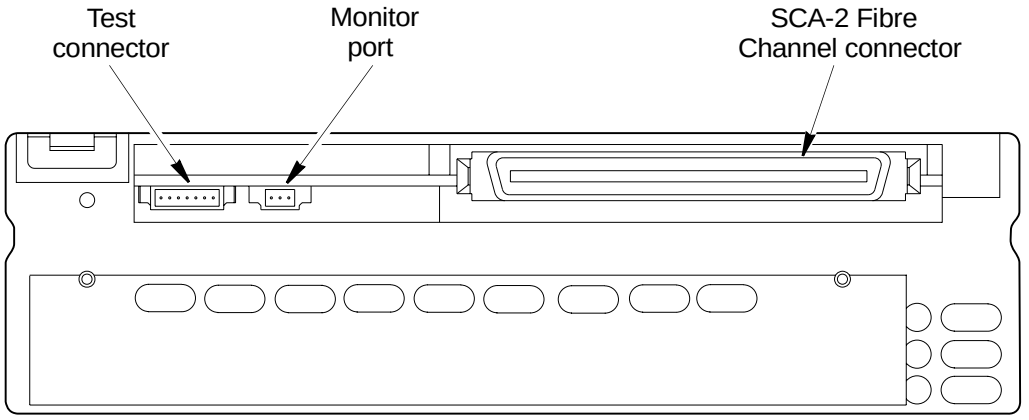
Components

The components of both the internal and tabletop models of M2 with Fibre Channel are identical to those of M2 with SCSI, with the following exceptions:

- A Fibre Channel interface card replaces the SCSI interface card inside the tape drive. The new card includes the microprocessor that controls the data path and system interface. Also included on the card are a Fibre Channel Interface chip, two SDRAM buffer memory chips for the Fibre Channel buffer, voltage and frequency references, and components for power supply isolation. The card also contains the compression engine, buffer controller, ECC3, and track formatting circuits.

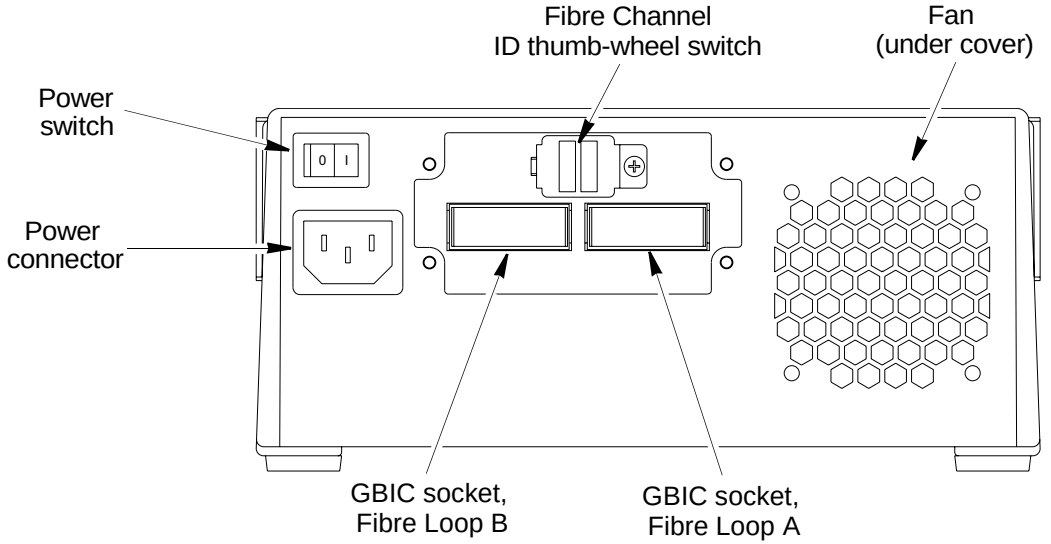
- The location of the monitor port and the test connector on the internal tape drive has been changed slightly, as shown in the following figure.

- An 80-pin SCA-2 connector on the back panel of the internal tape drive, shown in the following figure, replaces the SCSI connector. This connector allows you to connect the tape drive's Fibre Channel ports to a separate interface board or system backplane. In addition, the internal tape drive's power is supplied through this connector.



- Two GBIC (gigabit interface converter) sockets on the back of the tabletop tape drive, shown in the following figure, provide the connections to the tape drive's two Fibre Channel loops.

- A thumb-wheel switch allows you to set the hexadecimal Fibre ID for the tabletop tape drive. Addresses are selectable from 00h to 7Fh. The factory default is set to 0Dh. The switch is recessed to prevent accidental changes.



Tape Drive Installation

Installing M2 with a Fibre Channel interface is identical to installing M2 with a SCSI interface, with the following exceptions:

- Setting the Fibre ID (instead of setting the SCSI ID)
- Connecting to a Fibre Channel network (instead of connecting to a SCSI bus)
- Verifying the Fibre Channel link

The following table summarizes the steps for installing and configuring the tape drive.

For this step...	Look here for instructions...
Set the Fibre ID.	See page 11.
Connect the tape drive to the network.	See page 12.
Connect the power cord (tabletop tape drive only).	Read the *Exabyte Mammoth-2 Installation and Operation*.
Power on the tape drive.	
Verify the Fibre Channel link.	See page 15.

Setting the Fibre ID

> **Important** The tape drive physically allows selection of addresses 00h through FFh. However, within this range, the address 7Eh is reserved for use by the fabric (FL_PORT) and 7Fh is reserved. Furthermore, if you select an address higher than 7Fh, the tape drive ignores the most significant bit of the binary representation of the address.
>
> If you select either 7Eh or 7Fh as the address, the tape drive automatically uses soft addressing when obtaining an AL_PA.

