EXB-8500 8mm Cartridge Tape Subsystem

User's Manual

Exabyte

510201-002

Copyright

Disclaimer

Trademark Notices

Revision History

Previous revisions of this manual include the following:

Revision	Date
000	December 1990
001	April 1991
002	December 1991

For information about the changes and enhancements to this revision, refer to page iv.

Product Warranty Caution

The EXB-8500 8mm Cartridge Tape Subsystem (CTS) is warranted to be free from defects in materials, parts, and workmanship and will conform to the current product specification upon delivery. **For the specific details of your warranty, refer to your sales contract or contact the company from which the EXB-8500 was purchased.**

The warranty for the EXB-8500 shall not apply to failures of any unit when:

- The EXB-8500 is repaired by anyone other than the Manufacturer's personnel or approved agent.
- The EXB-8500 is physically abused or is used in a manner that is inconsistent with the operating instructions or product specification defined by the Manufacturer.
- The EXB-8500 fails because of accident, misuse, abuse, neglect, mishandling, misapplication, alteration, faulty installation, modification, or service by anyone other than the factory service center or its approved agent.
- The EXB-8500 is repaired by anyone, including an approved agent, in a manner that is contrary to the maintenance or installation instructions supplied by the Manufacturer.
- The Manufacturer's serial number tag is removed.
- The EXB-8500 is damaged because of improper packaging on return.

CAUTION

Returning the EXB-8500 in unauthorized packaging may damage the unit and void the warranty.

If you are returning the EXB-8500 for repair, package it in its original packaging (or in replacement packaging obtained from your vendor). Refer to the packing instructions in this manual.

If problems with the EXB-8500 occur, contact your maintenance organization; do not void the product warranty by allowing untrained or unauthorized personnel to attempt repairs.

Changes and Enhancements to This Manual

This revision of the *EXB-8500 8mm Cartridge Tape Subsystem User's Manual* includes the following changes and enhancements:

- Improved instructions in Section 2.4 for mounting the EXB-8500.
- New instructions in Section 2.7 for performing the first power on if the EXB-8500 has been stored for more than six months.
- Revised information in Section 3.1 about the EXB-8500's read/write compatibility with other EXABYTE 8mm Cartridge Tape Subsystems.
- Revised information in Table 3-2 about filemarks, including hexadecimal values for filemark lengths.
- New Section 3.3 describing the optional EXB-8500 directory support feature.
- Revised Table 3-5 showing EXB-8500 states indicated by LEDs.
- New Section 3.8 describing the unload button options.
- Modifications to Chapter 5 describing how to load new microcode from tape.
- New flowcharts in Chapter 6 describing EXB-8500 message processing.
- Revised and clarified information in Chapter 6 about recovering from SCSI bus parity errors.
- New Table 9-1 for the INQUIRY (12h) command describing byte and bit settings.
- ADE bit added to the LOCATE (2Bh) command (Chapter 11) for the optional EXB-8500 directory support feature.
- Chapter 12 (MODE SELECT command) reorganized to match the organization of Chapter 13 (MODE SENSE command).
- Section 12.12 added to the MODE SELECT chapter. This new section provides step-by-step instructions for writing, reading, and appending to tapes in EXB-8500 and EXB-8200 format.
- MODE SELECT (15h) and MODE SENSE (1Ah) commands revised to allow compatibility with SCSI drivers supporting data compression.
- New Vendor Unique Parameters Page 2 added to the MODE SELECT and MODE SENSE commands.

- New Chapter 17 describing the READ BUFFER (3Ch) command.
- Clarified description of the RECEIVE DIAGNOSTIC RESULTS (1Ch) command in Chapter 19.
- New status bits—RRR, CLND, and CLN—added to the information returned by the REQUEST SENSE (03h) command (Chapter 21).
- ADE bit added to the SPACE (11h) command (Chapter 25) for the optional EXB-8500 directory support feature.
- Revised Section 28.4 explaining what happens if the EXB-8500 encounters LEOT during a write operation.
- New Appendix B describing a sample application for the optional EXB-8500 directory support feature.
- Revised Appendixes D and E. Appendix E now includes recommended error recovery procedures for each Fault Symptom Code.

Contents

Tables

MODE SENSE (1Ah)

RECEIVE DIAGNOSTIC RESULTS (1Ch)

REQUEST SENSE (03h)

SEND DIAGNOSTIC (1Dh)

SPACE (11h)

WRITE (0Ah)

WRITE BUFFER (3Bh)

WRITE FILEMARKS (10h)

Data Cartridge Capacities

Fault Symptom Codes

Figures

General Information

Installing the EXB-8500

Operating the EXB-8500

Cleaning and Packing the EXB-8500

SCSI Physical Path Communications

Part 1

Installing and Operating the EXB-8500

1 General Information

This manual provides instructions for installing and using the EXABYTE® EXB-8500 8mm Cartridge Tape Subsystem (EXB-8500). It also provides reference information for developing software to support EXB-8500 applications.

1.1 About the EXB-8500

The EXB-8500 is a high-performance, high-capacity 8mm cartridge tape subsystem designed to meet the demands of super-mini and mainframe computer systems. The EXB-8500, shown in Figure 1-1, is packaged in the industry-standard 5.25-inch form factor and provides up to 5,000 megabytes—5 gigabytes—of data storage capacity on a single, standard 8mm data cartridge.

By using dual read and write head pairs with helical-scan recording technology, the EXB-8500 can achieve a transfer rate of up to 500 KBytes per second with peak transfer rates of up to 4 MBytes per second. The EXB-8500 uses sophisticated error correction code (ECC) and error recovery procedures along with full read-after-write verification to ensure data integrity. Data interchange is maintained through read and write compatibility with other EXABYTE 8mm Cartridge Tape Subsystems, including the EXB-8200, EXB-8200SX, EXB-8205, and EXB-8500c.

The EXB-8500 includes a Small Computer System Interface (SCSI) controller and is available in single-ended and differential SCSI configurations.

For detailed information about EXB-8500 specifications, refer to the *EXB-8500 8mm Cartridge Tape Subsystem Product Specification*.

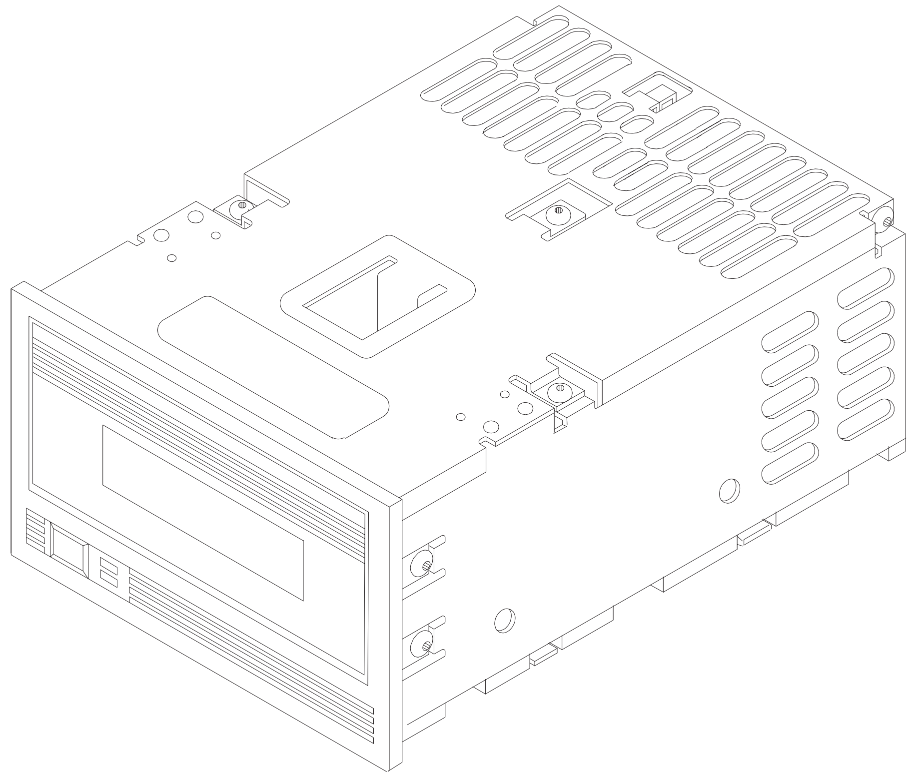


Figure 1-1 EXABYTE EXB-8500 8mm Cartridge Tape Subsystem

1.2 About This Manual

This manual includes the following information:

- Part 1 includes this chapter and Chapters 2 through 5. Read Part 1 to learn about installing, operating, cleaning, and shipping the EXB-8500 and downloading microcode updates from a tape.
- Part 2 includes Chapters 6 through 30. These chapters describe how the Small Computer System Interface (SCSI) is implemented in the EXB-8500 and provide details about the SCSI commands supported by the EXB-8500. To help you find the information you need quickly, the commands are listed in alphabetic order.
- Appendix A lists the cable requirements for the EXB-8500.
- Appendix B provides a sample application for using the EXB-8500's directory support feature. This option is available as a special EEPROM image.

- Appendix C describes how the EXB-8500 autosizes tapes and lists the track and physical block counts for the different types and sizes of data cartridges supported by the EXB-8500.

- Appendix D lists the possible combinations of values for the Additional Sense Code (ASC) and Additional Sense Code Qualifier (ASCQ) fields returned by the REQUEST SENSE (03h) SCSI command. The ASC and ASCQ values are listed in order for each sense key.

- Appendix E lists the Fault Symptom Codes that may be returned by the REQUEST SENSE (03h) command. These EXABYTE-unique codes can be used to determine the specific nature of hardware and software errors and other events. This appendix also describes the recommended recovery procedures for each Fault Symptom Code.

- A glossary, index, and reader's comment form are included at the back of this manual.

Intended Audience

This manual is intended for any EXB-8500 user who is responsible for:

- Installing and operating the EXB-8500
- Writing SCSI device drivers for the EXB-8500.

Before reading this manual, you should be familiar with the specifications for the EXB-8500 as described in the *EXB-8500 8mm Cartridge Tape Subsystem Product Specification*. Part 2 of this manual assumes that you are familiar with basic SCSI terminology and concepts.

1.3 Related Publications

This manual provides instructions for installing, operating, and cleaning the EXB-8500 and for implementing the EXB-8500's SCSI command set. For additional information about the EXB-8500, refer to the following publications:

- *EXB-8500 8mm Cartridge Tape Subsystem Product Specification*, 510200

- *Monitor User's Guide for the 8mm Cartridge Tape Subsystem*, 510206

For information about the standards used for the EXB-8500, refer to the following publications:

- ANSI *Small Computer System Interface (SCSI)*, X3.131-1989
- ANSI *Small Computer System Interface-2 (SCSI-2)*, X3T9/89-042
- ANSI *Helical-Scan Digital Computer Tape Cartridge*, X3B5/89-136, Rev. 6

Finally, for information about other EXABYTE 8mm Cartridge Tape Subsystems, refer to the following publications:

- *EXB-8200 8mm Cartridge Tape Subsystem Product Specification*, 510005
- *EXB-8200 8mm Cartridge Tape Subsystem User's Manual*, 510006
- *EXB-8200SX 8mm Cartridge Tape Subsystem Product Specification and User's Manual*, 510011
- *EXB-8205 8mm Cartridge Tape Subsystem Product Overview*, 510700
- *EXB-8500c 8mm Cartridge Tape Subsystem Product Specification and User's Manual*, 510207

1.4 Safety and Regulatory Agency Standards

Safety Standards
When purchased from EXABYTE Corporation, the EXB-8500 is certified as a component by the following domestic and international product safety standards:

- UL Standard 1950, 1st Edition, Information Technology Equipment
- UL Standard 478, 4th Edition, Electronic Data Processing Units and Systems
- CSA Standard C22.2 No. 220-M1986, Information Processing and Business Equipment
- CAN/CSA Standard C22.2 No. 950-M89, Safety of Information Technology Equipment (pending)
- IEC 950/EN60950, Safety of Information Technology Equipment including Electrical Business Equipment (TUV)

Electromagnetic Compatibility (EMC) Standards

When properly installed with shielded cables and adequate grounding of the SCSI bus and the input power, the EXB-8500 meets the requirements for radiated and conducted emissions as defined by the following standards:

- FCC Rules, Part 15, Class B, Computing Devices
- Canadian Department of Communications, Radio Interference Regulation, Digital Apparatus, Class B
- VDE Vfg 1046/1984, Class B
- CISPR Publication 22, 1985, Class A

Electromagnetic Interference (EMI) Standards

When properly installed with shielded cables and adequate grounding of the SCSI bus and the input power, the EXB-8500 will continue to operate without error when subjected to moderate levels of electromagnetic energy as defined by the following standard:

- IEC Publication 801-3, Severity Level 3

Other Test Standards

When shipped, the EXB-8500 is packaged in a manner that complies with the testing criteria defined by the following standard:

- National Safe Transit Association (NSTA) Project 1

Notes:

2 Installing the EXB-8500

This chapter describes how to install the EXB-8500. Installing the EXB-8500 involves unpacking it, setting the SCSI ID, attaching the drive to a mounting frame (if desired), connecting it to the SCSI bus, connecting it to a power supply, and performing the initial power on. Although you can perform some of these tasks in any order, this manual presents these tasks in the order you will typically follow.

Note: For information about the cable requirements for the EXB-8500, refer to Appendix A. For details about the power specifications and environmental conditions required for the EXB-8500, refer to the *EXB-8500 8mm Cartridge Tape Subsystem Product Specification*.

2.1 Required and Optional Equipment

To install the EXB-8500, the following equipment is required:

- A SCSI cable with sufficient connectors attached to operate the desired number of EXB-8500s.

  Note: The SCSI cable is not provided with the EXB-8500. Refer to Appendix A for a description of the cable requirements. For single-ended SCSI configurations, ensure that the total length of the cable does not exceed 6 meters (19.68 feet). For differential SCSI configurations, ensure that the total length of the cable does not exceed 25 meters (82 feet).

- External SCSI bus terminator (differential SCSI configuration only).

  If you are installing the differential SCSI configuration of the EXB-8500 and the EXB-8500 will terminate the SCSI bus, you must provide external termination. To ensure that the EXB-8500 performs to specification, EXABYTE recommends a Methode Electronics, Inc. dataMate® DM103-01-0 differential external terminator.

  Note: If necessary, you can terminate the single-ended EXB-8500 externally. In this case, remove the resistor terminators from the back of the EXB-8500 and install an external terminator. To ensure that the EXB-8500 performs to specification, EXABYTE recommends a Methode Electronics, Inc. dataMate DM103-02-0 single-ended external terminator.

- Power cable. See Appendix A for a description of the cable requirements.
- Standard DC supply voltages: +5 volts and +12 volts.

The following equipment is optional:

- Remote switch or jumpers (if you want to set the SCSI ID remotely). The initiator must use a female Molex® 22-55-2061 or equivalent cable connector to control the address remotely.
- Mounting frame or brackets (if desired).
- Four #6-32 screws and screwdriver (if needed to attach the EXB-8500 to a mounting frame).
- Flat-nose wiring pliers (if the EXB-8500 will not terminate the SCSI bus).
- $\frac{1}{4}$-inch female spade connector or an M3-0.5 $\times$ 6 mm self-tapping screw (if an additional chassis ground is desired).

2.2 Unpacking the EXB-8500

To unpack the EXB-8500, follow these steps:

1. Place the shipping carton on a flat, level surface.
2. Remove the adhesive tape from the top of the carton and open the carton flaps.
3. Carefully remove the packing material from the top of the EXB-8500.
4. Holding the bottom edges of the EXB-8500, lift it out of the carton and place it on a flat, level surface.
5. Check the contents of the carton against the packing list and inspect the EXB-8500 for possible damage. If a part is missing or the EXB-8500 is damaged, notify the carrier and your vendor immediately.
6. Let the EXB-8500 acclimate to the operating environment for at least two hours before applying power.

Note: If the EXB-8500 has been stored for more than six months, follow the instructions in Section 2.7 when applying power for the first time.

2.3 Setting the SCSI ID

After you have unpacked the EXB-8500, you can set the SCSI ID. When you set the SCSI ID, you select the address to be asserted by the EXB-8500 during arbitration. You can select addresses 0 through 7 for the EXB-8500. The EXB-8500 sets its SCSI ID internally following normal power-on or after the EXB-8500 is reset by a SCSI bus reset or a Bus Device Reset message. Changes in the SCSI ID setting will not take effect until one of these conditions occurs.

Note: The logical unit number (LUN) of the EXB-8500 is 0 and cannot be changed.

You can use any one of the following methods to set the SCSI ID:

- Set the DIP switches on the rear of the EXB-8500
- Connect a remote switch to the remote connector on the back of the EXB-8500
- Attach jumpers (shunts) to the pins on the remote connector. Jumpers are provided with the EXB-8500.

These methods are explained in the following sections.

Important

If you are using a remote switch or jumpers to set the SCSI ID, make sure that the DIP switches are set to address 0. Similarly, if you are using the DIP switches to set the SCSI ID, make sure that the remote switch or jumpers are set to address 0.

If you set both the DIP switches and the remote switch to a particular address, the actual SCSI ID will be the logical OR of the two settings. For example, if the remote switch is set for address 1 and the DIP switches are set for address 2, the actual SCSI ID will be 3.

Setting the SCSI ID with the DIP Switches

To set the SCSI ID with the DIP switches on the EXB-8500, follow these steps:

1. Locate the DIP switches (labeled U2) on the back of the EXB-8500, as shown in Figure 2-1.

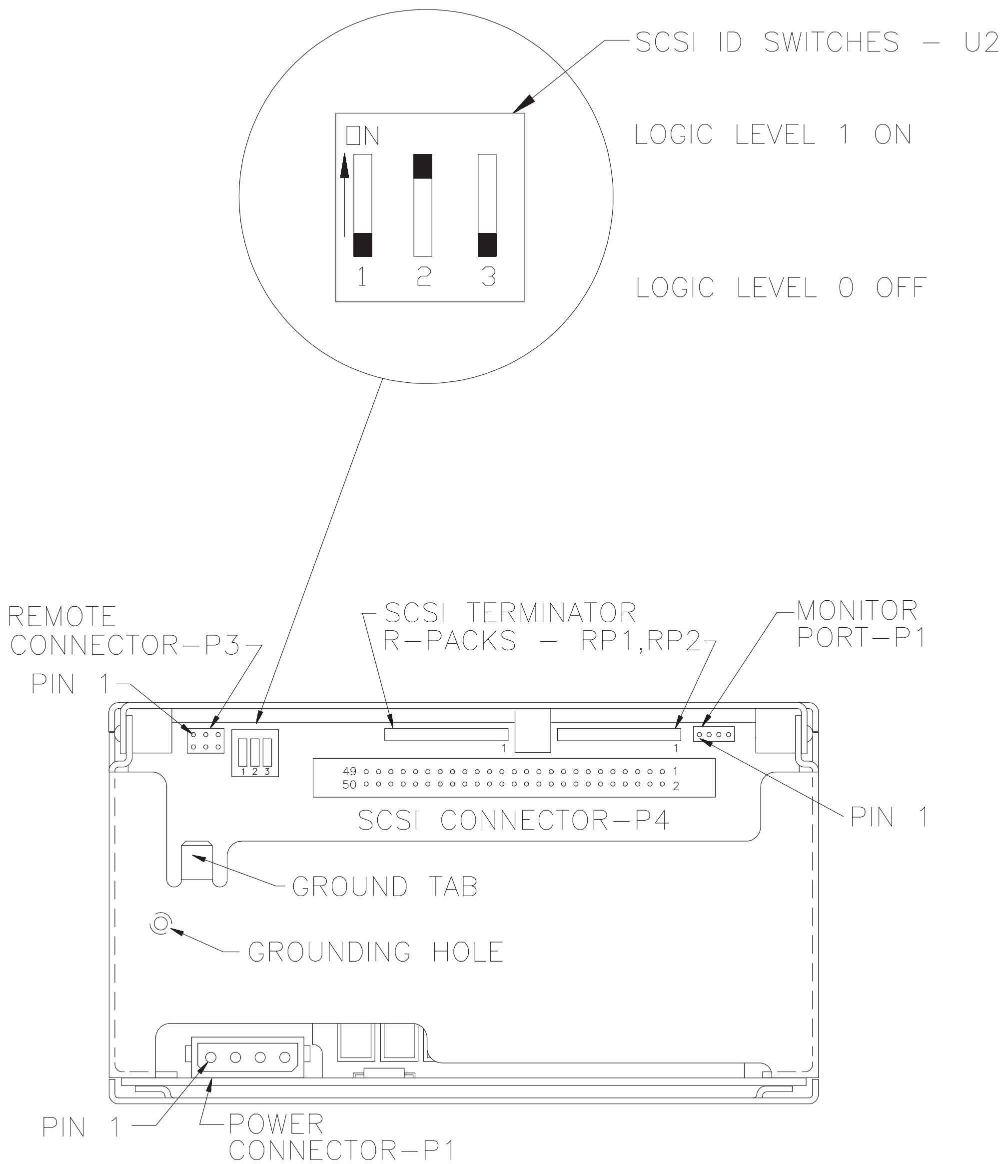


Figure 2-1 Connectors and Controls on the Back Panel of the EXB-8500

2. Change the settings to the correct address for your configuration. Figure 2-2 shows the settings for addresses 0 through 7.

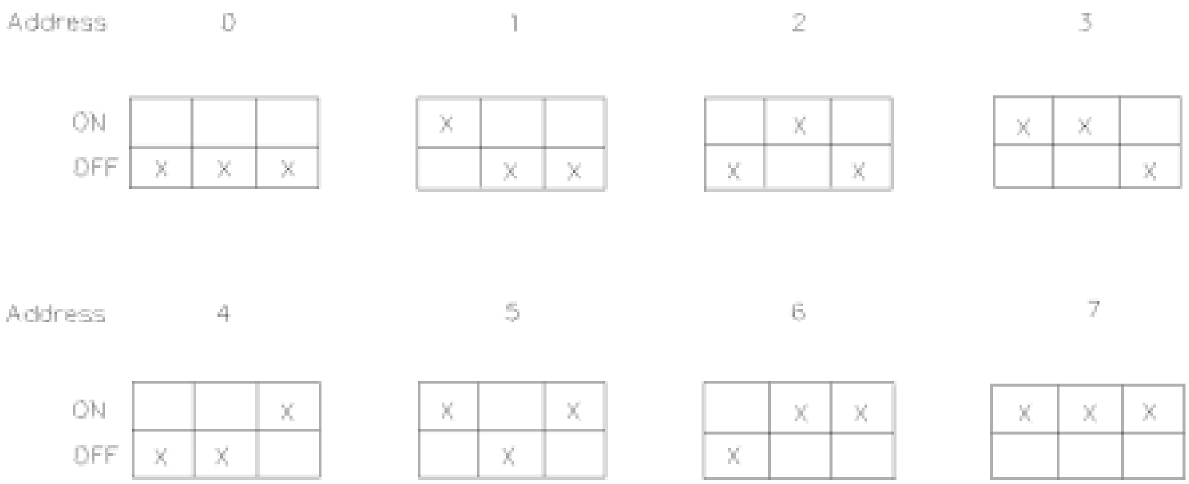


Figure 2-2 DIP Switch Settings for the EXB-8500's SCSI ID

Setting the SCSI ID with a Remote Switch

The EXB-8500 includes a remote connector (labeled P3) to enable you to set the SCSI ID remotely. To set the SCSI ID with a remote switch (not provided with the EXB-8500), follow these steps:

1. Locate the DIP switches (labeled U2) on the back of the EXB-8500, as shown in Figure 2-1.

2. Set all three DIP switches to off (address 0).

3. Locate the remote connector (labeled P3) on the back of the EXB-8500, as shown in Figure 2-1.

4. Connect a remote switch to the connector. Ensure that the remote switch is no more than 12 inches from the remote connector. Figure 2-3 shows the location of the pins on the remote connector.

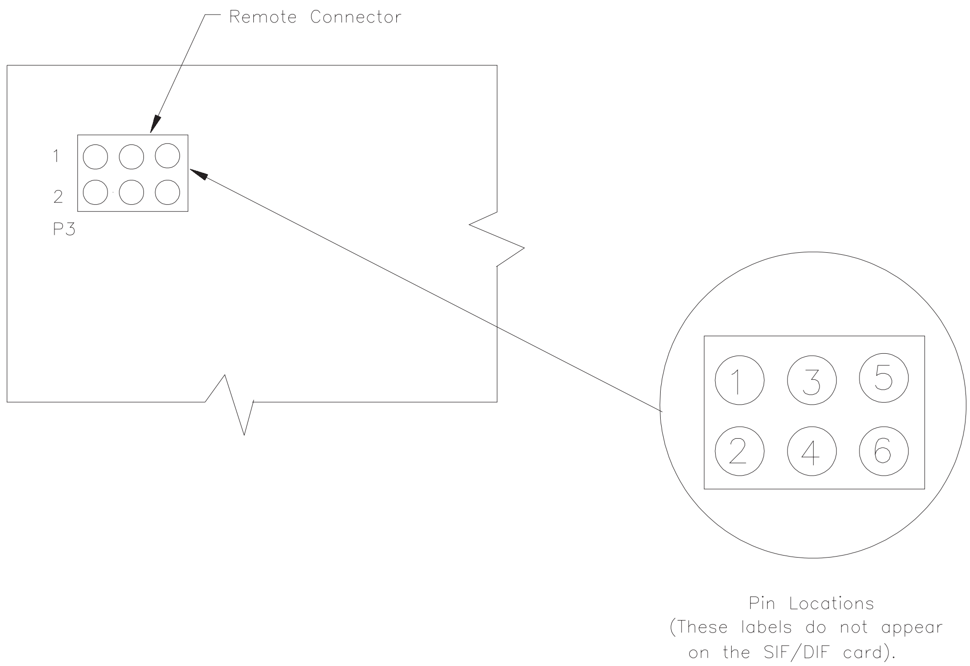


Figure 2-3 Location of the Pins on the Remote Connector

5. Change the settings on the remote switch to the correct address for your configuration. Table 2-1 shows the pin assignments for the remote connector. Note that the switch settings for the remote connector should emulate the jumper positions shown in Figure 2-4.

Table 2-1 Pin Assignments on the Remote Connector

Pin	Assignment
1	SCSI ID Bit 2 (MSb)
2	Ground
3	SCSI ID Bit 1
4	Ground
5	SCSI ID Bit 0 (LSb)
6	Ground

Setting the SCSI ID with Jumpers

To set the SCSI ID using jumpers (provided with the EXB-8500), follow these steps:

1. Locate the DIP switches (labeled U2) on the back of the EXB-8500, as shown in Figure 2-1.
2. Set all three DIP switches to off (address 0).
3. Locate the remote connector (labeled P3) on the back of the EXB-8500, as shown in Figure 2-1.
4. Connect jumpers to the pins on the remote connector to obtain the correct address for your configuration. Figure 2-4 shows how to position the jumpers for addresses 0 through 7.

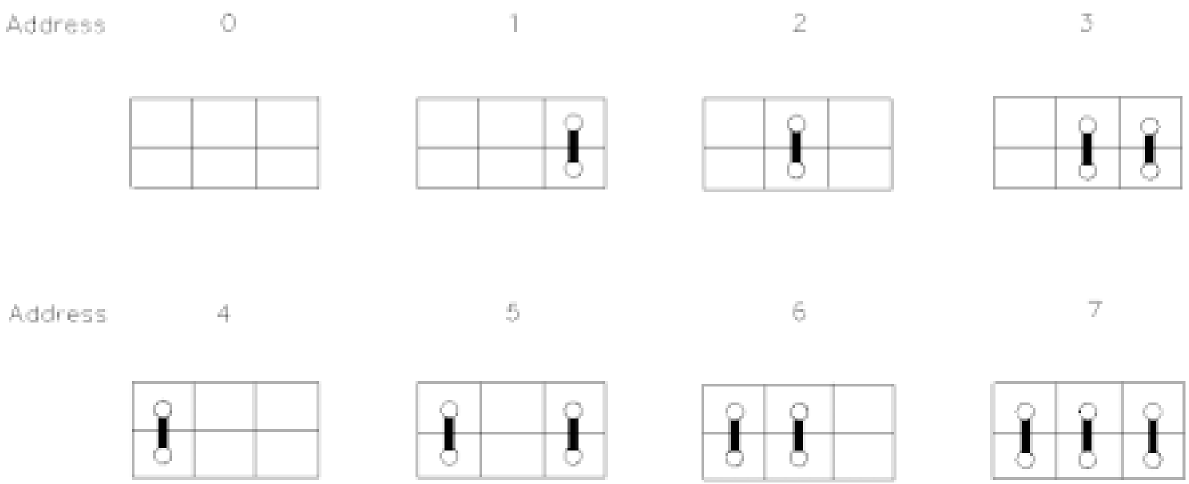


Figure 2-4 Jumper Connections for the EXB-8500's SCSI ID

2.4 Attaching the EXB-8500 to a Frame

The procedure you use to attach the EXB-8500 to a mounting frame or bracket depends on the requirements of your installation. The main housing of the EXB-8500 includes two sets of mounting holes (one set on the sides and one set on the bottom) to allow for a number of mounting positions. These mounting holes accommodate #6-32 screws and are designed for standard 5.25-inch form factor mounting requirements.

The EXB-8500 can be mounted either horizontally or vertically and in a stationary or sliding position. When the EXB-8500 is mounted horizontally, the door opens down from the top. When the EXB-8500 is mounted vertically, the door can open to the left or right.

When mounting the EXB-8500, follow these guidelines:

- Use either the four mounting holes on the sides of the EXB-8500 (shown as “A” in Figure 2-5) or the four mounting holes on the bottom (SYS card cover) of the EXB-8500 (shown as “B” in Figure 2-6). To ensure that the EXB-8500 is securely mounted and that the chassis is not subject to distortion, use all four holes in whichever set you choose.
- Do not obstruct the ventilation slots on the sides and top of the device. This ensures that the EXB-8500 can be adequately cooled.

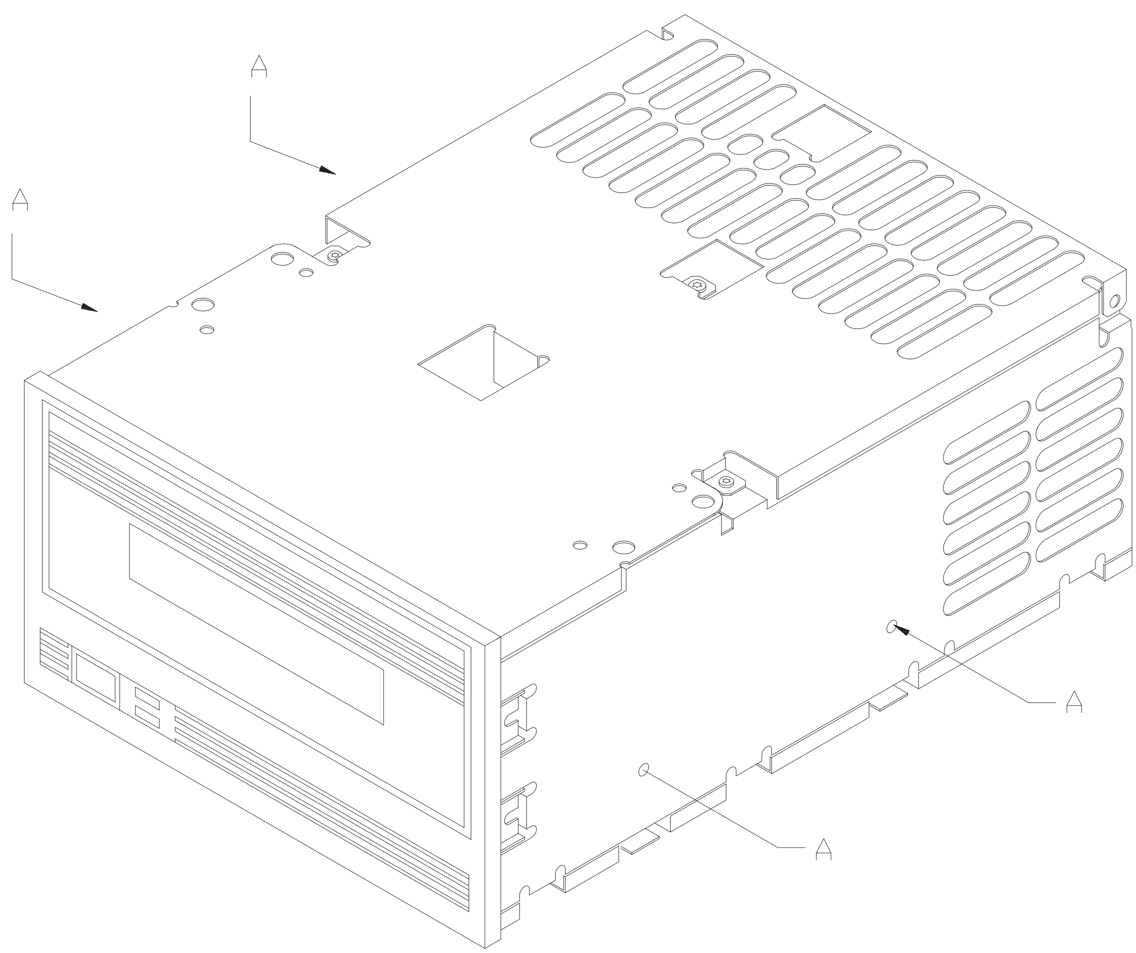


Figure 2-5 Location of the Four Mounting Holes on the Sides of the EXB-8500

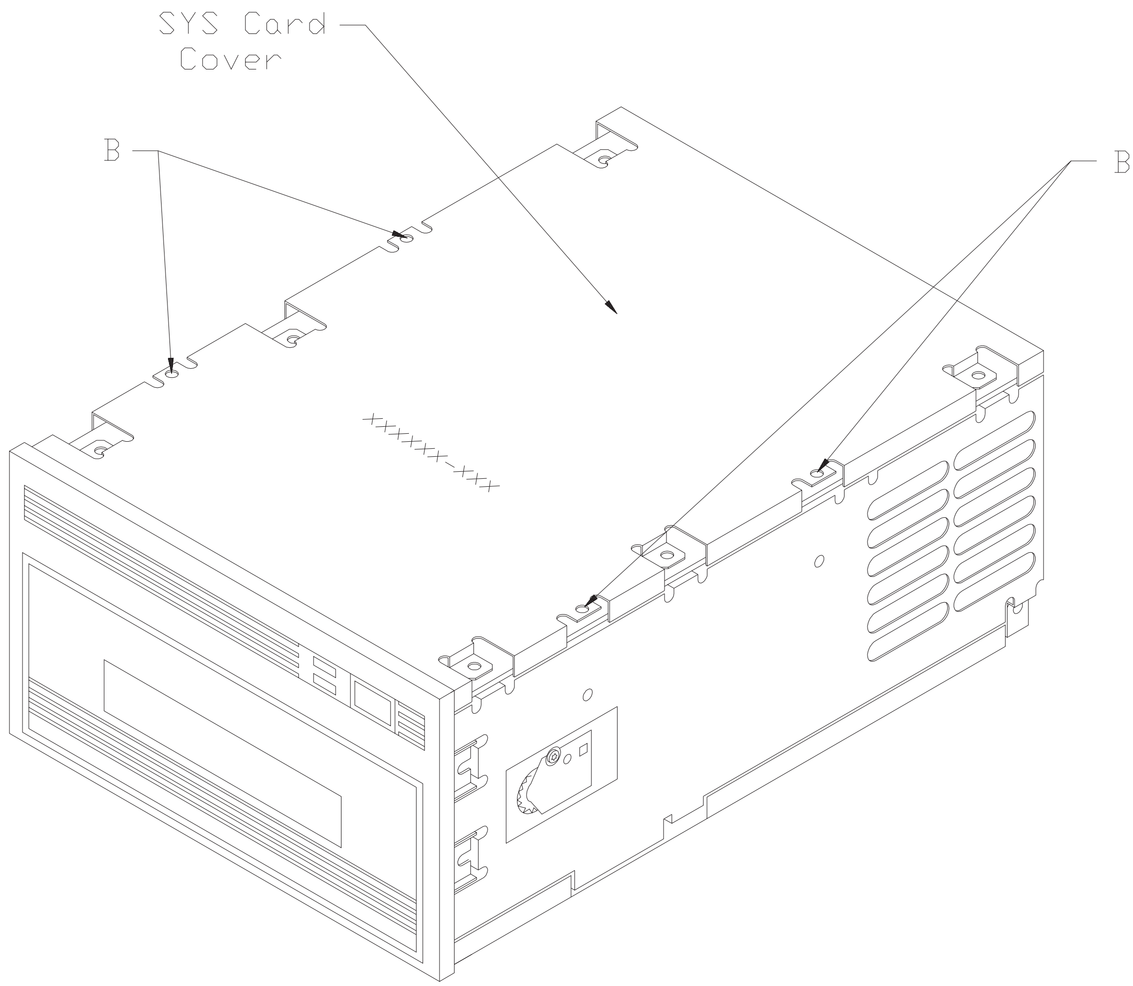


Figure 2-6 Location of the Four Mounting Holes on the Bottom of the EXB-8500

Refer to the *EXB-8500 8mm Cartridge Tape Subsystem Product Specification* for detailed information about the locations and dimensions of these mounting holes.

2.5 Connecting the EXB-8500 to the SCSI Bus

The procedure you use to connect the EXB-8500 to the SCSI bus depends on whether the EXB-8500 uses a single-ended or a differential SCSI configuration and whether it terminates the SCSI bus.

Single-Ended SCSI Configuration

The single-ended SCSI configuration of the EXB-8500 includes two single in-line package (SIP) resistor terminators (R-packs) that can be used if the EXB-8500 terminates the SCSI bus. These terminators must be removed if the EXB-8500 does not terminate the SCSI bus or if external SCSI bus termination will be used.

To remove the R-packs, follow these steps:

1. Locate the two R-packs on the back of the EXB-8500. Figure 2-7 shows the location of these R-packs, labeled RP1 and RP2.

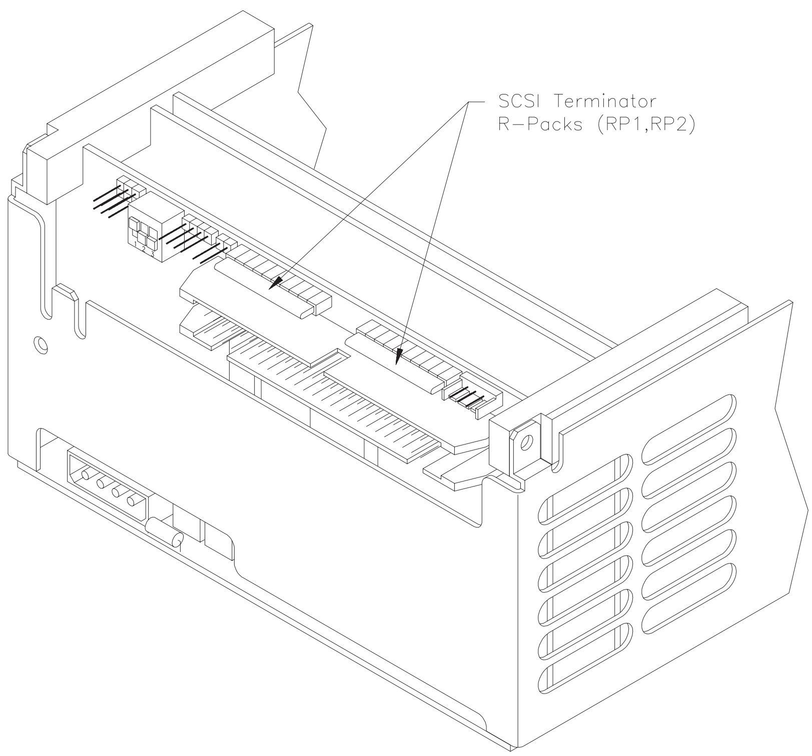


Figure 2-7 R-Packs on the Back of the EXB-8500 (Single-Ended SCSI)

2. Using a pair of flat-nose wiring pliers, grasp either one of the R-packs in the center. Be careful not to squeeze the pliers too tightly or you may break the R-pack.

3. Pull the R-pack straight out.

4. Remove the remaining R-pack in the same manner.

CAUTION

If you replace the R-packs, be sure to use the correct size and type of terminators. Otherwise, damage to the EXB-8500 can occur. The EXB-8500 uses two 10-pin, 9-resistor SIP terminators, rated at 110 ohms. Replacement R-packs are available from EXABYTE (part number 002228).

In addition, when replacing an R-pack, make sure that pin 1 of the terminator is aligned with pin 1 of the socket and that no pins are bent.

Differential SCSI Configuration

The differential SCSI configuration of the EXB-8500 does not include internal terminators. If a differential EXB-8500 terminates the SCSI bus, it must be terminated externally.

Connecting the SCSI Cable

After removing or installing terminators as required, connect the SCSI cable to the SCSI connector (labeled P4) on the back of the EXB-8500. Figure 2-1 shows the location of the SCSI connector. See Appendix A for more information about the SCSI cable.

2.6 Connecting the EXB-8500 to the Power Supply

The EXB-8500 operates from standard +5 VDC and +12 VDC supply voltages; it does not use external AC power. Refer to the *EXB-8500 8mm Cartridge Tape Subsystem Product Specification* for detailed information about power specifications; refer to Appendix A for information about the power cable.

> **CAUTION**
>
> The EXB-8500 does not provide any overvoltage or overcurrent protection. For this reason, be sure that the power is off before connecting the EXB-8500 to a power supply.

To connect power to the EXB-8500, follow these steps:

1. If additional chassis grounding is desired, connect a ¼-inch female spade connector to the ground tab or an M3-0.5 × 6 mm self-tapping screw to the grounding hole on the rear of the EXB-8500, shown in Figure 2-1.

2. Locate the power connector (labeled P1) on the back of the EXB-8500, as shown in Figure 2-1.

3. Connect the power cable to the power connector.

> **CAUTION**
>
> The power cable plug and the power connector are keyed, so they can fit together in only one way. Before attempting to connect the plug to the EXB-8500, be sure that the beveled edges of the plug are oriented in the same way as the beveled edges on the power connector. Do not force the plug into the connector or you may damage the EXB-8500.

2.7 Performing the Initial Power On

After you have connected the EXB-8500 to the power supply, you can perform the initial power on. As described in this section, the procedure for performing the initial power on depends on whether the EXB-8500 has been stored.

If the EXB-8500 Has Been Stored for Less Than Six Months

If the EXB-8500 has been stored for less than six months, performing the initial power on involves the following step:

- Apply power to the EXB-8500. If the EXB-8500 is connected correctly, both the amber and green LEDs will be lit. After the power-on initialization and self-test have completed, both LEDs will be turned off.

The EXB-8500 is now ready for normal operation.

If the EXB-8500 Has Been Stored for Six Months or More

If the EXB-8500 has been stored for six months or more, perform the following steps to ensure that the EXB-8500's internal lubrication is properly distributed:

1. Connect the EXB-8500 to a suitable test system through the SCSI interface.
2. Apply power to the EXB-8500. If the EXB-8500 is connected correctly, both the amber and green LEDs will be lit. After the power-on initialization and self-test have completed, both LEDs will be turned off. This takes about 65 seconds.
3. Press the unload button on the front of the EXB-8500 and insert a data cartridge.
4. Push the door shut and wait while the EXB-8500 loads the tape and positions it at LBOT. This takes about 50 seconds.
5. Issue a WRITE command to write approximately 500 MBytes of data to the tape.
6. Issue a REWIND command to rewind the tape to LBOT.
7. Issue a READ command to read the data written on the tape in step 5.

8. Repeat steps 5 through 7 at least two times or for two hours (whichever is greater).

   Note: If the EXB-8500 has been stored for a long period, errors may occur during the break-in period. If an error occurs, reset the EXB-8500 and repeat steps 4 though 8 as appropriate.

When you have completed step 8, the EXB-8500 is ready for normal operation.

3 Operating the EXB-8500

This chapter discusses EXB-8500 operation. It includes information about the following:

- The read and write compatibility of the EXB-8500 with other EXABYTE 8mm Cartridge Tape Subsystems
- The differences between EXB-8500 format and EXB-8200 format
- The EXB-8500's ability to operate in streaming and start/stop modes
- The EXB-8500's optional directory support feature (available from EXABYTE as a special EEPROM image)
- The configuration options that can be set with the CTS Monitor program to control EXB-8500 operation
- EXB-8500 operator controls and indicators, including a description of the unload button options and a table showing the EXB-8500 states depicted by the LEDs
- How to set the write-protect switch on the data cartridge
- How to load and unload data cartridges

Note: Refer to the *EXB-8500 8mm Cartridge Tape Subsystem Product Specification* for operating specifications for the EXB-8500.

3.1 Read/Write Compatibility

The EXB-8500 can write and read data in two tape formats:

- EXB-8500 format
- EXB-8200 format

Table 3-1 shows the compatibility of these formats with other EXABYTE 8mm Cartridge Tape Subsystems and with other tape formats.

Table 3-1 Read and Write Compatibility of EXABYTE 8mm Cartridge Tape Subsystems

A tape written in this format...	Can be written and read by an ...				
	EXB-8500	**EXB-8200**	**EXB-8200SX**	**EXB-8205**	**EXB-8500c**
EXB-8500 format	✔				✔
EXB-8200 format	✔	✔	✔	✔	✔
EXB-8200c compressed format				✔	✔
EXB-8500c compressed format					✔

Controlling the Tape Format

As described in the examples in Section 12.12, whenever you write, append to, or read a tape, you should keep the following four rules in mind:

- The EXB-8500 allows only one format on any one tape.
- If you are writing data, you must decide the tape's format at LBOT. This is because the LBOT blocks define the format for the tape. If you do not select a format, the EXB-8500 writes in the power-on default format.