The Fibre ID for the internal tape drive is set through the address bits (pins 21 – 24 and 69 –71) on the SCA-2 connector.

The Fibre ID for the tabletop model is a two-digit hexadecimal number set using the thumb-wheel switches on the back of the enclosure (see the figure on page 9). The factory default Fibre ID is 0Dh.

See "Device Addressing" on page 26 for more information about device addressing and AL_PAs.

Connecting to the Fibre Channel Network

The process for connecting the tape drive to a Fibre Channel network depends on whether you are integrating the internal tape drive into an enclosure or using the tabletop model.

➤ **Important** M2 tape drives with Fibre Channel can transfer data at up to 30 MB per second. A Fibre Channel loop has a maximum transfer rate of 100 MB per second. Connecting too many devices on a single loop may reduce the performance of the tape drive.

Internal Tape Drive

When integrating the internal drive, connect the 80-pin SCA-2 connector to a separate interface board or system backplane that provides the following:

- Power
- Provisions for setting the hardware address (the Fibre ID)
- Connection to the two fibre ports

The following table shows the connector pin assignments. Unless otherwise noted, all signals are defined in the SFF-8067 specification.

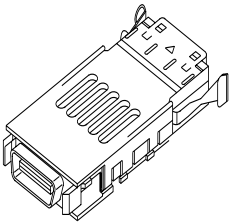
Pin #	80-pin Connector Contact and Signal Name	80-pin Connector Contact and Signal Name	Pin #
1	12 V CHARGE	GROUND (12 V)	41
2	12 V	GROUND (12 V)	42
3	12 V	GROUND (12 V)	43
4	12 V	MATED 2 (not connected)	44
5	12 V	OPT 12 V GROUND (not connected)	45
6	12 V	GROUND (12 V)	46

Pin #	80-pin Connector Contact and Signal Name	80-pin Connector Contact and Signal Name	Pin #
7	OPT 12 V (not connected)	– DRIVE_ATN (not connected)	47
8	OPT 12 V (not connected)	– LIB_RST (not connected)	48
9	OPT 12 V (not connected)	– LIB_SEN (not connected)	49
10	Reserved	– LIB_DRV_SEN (not connected)	50
11		+ LIB_TX (not connected)	51
12		– LIB_TX (not connected)	52
13		– LIB_RX (not connected)	53
14		+ LIB_RX (not connected)	54
15		Reserved	55
16	–ENBL BYP CH1 (not connected)	OPT 12 V GROUND (not connected)	56
17	– PARALLEL ESI (not connected)	+ PORT 1_IN	57
18	READY LED (not connected)	– PORT 1_IN	58
19	POWER CONTROL (not connected)	GROUND (12 V)	59
20	–ENBL BYP CH2 (not connected)	+ PORT 2_IN	60
21	SEL_6	– PORT 2_IN	61
22	SEL_5	GROUND (12 V)	62
23	SEL_4	+ PORT 1_OUT	63
24	SEL_3	– PORT 1_OUT	64
25	FAULT LED (not connected)	GROUND (5 V)	65
26	DEVICE CONT 2 (not connected)	+ PORT 2_OUT	66
27	DEVICE CONT 1 (not connected)	– PORT 2_OUT	67
28	5 V	GROUND (5 V)	68
29	5 V	SEL_2	69
30	5 V	SEL_1	70
31	5 V	SEL_0	71
32	5 V	DEVICE CONT 0 (not connected)	72
33	5 V	GROUND (5 V)	73
34	5 V	MATED 1 (not connected)	74
35	5 V	GROUND (5 V)	75
36	5 V CHARGE	GROUND (5 V)	76
37	Reserved	Reserved	77

Pin #	80-pin Connector Contact and Signal Name	80-pin Connector Contact and Signal Name	Pin #
38	RMT_START (not connected)	DLYD_START (not connected)	78
39	GROUND (5 V)	GROUND (5 V)	79
40	GROUND (5 V)	GROUND (5 V)	80

Tabletop Tape Drive

The tabletop tape drive is connected to the network using a GBIC similar to the one shown in the following figure. GBICs are available in a variety of types for use with either copper or optical fiber cables. The following table lists GBICs that are available from Exabyte and the maximum cable lengths supported by each. M2 with Fibre Channel can also be used with other types of GBICs.



GBIC	Cable type	Signal strength (megabits per second)	Maximum length (meters)
Copper with DB-9 or Copper with HSSDC (high speed serial data connector)	Shielded twisted pair (100-TP-EL-S)	100	25
Optical with dual SC	50-micron multimode fiber	100, shortwave	500

1. Install a GBIC in one or both of the Fibre Channel sockets on the back of the tape drive. Only one GBIC is used at a time.

2. Attach a fibre cable from the host or hub to one of the tape drive GBICs. The connectors on the GBIC and the cable are keyed to ensure that the cable is attached in the correct orientation.

   Notes:

   - Connect the tape drive to only one loop at a time. Loop A is typically used as the primary connection. Do not attempt to perform diagnostics on the tape drive using a loop-back connector.

   - Make sure that you use the same type of GBIC on both ends of the fibre cable.

Verify the Fibre Channel Link

After the tape drive is powered on, it automatically attempts to initialize the loops to which it is attached and obtain individual arbitrated loop physical addresses (AL_PAs). Most hubs and switches have link indicators that showing link status.

Tape Drive Operation

Operating M2 with Fibre Channel is identical to the operation of M2 with SCSI, with the following exceptions:

- New LCD messages
- Front panel precautions

For detailed operating instructions, refer to *Exabyte Mammoth-2 Installation and Operation*.