  Note: To rewrite a tape in a different format, you must overwrite the previously written LBOT pattern by issuing a WRITE (0Ah) or WRITE FILEMARKS (10h) command at LBOT.

- If you are appending to a previously written tape at a location other than LBOT, the EXB-8500 automatically writes in the format of the data already on the tape.
- If you are reading a previously written tape, the EXB-8500 automatically determines the tape's format for you.

Appending Data to a Previously Written Tape

If the tape is in EXB-8500 format, new data can be appended to existing data if the tape is positioned on either side of a long filemark or at the end-of-data mark. If the tape is in EXB-8200 format, new data can be appended to existing data if the tape is positioned at the beginning-of-tape side of a long filemark or at the end of data (blank tape).

EXB-8500 Format Compared to EXB-8200 Format

This section highlights the differences between EXB-8500 format and EXB-8200 format. For detailed information about EXB-8500 recording format and recording parameters, refer to the *EXB-8500 8mm Cartridge Tape Subsystem Product Specification*. For detailed information about EXB-8200 recording format and recording parameters, refer to the *EXB-8200 8mm Cartridge Tape Subsystem Product Specification*.

Track Structure—EXB-8500 Format

When writing data in EXB-8500 format, the EXB-8500 uses its two write heads (W1 and W2) to write two partially overlapping physical tracks to the tape during the first 180-degree rotation of the drum. The two read heads (R1 and R2) perform the read-after-write operation during the second 180-degree rotation of the drum.

When reading data written in EXB-8500 format, the EXB-8500 uses its two read heads (R1 and R2) to read the two partially overlapping physical tracks. The single servo head (SVO) reads the servo data that was written on the tape by the second write head (W2). The servo data is used to ensure accurate positioning of the read heads over the tracks.

Of the two tracks in the pair, track 1 has a +20 degree azimuth. This track is written by head W1 and read by head R1. Track 2 has a –10 degree azimuth. This track is written by head W2 and read by heads R2 and SVO.

Track Structure—EXB-8200 Format

When writing and reading data in EXB-8200 format, the EXB-8500 uses the W2, R2, and SVO heads to write and read a single track with a –10 degree azimuth.

Physical Blocks

In both EXB-8500 format and EXB-8200 format, each physical track contains eight physical blocks. A physical block can contain user data and other information. In both formats, a physical block containing user data includes the following information:

- 14 bytes of header information
- 1,024 bytes of user data
- 2 bytes of cyclic redundancy check (CRC) data
- 400 bytes of error correction code (ECC) data.

Note: This information is arranged somewhat differently in EXB-8500 format than in EXB-8200 format.

Since each physical track contains eight physical blocks, each track can contain a maximum of 8,192 bytes of user data. The header, ECC data, and CRC data do not affect the data capacity of the tape.

Logical Blocks

A logical block is a block of data transferred from the initiator to the EXB-8500. In both EXB-8500 format and EXB-8200 format, logical blocks can have fixed or variable lengths. In addition, both formats support logical block sizes from 0 to 240 KBytes.

In EXB-8500 format, each 1,024-byte physical block can contain multiple logical blocks (for example, two 512-byte logical blocks can be written in one physical block). In addition, a logical block can start in one physical block and end in a different physical block. This logical block packing prevents the loss of data capacity for tapes with small logical blocks written in EXB-8500 format.

Note: In EXB-8200 format, only one logical block can be written in each physical block.

For detailed information about logical block packing in EXB-8500 format, refer to the *EXB-8500 8mm Cartridge Tape Subsystem Product Specification*.

Search Fields

A track written in EXB-8500 format also contains search fields that enable the EXB-8500 to perform high-speed searches at up to 75 times the nominal tape speed. A high-speed search occurs when the initiator issues a LOCATE (2Bh) or SPACE (11h) command. The search fields are the only areas of the tape that are read during a high-speed search. They consist of small data areas interspersed with clock sync areas. The search field data contains information for locating files and blocks and detecting the end-of-data (EOD) mark during high-speed searches.

Note: Tapes written in EXB-8200 format do not contain search fields and do not support EXB-8500 high-speed search. In addition, the EXB-8500 does not support the EXB-8200SX high-speed search feature.

Filemarks

Like the EXB-8200 and the EXB-8200SX, the EXB-8500 supports both short and long filemarks. However, the sizes of these filemarks are different in EXB-8500 format than they are in EXB-8200 format.

- The long filemark in EXB-8500 format occupies 48 KBytes of space and allows data to be appended to it.

- The short filemark in EXB-8500 format occupies 1 KByte of space but does not allow data to be appended to it.

As described in Table 3-2, the size of the filemarks that can be written depend on the format of the tape and on the setting of the Short bit in the WRITE FILEMARKS (10h) command (see Chapter 30).

Table 3-2 Type and Size of Filemarks

Tape Written By...	Type and Size of Filemarks			
	Long (Short bit = 0)		Short (Short bit = 1)	
	KBytes	Hex	KBytes	Hex
EXB-8500 in EXB-8500 format	48	C000h	1	400h
EXB-8500 in EXB-8200 format	2,160	21C000h	184*	2E000h
EXB-8200	2,160	21C000h	480	78000h
EXB-8200SX	2,160	21C000h	184*	2E000h

* The short filemark written by the EXB-8500 in EXB-8200 format is equivalent to the short filemark written by the EXB-8200SX.

End of Data (EOD)

When writing data in EXB-8500 format, the EXB-8500 writes an end-of-data (EOD) mark to indicate the location of the last data on tape. The EOD mark is automatically written when the EXB-8500 receives one of the following commands after completing a WRITE or WRITE FILEMARKS operation:

- LOAD/UNLOAD (1Bh)
- LOCATE (2Bh) in the reverse direction
- REWIND (01h)
- SPACE (11h) in either direction

The EOD mark is overwritten when additional data is written to tape.

Note: The EOD mark is not used for EXB-8200 format.

3.2 Streaming and Start/Stop Modes

The EXB-8500 includes a 1-MByte data buffer that enables it to operate as either a streaming tape device or as a start/stop tape device. The mode of operation depends on the rate that data can be transferred between the initiator and the EXB-8500. If the initiator can sustain a minimum transfer rate of 500 KBytes per second, the EXB-8500 operates in streaming mode. If the initiator cannot sustain this transfer rate, the EXB-8500 starts and stops the tape automatically.

In start/stop mode, the motion threshold can be used to fine-tune the starting and stopping of tape motion. In streaming mode, the reconnect threshold can be used to fine-tune the rate of disconnects and reconnects between the EXB-8500 and the initiator.

Motion Threshold

The motion threshold is used in start/stop mode to control data transfers between the buffer and the tape. The motion threshold is measured in 4-KByte increments. The default value for motion threshold is 80h (512 KBytes); this value can be changed with a MODE SELECT command.

Start/Stop Write Operation

In a start/stop write operation, the initiator-to-buffer transfer speed is slower than the buffer-to-tape transfer speed (that is, data transfers from the initiator occur at less than 500 KBytes per second). In this mode of operation, the motion threshold value represents the minimum amount of data (in 4-KByte increments) that must be in the EXB-8500's 1-MByte buffer before tape motion will start and data will be written to tape.

Note: Because of hardware requirements, only one quarter of the buffer is used during write operations in EXB-8200 format. For this reason, the motion threshold for EXB-8200 write operations is expressed in 1-KByte increments.

When the motion threshold value is exceeded, tape motion starts. The write-to-tape operation continues until the buffer is empty and the tape motion stops. Tape motion does not restart until the amount of data in the buffer once again exceeds the motion threshold value or until the buffer is flushed for some other reason (such as a reverse tape motion command).

Start/Stop Read Operation

In a start/stop read operation, the buffer-to-initiator transfer speed is slower than the tape-to-buffer transfer speed (that is, data transfers to the initiator occur at less than 500 KBytes per second). In this mode of operation, the motion threshold value represents the minimum amount of free space (in 4-KByte increments) that must be in the EXB-8500's 1-MByte buffer before tape motion will start and data will be read from the tape to the buffer.

When the motion threshold value is exceeded, tape motion starts. The read-from-tape operation continues until the buffer is full and the tape motion stops. Tape motion does not restart until the amount of free space in the buffer once again exceeds the motion threshold value.

Reconnect Threshold

The reconnect threshold is used in streaming mode to control data transfers between the buffer and the initiator. The reconnect threshold is measured in 4-KByte increments. The default value for reconnect threshold is 80h (512 KBytes); this value can be changed with a MODE SELECT command.

Streaming Write Operation

In a streaming write operation, the initiator-to-buffer transfer rate is equal to or greater than the buffer-to-tape transfer rate (that is, data transfers from the initiator occur at 500 KBytes per second or faster). In this mode of operation, the EXB-8500 disconnects from the initiator when the buffer becomes full but continues to write data to tape. The reconnect threshold value represents the minimum amount of free space (in 4-KByte increments) that must be in the EXB-8500's 1-MByte buffer before the EXB-8500 will reconnect to the initiator to accept additional data.

Note: Because of hardware requirements, only one quarter of the buffer is used during write operations in EXB-8200 format. For this reason, the reconnect threshold for EXB-8200 write operations is expressed in 1-KByte increments.

When the reconnect threshold value is exceeded, the EXB-8500 reconnects to the initiator and data transfer continues. The data transfer from the initiator continues until the buffer is full or until the initiator has no more data to write. Then, the EXB-8500 disconnects from the initiator but continues to transfer data from the buffer to the tape until the buffer is empty.

Streaming Read Operation

In a streaming read operation, the buffer-to-initiator transfer rate is equal to or greater than the tape-to-buffer transfer rate (that is, data transfers to the initiator occur at 500 KBytes per second or faster). In this mode of operation, the EXB-8500 disconnects from the initiator when the buffer becomes empty but continues to read data from the tape. The reconnect threshold value represents the minimum amount of data (in 4-KByte increments) that must be in the EXB-8500's 1-MByte buffer before the EXB-8500 will reconnect to the initiator to transfer data from the buffer.

When the reconnect threshold value is exceeded, the EXB-8500 reconnects to the initiator and data transfer resumes. The data transfer to the initiator continues until the buffer is empty. Then, the EXB-8500 disconnects from the initiator but continues to transfer data from the tape to the buffer.

Summary of Motion and Reconnect Thresholds

Table 3-3 provides summary information about the motion and reconnect thresholds. As shown in the table, the default value for both the motion threshold and the reconnect threshold is 80h. The 80h default is in the middle of the 1-MByte buffer, which serves to optimize an initiator transfer rate of 500 KBytes/second.

Table 3-3 Motion Threshold and Reconnect Threshold Summary

	Default value	What it controls...	During a write operation...	During a read operation...
Motion Threshold	80h (512 KBytes)	Starting and stopping of tape motion (buffer/tape transfers)	Amount of data in buffer controls when data is transferred to the tape	Space available in buffer controls when data is transferred from the tape
Reconnect Threshold	80h (512 KBytes)	Rate of disconnects and reconnects between the EXB-8500 and the initiator (initiator/buffer transfers)	Space available in buffer controls when the EXB-8500 reconnects to the initiator	Amount of data in buffer controls when the EXB-8500 reconnects to the initiator

3.3 EXB-8500 Directory Support

The EXB-8500 directory support feature is an optional feature that requires a special EEPROM image available from EXABYTE. This option is not set in standard EXB-8500s. You can use the directory support feature to maintain a directory at the beginning of an EXB-8500 format tape. This directory indicates where various data sets are located on the tape and can include the following types of information:

- **The names of the data sets on the tape.** You can use this information to determine quickly what data is on the tape. For example, if you want to know which of several tapes contain a particular data set, you can simply read the directory at the beginning of each tape.
- **The locations of the data sets on the tape.**You can use this information to take advantage of the EXB-8500's high-speed search capability. Once you know a data set's location, you can issue a LOCATE (2Bh) or SPACE (11h) command to move to that data set at 75 times the normal tape speed (that is, at a rate of up to 37.5 MBytes per second).

When the EXB-8500 includes the EEPROM image for directory support, the EXB-8500 allows the tape to have two end-of-data (EOD) marks: one at the end of the directory and the other at the actual end of data on the tape. As long as the first EOD mark is located before the first filemark, the EXB-8500 can space over it.

As described in the sample application in Appendix B, you perform the following types of steps to create a directory at the beginning of the tape:

1. Reserve an area of the tape after LBOT for the directory (this is called the *directory pad*).
2. Write a long filemark to separate the directory pad from the data area of the tape.
3. Issue a READ POSITION (34h) command to determine the starting location for the first data set. Save the returned data in the initiator's memory.
4. Write the first data set to the tape.
5. Issue another READ POSITION command to determine the starting location of the next data set. Save the returned data in the initiator's memory.
6. Write the next data set to tape.

7. Repeat steps 5 and 6 until the tape is full or until you have no more data to write.

8. Rewind the tape and create a directory at the beginning of tape that lists the data set names along with the data returned for each READ POSITION command.

Note: As shown in the application in Appendix B, you may also want to create other directories throughout the tape that list the location of each file or block in the data set.

3.4 EXB-8500 Configuration Options

As described in the *Monitor User's Guide for the 8mm Cartridge Tape Subsystem*, you can use the CTS Monitor program to change several of the EXB-8500's normal power-on defaults. Once changed with Monitor, the new settings for these configuration options become the power-on defaults. Note that because these configuration options correspond to fields in the MODE SELECT command (see Table 3-4), a MODE SELECT command issued after power-on can override the settings of the configuration options.

Table 3-4 EXB-8500 Configuration Options

Configuration option set with Monitor	What this option does...	Normal power-on default	Equivalent field in MODE SELECT
8500 density	Determines whether the EXB-8500 writes data in EXB-8500 format or EXB-8200 format	EXB-8500 format	Density Code
SCSI parity checking	Enables or disables parity checking on the SCSI bus	Parity checking enabled	PE
Disconnect on even byte	Enables or disables even-byte boundary disconnects	Disconnect on any byte	EBD
Disconnect in data	Indicates whether the EXB-8500 can disconnect from the initiator during data transfers	Allow disconnect during data transfers	ND
Cartridge type	Defines what type of data cartridge (P5, P6, PI) is expected to be loaded	P6	CT and P5
Default block size	Determines whether the EXB-8500 writes fixed-length or variable-length logical blocks and indicates the default length for fixed-length blocks	1-KByte (400h) fixed-length logical blocks	Block Length

3.5 EXB-8500 Controls and Indicators

Figure 3-1 shows the location of the unload button and the green and amber LEDs on the front panel of the EXB-8500.

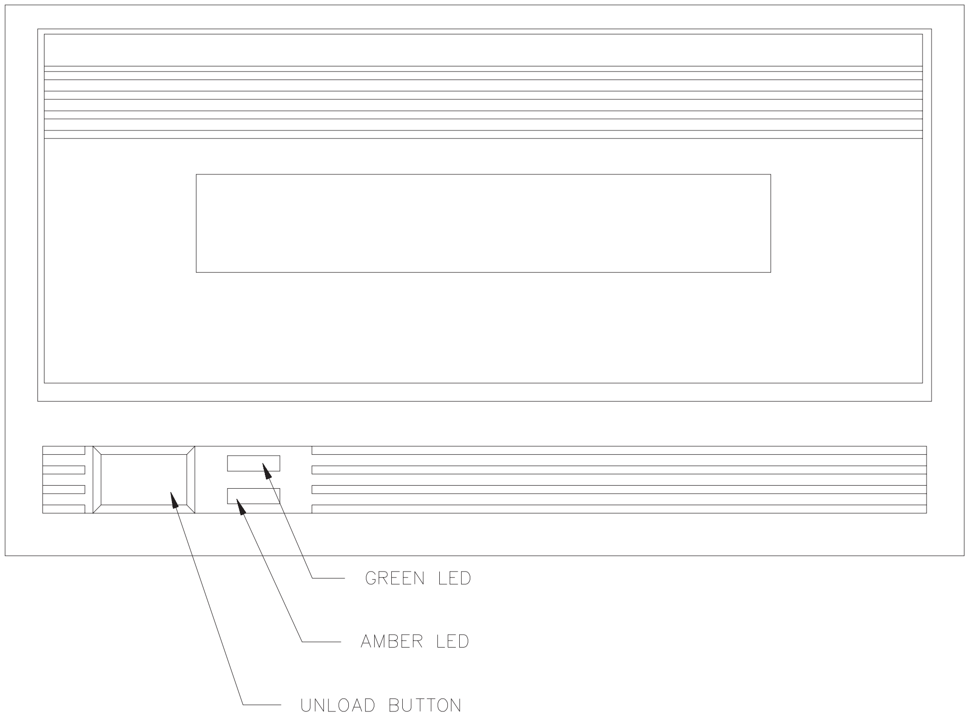


Figure 3-1 EXB-8500 Front Panel

Unload Button

The unload button is the only operator control on the EXB-8500. It can be used to unload the tape from the EXB-8500. Depending on the EXB-8500's EEPROM image, the unload button can function in one of three ways:

- As a "normal" unload button (default)
- As a "fast" unload button
- As a "super fast" unload button

These three unload button options are described in Section 3.8 on page 3-16.

Green and Amber LEDs

The green and amber LEDs are status indicators for the EXB-8500. The green LED indicates that the EXB-8500 can accept a tape access command, while the amber LED indicates SCSI bus activity and EXB-8500 error conditions.

Table 3-5 describes the EXB-8500 states indicated by the LEDs.

● The LED is on.

❍ The LED is off.

❊ The LED is flashing, as follows:
- A slow flash is about one flash per second (0.94 Hz)
- A fast flash is about four flashes per second (3.76 Hz).

Table 3-5 EXB-8500 States Indicated by LEDs

When the amber LED is...	And the green LED is...	The EXB-8500 state is...	Take this corrective action...
●	●	Power-on initialization[a]	none
❍	❍	Passed power-on self-test[b]	none
	●	Ready and tape loaded	
● or ❍[c]	slow ❊	Normal tape motion	none
	fast ❊	High speed search/rewind	
● or ❍ or ❊	four ❊s then ❍	Servo error	Reset the EXB-8500 by pressing the unload button. If this does not clear the error, power the EXB-8500 off and back on again. If the error occurs again, the EXB-8500 needs service.
slow ❊	● or ❍	CRC fail[d]	Power the EXB-8500 off and back on again. If the error occurs again, try reloading new code. If the error persists, the EXB-8500 needs service.
		Unrecoverable fault[d]	Reset the EXB-8500 by pressing the unload button. If this does not clear the error, power the EXB-8500 off and back on again. If the error occurs again, the EXB-8500 needs service.
fast ❊	❍	Failed power-on self-test	Power the EXB-8500 off and back on again. If the error occurs again, the EXB-8500 needs service.
	● or ❍	Unload button fail	

[a] The EXB-8500 is performing power-on self-test diagnostics. This takes less than 60 seconds.

[b] The green LED may go off before the amber LED if no tape is loaded.

[c] The amber LED is on (●) when data transfer is occurring on the SCSI bus. The amber LED is off (❍) when no data transfer is occurring. The combination of on and off may appear as an irregular flash.

[d] CRC failures occur only within the first two seconds after a power-on reset. An unrecoverable fault can occur anytime during operation.

3.6 Setting the Write-Protect Switch

The EXATAPE™ 8mm data cartridge is equipped with a write-protect switch to prevent the tape from being written to unintentionally. Before loading a data cartridge in the EXB-8500, ensure that the write-protect switch is set correctly for the desired operation. You can use a ball-point pen or similar instrument to set the write-protect switch.

- **To write protect the data cartridge**, move the write-protect switch away from the edge of the data cartridge, as shown in Figure 3-2. If the red tab is visible, the cartridge is write protected and cannot be written to or erased.
- **To write enable the data cartridge**, move the write-protect switch toward the edge of the data cartridge, as shown in Figure 3-2. If the red tab is not visible, the data cartridge is write enabled and can be written to or erased.

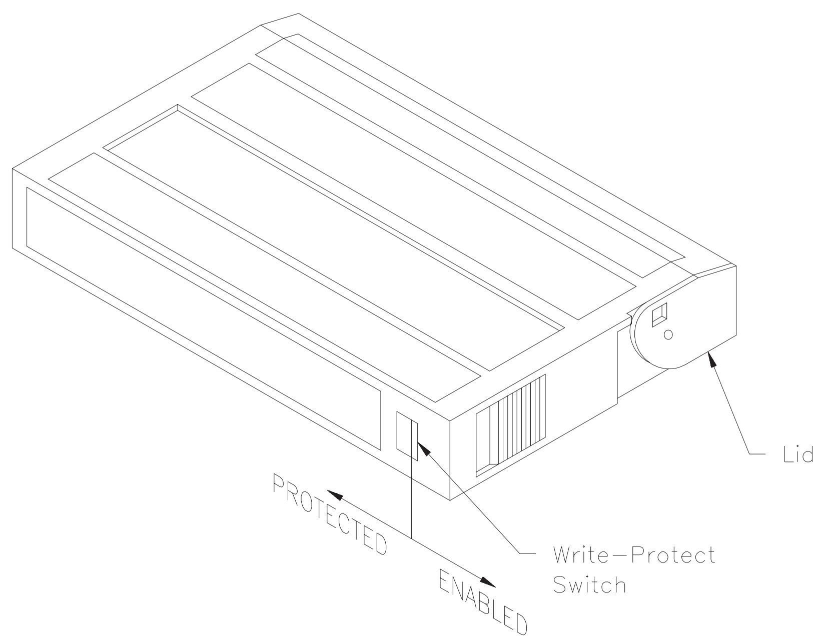


Figure 3-2 Write-Protect Switch on EXATAPE 8mm Data Cartridge

3.7 Loading a Data Cartridge in the EXB-8500

To load a data cartridge into the EXB-8500, follow these steps:

1. Ensure that the write-protect switch has been set correctly for the desired operation. (See Section 3.6.)

2. If you have just powered on the EXB-8500, be sure that the green LED on the front panel is off, indicating that the EXB-8500 is ready to load the data cartridge.

3. If necessary, press the unload button to open the door on the EXB-8500.

4. Insert the data cartridge into the EXB-8500 with the label side up and the write-protect switch facing you.

5. Gently close the door. The EXB-8500 automatically loads the data cartridge and presents ready status (green LED on).

   Note: If you have disabled autoload with a MODE SELECT command, the EXB-8500 will not go to the ready state until a LOAD (1Bh) command has been executed.

Three options are available from EXABYTE to control how the EXB-8500 handles tape motion commands during the load operation. Depending on the EXB-8500's EEPROM image, the EXB-8500 performs one of the following actions when it receives tape motion commands during a load operation:

- It queues (holds) tape motion commands (and disconnects, if allowed) until the load operation is complete. Then it executes the commands.
- It returns Busy status.
- It returns Check Condition status with the sense key set to Not Ready.

Note: If another initiator has reserved the EXB-8500 for its exclusive use, the EXB-8500 returns Reservation Conflict status.

For information about these status conditions, see Section 7.4.

Load Time

The time required to load the data cartridge and position the tape to LBOT after the door is closed is approximately 30 seconds for a rewound cartridge. When loading a tape, the EXB-8500 spaces forward from PBOT and determines the tape format (blank, EXB-8500 format, or EXB-8200 format).

In addition, when the EXB-8500 spaces forward, it determines the adaptive servo parameters. This process enables the EXB-8500 to read tapes produced by different manufacturers, tapes that are aged and worn, and tapes written by other EXABYTE 8mm Cartridge Tape Subsystems.

Finally, during a load operation, the EXB-8500 autosizes the data cartridge (that is, it determines the length of the tape in use). For information about data cartridge autosizing, refer to Appendix C.

3.8 Unload Procedure

This section describes what happens when you press the unload button; for information about using the LOAD/UNLOAD (1Bh) command, see Chapter 10.

Unload Button Options

Three options are available from EXABYTE to control what happens when you press the unload button. Depending on the EXB-8500’s EEPROM image, the unload button can function in one of three ways:

- As a “normal” unload button (default)
- As a “fast” unload button
- As a “super fast” unload button

This section describes each of these options.

Normal Unload

If the EXB-8500's EEPROM image includes the "normal" unload button setting (default), the following actions occur when you press the unload button. (These steps assume that a data cartridge is loaded and that the EXB-8500 is ready.)

1. Any command or operation currently in progress is completed.
2. Any buffered data and filemarks are written to tape, and an EOD mark is written to indicate the end of data (EXB-8500 format tapes only).
3. The tape is rewound to the physical beginning of tape (PBOT).
4. The tape is unloaded from the tape path.
5. The EXB-8500's door is opened and the data cartridge is ejected (unless media removal has been prevented with the PREVENT/ALLOW MEDIUM REMOVAL command).

Note: If the unload button is pressed and there is no data cartridge in the EXB-8500, the door is opened.

Fast Unload

If the EXB-8500's EEPROM image includes the "fast" unload button setting (optional), the following actions occur when you press the unload button. (These steps assume that a data cartridge is loaded and that the EXB-8500 is ready.)

1. Any command or activity currently in progress is aborted.

   Note: If the EXB-8500 is performing a write operation when you press the "fast" version of the unload button, the EXB-8500 will abort the command *after* it writes to tape the last logical block that was completely transmitted from the initiator. However, any partially transmitted logical blocks will be lost.

2. If necessary, an EOD mark is written to the tape to indicate the end of data.

3. The tape is rewound to the physical beginning of tape (PBOT).

4. The tape is unloaded from the tape path.

5. The EXB-8500's door is opened and the data cartridge is ejected (unless media removal has been prevented with the PREVENT/ALLOW MEDIUM REMOVAL command).

CAUTION

When you use the "fast" version of the unload button to unload the tape, the data in any partially transmitted logical blocks is lost (not put on tape for a write operation or not sent to the initiator for a read operation).

“Super Fast” Unload

If the EXB-8500’s EEPROM image includes the “super fast” unload button setting (optional), the following actions occur when you press the unload button. (These steps assume that a data cartridge is loaded and that the EXB-8500 is ready.)

1. Any command or activity that is currently in progress is immediately aborted. The contents of the buffer are lost. No EOD mark is written to the tape to indicate the end of data.

2. The tape is unloaded from the tape path without being rewound to the physical beginning of tape (PBOT) or moved from its current position.

3. The EXB-8500’s door is opened and the data cartridge is ejected (regardless of whether media removal has been prevented with the PREVENT/ALLOW MEDIUM REMOVAL command).

4. The EXB-8500 is reset.

CAUTION

- Since the tape is not rewound when you use the “super fast” version of the unload button, the tape is unloaded from the EXB-8500 at its current position. If the unload occurs when the tape is positioned over data, tape damage and data loss can occur.

- When you use this feature, any data and filemarks in the buffer are lost.

- If the button is pressed while the EXB-8500 is performing a write operation, the integrity of the last data written to the tape is questionable and may cause serious errors to occur when you read the tape.

EXABYTE assumes no liability for data loss occurring when the “super fast” unload button option is used.

Unload Time

Table 3-6 summarizes the EXB-8500's actions for each of the unload button options.

The time required for each of the actions listed in the table is as follows:

- The time required to complete the current operation depends on the operation.
- A maximum of 12 seconds is required to empty the buffer to tape and to write an EOD mark (EXB-8500 format tapes only).
- A maximum of 180 seconds (for a 112m tape) is required to rewind a tape.
- A maximum of 30 seconds is required to unload and eject a data cartridge.

Table 3-6 Summary of Unload Button Options

Unload Button Option	**EXB-8500 Action**			
	Complete current operation	**Write contents of buffer to tape and write EOD**	**Rewind to PBOT**	**Unload and eject tape**
Normal	✔	✔	✔	✔ [b]
Fast		✔ [a]	✔	✔ [b]
Super Fast				✔ [c]

[a] If the EXB-8500 is performing a write operation when you press the "fast" version of the unload button, the EXB-8500 will abort the command *after* it writes to tape the last logical block that was completely transmitted from the initiator. However, any partially transmitted logical blocks will be lost.

[b] If media removal has been prevented with the PREVENT/ALLOW MEDIUM REMOVAL command, the tape will be unloaded but the data cartridge will not be ejected.

c The tape will be ejected whether or not media removal has been prevented with the PREVENT/ALLOW MEDIUM REMOVAL command.

Status Reported for Unload Procedure

If a command is issued to the EXB-8500 during the unload procedure, the EXB-8500 returns Check Condition status with the sense key set to Unit Attention (6h). Once the Unit Attention condition is reported, all subsequent commands (except INQUIRY and REQUEST SENSE) receive Check Condition with the sense key set to Not Ready (2h). (For information about clearing a Unit Attention condition, see Section 6.4.)

Effect of PREVENT/ALLOW MEDIUM REMOVAL Command

If an initiator has issued a PREVENT MEDIUM REMOVAL (1Eh) command to prevent the removal of the data cartridge, the door on the EXB-8500 will not open until that initiator sends an ALLOW MEDIUM REMOVAL command to allow the data cartridge to be removed.

If more than one initiator has issued PREVENT MEDIUM REMOVAL commands to the EXB-8500 to prevent the removal of the data cartridge, the EXB-8500’s door will not open until each of those same initiators sends an ALLOW MEDIUM REMOVAL command to release the condition.

Note: If the EXB-8500’s EEPROM image includes the “super fast” unload button setting, the EXB-8500 will eject the tape whether or not media removal has been prevented with the PREVENT/ALLOW MEDIUM REMOVAL command.

For information about using the PREVENT/ALLOW MEDIUM REMOVAL command, see Chapter 14.

Error During Unload Procedure

If an error exists before or during the unload procedure, the unload sequence will be suspended and the amber LED will flash. If the unload button is pressed again, the unload sequence will be reattempted; however, unwritten data in the buffer will not be written to tape. The buffer and errors will be cleared.

Note: If the EXB-8500’s EEPROM image includes the “super fast” unload button setting, the EXB-8500 will unload the tape even if errors are present during the unload procedure (unless the error is a serious hardware error).

Notes:

4 Cleaning and Packing the EXB-8500

This chapter describes how to clean the EXB-8500's tape heads and tape path and provides procedures for packing the EXB-8500 for shipment.

Note: Except for cleaning, the EXB-8500 has no user serviceable adjustments or maintenance procedures. All service or repairs to the EXB-8500 must be performed by EXABYTE Corporation or by authorized service personnel.

4.1 Cleaning the EXB-8500

The EXB-8500's heads and tape path should be cleaned on a regular basis. The only cleaning material authorized for use with the EXB-8500 is an EXABYTE or EXABYTE-approved 8mm Cleaning Cartridge.

Important

Using cloth swabs, cotton swabs, cleaning agents, or cleaning cartridges not approved by EXABYTE Corporation will void the warranty on the EXB-8500.

Use the following guidelines to determine how often to clean the EXB-8500:

- When using the EXB-8500 to read and write data in EXB-8500 format, clean the tape heads and tape path once a month or after 60 GBytes of data transfer, whichever occurs first. For planning purposes, approximately 2 GBytes of data are transferred per hour of operation in EXB-8500 mode.
- When using the EXB-8500 to read and write data in EXB-8200 format, clean the tape heads and tape path once a month or after 30 GBytes of data transfer, whichever occurs first. For planning purposes, approximately 1 GByte of data is transferred per hour of operation in EXB-8200 mode.

To use the cleaning cartridge, follow these steps:

1. Apply power to the EXB-8500. When the power-on self-test is complete, press the unload button and remove any data cartridge in the EXB-8500. Leave the door open.

2. Place the cleaning cartridge in the EXB-8500 and close the door.

   The remainder of the cleaning cycle is performed automatically by the EXB-8500. When the cleaning cycle is complete, the cleaning cartridge is unloaded and ejected from the EXB-8500. The average cleaning cycle is 15 seconds.

3. Record the date the cleaning was performed on the cleaning cartridge label.

4. Store the cleaning cartridge for future use.

   Note: If the cleaning cartridge is ejected from the EXB-8500 without performing a cleaning cycle (that is, before 15 seconds), the cleaning cartridge has reached the end of its useful life and should be discarded.

CAUTION

To prevent contamination of the EXB-8500, do not use the cleaning cartridge for more than the number of cleaning cycles specified on the cartridge label.

4.2 Packing the EXB-8500 for Shipment

If you need to ship an EXB-8500, follow the instructions in this section.

Shipping Cartons

The EXB-8500 is sealed in a static protection bag and is shipped with either one drive per carton (single pack) or four drives per carton (four pack). The shipping cartons and internal packing materials are designed so that an enclosed EXB-8500 does not receive a shock greater than 45 g when the carton is dropped on any surface, corner, or edge from the following heights:

- 48 inches (121.9 cm) at a velocity change of 192 inches per second (488 cm/sec) for the single-pack carton
- 36 inches (91.4 cm) at a velocity change of 167 inches per second (424 cm/sec) for the four-pack carton

Both sizes of shipping carton pass the tests described in the National Safe Transit Association (NSTA) Project 1A for packaged products weighing less than 100 pounds.

The single-pack shipping carton measures 15 inches long × 12 inches wide × 10 inches high (38 × 32 × 26 cm).

Note: Do not use a four-pack shipping carton when shipping a single EXB-8500. If you use a four-pack shipping carton, you must place four EXB-8500 in the carton.

Packing the EXB-8500

To pack the EXB-8500 for shipment, follow these steps:

1. Obtain the original single-pack shipping carton or contact your regional account representative to receive a new one. Figure 4-1 shows the single-pack shipping carton and packing materials for the EXB-8500.

CAUTION

To avoid damaging the EXB-8500 and voiding your warranty, be sure to use the original shipping materials (or replacement materials obtained from EXABYTE) when repacking and shipping the EXB-8500.

In addition, to ensure that the packaging meets the required specifications, do not modify the packaging in any way. The shipping carton and packing materials are not intended to be used for shipping items other than or in addition to an EXB-8500.

2. Assemble the carton and tape it shut at the bottom.
3. Place the bottom packing cushion in the carton, with the fitted space for the EXB-8500 facing up.
4. Place the EXB-8500 in the bottom packing cushion’s fitted space.
5. Place the top carton cushion over the EXB-8500 with the cardboard side facing down.
6. Close the carton and tape the top seam with two-inch packing tape so that the carton is completely closed.

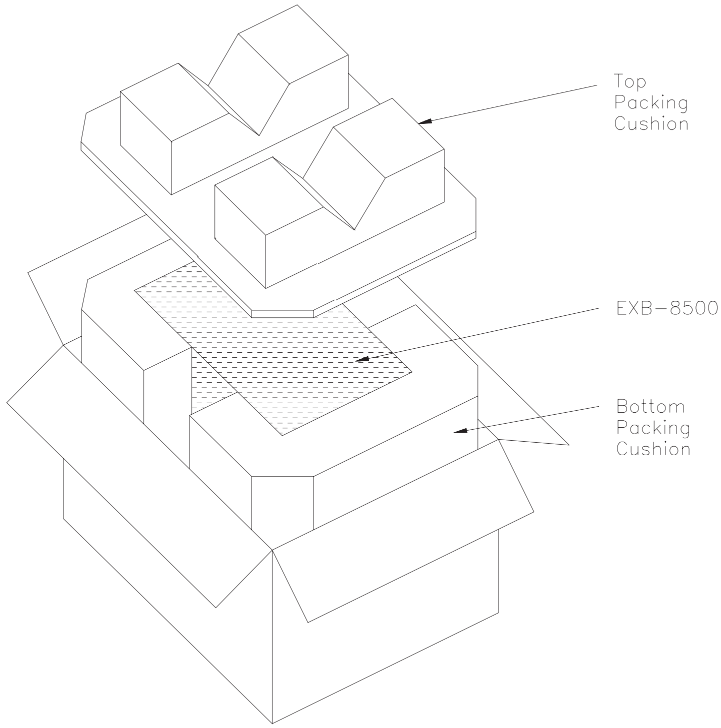


Figure 4-1 Single-Pack Carton and Packing Materials for the EXB-8500

Environmental Requirements for Shipping the EXB-8500

When shipping an EXB-8500, be sure to comply with the environmental specifications shown in Table 4-1.

Table 4-1 Environmental Specifications for Shipping the EXB-8500

Temperature Range	–40° C to +60° C (–40° F to +140° F)
Temperature Variation	1° C per minute up to a maximum of 20° C per hour (2° F per minute up to a maximum of 36° F per hour)
Relative Humidity	10% to 90% non-condensing
Wet Bulb	26° C max (79° F max)
Altitude	–304.8 m to +12,192 (–1,000 ft to +40,000 ft)

Notes:

5 Loading New Microcode from Tape

This chapter describes the steps and time involved in using and creating a *microcode update tape*. This tape is used to upgrade the EXB-8500 to a new level of microcode. You can obtain a microcode update tape from EXABYTE when a new firmware release becomes available, or you can create your own with the CTS Monitor program.

5.1 Using a Microcode Update Tape

When a microcode update tape is inserted into the EXB-8500, the EXB-8500 automatically detects its presence and upgrades the microcode to the new level. No operator intervention is needed other than inserting the tape into the EXB-8500.

To use a microcode update tape, follow these steps:

1. Disconnect the EXB-8500 from the SCSI bus by unplugging the SCSI connector from the back of the unit. If the location of the EXB-8500 makes removing the cable inconvenient, ensure that a SCSI bus reset cannot occur during the microcode update process.

2. Apply power to the EXB-8500 and wait for it to complete its power-on self-test.

3. Insert the microcode update tape in the EXB-8500 and close the door.

Steps During Microcode Update Process

The following steps occur automatically when you insert a microcode update tape in the EXB-8500.

1. The EXB-8500 loads the tape, reads the digital LBOT pattern, and identifies it as a microcode update tape.

2. The EXB-8500 reads the data on the tape into its buffer. The amber LED will begin to flash slowly (about 1 blink per second) at this point.

3. The image in the buffer is validated. This step ensures that the microcode to be loaded into the EXB-8500 is valid.

   During validation, the buffer image is checked for the following:

   — Correct header format.

   — Proper number of files.

   — Correct format for each “line.” Each line of code bytes must have a proper address, data type, and checksum.

   — CRC match.

   — Hardware/boot code support for new microcode version.

4. After the data has been read into the buffer and validated, the EXB-8500 unloads the tape but does not eject it (the door is not opened).

   Note: If any of the validation steps fail, the amber light will flash at a fast rate (about 4 blinks per second). Push the unload button to eject the tape and restore normal EXB-8500 operation; then repeat the process with a new microcode update tape.

5. The current contents of the EXB-8500’s program memories are erased and replaced with the validated microcode from the buffer.

CAUTION

Do not power off or reset the EXB-8500 during this step. Wait until step 6 completes. The tape will be ejected when the load process is complete.

If a hardware or power failure occurs during this step, the EXB-8500 may not be able to operate. If this occurs, use the CTS Monitor program to reload microcode (from a *.BIN file) through a serial cable attached to the Monitor port. (See the *Monitor User’s Guide for the 8mm Cartridge Tape Subsystem* for complete instructions.)

6. When the new microcode has been loaded successfully, the EXB-8500 performs a full power-on reset and self-test. The amber LED will be lit during the 30-second self-test. The load tape is ejected after approximately 15 seconds into the 30-second self-test. If the CTS Monitor program is running and the load was successful, the following message will be displayed:

   L: Load of new code is successful!

   If the load fails, the amber LED will flash. If the CTS Monitor program is running, the following message will be displayed:

   K: Load of new code failed!

   If a failure occurs, retry the operation with another tape or use the CTS Monitor program to reload microcode (from a *.BIN file) through a serial cable attached to the Monitor port. (See the *Monitor User's Guide* for complete instructions.)

Time Required to Load Code from Tape

As shown in Table 5-1, approximately two minutes are required to load new microcode from a microcode update tape.

Table 5-1 Time Required to Load Code from Tape

Step	Time required (seconds)
Load the microcode update tape	35
Read data from tape into buffer	7
Validate image in buffer	19
Unload tape	18
Load new code into flash EPROMs	16
Perform a power-on reset and self-test (first half, until the tape is ejected)	15
Perform a power-on reset and self-test (second half)	17
TOTAL	**127 (approx.)**

5.2 Creating a Microcode Update Tape

You can use the CTS Monitor program to create a microcode update tape from a working EXB-8500. This process enables you to transfer the microcode from one EXB-8500 to another.

When you make a microcode update tape, you can copy the servo code and control code only, or you can copy the servo code, control code, and the portions of the EEPROM code that contain MODE SELECT power-on defaults, such as block size, parity checking, and even-byte disconnect. Normally, you only need to copy the servo code and control code.

Steps for Making a Microcode Update Tape

To make a microcode update tape, follow these steps:

1. Start the CTS Monitor program and select “Firmware” from the Main Menu.

   Note: If necessary, refer to the *Monitor User’s Guide* for instructions for starting and using the CTS Monitor program.

2. Select “Make code tape” from the Firmware Menu, or press **Alt-N**.

   A prompt is displayed asking if you want to include the mode selectable portion of the EEPROM.

3. Press **Y** if you want the power-on defaults for MODE SELECT to be copied to the tape; press **N** if you do not want them to be copied; or press **Esc** to cancel the operation.

   A prompt is displayed asking if the EXB-8500 is idle and ready to create a firmware load tape.

4. Press **Y** if the EXB-8500 is idle and you want to continue; press **N** to cancel the operation.

   After you press **Y**, the amber light will begin to flash slowly (about 1 blink per second) and will continue to flash for the duration of the make-microcode-tape process. If there is a tape in the EXB-8500, the tape is ejected to prevent the EXB-8500 from writing over a good tape.

5. Insert a new tape in the EXB-8500.

   Note: Once a tape has been made into a microcode update tape, it cannot be reused as a data tape. To avoid wasting tape, use a 15m tape. If necessary, you can use a previously written data tape or microcode update tape to create a new microcode update tape.

   When the tape is inserted, the EXB-8500 loads it and copies its control code, servo code, and EEPROM code (if specified) to the tape.

6. If the tape is made successfully, the EXB-8500 unloads and ejects the tape, and the following message is displayed in the CTS Monitor program:

   G: Load tape made successfully and tape ejected!

   Remove the tape from the EXB-8500, label it as a microcode update tape, and store it in a safe location to prevent it from being used inadvertently.

   Note: If an error occurs while the EXB-8500 is making the microcode update tape, the amber light will flash at a faster rate (about 4 blinks per second) and the tape will not be ejected. One of the following messages is displayed in the CTS Monitor program:

   E: Can’t write on tape –- tape is write protected!
   B: Can’t start operation until self test and autoload are done!
   o: Hardware must be upgraded to support this operation!

   Press the unload button to eject the tape and restore normal EXB-8500 operation. Then, reset the EXB-8500, wait until it is idle, and restart the process with a new 15m tape.

Time Required to Make a Microcode Update Tape

As shown in Table 5-2, approximately two minutes are required to make a microcode update tape (not including the time required to rewind, unload, and eject any tape present in the EXB-8500 before the new tape is inserted).

Table 5-2 Time Required to Make a Microcode Update Tape

Step	Time required (seconds)
Load new tape	35
Copy code memories to buffer	5
Validate image in buffer	19
Write buffered data to tape	44
Unload and eject tape	18
TOTAL	**121 (approx.)**

Part 2

SCSI Commands for the EXB-8500

6 SCSI Physical Path Communications

This chapter describes the following aspects of SCSI physical path communications for the EXB-8500:

- How the EXB-8500 processes SCSI bus messages
- How the EXB-8500 recovers from SCSI bus errors
- How the EXB-8500 processes the Unit Attention condition
- How the EXB-8500 handles different types of resets

Note: The ANSI *Small Computer System Interface-2 (SCSI-2) Specification* provides detailed information about SCSI physical characteristics. As described in that specification, SCSI devices can be daisy-chained together using a common cable. Both ends of the cable must be terminated. All signals are common between all bus devices.

The EXB-8500 supports the following SCSI characteristics:

- Asynchronous data transfer rates of up to 1.5 MBytes/second
- Synchronous data transfer rates of up to 4.0 MBytes/second
- Sustained data transfer rate of up to 500 KBytes/second
- Single-ended or differential SCSI configurations
- SCSI-2 or SCSI-1 command set (sequential access device)

6.1 Message System

The message system allows communication between the initiator and the EXB-8500 for physical path management. Table 6-1 lists the messages supported by the EXB-8500.

Table 6-1 Messages Supported by the EXB-8500

Hex Value	Message	Direction*	
		In	**Out**
00h	Command Complete	✔	
01h	Extended Message (Synchronous Data Transfer Request)	✔	✔
02h	Save Data Pointers	✔	
03h	Restore Pointers	✔	
04h	Disconnect	✔	
05h	Initiator Detected Error		✔
06h	Abort		✔
07h	Message Reject	✔	✔
08h	No Operation		✔
09h	Message Parity Error		✔
0Ch	Bus Device Reset		✔
80h or C0h	Identify	✔	✔

* In: EXB-8500 to initiator
Out: Initiator to EXB-8500

Command Complete (00h)

The EXB-8500 sends the Command Complete message to the initiator to indicate that the execution of a command has terminated and that valid status has been sent to the initiator. After successfully sending this message, the EXB-8500 goes to the Bus Free phase.

Extended Message (01h)

The EXB-8500 supports only one Extended message, the Synchronous Data Transfer Request message.

01h Synchronous Data Transfer Request

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	0	0	0	0	1
01	Extended Message Length							
02	Extended Message Code							
03	Transfer Period							
04	REQ/ACK Offset							

The Synchronous Data Transfer Request message consists of five bytes. The field definitions for these bytes are as follows:

Byte 00 - Extended Message The valid value for the Extended Message field is 01h, indicating that this is an extended message that contains multiple bytes.

Byte 01 - Extended Message Length The valid value for the Extended Message Length field is 03h, indicating that there are three additional message bytes to be transferred, not including this byte.