LCD Messages

Both the Fibre Channel and SCSI models of M2 include a liquid crystal display (LCD) that displays alphanumeric information about the tape drive's operational status. The following table lists the updated LCD messages that reflect the use of a Fibre Channel interface. For a complete list of the messages displayed on the LCD, refer to *Exabyte Mammoth-2 Installation and Operation*.

Reset messages (When the tape drive is reset, the LCD cycles through the following messages.)	
LV DIFFERENTIAL *or* FIBRE CHANNEL	The tape drive has an LVD (low voltage differential) SCSI or Fibre Channel configuration.
SCSI ID: *or* FIBRE ID:	The SCSI ID or Fibre ID of the tape drive.

ESD Precautions

Before you touch the front panel of the tape drive or an unused GBIC slot on the back panel of the tabletop tape drive for any reason, discharge any static electricity by touching a known grounded surface.

CAUTION

To avoid interrupting tape drive operation, discharge static electricity from your body before touching the tape drive. (Touch a known grounded surface, such as your computer's metal chassis or the rear of the drive enclosure.)

Software Compatibility

M2 is compatible with numerous software applications. For the latest information about device drivers and software compatibility, go to Exabyte's web site at www.exabyte.com. If your software application is not listed, contact Exabyte Technical Support.

Notes

3 Specifications

This chapter provides the performance specifications, functional specifications, and agency standards that are unique to M2 with Fibre Channel. Tape drives are tested to specifications using Exabyte AME media at the factory. For detailed information about M2 specifications and agency standards, refer to the *Exabyte Mammoth-2 Product Specification*.

Performance Specifications

The performance specifications for the M2 with Fibre Channel tape drive (including specifications for read and write access times, reselection phase timeout, tape speeds, and ready states) are identical to the specifications for M2 with SCSI, with the exception of the burst data transfer rate, which is 106 MB per second.

Functional Specifications

The functional specifications for the M2 with Fibre Channel tape drive (including specifications for reliability, environment, and shipping) are identical to the specifications for M2 with SCSI, with the following exceptions:

- DC voltage specifications
- Power consumption

DC Voltage

The internal model of the Fibre Channel tape drive operates from standard + 5 VDC and + 12 VDC supply voltages, as specified in the following table. All specified voltages are DC; no external AC power is used.

	+ 5 Volts	+ 12 Volts
Nominal tolerance:[a] Ripple and noise[b] (60 Hz to 20 MHz)	± 5% 125 mVpp max	± 10% 125 mVpp max
Operating current (in amps): Nominal[c] Peak[d]	 2.9 amp 3.1 amp	 0.5 amp 3.1 amp

[a] The tolerance is limited by some digital parts having a 5% tolerance specification.

[b] The ripple voltage is included in the total voltage tolerance.

[c] Nominal current occurs during streaming write or read operation.

[d] The peak current occurs during load, drum spin-up, unload, or at the start of search or rewind operations, and lasts for less than 5 seconds.

Power Consumption

The following table shows the internal tape drive's power consumption when operating and when idle.

Power consumption when operating[a]	18 watts
Power consumption when idle[b]	7 watts

[a] Assumes that the tape drive is reading data 50% of the time and writing data 50% of the time.

[b] Sleep 2 state.

Safety and Agency Standards

The internal and tabletop models of the M2 with Fibre Channel tape drive meet the same safety and agency standards as the corresponding models of the M2 with SCSI, with the following exceptions:

- Laser safety standards (new)
- Electromagnetic compatibility (EMC) (changed)
- Agency notices (changed)

Laser Safety Standards

The tabletop M2 with Fibre Channel tape drive must be used with an 850 nm shortwave laser and an optical multimode GBIC transceiver module. To maintain a Class 1 laser classification for the M2 with Fibre Channel, the transceiver must meet the Class 1 laser device classification as defined by the following list of laser safety standards.

- 21 CFR 1010.10 and 1040.11, Class I for laser products
- IEC 825-1, Safety of Laser Products, Part 1: Equipment Classification, Requirements and User's Guide

Electromagnetic Compatibility (EMC)

When properly installed in a shielded cabinet with shielded cables and adequate grounding of the input power, the tape drive meets the requirements for emissions and immunity as defined by the standards listed in the following table.

USA:	FCC, CFR 47, Ch. I, Part 15, Subpart B, Class A
Canada:	ICES-003, Class A
Australia:	AS/NZ 3548, Class A
Taiwan:	CNS-13438, Class A
Europe:	EN55022/CISPR 22, Class A EN55024: 1998, Information Technology Equipment

For the tabletop tape drive, the requirement for a shielded cabinet is met by the enclosure.

Agency Notices

This section lists the agency compliance for the tabletop tape drive. This information is in addition to the safety standards listed in the *Exabyte Mammoth-2 Product Specification*.

FCC Notice

The tabletop model of the M2 with Fibre Channel tape drive has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of FCC rules.

Industry Canada notice per ICES-003

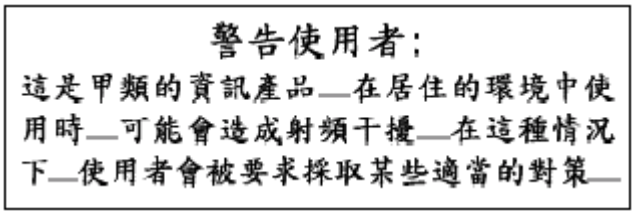
English This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

French Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Bureau of Standards, Metrology, and Inspection (BSMI) – Taiwan

This equipment has been tested and complies with CNS 13438.

Taiwanese



English 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.