Byte 02 - Extended Message Code The Extended Message Code byte identifies the specific extended message being sent. The valid value for this byte is 01h, indicating that the Extended message is a Synchronous Data Transfer Request.

Byte 03 - Transfer Period This byte identifies the minimum time allowed between leading edges of successive REQ pulses and ACK pulses for successful reception of data. The value represents the number of 4-nanosecond increments allowed for the synchronous transfer period. The EXB-8500 supports a minimum of 62 increments or 250 nanoseconds for the minimum synchronous transfer period.

Byte 04 - REQ/ACK Offset This byte identifies the maximum number of REQ pulses that can be outstanding before the leading edge of the corresponding ACK is received by the EXB-8500. The EXB-8500 allows up to 12 outstanding REQ pulses.

The Synchronous Data Transfer Request message is used to negotiate synchronous data transfer agreements. If the initiator wants to transfer data synchronously, it must negotiate a synchronous data transfer agreement before transferring data.

Note: The EXB-8500 will not originate a synchronous data transfer request. However, it sends a Synchronous Data Transfer Request message in response to the initiator's request.

A negotiation for synchronous data transfer is accomplished as follows:

1. The initiator sends a Synchronous Data Transfer Request message to the EXB-8500. This message specifies a transfer period and a REQ/ACK offset.

2. The EXB-8500 returns a Synchronous Data Transfer Request message. The transfer period returned by the EXB-8500 will be equal to or greater than the initiator's value, and the REQ/ACK offset will be less than or equal to the initiator's value.

Once negotiated, the synchronous transfer agreement stays in effect with the initiator until renegotiated or until a reset condition (SCSI bus reset, Bus Device Reset message, or power-on reset) occurs. The agreement can also be terminated immediately after the negotiation if the initiator asserts the Attention signal and then sends either an Initiator Detected Error or a Message Reject message.

Note: If this abnormal termination of the synchronous transfer agreement happens more than eight times, the EXB-8500 aborts synchronous transfer negotiations by going to the Bus Free phase.

Save Data Pointer (02h)

The EXB-8500 sends the Save Data Pointer message to direct the initiator to save a copy of the present active data pointer for the currently attached LUN.

Restore Pointers (03h)

The EXB-8500 sends the Restore Pointers message to direct the initiator to restore the most recently saved data pointers for the currently attached LUN to the active state. Pointers to the Command, Data, and Status locations for the LUN are restored to the active pointers. Command and Status pointers are restored at the beginning of the present command and status areas. The data pointer is restored to the value at the beginning of the data area or the most recent Save Data Pointer value.

Disconnect (04h)

The EXB-8500 sends the Disconnect message to inform the initiator that the present physical path will be broken (the EXB-8500 will disconnect by releasing the BSY signal) and that a later reconnect is required to complete the current operation.

If it does not send either this message or the Command Complete message before going to the Bus Free phase (other than as a result of the reset condition), the EXB-8500 indicates either of the following:

- A catastrophic error condition has occurred on the current command
- The initiator aborted the command

Note: This message should not cause the initiator to save the data pointer.

Initiator Detected Error (05h)

The initiator sends the Initiator Detected Error message to inform the EXB-8500 that an error has occurred that does not preclude the EXB-8500 from retrying the operation. The present pointer integrity is not ensured.

Abort (06h)

The initiator sends the Abort message to the EXB-8500 to clear the present operation. If a LUN has been identified in the Identify message (must be 0), all pending data and status for the issuing initiator is cleared, and the EXB-8500 goes to the Bus Free phase. If no Identify message has been sent or if the LUN is not 0, the EXB-8500 goes to the Bus Free phase. No status or ending message is sent for the operation.

If a process is aborted, the EXB-8500 generates sense data that indicates how the process terminated (either aborted or an error condition).

Message Reject (07h)

Either the EXB-8500 or the initiator can send the Message Reject message to indicate that the last message received was inappropriate or has not been implemented.

Note: If the initiator sends a Message Reject message after a non-message phase, the EXB-8500 treats this as an error by the initiator and aborts any processes owned by the initiator.

To indicate its intention of sending this message, the initiator must assert the Attention signal before releasing ACK for the REQ/ACK handshake of the message that will be rejected. When the EXB-8500 sends this message, it changes to Message In phase and sends this message before requesting additional message bytes from the initiator. This provides an interlock so that the initiator can determine which message is rejected.

No Operation (08h)

The initiator sends the No Operation message in response to the EXB-8500's request for a message when the initiator does not currently have any other valid message to send.

Message Parity Error (09h)

The initiator sends the Message Parity Error message to the EXB-8500 to indicate that the last message it received had a parity error. The EXB-8500 responds by re-sending the previous message.

Note: If the EXB-8500 receives a Message Parity Error message when the last phase was not Message In, it sends a Message Reject message to the initiator.

To indicate its intention of sending this message, the initiator must assert the Attention signal before releasing ACK for the REQ/ACK handshake of the message that has the parity error. This provides an interlock so that the EXB-8500 can determine which message has the parity error.

Bus Device Reset (0Ch)

The initiator sends the Bus Device Reset message to direct the EXB-8500 to reset all current I/O operations. This message forces the EXB-8500 to an initial state with no operations pending for any initiator. Upon recognizing this message, the EXB-8500 goes to the Bus Free phase.

Note: Refer to Section 6.5 for more information about the effect of the Bus Device Reset message.

Identify (80h or C0h)

Either the initiator or the EXB-8500 can send the Identify message. The message is used to establish the physical path connection between an initiator and the EXB-8500.

When the EXB-8500 sends the Identify message to the initiator during reconnection, an implied Restore Pointers message must be implemented by the initiator before completion of this message.

Identify Message

Bit Byte	7	6	5	4	3	2	1	0
00	Identify	DiscPriv	LUNTAR	Reserved		LUNTRN		

Bit 7 - Identify The Identify bit is set to 1 to distinguish the Identify message from all other messages.

Bit 6 - DiscPriv The initiator sets the DiscPriv (disconnect privilege) bit to grant the EXB-8500 disconnect privileges.

0 – Disconnect is not allowed
1 – Disconnect is allowed.

Bit 5 - LUNTAR The EXB-8500 does not support this field; the only valid value for this field is 0.

Bits 2 through 0 - LUNTRN The EXB-8500 is a single device target and does not support multiple devices; therefore, the LUN must be 0.

Message Sequence

When the EXB-8500 connects to the SCSI bus, the following sequence of events occurs:

1. The initiator indicates its ability to accommodate more than the Command Complete message by asserting the Attention signal in the Selection phase before the Select signal is driven true and the Busy signal is driven false.

2. To indicate its ability to accommodate more than the Command Complete message, the EXB-8500 responds to the Attention signal by transitioning to the Message Out phase immediately after completing the Selection phase.

3. If the initiator supports messages other than Command Complete, the first message sent by the initiator after the Selection phase is the Identify message. This allows the physical path to be established for the LUN specified by the initiator. The EXB-8500 support an LUN of 0 only.

4. If the DiscPriv bit (bit 6) in the Identify message is set, the EXB-8500 may send the Disconnect message to the initiator to indicate that the physical path will be broken temporarily.

   or

   If the DiscPriv bit is not set, the EXB-8500 will not send the Disconnect message and will not temporarily suspend the physical path.

5. If the physical path has been broken temporarily, the EXB-8500 will re-establish the communication path with the initiator by entering the Reselection phase. After completing the reselection, the EXB-8500 will send an Identify message to the initiator to re-establish the physical path.

6.2 SCSI Bus Error Recovery (Initiators Supporting Command Complete Message Only)

This section describes the actions to be taken by the initiator and the EXB-8500 when a SCSI bus parity error occurs. The information in this section applies to those initiators that support the Command Complete message only.

Parity Error in Command Out Phase
When parity checking is enabled and the EXB-8500 detects a parity error during the Command Out phase, it immediately sends Check Condition status to the initiator, followed by a Command Complete (00h) message. The sense key is set to Aborted Command (Bh) and the SCSI Bus Parity Error (BPE) bit is set to 1. The initiator should reissue the command.

Parity Error in Data Out Phase
When parity checking is enabled and the EXB-8500 detects a parity error in the user data associated with the WRITE command, it aborts the data transfer.

When this condition occurs, the EXB-8500 immediately sends Check Condition status to the initiator, followed by a Command Complete (00h) message. The sense key is set to Aborted Command (Bh) and the SCSI Bus Parity Error (BPE) bit is set to 1. The initiator may be able to recover by reissuing the WRITE command.

Parity Error in the Data In Phase
If the parity error is detected in the user data associated with a READ command, the initiator should do a backspace-*n*-blocks operation and set up to reread the blocks by reissuing the command.

If the parity error is detected during the execution of any other data command (for example, during sense operations), it is only necessary to reissue the command. If the command was REQUEST SENSE, valid sense data will be returned because the sense data is not reset until the next non-REQUEST SENSE or non-INQUIRY command is issued.

6.3 Message Processing and SCSI Bus Error Recovery (Initiators Supporting Additional Messages)

This section describes EXB-8500 message processing and SCSI bus error recovery for initiators supporting messages in addition to Command Complete. It includes a number of charts showing the actions that the EXB-8500 will take in response to each message it receives from the initiator.

The charts are organized by phase transitions; that is, there is a chart for each possible initial phase with the transition to the Message Out phase. The charts indicate the specific action the EXB-8500 will take for each type of message. The text accompanying each chart also describes the actions to be taken by the initiator and the EXB-8500 when a SCSI bus parity error occurs.

EXB-8500 Response to the Attention Signal

Once the physical path management mechanism has been established by the initiator using the Identify message, the EXB-8500 will accept and process messages from the initiator whenever the Attention signal is driven true.

The EXB-8500 will respond to the Attention signal for each SCSI bus phase as described in Table 6-2.

Table 6-2 EXB-8500 Responses to Attention Signal

If the initiator asserts the Attention signal during this phase...	The EXB-8500 responds...
Selection	Immediately following the selection.
Command	At the end of the phase, after all CDB bytes have been received.
Data In	After the next byte has been received by the initiator.
Data Out	After the next byte has been received by the EXB-8500.
Status	After the Status byte has been received by the initiator.
Message In	After the next message byte has been received by the initiator.
Message Out	After the next message byte has been received by the EXB-8500 (will stay in Message Out phase).

Message Processing after the Selection Phase

Figure 6-1 shows that the EXB-8500 will only accept three legal messages immediately after the Selection phase (Abort, Reset, and Identify).

Parity Error in the Selection Phase

When parity checking is enabled and the EXB-8500 detects a parity error during the Selection phase, it stays in the Message Out phase until the Attention signal goes low. Then, it retries by going to the Message Out phase again.

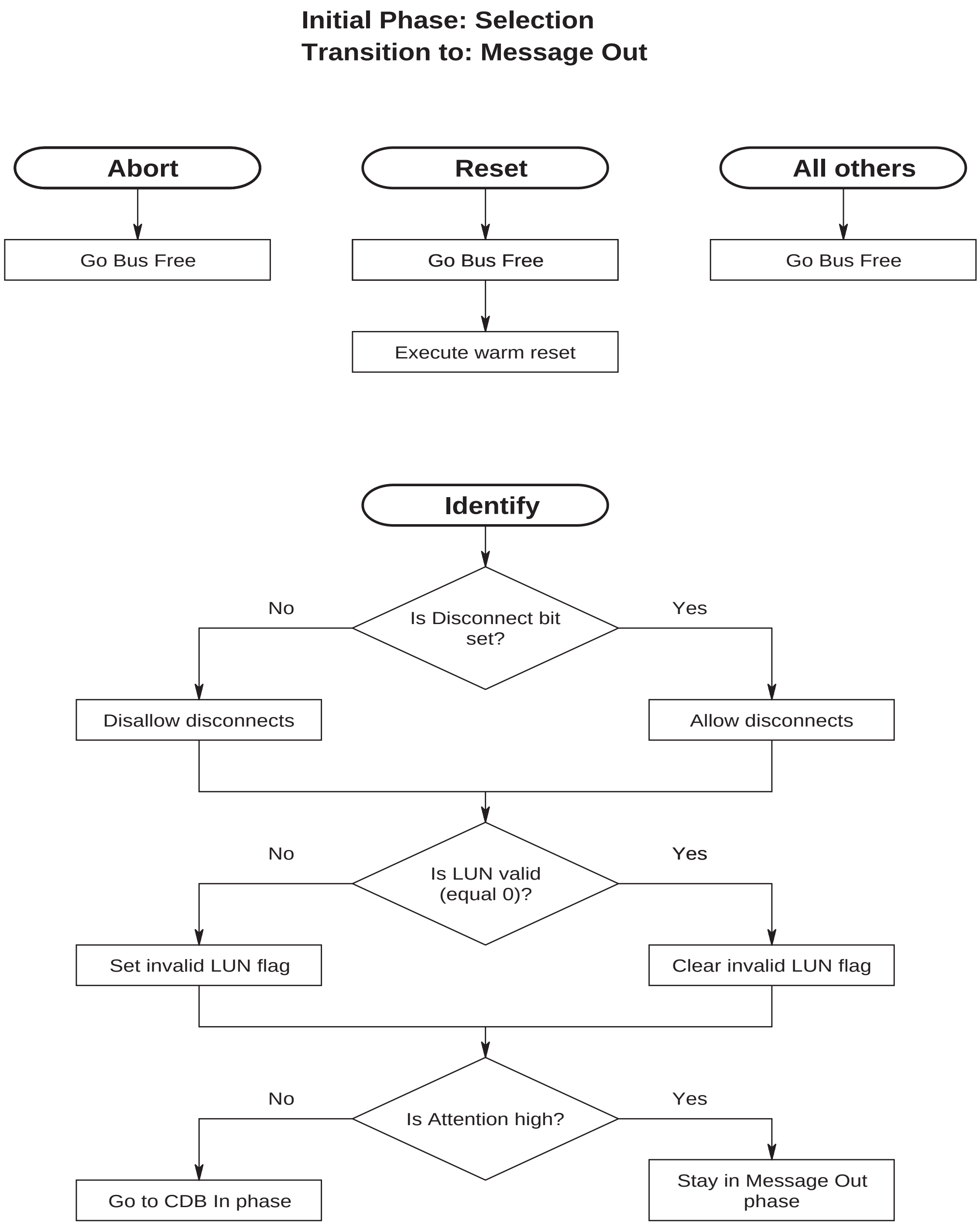


Figure 6-1 Message Processing after the Selection Phase

Message Processing in the Message Out Phase

Figure 6-2 shows the message sequences for Message Out bytes received during a previously initiated Message Out phase. Note that Message Reject and Initiator Detected Error messages received after a previous Message Out phase are treated as catastrophic errors committed by the initiator.

Parity Error in the Message Out Phase

When parity checking is enabled and the EXB-8500 detects a parity error in a message received from the initiator, the EXB-8500 requests that the initiator reissue the message by going to the Message Out phase again.

If a parity error occurs during the first message sequence (Identify message followed by contiguous Message Out bytes), the entire sequence must be retransmitted (that is, the initiator should reissue the Identify message and all following bytes). If a parity error is detected the second time the message is received, the EXB-8500 goes to the Bus Free phase by releasing the BSY signal.

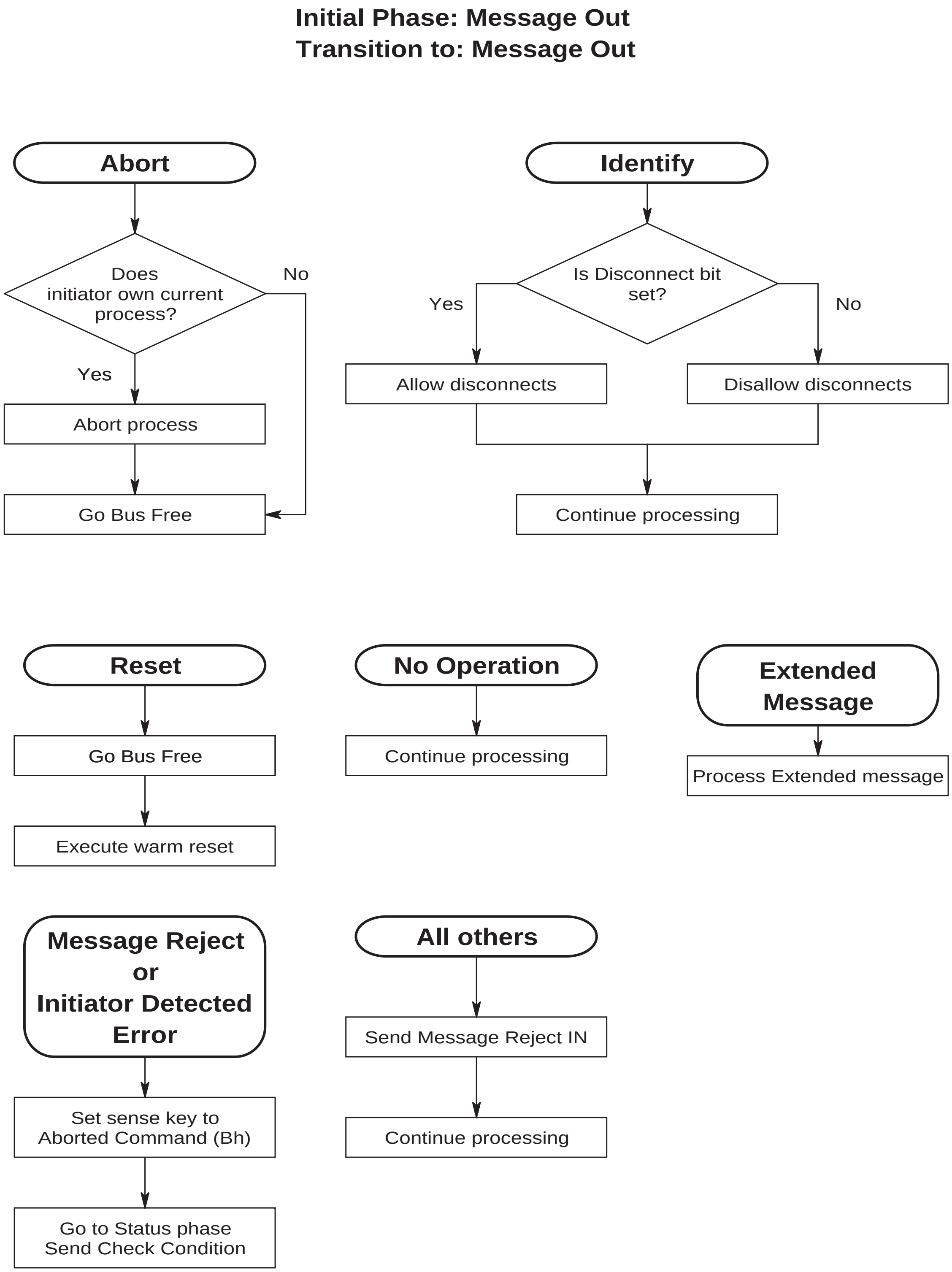


Figure 6-2 Message Out Bytes Received after Previous Message Out Phase

Processing during the Command Out Phase

Figure 6-3 shows how CDB bytes are processed. Note that the Group Code in the CDB's first byte determines how many CDB bytes are to be transmitted. If the initiator asserts the Attention signal during the Command In phase, the EXB-8500 waits until all CDB bytes have been received and then goes to the Message Out phase.

Parity Error in Command Out Phase

If a parity error is detected in the CDB byte being sent by the initiator, the EXB-8500 goes to Message In phase and sends a Restore Data Pointers message. Then, the EXB-8500 transitions to the Command Out phase and tries to process the CDB again. If this retry process occurs 15 times (16 times total), the EXB-8500 goes to Status phase and returns Check Condition. The sense key is set to Aborted Command (Bh) and the ASC and ASCQ are set to 43h and 00h. The FSC is set to E0h.

CDB Processing

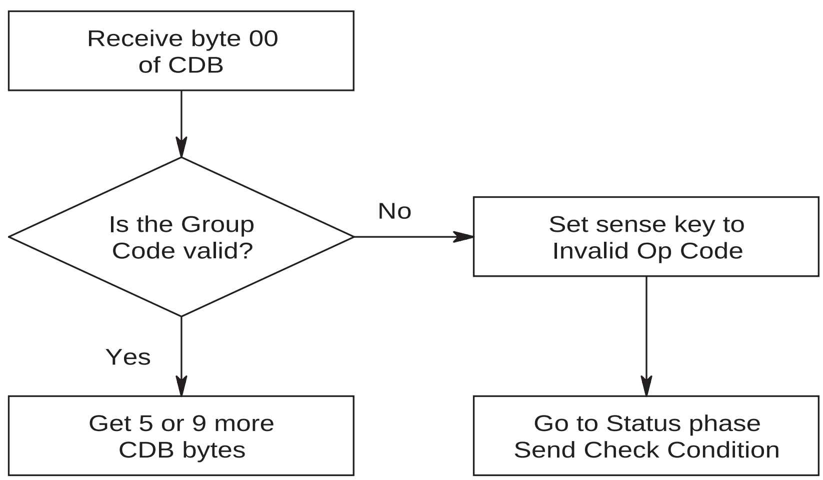


Figure 6-3 Processing of CDB Bytes

Message Processing in the Message Out Phase after Command Phase

Figure 6-4 shows how messages are processed after the Command phase and before any Data phase. This processing is the same as that in Figure 6-2. Message sequences that are legal before the CDB is received are also legal after the CDB is received.

Parity Error in the Message Out Phase

When parity checking is enabled and the EXB-8500 detects a parity error in a message received from the initiator, the EXB-8500 goes to the Message Out phase again to request that the initiator reissue the message.