Notes

4 Fibre Channel Interface Overview

This chapter provides an overview of the Fibre Channel interface and some general guidelines for connecting the library to a Fibre Channel environment.

Fibre Channel is a highly-reliable gigabit interconnect technology that allows simultaneous communications among workstations, mainframes, servers, data storage systems, and other peripherals using SCSI and IP protocols. M2 with Fibre Channel interface allows the tape drive to connect directly to a Fibre Channel network or fabric, without an intermediate Fibre Channel to SCSI bridge.

The Fibre Channel standard defines five functional levels. Of these five, the first four levels (FC-0 through FC-3) are concerned with the physical and logical mechanics of the Fibre Channel interface. The FC-4 protocol layer defines the mapping between the underlying Fibre Channel protocols and the SCSI command set used by the tape drive.

The upper protocol layer (FC-4) of the M2 with Fibre Channel interface conforms to the standards and specifications listed on page 5. In addition, the tape drive meets the requirements dictated by the SANWorks development effort to ensure seamless integration into SAN (storage area network) environments. Fabric and Direct Connect topologies are supported.

The following sections provide specific information about the Fibre Channel features implemented in the tape drive.

Device Addressing

The Fibre Channel protocol and the SCSI protocol employ different methods of addressing devices. Unlike the SCSI protocol, which uses fixed SCSI IDs, the Fibre Channel protocol uses different addressing depending on the type of topology used for the network: point-to-point, arbitrated loop, or fabric. The addresses are set dynamically at the time the device attaches to the network.

For the M2 with Fibre Channel tape drive, the most commonly used type of network connection is through an arbitrated loop. An arbitrated loop supports up to 126 devices. During the loop initialization process, each device on the loop obtains a Loop ID.

Loop ID

When the tape drive attaches to a Fibre Channel network it can use either hard or soft addressing when obtaining the Loop ID during the loop initialization (LIP) process, as follows:

- If the tape drive was previously on a loop, it first attempts to get the previously assigned Loop ID during loop initialization.
- If no Loop ID was previously assigned or if the Loop ID is no longer available, the tape drive attempts to obtain a Loop ID based on the Fibre ID (hard address) selected by the address bits (pins 21 – 24 and pins 69 – 71) connected on the 80-pin SCA-2 connector (for the internal model, shown on page 8) or on the Fibre ID thumb-wheel switch or (for the tabletop model, shown on page 9).

➤ **Important** The tape drive physically allows selection of addresses 00h through FFh. However, within this range, the address 7Eh is reserved for use by the fabric (FL_PORT) and 7Fh is reserved. Furthermore, if you select an address higher than 7Fh, the tape drive ignores the most significant bit of the binary representation of the address.

If you select either 7Eh or 7Fh as the address, the tape drive automatically uses soft addressing when obtaining an AL_PA.

If all of the tape drives and other devices on the loop have unique hard addresses, then the Loop ID is same as the hard address.

- If the hard address is already in use by another device on the network, the tape drive attempts to use soft addressing to obtain an Loop ID. When soft addressing is used, the Loop ID for the device is determined during initialization and is dynamically set to an available address within the range from 00h to EFh.

> **Important** If the tape drive is unable to obtain an address, it enters a non-participating state on the Loop.

Setting the RHA (Require Hard Address) bit on the Fibre Channel Port Control mode page prevents the drive from using soft addressing (see page 48). If the hard address cannot be used and use of a soft address is prevented, the drive enters the nonparticipating mode.

Arbitrated Loop Physical Address (AL_PA)

When the tape drive is on an arbitrated loop, the host uses a lookup table to associate the Loop ID with an arbitrated loop physical address (AL_PA) for each port. AL_PAs are one-byte values dynamically assigned each time the loop is initialized. The AL_PA for each Fibre Channel loop attached to the tape drive is dynamically set to the lowest available AL_PA. After obtaining an AL_PA, the tape drive is available to participate on the Fibre Channel loop.

World-Wide Names

Each tape drive is assigned three unique, 48-bit world-wide names for Fabric Login: one for the tape drive (the node) and one for each of the two Fibre Channel ports. The tape drive reports these world-wide names to the device server through the INQUIRY command, Vital Product Data Device Identification Page (Page Code 83h).

During the Fibre Channel login process the device server typically obtains the world-wide names for each host and device on the network. The server then associates each device's world-wide names with the currently assigned AL_PAs and uses this association to maintain a relationship between the host's address identifier and any persistent reservations for a port.

Any time the host or a device on the network detects a change to the configuration of the system, it reinitializes the loop. The reinitialization can result in new AL_PAs being assigned to all the devices on the loop. When initialization is complete, the device server reestablishes the relationship between the new AL_PAs and the world-wide names to maintain any pre-existing registrations and reservations.

Loop Initialization

Loop Initialization is a logical procedure used by an L_Port or NL_Port to determine its environment and to validate an AL_PA. Each of the tape drive's two Fibre Channel ports is an NL_PORT.

When a device issues a Loop Initialization Primitive (LIP) sequence on an active loop, any exchanges in progress are temporarily suspended while loop initialization occurs. Whenever possible, the suspended exchanges resume after initialization is complete.

The tape drive issues a Loop Initialization Primitive (LIP) sequence to initialize the fibre loop before beginning loop operations or whenever it detects configuration changes.

The tape drive performs Loop Initialization procedures as specified in the *Fibre Channel Arbitrated Loop Standard*, with the exception of the Loop Initialization Select Master (LISM) procedure.

Loop Initialization Select Master (LISM)

The tape drive's response to LISM frames is configured through the Disable Loop Master (DLM) bit on the Fibre Channel Port Control mode page (see page 48). The setting for the DLM bit is always 1 (enabled), which specifies that the tape drive forwards any received LISM frames rather than transmitting its own LISM frame. This setting prevents the tape drive from becoming Loop Master and allows the host to control the Loop Initialization sequence.