Initial Phase: Message Out
Transition to: Message Out

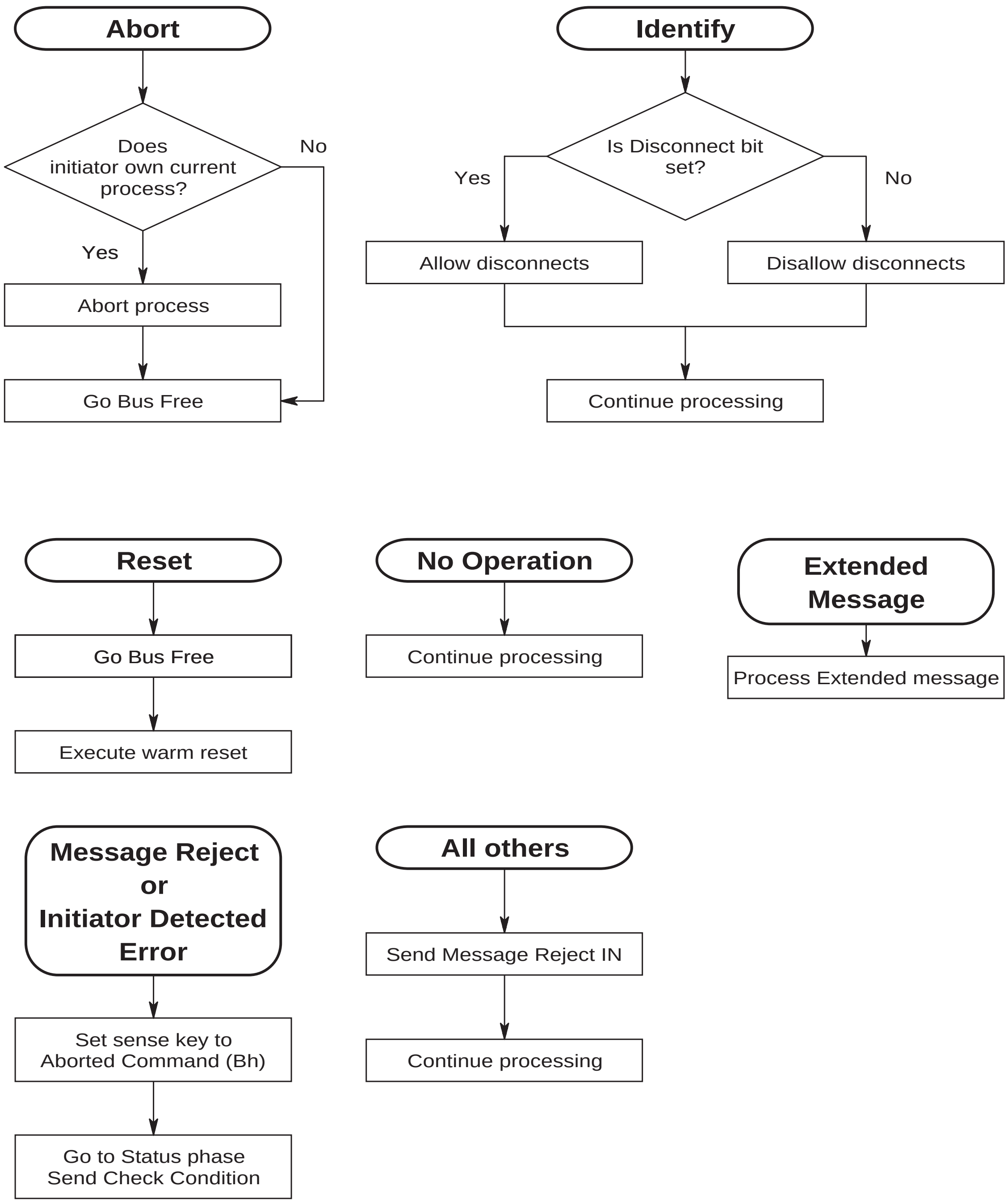


Figure 6-4 Message Processing after the Command Phase and before the Data In

Processing of Extended Message Out

Figure 6-5 shows how Extended Message Out messages are processed. Note that the Attention signal must coincide with the message byte numbering sequence. The EXB-8500 responds to the initiator's Synchronous Data Transfer Request with a transfer period of *xx* or 3Eh (250 nanoseconds), whichever is larger (slower), and a REQ/ACK offset of *yy* or 12, whichever is smaller.

Parity Error in Extended Message Out

When parity checking is enabled and the EXB-8500 detects a parity error in the Synchronous Data Transfer Request message received from the initiator, the EXB-8500 stays in the Message Out phase until the Attention signal goes low. Then, it goes to the Message Out phase again to request that the initiator reissue the entire message sequence.

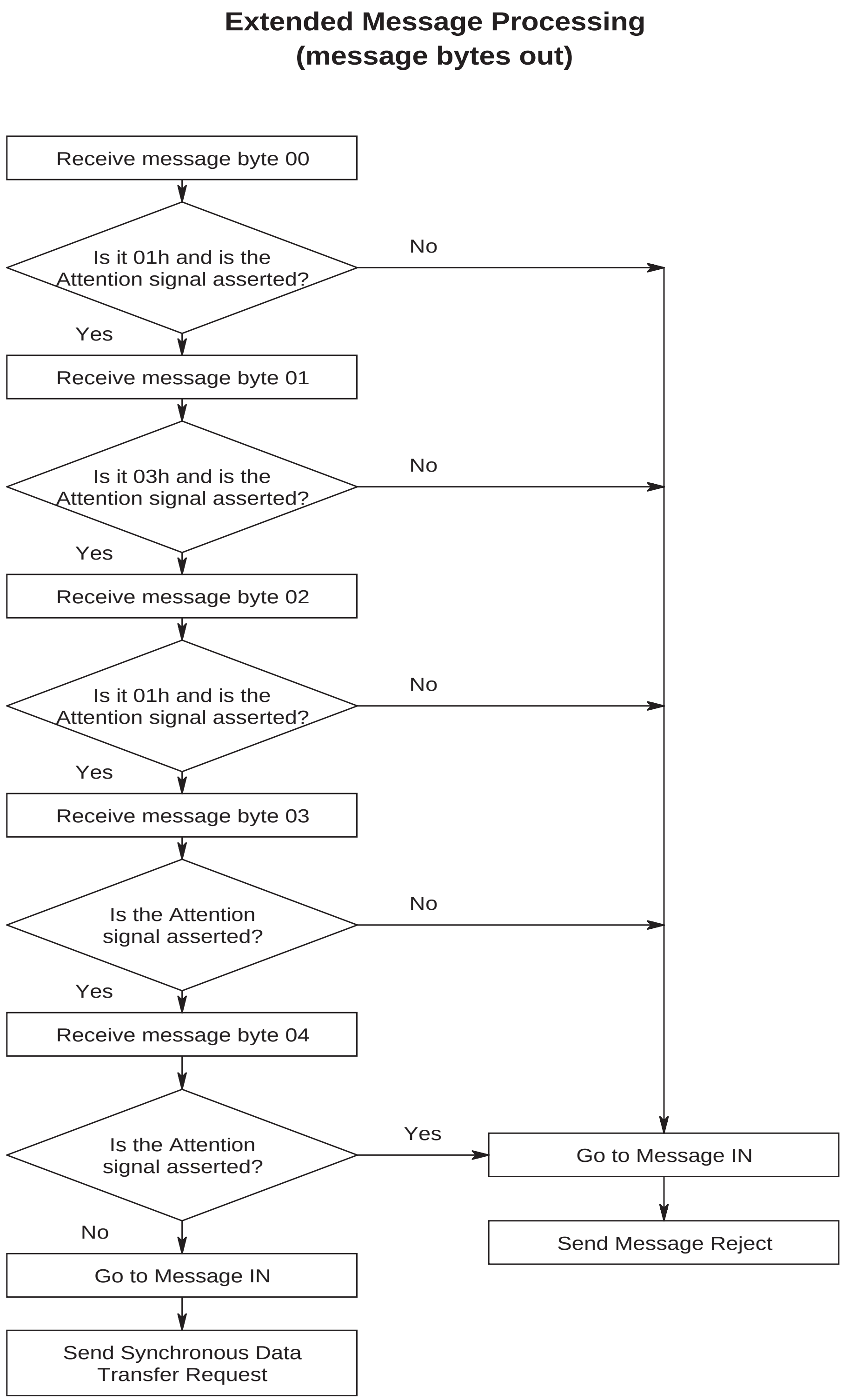


Figure 6-5 Message Processing of Extended Message Out Bytes

Processing of Extended Message In

Figure 6-6 shows how the Extended Message In messages are processed. The EXB-8500 executes this message sequence in response to an initiator's Synchronous Data Transfer Request.

Parity Error in Extended Message In

If the initiator detects a parity error in the Synchronous Data Transfer Request byte being sent by the EXB-8500, it responds by sending a Message Parity Error message to the EXB-8500. The EXB-8500 responds by re-sending the Synchronous Data Transfer Request byte. If the EXB-8500 receives 16 consecutive Message Parity Error messages or one Message Reject message, it cancels the Synchronous Data Transfer Request and resumes asynchronous data transfer for that initiator.

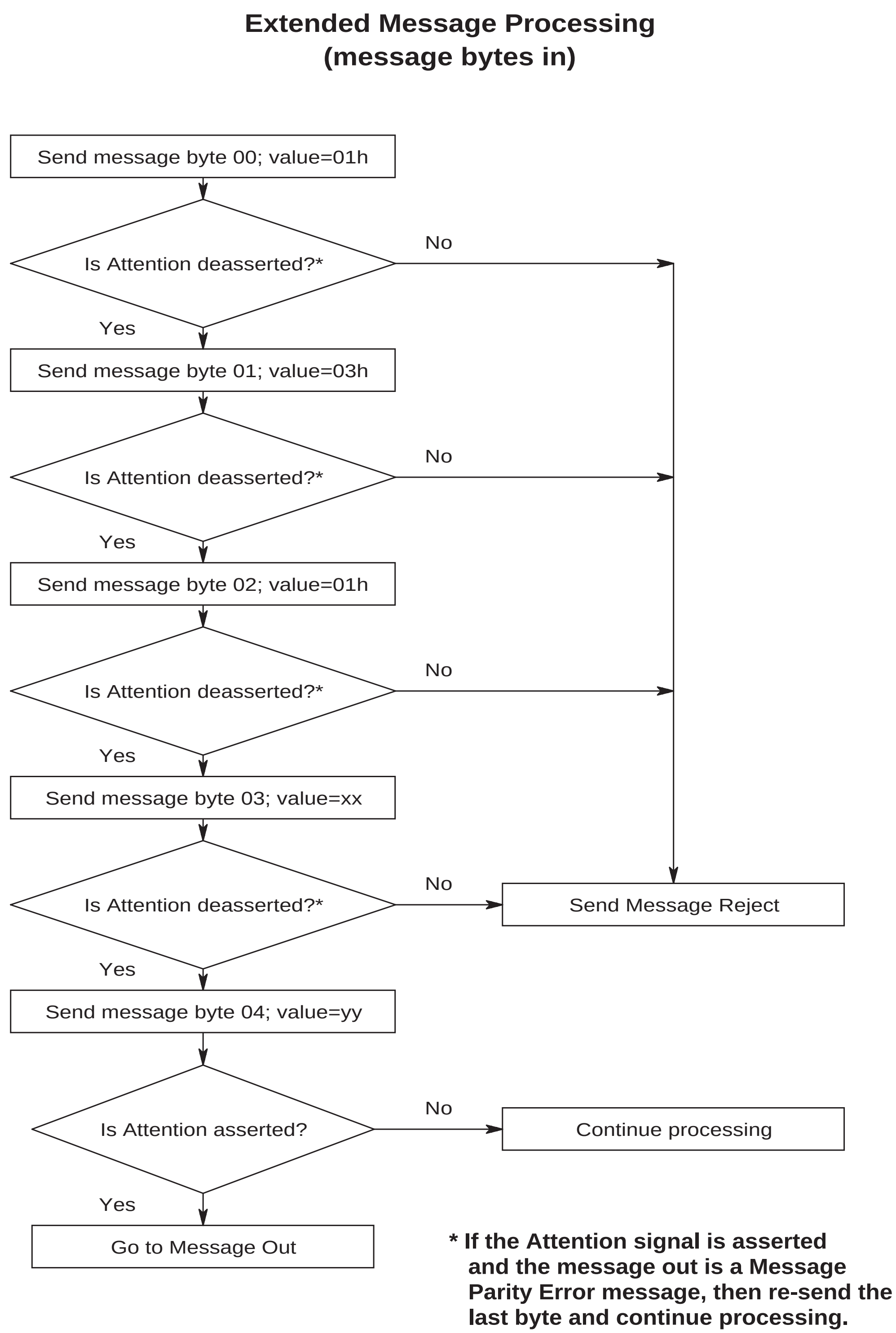


Figure 6-6 Message Processing for Synchronous Data Transfer Request Message

Message Processing in Data Out Phase (WRITE Command)

Figure 6-7 shows how each message is processed during the Data Out phase of a WRITE command.

Parity Error in User Data Associated with WRITE Command

When parity checking is enabled and the EXB-8500 detects a parity error in the logical blocks of user data received from the initiator, the EXB-8500 aborts the data transfer. The data block containing the parity error is not written to tape.

After aborting the data transfer, the EXB-8500 sends Check Condition status to the initiator, followed by a Command Complete message. The sense key is set to Aborted Command (Bh) and the ASC and ASCQ bytes are set to 47h and 00h. The SCSI Bus Parity Error (BPE) bit is set to 1.

- **If you are attempting to write a variable-length block**, you may be able to recover by reissuing the WRITE command an unlimited number of times. Each time a failure is detected, the EXB-8500 returns Check Condition status.
- **If you are attempting to write fixed-length blocks**, you may be able to recover by following these steps:
    1. Issue a REQUEST SENSE command.
    2. Look at the Information Bytes to determine how many fixed blocks need to be re-sent. These bytes indicate how many logical blocks were not transferred successfully (including the logical block with the parity error).
    3. Adjust the initiator’s data pointer to reflect the number of blocks that were successfully transferred.
    4. Issue a WRITE command to re-send the blocks that were not successfully transferred.

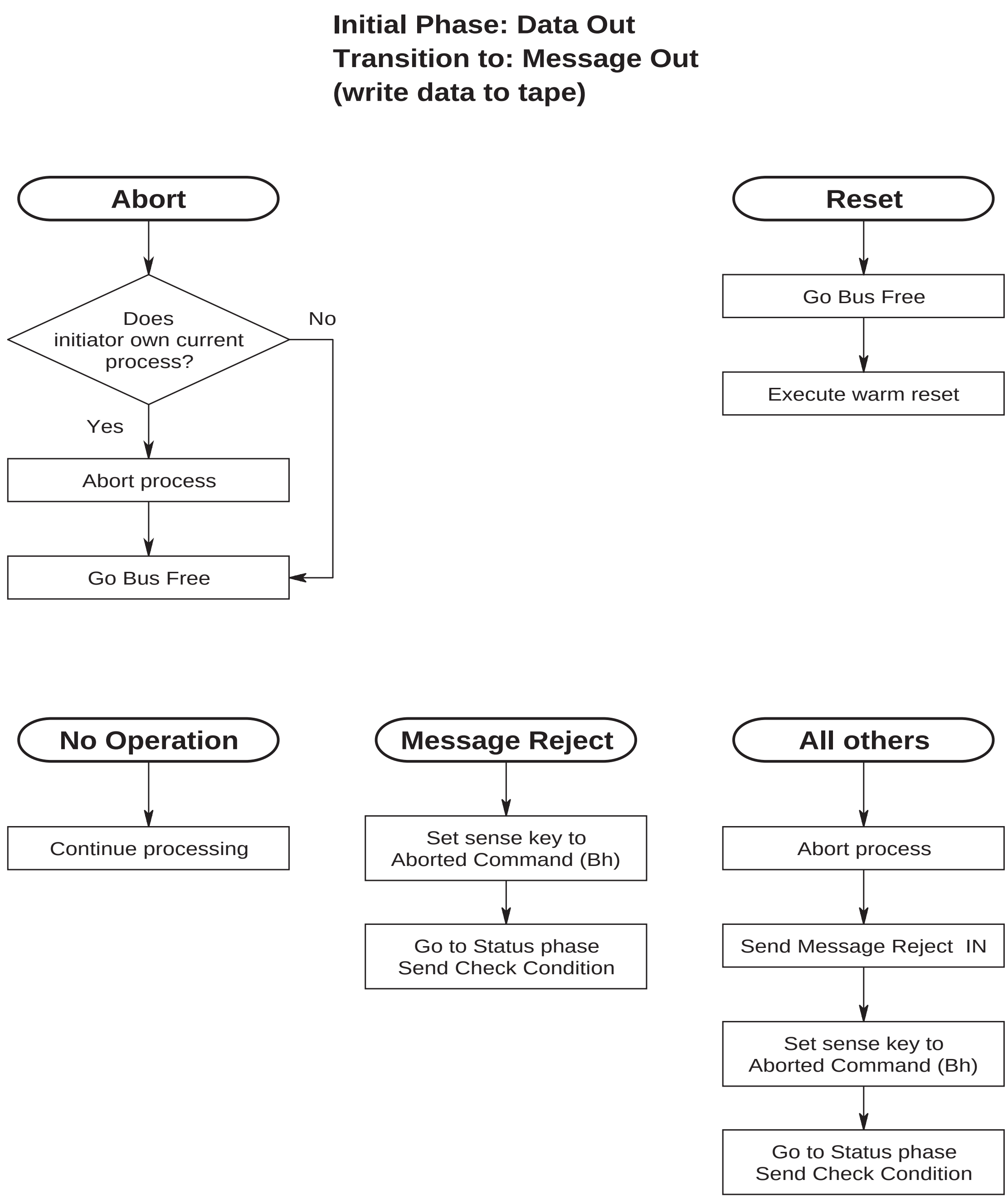


Figure 6-7 Message Processing during the Data Out Phase of a WRITE Command

Message Processing in Data Out Phase (Information Commands)

Figure 6-8 shows how messages are processed during the Data Out phase for commands other than WRITE (for example, MODE SELECT).

Parity Error in Data Out Phase (Information Command)
When parity checking is enabled and the EXB-8500 detects a parity error in the data sent after the MODE SELECT CDB, it goes to the Message In phase and sends a Restore Pointers message. The initiator must restore the pointer to the start of the data. The EXB-8500 then goes to the Data Out phase and requests the data again.

The initiator should count the Restore Pointers messages received during the Data Out phase to qualify the communication. If the count exceeds some threshold, the initiator should clear the EXB-8500 from the bus by doing one of the following:

- Sending the Abort message
- Performing a SCSI bus reset
- Sending the Bus Device Reset message.

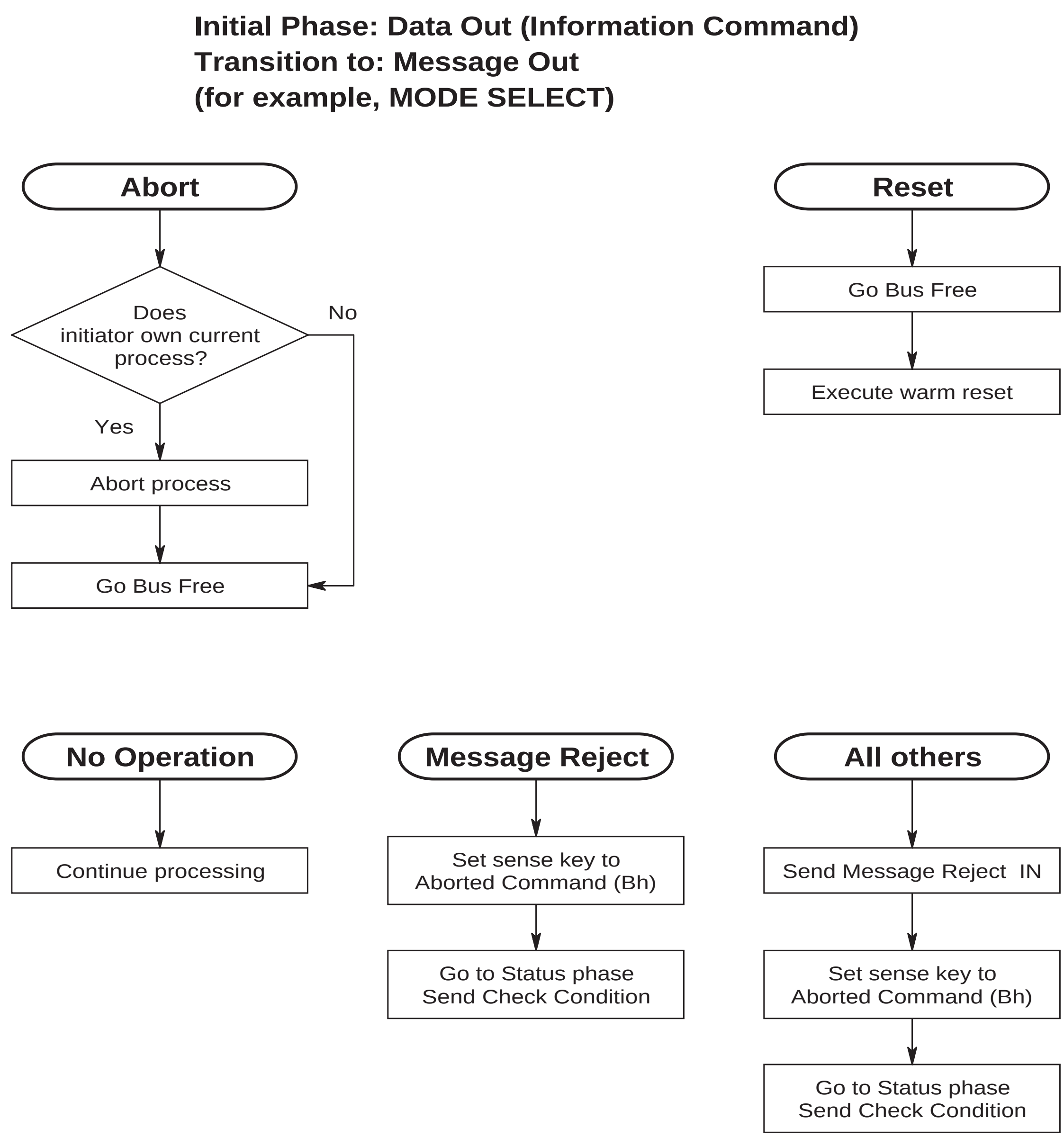


Figure 6-8 Message Processing during the Data Out Phase of MODE SELECT Command

Message Processing in Data In Phase (READ Command)

Figure 6-9 shows how messages are processed during the Data In phase of a READ command (that is, when the initiator asserts the Attention signal while it is receiving user data from the EXB-8500). Note that the EXB-8500 does not allow the physical path characteristics to be altered while it is transferring data–this is treated as a catastrophic error committed by the initiator. In other words, the initiator should not send a Synchronous Data Transfer Request message or the Identify message during data transfer.

Parity Error in Data Associated with READ Command

If the initiator detects a parity error in data transferred from the EXB-8500 during a READ command, it should assert the Attention signal. This causes the EXB-8500 to stop the data transfer. The initiator should then send an Initiator Detected Error message to the EXB-8500.

When it receives the Initiator Detected Error, the EXB-8500 assumes that a parity error has occurred and aborts the data transfer. The EXB-8500 is positioned at the start of the next block.

After aborting the data transfer, the EXB-8500 sends Check Condition status to the initiator followed by a Command Complete message. The sense key is set to Aborted Command (Bh), and the ASC and ASCQ are set to 47h and 00h. The SCSI Bus Parity Error bit is set to 1. In fixed-block mode, the Information bytes contain the number of blocks not sent to the initiator.

The initiator should backspace *n* blocks and attempt to reread the blocks by reissuing the READ command.

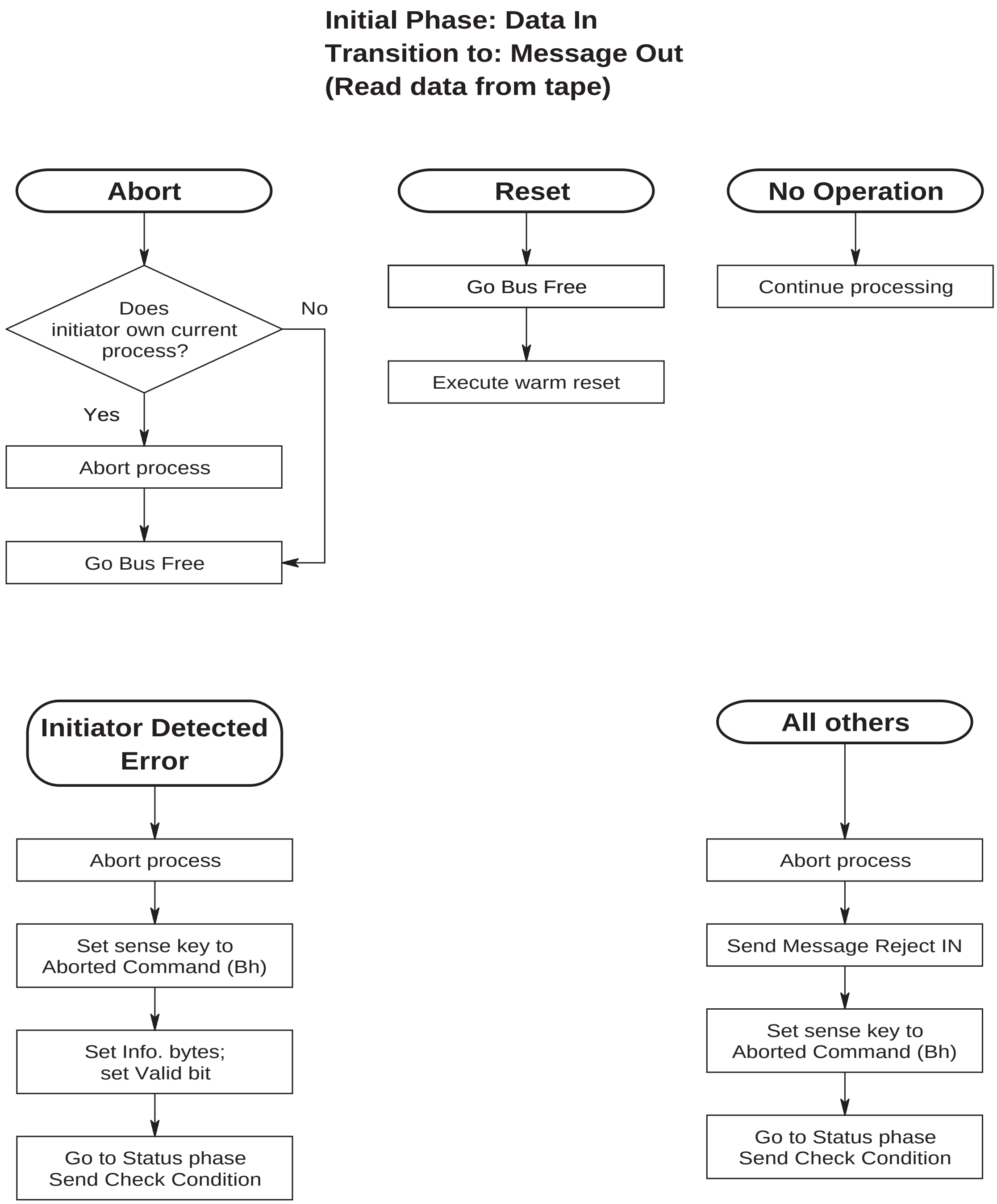


Figure 6-9 Message Processing during the Data In Phase of a READ Command

Message Processing in Data In Phase (Information Commands)

Figure 6-10 shows how messages are processed during the Data In phase for commands other than READ (for example, INQUIRY, REQUEST SENSE, and MODE SENSE).

Parity Error in Data In Phase (Information Commands)

If the initiator detects a parity error in data transferred from the EXB-8500 during a REQUEST SENSE, MODE SENSE, READ POSITION, or INQUIRY command, it should assert the Attention signal. This causes the EXB-8500 to stop the data transfer. The initiator should then send an Initiator Detected Error message to the EXB-8500.

When it receives the Initiator Detected Error, the EXB-8500 issues a Restore Pointers message and re-sends the data.

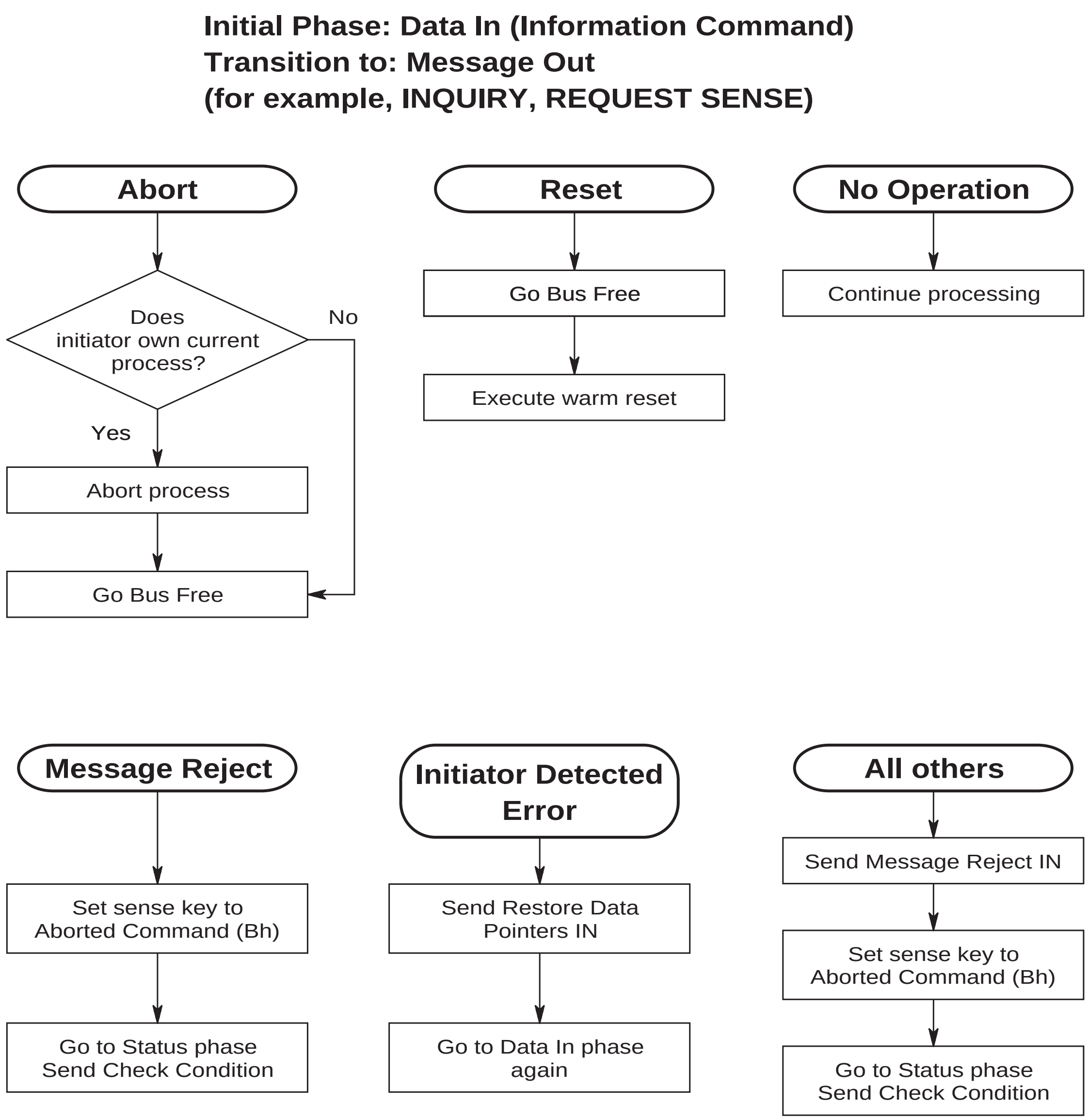


Figure 6-10 Message Processing during Data In Phase of Commands Other Than READ

Message Processing In Status In Phase

Figure 6-11 shows how messages are processed during the Status In phase. Note that attempts to change the physical path characteristics are not processed.

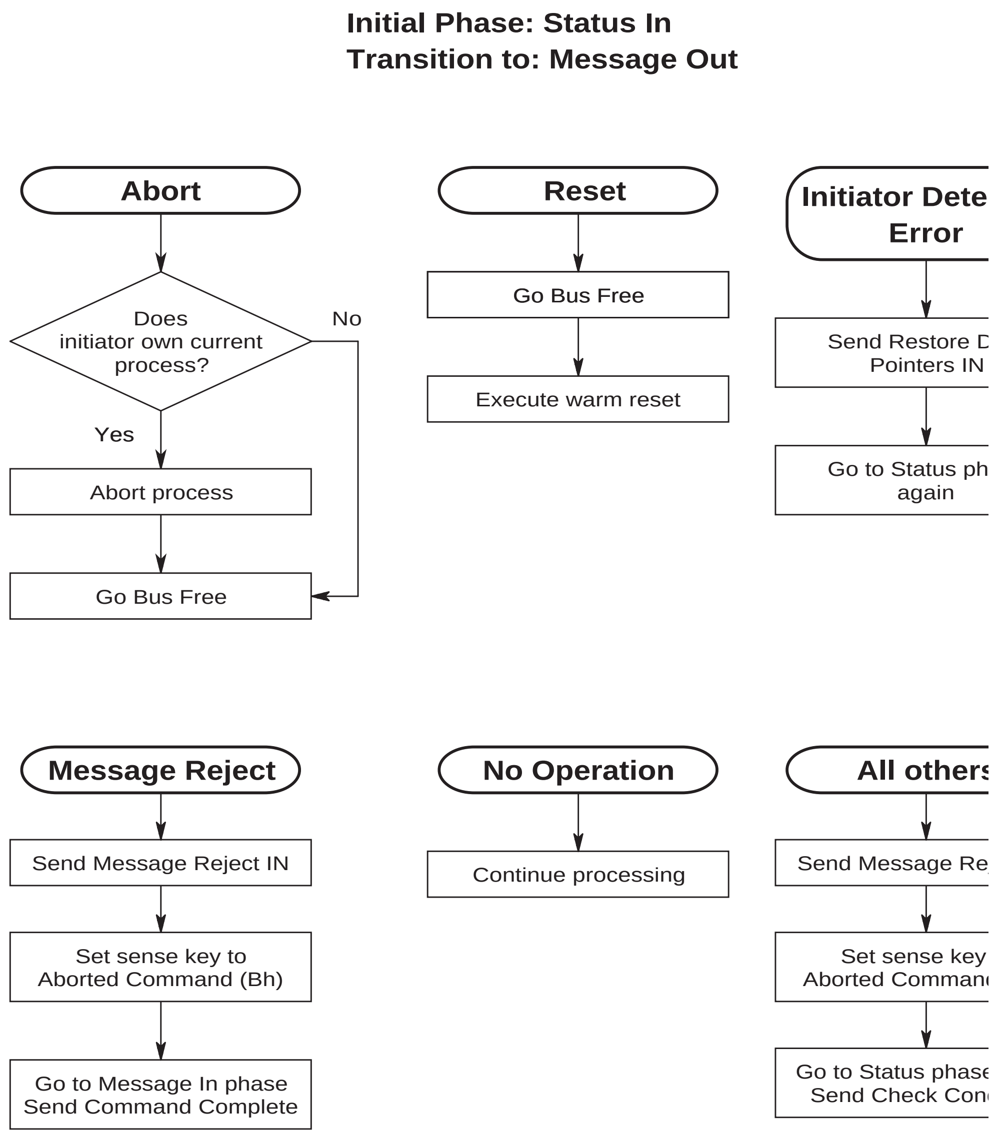


Figure 6-11 Message Processing during the Status In Phase

Message Processing in Message In Phase (Command Complete)

Figure 6-12 shows how messages are processed while the EXB-8500 is attempting to send the Command Complete message.

Parity Error Sending the Command Complete Message In
If the initiator detects a parity error during the Command Complete Message In phase, it sends a Message Parity Error message to the EXB-8500. The EXB-8500 responds by re-sending the Command Complete message.

The initiator should count Message Parity Error messages to qualify the communication. If the count exceeds some threshold, the initiator should clear the EXB-8500 from the bus by doing one of the following:

- Sending the Abort message
- Performing a SCSI bus reset
- Sending the Bus Device Reset message

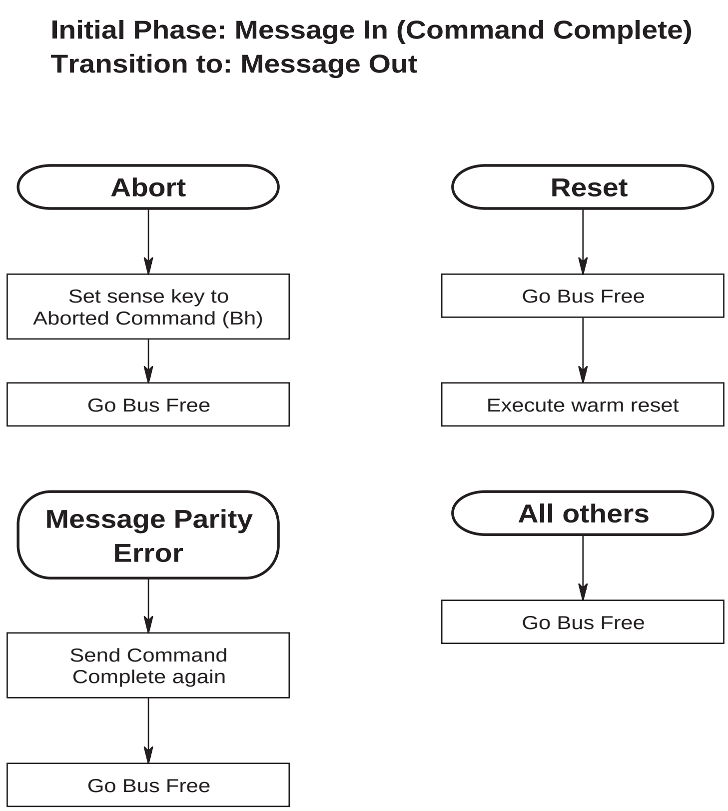


Figure 6-12 Message Processing during Command Complete Message In Phase

Message Processing after Reselection

Figure 6-13 shows how messages are processed after the EXB-8500 has reselected the initiator and sent the Identify message in. Note that if the initiator sends the EXB-8500 a Message Reject message, this will be treated as a catastrophic error committed by the initiator.

Parity Error Sending the Identify Message In

If the initiator detects a parity error when the EXB-8500 sends the Identify message in, it responds by sending a Message Parity Error message to the EXB-8500. The EXB-8500 responds by re-sending the Identify message.

The initiator should count Message Parity Error messages to qualify the communication. If the count exceeds some threshold, the initiator should clear the EXB-8500 from the bus by doing one of the following:

- Sending the Abort message
- Performing a SCSI bus reset
- Sending the Bus Device Reset message

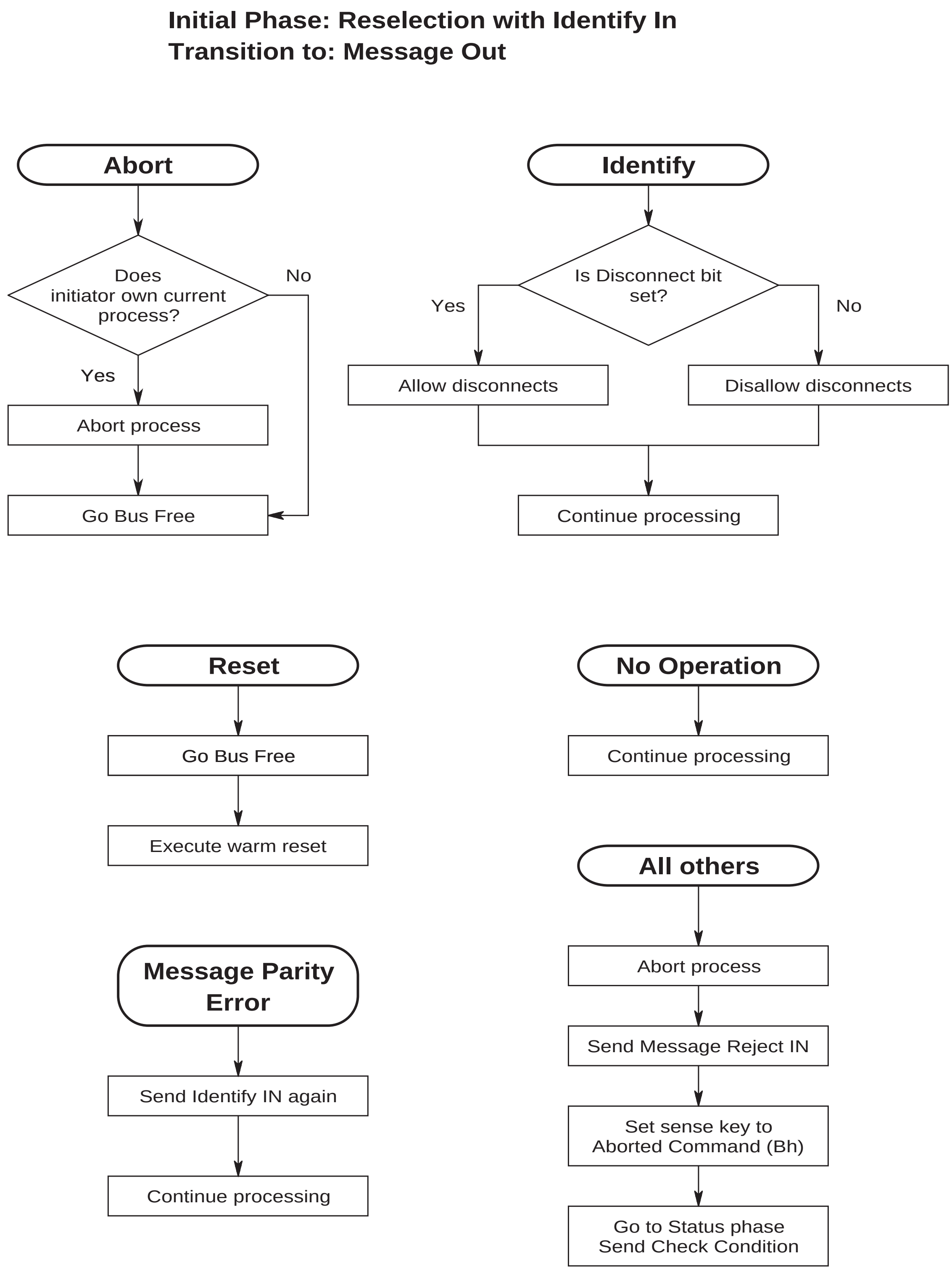


Figure 6-13 Message Processing after EXB-8500 Reselects Initiator with Identify Message

Message Processing during Disconnect Sequence

Figure 6-14 shows how messages are processed while the EXB-8500 is executing the “disconnect” sequence. Note that attempts to change the physical path characteristics are not allowed. Also, the disconnect sequence may be aborted if the initiator sends a Message Reject message.

Parity Error Sending Disconnect or Save Data Pointers Message In

If the initiator detects a parity error when the EXB-8500 sends a Disconnect or Save Data Pointers message in, it responds by sending a Message Parity Error message to the EXB-8500. The EXB-8500 responds by re-sending the Disconnect or Save Data Pointers message.

The initiator should count Message Parity Error messages to qualify the communication. If the count exceeds some threshold, the initiator should clear the EXB-8500 from the bus by doing one of the following:

- Sending the Abort message
- Performing a SCSI bus reset
- Sending the Bus Device Reset message

Initial Phase: Message In Sending Save Data Pointers or Disconnect
Transition to: Message Out

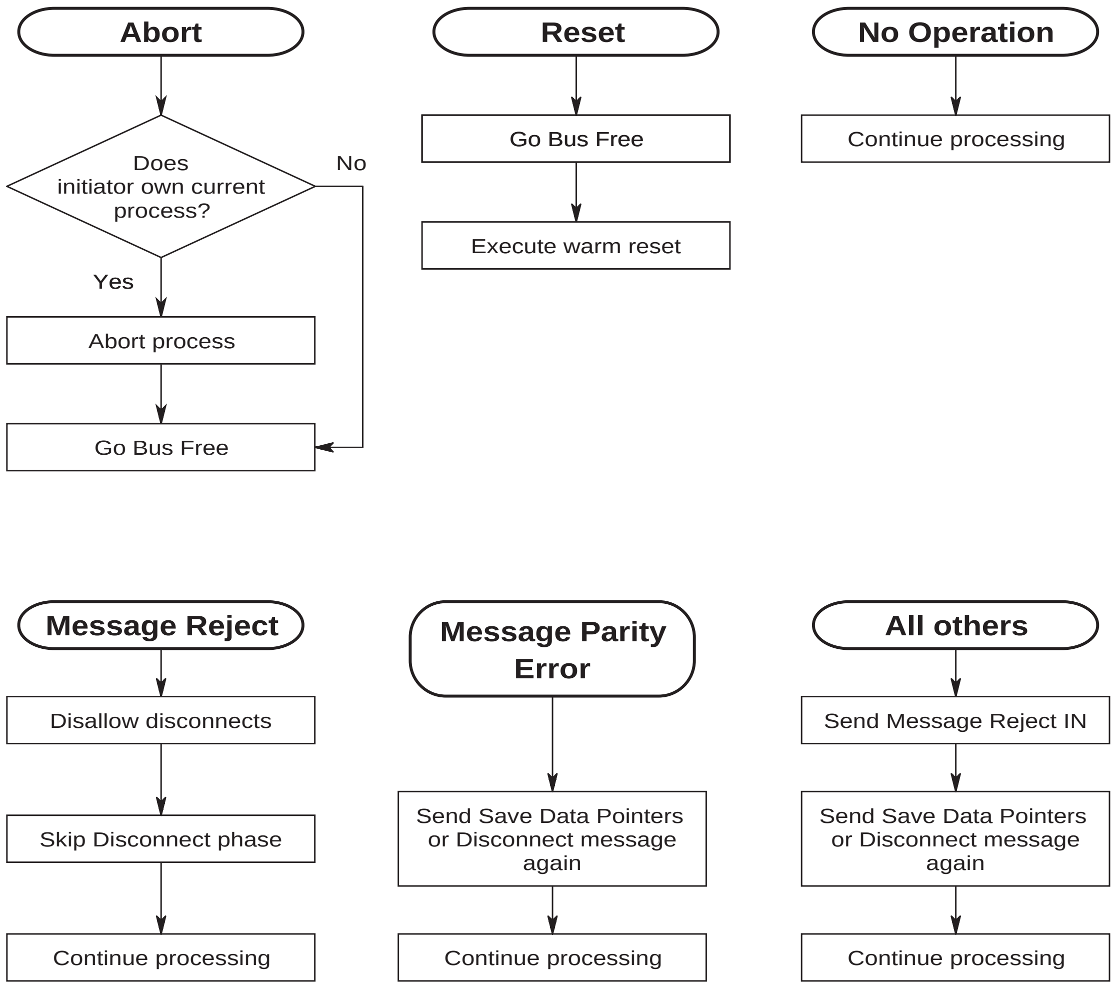


Figure 6-14 Message Processing while EXB-8500 Is Executing Disconnect Sequence

6.4 Unit Attention

A Unit Attention condition is created for each initiator when any of the following conditions occurs:

- The EXB-8500 is reset (whether by a Bus Device Reset message, a SCSI bus reset, or a power-on reset)
- The MODE SELECT parameters are changed by an initiator other than the one attempting to communicate with the EXB-8500
- The unload button is pressed and the data cartridge is ejected
- A data cartridge is inserted and automatically loaded
- The internal microcode (firmware) is changed

Effect of Changing Data Cartridges

The first command received after the unload button on the front of the EXB-8500 is pressed receives Check Condition status with the sense key set to Unit Attention (6h). Then, all subsequent commands that require tape motion receive Check Condition status with the sense key set to Not Ready (2h).