Fabric Login

The behavior of the tape drive during fabric login is configured by the Disable Tape Drive Fabric Discovery (DTFD) bit on the Fibre Channel Port Control mode page (see page 48). The default setting for the DTFD bit is 0 (disabled). Disabling DTFD causes the tape drive to use Fabric Login to detect whether a fabric is present. If the tape drive detects the presence of a fabric, it establishes a session with the fabric by communicating its identity and exchanging service parameters.

If the DTFD bit is 1 (enabled), the tape drive does not attempt a Fabric Login.

Fabric Login is also the mechanism used by the fabric to assign a Loop ID to the tape drive. The tape drive attempts a Fabric Login after Loop Initialization is complete. During the Fabric Login process, the tape drive sets the Sequential Delivery bit (byte 0, bit 27 of the N_Port Class Service Parameters for Fabric Login) to 1, which specifies that frames must be delivered in the same order that they were sent.

Dual Loop Support

The tape drive supports dual loop operation. However, it does not support active data transfers on both loops simultaneously. If one channel is actively transferring data, data transfer on the other loop cannot be initiated until the current transfer is complete. This restriction does not preclude the ability of the second loop from issuing commands to determine drive status.

Persistent Reserve/ Release

The tape drive supports the RESERVE UNIT and RELEASE UNIT commands. These commands allow a device attached to either fibre port to reserve the drive for data transfers. The device that issued the RESERVE UNIT command must issue a RELEASE UNIT command to release the drive before a different device on either fibre port can initiate a data transfer to the drive. This reserve mechanism is persistent during reset and power down conditions. See the chapters entitled “RESERVE UNIT (16h, 56h)” and “RELEASE UNIT (17h, 57h)” in the *Exabyte Mammoth-2 SCSI Reference* for detailed information.

Notes

5 SCSI Commands

The FC-4 layer of the Fibre Channel Protocol maps the signaling and data transmission protocols of the Fibre Channel interface onto the SCSI commands used to control tape drive operation.

The SCSI commands for M2 with Fibre Channel are identical to those for M2 with SCSI, with the exception of modifications to the following commands:

- INQUIRY
- MODE SELECT
- MODE SENSE

For detailed information about the tape drive's SCSI command set, refer to the *Exabyte Mammoth-2 Tape Drive SCSI Reference*.

INQUIRY (12h)

This section describes modifications to the information the tape drive returns when it receives an INQUIRY command, as follows:

- The Product Identification field in the Standard Inquiry Data has changed.
- The Submodel ID field has been added to the Standard Inquiry Data.
- The Device Identification Page (Page Code 83h) has been added.

All Inquiry parameters not defined in this section are described in the *Exabyte Mammoth-2 SCSI Reference*.

Returning Inquiry Data

The following table summarizes the values you should specify in the INQUIRY CDB to return the different types of inquiry data.

To return this inquiry data...	Set these fields to...		And specify this value for the Allocation Length...	Number of bytes returned (hex)
	EVPD	Page Code		
Standard Inquiry Data	0	00h	any value from 0 to FFh	0 to 106 bytes (0h to 6Ah)
Supported Vital Product Data Page	1	00h	07h	7 bytes (7h)
Unit Serial Number Page	1	80h	0Eh	14 bytes (0Eh)
Device Identification Page	1	83h	42h	66 bytes (42h)

Standard Inquiry Data

The tape drive returns the Standard Inquiry Data when the EVPD bit in the command CDB is 0. With the exception of the Product Identification and the Submodel ID fields, the M2 with Fibre Channel returns the information for the Standard Inquiry Data as defined in the *Exabyte Mammoth-2 SCSI Reference*.

Note: The changes to the Standard Inquiry Data for the definition of the Product Identification field and the addition of the Submodel ID field are also applicable to current and future versions of the M2 with SCSI.

Bit Byte	7	6	5	4	3	2	1	0
00	Peripheral Qualifier			Peripheral Device Type				
01	RMB	Device-Type Modifier						
02	ISO Version		ECMA Version			ANSI Version		
03	AENC	TrmIOP	Reserved		Response Data Format			
04	Additional Length							
05	Reserved							
06								
07	RelAdr	WBus32	WBus16	Sync	Linked	RSVD	CmdQue	SftRe
08 ⋮ 15	Vendor Identification							
16 ⋮ 31	Product Identification							

Bit Byte	7	6	5	4	3	2	1	0
32 ⋮ 35	Product Revision Level							
36 ⋮ 43	Submodel ID							
44 ⋮ 55	Vendor Specific							
56 ⋮ 95	Reserved							
96 ⋮ 105	Unit Serial Number							

Bytes 16 through 31 – Product Identification

Contains the ASCII representation of the product name followed by sufficient spaces to fill the field (for example, Mammoth2_____, where each "_" represents an ASCII space character).

Bytes 36 through 43 – Submodel ID

Contains the ASCII representation of the EEPROM image identifier (for example, MH000105).

Supported Vital Product Data Page

The tape drive returns the Supported Vital Product Data page when the EVPD bit in the command CDB is 1 and the Page Code is 00h.

Bit Byte	7	6	5	4	3	2	1	0
00	Peripheral Qualifier			Peripheral Device Type				
01	Page Code							
02	Reserved							
03	Page Length							
04	First Page Code Supported							
05	Second Page Code Supported							
06	Third Page Code Supported							

Byte 00, Bits 7 through 5 – Peripheral Qualifier

The value for this field is 0, indicating that this is a single LUN device.

Byte 00, Bits 4 through 0 – Peripheral Device Type

The value returned for this field is 01h, which identifies the tape drive as a sequential access device.

Byte 01 – Page Code

The Page Code for the Vital Product Data page is 00h.

Byte 03 – Page Length

The value returned for this field is 03h, which indicates that three additional bytes are available, excluding this byte.

Byte 04 – First Page Code Supported

The value for this field is 00h, which indicates support for the Vital Product Data page.

Byte 05 – Second Page Code Supported

The value returned for this field is 80h, which indicates support for the Unit Serial Number page.

Byte 06 – Third Page Code Supported

The value returned for this field is 83h, which indicates support for the Device Identification Page.

Device Identification Page (Page Code= 83h)

The Device Identification Page allows the tape drive to report its world-wide names as specified for the Fibre Channel protocol (FCP). The tape drive returns the Device Identification page when the EVPD bit in the CDB is 1 and the Page Code is 83h.

Bit / Byte	7	6	5	4	3	2	1	0
00	Peripheral Qualifier			Peripheral Device Type				
01	Page Code							
02	Reserved							
03	Page Length (3E)							
04	Reserved				Code Set			
05	Reserved		Association		Identifier Type			
06	Reserved							
07	Identifier Length (22h)							

Bit / Byte	7	6	5	4	3	2	1	0
08 ⋮ 41	(MSB) Device Identifier 1 (LSB)							
42	Reserved				Code Set			
43	Reserved		Association		Identifier Type			
44	Reserved							
45	Identifier Length (8h)							
46 ⋮ 53	(MSB) Device Identifier 2 (LSB)							
54	Reserved				Code Set			
55	Reserved		Association		Identifier Type			
56	Reserved							
57	Identifier Length (8h)							
58 ⋮ 65	(MSB) Device Identifier 3 (LSB)							

Byte 00, Bits 7 through 5 – Peripheral Qualifier

The value for this field is 0, indicating that this is a single LUN device.

Byte 00, Bits 4 through 0 – Peripheral Device Type

The value returned for this field is 01h, which identifies the tape drive as a sequential access device.

Byte 01 – Page Code

The Page Code for the Device Identification page is 83h.

Byte 03 – Page Length

The value returned for this field is 3Eh, which indicates that there are 62 additional bytes available, excluding this byte.

Byte 04, Bits 3 through 0 – Code Set

The value returned for this field is 02h, which indicates that the Device Identifier 1 field contains ASCII data.

Byte 05, Bits 5 and 4 – Association

The value returned for this field is 0h, indicating that Identifier 1 is associated with the tape drive.

Byte 05, Bits 3 through 0 – Identifier Type

The value returned for this field is 1h, indicating that the first eight bytes of the field contain the Vendor Identification returned for the Standard Inquiry Data.

Byte 07 – Identifier Length

The value returned for this field is 22h, which indicates that the length of the Device Identifier 1 field is 34 bytes, excluding this byte.

Byte 08 through Byte 41 – Device Identifier 1

This field contains the Device Identifier for the tape drive, as follows:

- **Bytes 08 through 15** contain the ASCII representation of "EXABYTE", followed by a single ASCII space character.
- **Bytes 16 through 32** contain the ASCII representation of Mammoth2 followed by eight ASCII space characters.
- **Bytes 33 through 41** contains the tape drive's serial number in the format *ddddddddd*, where *d* is the ASCII representation of a decimal digit (0-9). For example, 000000123 represents serial number 123.

Byte 42, Bits 3 through 0 – Code Set

The value returned for this field is 01h, which indicates that the Device Identifier 2 field contains binary data.

Byte 43, Bits 5 and 4 – Association

The value returned for this field is 0h, indicating that Device Identifier 2 is associated with the addressed physical device (the tape drive).

Byte 43, Bits 3 through 0 – Identifier Type

The value returned for this field is 2h, indicating that the Device Identifier 2 field contains an IEEE Extended Unique Identifier (world-wide name).

Byte 45 – Identifier Length

The value returned for this field is 8h, which indicates that the length of the Device Identifier 2 field is 8 bytes, excluding this byte.

Byte 46 through Byte 53 – Device Identifier 2

Contains the binary representation of the 48-bit world-wide name for the tape drive node on the Fibre Channel fabric, formatted as follows:

Bit / Byte	7	6	5	4	3	2	1	0
46	(MSB)							
47	IEEE Company ID							
48								(LSB)
49	FFh							
50	FFh							
51	(MSB)							
52	Global Device ID							
53								(LSB)

Bytes 46 through 48 – IEEE Company ID The value returned for this field is 00D080, the IEEE Company ID for Exabyte Corporation.

Bytes 51 through 53 – Global Device ID The value returned for this field is the unique world-wide name associated with the tape drive as a node during Fabric Login.

Byte 54, Bits 3 through 0 – Code Set

The value returned for this field is 01h, which indicates that the Device Identifier 2 field contains binary data.

Byte 55, Bits 5 and 4 – Association

The value returned for this field is 1h, indicating that Device Identifier 3 is associated with the port that received the INQUIRY request.

Byte 55, Bits 3 through 0 – Identifier Type

The value returned for this field is 2h, indicating that the Device Identifier 3 field contains a 64-bit IEEE Extended Unique Identifier (world-wide name).

Byte 57 – Identifier Length

The value returned for this field is 8h, which indicates that the length of the Device Identifier 3 field is 8 bytes, excluding this byte.

Byte 58 through Byte 65 – Device Identifier 3

Contains the binary representation of the 48-bit world-wide name for the port that received the INQUIRY request, formatted as follows:

Bit / Byte	7	6	5	4	3	2	1	0
58	(MSB)							
59	IEEE Company ID							
60								(LSB)
61	FFh							
62	FFh							
63	(MSB)							
64	Global Device ID							
65								(LSB)

Bytes 58 through 60 – IEEE Company ID The value returned for this field is 00D080, the IEEE Company ID for Exabyte Corporation.

Bytes 63 through 65 – Global Device ID The value returned for this field is the unique world-wide name associated with the fibre port that received the Inquiry request.

MODE SELECT (15h, 55h); MODE SENSE (1Ah, 5Ah)

This section describes the MODE SELECT and MODE SENSE pages that influence, control, and report the behavior of the tape drive within the Fibre Channel protocol (FCP). The mode pages associated with the Fibre Channel operation are listed in the following table.

Page code	Description
02h	Disconnect-Reconnect page
18h	Fibre Channel Logical Unit Control page
19h	Fibre Channel Port Control page
3Fh	Return all pages (valid only for the MODE SENSE command)

All mode parameters not defined in this section are described in the *Exabyte Mammoth-2 SCSI Reference*.

Disconnect-Reconnect Page (Page Code= 02h)

The Disconnect-Reconnect Page specifies how the tape drive handles disconnects and reconnects during data transfers. Only the parameters unique to M2 with Fibre Channel are defined in this section. All other parameters are defined in the *Exabyte Mammoth-2 Tape Drive SCSI Reference.*

Bit Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code (02h)					
01	Page Length							
02	Buffer Full Ratio							
03	Buffer Empty Ratio							
04	(MSB)							
05	Bus Inactivity Limit							(LSB)
06	(MSB)							
07	Disconnect Time Limit							(LSB)
08	(MSB)							
09	Connect Time Limit							(LSB)
10	(MSB)							
11	Maximum Burst Size							(LSB)
12	EMDP	FARD	FAWRT	FASTAT	Reserved			
13	Reserved							
14	(MSB)							
15	First Burst Size							(LSB)

Byte 12, Bit 07 – Enable Modify Data Pointers (EMDP)

The EMDP bit indicates whether the tape drive supports reordering FCP_Data information units for a single SCSI command. The value returned for this bit is 0, indicating that the tape drive does not support reordering information units.

Byte 12, Bit 06 through Bit 04 – Access Fairness Management

The FARD (Fairness Access Read), FAWRT (Fairness Access Write), and FASTAT (Fairness Access Status) bits indicate whether a tape drive in a loop configuration uses the access fairness algorithm when beginning the interconnect tenancy. The value returned for these bits is 1, indicating that the tape drive always uses the access fairness algorithm.

- The FARD bit controls arbitration when the tape drive sends one or more FCP_DATA frames to the host.
- The FAWRT bit controls arbitration when the tape drive sends one or more FCP_XFER_RDY frames to the host.
- The FASTAT bit controls arbitration when the tape drive sends one or more FCP_RSP frames to the host or FCP_CMND frames to another tape drive.

Bytes 14 and 15 – First Burst Size

The First Burst Size field indicates the maximum amount of data that can be transmitted in the first FCP_DATA information unit sent from the host to the tape drive when Write Transfer Ready is disabled.

The tape drive always returns 0 for this field, indicating that there is no First Burst Size limit.

Fibre Channel Logical Unit Control Page (Page Code= 18h)

The Fibre Channel Logical Unit Control Page specifies parameters that select FCP logical unit operation options.

Bit Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code (18h)					
01	Page Length							
02	Reserved							
03	Reserved							EPDC
04	Reserved							
05								
06								
07								

Byte 00, Bits 5 through 0 – Page Code

Identifies the page being transferred. The valid value is 18h (Fibre Channel Logical Unit Control Page).

Byte 01 – Page Length

Indicates the number of bytes in the Fibre Channel Logical Unit Control Page that follow this byte. The valid value is 06h.

Byte 03, Bit 0 – Enable Precise Delivery Checking (EPDC)

The EPDC bit indicates whether the tape drive uses the precise delivery function defined by the Fibre Channel standard. The valid value for this field is 0, indicating that the tape drive does not use the precise delivery function and ignores the contents of the Command Reference Number (CRN) field in the FCP information unit (IU).

Fibre Channel Port Control Page (Page Code= 19h)

The Fibre Channel Port Control Page specifies parameters that select FCP port operation options.

Bit Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code (19h)					
01	Page Length							
02	Reserved							
03	DTFD	PLPB	DDIS	DLM	RHA	ALWLI	DTIPE	DTOLI
04	Reserved							
05								
06	RR_TOV Units							
07	Resource Recovery Time Out Value (RR_TOV)							
08	Reserved						Control MCM	
09	Reserved							
10								
11	Originator CMRS Per Port							

Bit Byte	7	6	5	4	3	2	1	0
12	Reserved							
13	Responder CMRS Per Port							
14	(MSB)	MCM Time Out Value (MCM_TOV)						
15								(LSB)

Byte 00, Bits 5 through 0 – Page Code

Identifies the page being transferred. The valid value is 19h (Fibre Channel Port Control Page).

Byte 01 – Page Length

Indicates the number of bytes in the Fibre Channel Port Control Page that follow this byte. The valid value is 0Dh.

Byte 03, Bit 7 – Disable Tape Drive Fabric Discovery (DTFD)

The DTFD bit indicates whether the tape drive recognizes the presence of a fabric loop port on the loop, as follows:

0 – The tape drive recognizes a fabric loop port if it is present on the loop and performs public loop functions.

1 – The tape drive does not recognize the presence of a fabric loop port on the loop. The tape drive only performs private loop functions.

Byte 03, Bit 6 – Prevent Loop Port Bypass (PLPB)

The valid value returned for this bit is 0, indicating that the tape drive allows the Loop Port Bypass (LPB) and Loop Port Enable (LPE) primitive sequences to control the port bypass circuit and participation on the loop, as specified by FC-AL.

Byte 03, Bit 5 – Disable Discovery (DDIS)

The DDIS bit indicates whether the tape drive requires receipt of Address or Port Discovery (ADISC or PDISC ELSs) following loop initialization when it is attached to an FC-AL loop, but does not have a valid Fabric Login, as follows:

0 – The tape drive waits to complete Address or Port Discovery as defined by FC-PLDA and FC-FLA before allowing processing of tasks to resume.

1 – The tape drive does not require receipt of Address or Port Discovery (ADISC or PDISC ELSs) following loop initialization. The tape drive resumes processing tasks when loop initialization is complete.

If the tape drive has a valid Fabric Login, it ignores this bit.

Byte 03, Bit 4 – Disable Loop Master (DLM)

The tape drive returns 1 for this bit, indicating that the tape drive does not participate in loop master arbitration and does not become loop master. The tape drive only repeats LISM frames it receives.

Byte 03, Bit 3 – Require Hard Address (RHA)

The RHA indicates whether the tape drive requires a hard address during loop initialization, as follows:

0 – The tape drive follows the normal initialization procedure, including obtaining a soft address if it cannot use its hard address (set by the address bits on the 80-pin SCA-2 connector for the internal model or on the Fibre Channel ID thumb-wheel switch on the tabletop model) during the loop initialization process.

1 – The tape drive will only use the hard address during loop initialization. The tape drive does not attempt to obtain a soft address during the loop initialization soft assigned (LISA) phase of initialization.

Byte 03, Bit 2 – Allow Login Without Loop Initialization (ALWLI)

The ALWLI bit indicates whether the tape drive enters the monitoring state in participating mode and accepts logins without using the loop initialization procedure. The only valid value for this bit is 0, indicating that the tape drive performs the normal loop initialization procedure before entering the monitoring mode and accepting a LOGIN ELS.

Byte 03, Bit 1 – Disable Tape Drive Initiated Port Enable (DTIPE)

The DTIPE bit indicates whether the tape drive performs a Loop Initialization (LIP) sequence and inserts itself into a loop without waiting for the host to issue a Loop Port Enable (LPE) sequence. The only valid value for this bit is 0, indicating that the tape drive performs a LIP and attempts to participate in the loop as soon as power is applied.

Byte 03, Bit 0 – Disable Tape Drive Originated Loop Initialization (DTOLI)

The DTOLI bit indicates whether the tape drive generates an Initializing LIP following insertion into the loop, as follows:

1 – The tape drive does not generate an Initializing LIP following insertion into the loop. The tape drive responds to an Initializing LIP when it is received.

0 – The tape drive generates the Initializing LIP after it enables a port into a loop. If the tape drive detects loop failure at its input, it follows the error initialization process defined by FC-AL-2 regardless of the state of the DTOLI bit.

Byte 06 – Resource Recovery Time Out Value Units (RR_TOV Units)

The RR_TOV Units field indicates the units in which the RR_TOV is calculated, as shown in the following table.

Byte 06			Units of measure for RR_TOV
Bit 2	Bit 1	Bit 0	
0	0	0	No timer is specified
0	0	1	0.001 seconds
0	1	1	0.1 seconds
1	0	1	10 seconds
All other values			Reserved

Byte 07 – Resource Recovery Time Out Value (RR_TOV)

The RR_TOV field indicates the number of time units specified by the RR_TOV Units field (Byte 06) that are used by the timer that performs the RR_TOV timeout functions. If no timer is specified, the RR_TOV value is ignored.

Byte 08, Bits 1 and 0 – Control MCM

The Control MCM (multiple circuit mode) field indicates which MCM operations the tape drive is allowed to initiate. The value returned by the tape drive is 01b, indicating that the tape drive does not respond to any MCM primitives (that is, MCM is disabled to the tape drive).

Byte 11 – Originator CMRS (Circuity Management Resources) Per Port

The CMRS field indicates the minimum number of MCM circuits the tape drive may originate at each of the tape drive's ports. The value returned for this byte is zero, indicating that the tape drive does not support originator CMRS.

Byte 13 – Responder CMRS Per Port

This field indicates the minimum number of MCM circuits the tape drive may respond to at each of the tape drive's ports. The value returned for this byte is zero, indicating that the tape drive does not support originator CMRS.

Bytes 14 and 15 – MCM Time Out Value (MCM_TOV)

This field indicates the minimum time, in milliseconds, that an MCM device remains in the MCM state before transmitting an EMCM (end multiple circuit mode) signal. The tape drive returns a value of zero in this field, indicating that there is no minimum time an MCM device has to remain in the MCM state before transmitting an EMCM signal.

Notes

Index

H

I

L

M

P

S

W

Notes

Contacting Exabyte

To obtain technical support	
Exabyte Technical Support	1-800-445-7736
	1-303-417-7792
	1-303-417-7160 (fax)
e-mail	support@exabyte.com
World Wide Web	www.exabyte.com www.mammothtape.com www.m2wins.com
To order supplies and accessories	
Exabyte	1-800-774-7172 or 1-800-392-8273
To return equipment for service	
Exabyte Service	1-800-445-7736
	1-303-417-7199 (fax)
	Scotland: + 44-1-324-564564
e-mail	service@exabyte.com

Note: If it is more convenient to your location, contact Exabyte Technical Support in Europe at the following numbers:

Phone: + 31-30-254-8890
Fax: + 31-30-258-1582