Note: If the unload button is pressed and a data cartridge is already loaded, the EXB-8500 will unload the tape. The first command issued during the unload procedure receives Check Condition status with the sense key set to Unit Attention (6h). All subsequent commands that require tape motion receive Check Condition status with the sense key set to Not Ready (2h).

When a data cartridge is inserted into the EXB-8500, the EXB-8500 returns Check Condition status with the sense key set to Unit Attention (6h). If a data cartridge is inserted but the tape is not loaded (that is, autoload was disabled with a MODE SELECT command and a LOAD (1Bh) command was not received), the EXB-8500 returns Check Condition status with the sense key set to Not Ready.

Clearing the Unit Attention Condition

The Unit Attention condition persists for each initiator until that initiator issues any command other than INQUIRY (12h) or REQUEST SENSE (03h).

First Command Received after Unit Attention Occurs

If the first command received after a Unit Attention condition occurs is an INQUIRY or REQUEST SENSE command, the EXB-8500 executes the command, reports any pending status, and preserves the Unit Attention sense data. If the first command received after a Unit Attention condition occurs is any other command, the EXB-8500 does not execute the command and returns Check Condition status with the sense key set to Unit Attention (6h).

Next Command Received after Unit Attention Reported

If the next command after the Unit Attention condition has been reported with Check Condition status is a REQUEST SENSE or an INQUIRY command, the EXB-8500 executes the command and preserves the Unit Attention sense data. If, however, the next command after the Unit Attention condition has been reported with Check Condition status is any other command, then the command is executed and the Unit Attention sense data is cleared.

Note: If multiple Unit Attention conditions occur before the initiator selects the EXB-8500, only the sense data for the latest Unit Attention condition is presented.

6.5 Resetting the EXB-8500

The EXB-8500 can be reset by any of the following:

- Powering the EXB-8500 off and back on again (power-on reset).
- Sending an RST pulse on the SCSI bus for a minimum of 25 µsec (SCSI bus or “hard” reset). A SCSI bus reset immediately clears all devices from the bus, resets their associated equipment, and terminates all pending I/O processes.
- Issuing a Bus Device Reset (0Ch) message to the EXB-8500 (device or “warm” reset). A device reset clears the EXB-8500 from the bus, causes all commands sent to it to be cleared, and terminates all pending I/O processes.

Note: If a SCSI bus or device reset occurs during a power-on reset, the power-on reset will be restarted.

Effect of Power-on Reset

Performing a power-on reset causes the EXB-8500 to complete its power-on self-test as indicated by the LEDs (both on). In addition, a power-on reset has the following effects:

- If the EXB-8500 is connected to the SCSI bus, the SCSI bus goes to the Bus Free phase
- A cyclic redundancy check (CRC) of the control code is performed
- The servo is reset and a servo self-test is performed
- All EXB-8500 parameters are reset to their default states
- A test of the microprocessor’s external memory is performed
- A buffer memory test is performed.

After a power-on reset, the EXB-8500 will respond on the SCSI bus within 3 seconds.

Effect of SCSI Bus and Device Resets

SCSI bus and device resets have the following effects:

- If the EXB-8500 is connected to the SCSI bus, the SCSI bus goes to the Bus Free phase
- The servo is reset and a servo self-test is performed
- All EXB-8500 parameters are reset to their default states
- A test of the microprocessor’s external memory is performed.

After a SCSI bus or device reset, the EXB-8500 will respond on the SCSI bus within 250 msec.

Note: If the device that supplies SCSI bus terminator power is powered off, the RST line is left in an indeterminate state (either reset or not, depending on the voltages). It may be impossible to communicate with the EXB-8500 or to unload a data cartridge when the device is in this state. To remove the data cartridge, restore power to the terminating device or remove the SCSI cable from the EXB-8500 to allow independent EXB-8500 operation.

Reset Processing

This section describes how the EXB-8500 processes power-on resets, SCSI bus resets, and device resets. The EXB-8500 processes resets differently depending on whether or not a data cartridge is present.

Data Cartridge Present before Reset

If a data cartridge is present before the reset occurs, the tape is rewound and reloaded. When the reset is complete, the tape is positioned at the logical beginning of tape (LBOT) and the EXB-8500 is ready to process tape motion commands.

When a data cartridge is present, the EXB-8500 responds to the reset as follows:

- It returns Check Condition status to the first command received. The sense key is set to Unit Attention (6h), and the Additional Sense Code (ASC) and Additional Sense Code Qualifier (ASCQ) fields indicate that a reset occurred.
- It processes all non-motion commands. The default status returned by the TEST UNIT READY (00h) command is Check Condition status with the sense key set to Not Ready (2h). The ASC and ASCQ fields indicate that the device is becoming ready.

Three options are available from EXABYTE to control how the EXB-8500 handles tape motion commands during reset and load operations. Depending on the EXB-8500's EEPROM image, the EXB-8500 performs one of the following actions when it receives tape motion commands during a reset or load operation:

- It queues (holds) one tape motion command (and disconnects, if allowed) until the reset operation is complete and the tape is loaded. Once the load is complete, it processes the queued command.
- It returns Busy status.
- It returns Check Condition status with the sense key set to Not Ready.

If the tape is already rewound when the reset occurs, the reset takes about 35 seconds to complete. If the tape is positioned toward the end of tape (EOT), the reset may take as long as 3 minutes to complete.

Data Cartridge Not Present before Reset

When a data cartridge is not present, the EXB-8500 responds to the reset as follows:

- It returns Check Condition status to the first command received. The sense key is set to Unit Attention (6h), and the ASC and ASCQ fields indicate that a reset occurred.
- It processes all non-motion commands. The TEST UNIT READY (00h) command returns Check Condition status with the sense key set to Not Ready (2h). The ASC and ASCQ fields indicate that no tape is present.
- It returns Check Condition status to all tape motion commands. The sense key is set to Not Ready (2h), and the ASC and ASCQ fields indicate that no tape is present.

Note: After a reset, wait until the green LED turns off before inserting a data cartridge into the EXB-8500.

7 EXB-8500 SCSI Command Set

The EXB-8500 supports the SCSI commands listed in Table 7-1.

Table 7-1 EXB-8500 Command Set

OP Code	Command Name	Discussed in...
00h	TEST UNIT READY	Chapter 26
01h	REWIND	Chapter 23
03h	REQUEST SENSE	Chapter 21
05h	READ BLOCK LIMITS	Chapter 16
08h	READ	Chapter 15
0Ah	WRITE	Chapter 28
10h	WRITE FILEMARKS	Chapter 30
11h	SPACE	Chapter 25
12h	INQUIRY	Chapter 9
13h	VERIFY	Chapter 27
15h	MODE SELECT	Chapter 12
16h	RESERVE UNIT	Chapter 22
17h	RELEASE UNIT	Chapter 20
19h	ERASE	Chapter 8
1Ah	MODE SENSE	Chapter 13
1Bh	LOAD/UNLOAD	Chapter 10
1Ch	RECEIVE DIAGNOSTIC RESULTS	Chapter 19
1Dh	SEND DIAGNOSTICS	Chapter 24
1Eh	PREVENT/ALLOW MEDIUM REMOVAL	Chapter 14
2Bh	LOCATE	Chapter 11
34h	READ POSITION	Chapter 18
3Bh	WRITE BUFFER	Chapter 29
3Ch	READ BUFFER	Chapter 17

Chapters 8 through 30 contain the detailed descriptions of the SCSI commands supported by the EXB-8500. The commands are listed in alphabetic order, with each command starting a new chapter. For ease of reference, the command name and the operation code (OP code) are included in the header at the top of each page.

Sections 7.1, 7.2, 7.3, and 7.4 present basic information about command format, field definitions, command errors, and command status. This information is not repeated in the command descriptions.

The word *Reserved* or *RSVD* as used in field definitions for SCSI commands has one of the following meanings:

- Fields defined by in the *ANSI Small Computer System Interface 2 (SCSI-2)* standard. These fields are checked for a value of 0. If zeros are not present, Check Condition status is returned with the sense key set to Illegal Request (5h).
- EXABYTE undefined fields. These fields are reserved for future enhancements and are not currently checked for illegal values.

7.1 Command Format

The SCSI command formats for the six- and ten-byte commands are shown in the *ANSI Small Computer System Interface 2 (SCSI-2)* standard. The commands for the EXB-8500 are implemented according to this standard. The following are the formats for the six- and ten-byte command descriptor blocks, followed by the format of the Operation Code and the typical format for the Control byte.

Command Descriptor Block for Six-Byte Command

Bit / Byte	7	6	5	4	3	2	1	0
00	Operation Code							
01	Logical Unit Number			Vendor				
02	(MSB)							
03	Logical Block Address							
04								(LSB)
05	Control Byte							

Command Descriptor Block for Ten-Byte Command

Bit Byte	7	6	5	4	3	2	1	0
00	Operation Code							
01	Logical Unit Number			Vendor				
02 ⋮ 05	(MSB) Logical Block Address (LSB)							
06	Reserved							
07	(MSB) Transfer, Parameter List, or Allocation Length							
08	(LSB)							
09	Control Byte							

Format of the Operation Code

Bit Byte	7	6	5	4	3	2	1	0
00	Group Code			Command Code				

Typical Format of the Control Byte

Bit Byte	7	6	5	4	3	2	1	0
nn	Vendor Unique		Reserved				Flag	Link

7.2 Field Definitions for the Command Descriptor Block

The following sections provide field definitions for the six- and ten-byte command descriptor blocks (CDB).

Field Definitions for Six-Byte CDBs

The following are the definitions of the fields shown for the six-byte CDB.

Byte 00 - Operation Code
The Operation Code consists of two subfields, the Group Code and the Command Code, which are defined as follows:

> **Bits 7 through 5 - Group Code** The Group Codes supported by the EXB-8500 are defined by the specific command.
>
> **Bits 4 through 0 - Command Code** The Command Codes supported by the EXB-8500 are defined by the specific command.

Byte 01, Bits 7 through 5 - Logical Unit Number (LUN)
The LUN designates a specific unit within a group of devices associated with the target. Since the EXB-8500 is a single device target and does not support multiple devices, the LUN must be 0. All command definitions in this manual show this field containing 0.

Byte 01, Bits 4 through 0 - Vendor
These bits are used as defined in the specific commands.

Bytes 02 through 04 - Logical Block Address
These bytes are used as defined in the specific commands.

Byte 05 - Control Byte
The Vendor Unique portion of the Control byte is defined for each specific command, if used. The EXB-8500 does not support linked commands or recognize the Flag bit. The following are the field definitions for the Control byte:

> **Bits 7 and 6 - Vendor Unique** Command unique.
>
> **Bits 5 through 2 - Reserved** These bits are reserved.
>
> **Bit 1 - Flag** Not used, must be 0.
>
> **Bit 0 - Link** Not used, must be 0.

Field Definitions for Ten-Byte CDBs

The following are the definitions of the fields shown for the ten-byte CDB.

Byte 00 - Operation Code
The Operation Code consists of two subfields, the Group Code and the Command Code, which are defined as follows:

> **Bits 7 through 5 - Group Code** The Group Codes supported by the EXB-8500 are defined by the specific command.
>
> **Bits 4 through 0 - Command Code** The Command Codes supported by the EXB-8500 are defined by the specific command.

Byte 01, Bits 7 through 5 - Logical Unit Number (LUN)
The LUN designates a specific unit within a group of devices associated with the target. Since the EXB-8500 is a single device target and does not support multiple devices, the LUN must be 0. All command definitions in this manual show this field containing 0.

Byte 01, Bits 4 through 0 - Vendor
These bits are used as defined in the specific commands.

Bytes 02 through 05 - Logical Block Address
These bytes are used as defined in the specific commands.

Byte 06 - Reserved
This byte is reserved.

Bytes 07 and 08 - Transfer, Parameter List, or Allocation Length
These bytes contain the transfer length, the parameter list length, or the allocation length as required by the specific command.

Byte 09 - Control Byte
The Vendor Unique portion of the Control byte is defined for each specific command, if used. The EXB-8500 does not support linked commands or recognize the Flag bit. The following are the field definitions for the Control byte:

Bits 7 and 6 - Vendor Unique Command unique.

Bits 5 through 2 - Reserved These bits are reserved.

Bit 1 - Flag Not used, must be 0.

Bit 0 - Link Not used, must be 0.

7.3 Command Format Errors

This section defines the errors that occur when the contents of the command descriptor block (CDB), without parity error, are invalid or because of double-bit SCSI errors, host programming errors, or command implementation errors.

Illegal Operation Code

If the Operation Code in the CDB is not supported by the EXB-8500, the command is terminated and Check Condition status is returned to the initiator. The sense data is created as follows:

- The sense key is set to Illegal Request (5h).
- The Additional Sense Code is set to Illegal Operation Code (20h).
- The Additional Sense Code Qualifier is set to 0.

Illegal Logical Unit Number

If the Logical Unit Number in the CDB is not supported by the EXB-8500, the command is terminated and Check Condition status is returned to the initiator. The sense data is created as follows:

- The sense key is set to Illegal Request (5h).
- The Additional Sense Code is set to Logical Unit Not Supported (25h).
- The Additional Sense Code Qualifier is set to 0.

Reserved Byte or Bits Non-Zero

If the bytes or bits in the Reserved field (as defined by the ANSI SCSI-2 standard) are not 0, the command is terminated and Check Condition status is returned to the initiator. The sense data is created as follows:

- The sense key is set to Illegal Request (5h).
- The Additional Sense Code is set to Invalid Field in CDB (24h).
- The Additional Sense Code Qualifier is set to 0.

Control Byte or Bits Set Incorrectly

If the Link or Flag fields (bits 1 and 0) are not 0 or the Vendor Unique fields (bits 7 and 6) are other than valid Vendor Unique definitions for the specific command, the command is terminated and Check Condition status is returned to the initiator. The sense data is created as follows:

- The sense key is set to Illegal Request (5h).
- The Additional Sense Code is set to Invalid Field in CDB (24h).
- The Additional Sense Code Qualifier is set to 0.

7.4 Command Status

One status byte is sent from the EXB-8500 to the initiator at the completion of a command.

Status Byte

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved		Status Byte Code					RSVD

The meaning of the Status Byte Code, bits 5 through 1, is shown in Table 7-2. Note that bit 0 is reserved, so it is always 0.

Table 7-2 Definition of the Status Byte Code

Hex Value	Bit						Meaning
	5	4	3	2	1	0	
00h	0	0	0	0	0	0	**Good**. Indicates that the EXB-8500 successfully completed the command.
02h	0	0	0	0	1	0	**Check Condition.** Indicates any error, exception, or abnormal condition that causes sense information to be set.
08h	0	0	1	0	0	0	**Busy.** Indicates that the EXB-8500 is busy. This status is sent whenever the EXB-8500 is unable to accept a command from an initiator.
18h	0	1	1	0	0	0	**Reservation Conflict.** Indicates that the EXB-8500 is reserved for the exclusive use of another initiator.

Status Byte Explanations

The following sections explain the Status Byte Codes supported by the EXB-8500 and the reasons they were sent:

Good Status

Good status indicates that the operation specified by the CDB completed normally.

For those commands that support the immediate return of status, Good status indicates that the EXB-8500 has accepted the command and will attempt to perform the operation specified by the CDB. If the specified operation does not complete normally, Check Condition status will be reported to the initiator when the next command is received by the EXB-8500 from the same initiator.

Check Condition

The EXB-8500 returns Check Condition status if an error occurs while it is trying execute the command. The reporting of Check Condition status is immediate or deferred as follows:

- If status for the command is to be returned when the command is completed, Check Condition status is reported when the error occurs (immediate error reporting).
- If status for the command was returned when the command was initiated (that is, before the error occurred), Check Condition status is reported when the next command is received from the same initiator (deferred error reporting).
- If an error occurs while the command is executing and the EXB-8500 is disconnected from the initiator, Check Condition status is reported to the initiator after the reconnect process.

For specific definitions that return Check Condition status, refer to the command descriptions in Chapters 8 through 30.

Check Condition status is reported when a command is received in the following cases:

- When there is a bus parity error or format check error in a CDB.
- When the command is the first command sent to the EXB-8500 after it was reset by a SCSI bus reset or a Bus Device Reset message or after the data cartridge was replaced. The sense key in the sense data indicates Unit Attention (6h).

Busy

Busy status indicates that the EXB-8500 is in the busy state. The EXB-8500 is in a busy state when it is performing an internal operation that will not allow another command to be accepted until the operation is complete.

The EXB-8500 returns Busy status for a command request until the busy state is released. For this reason, the initiator must reissue the command to the EXB-8500. Once the busy state is released, selection operation and commands can be executed normally.

Reservation Conflict

Reservation Conflict status indicates that the EXB-8500 is currently reserved for the exclusive use of another initiator.

This status is reported until the initiator that reserved the EXB-8500 issues a RELEASE UNIT command or a reset condition occurs.

Notes:

8 ERASE (19h)

<table>
<tr><td>Bit
Byte</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>00</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>01</td><td colspan="3">Logical Unit Number</td><td colspan="3">Reserved</td><td>Immed</td><td>Long</td></tr>
<tr><td>02</td><td colspan="8" rowspan="3">Reserved</td></tr>
<tr><td>03</td></tr>
<tr><td>04</td></tr>
<tr><td>05</td><td colspan="2">Vendor Unique</td><td colspan="4">Reserved</td><td>0</td><td>0</td></tr>
</table>

The ERASE command causes the EXB-8500 to erase all tape from the current valid tape position to the physical end of tape (PEOT). When the erase operation is successfully completed, the tape is automatically rewound to the logical beginning of tape (LBOT).

Notes:

- If the disconnect option is enabled, the EXB-8500 disconnects from the initiator while the ERASE command is executing.
- If the ERASE command is received after a WRITE (0Ah) or WRITE FILEMARKS (10h) command, buffered data and filemarks are written to tape before the erase operation is performed.
- If an error occurs during the writing of the data in the buffer to the tape, the EXB-8500 returns Check Condition status. The erase operation is not performed. The initiator should issue a REQUEST SENSE (03h) command to determine the cause of the error.

The ERASE command performs the erase operation at the same speed as the READ and WRITE commands are performed; for example, starting at LBOT, a 5-GByte data cartridge will take approximately two hours to erase.

8.1 Field Definitions

Byte 01, Bit 1 - Immed
The Immed bit is used to determine when command status is returned to the initiator, as follows:

0 – Status is reported to the initiator when the ERASE command is completed.

1 – Status is reported to the initiator when the ERASE command is initiated by the EXB-8500.

If the buffer contains data from a previous WRITE command, the EXB-8500 disconnects from the SCSI bus (if disconnect was enabled by the Identify message) and writes the data in the buffer to the tape.

- If the Immed bit is set to 1, the EXB-8500 reconnects to the initiator when the write operation has been completed successfully. It then returns Good status and performs the erase operation.

  Note: Completing the write operation includes emptying the buffer to tape and writing the EOD mark (EXB-8500 format tapes only). This can take up to 12 seconds.

- If the Immed bit is set to 0, the EXB-8500 reconnects and returns status when the erase and rewind operations are complete.

Byte 01, Bit 0 - Long
The Long bit determines the amount of the tape to be erased, as follows:

0 – The command is accepted, but no erase operation is performed.
1 – All tape will be erased from the current position to PEOT.

Byte 05, Bits 7 and 6 - Vendor Unique
There are no vendor unique definitions for this command.

8.2 Tape Positioning

This section describes the legal tape positions for an erase operation.

EXB-8500 Format Tapes
For a tape written in EXB-8500 format, a legal position for an erase operation is the tape positioned at any one of the following locations:

- LBOT
- EOD mark
- Either side of a long filemark

Note: If an EOD mark is not already present, one will be written before the erase operation is performed.

EXB-8200 Format Tapes
For a tape written in EXB-8200 format, a legal position for an erase operation is the tape positioned at any one of the following locations:

- LBOT
- End of data (blank tape)
- BOT side of a long filemark

8.3 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the ERASE command.

Illegal Request

The EXB-8500 returns Check Condition status with the sense key set to Illegal Request (5h) if the ERASE command is issued from an illegal position.

Notes:

9 INQUIRY (12h)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	0	0	1	0
01	Logical Unit Number			Reserved				EVPD
02	Page Code							
03	Reserved							
04	Allocation Length							
05	Vendor Unique		Reserved				0	0

The INQUIRY command requests that information about EXB-8500 parameters be sent to the initiator. The INQUIRY command is executed whether a tape is loaded and whether the EXB-8500 has been reserved by another initiator.

Response to the INQUIRY command is not ignored or rejected during the power-on self-test. Responding to the INQUIRY command does not cause a pending Unit Attention to be cleared for that initiator.

9.1 Field Definitions

Byte 01, Bit 0 - EVPD
The Enable Vital Product Data bit indicates the type of inquiry data being requested by the initiator, as follows:

0 – Return the standard Inquiry Data Table

1 – Return one of the Vital Product Data pages, based on the value specified for the Page Code field (byte 02)

Byte 02 - Page Code
The Page Code field contains the page number of the Vital Product Data page to be returned to the initiator for this INQUIRY command. The EXB-8500 supports the following values for the Page Code:

00h – Supported Vital Product Data Page
80h – Unit Serial Number Page

If the EVPD bit (byte 1, bit 0) is set to 0, the Page Code must be 00h.

Byte 04 - Allocation Length
The Allocation Length specifies the number of bytes that the initiator has allocated for the return of Inquiry data. A value of 0 indicates that no Inquiry data is to be transferred and is not an error.

The EXB-8500 terminates the Data In phase when the number of bytes specified in the Allocation Length field has been transferred or when all available Inquiry data has been transferred to the initiator, whichever is less.

The amount of Inquiry data returned by the EXB-8500 depends on the type of data being returned, as follows:

- Up to 6Ah (106) bytes for the Standard Inquiry Data Table

  or

- 06h (6) bytes for the Supported Vital Product Data Page

  or

- 0Eh (14) bytes for the Unit Serial Number Page.

Byte 05, Bits 7 and 6 - Vendor Unique
There are no vendor unique definitions for this command.

Returning Inquiry Data

Table 9-1 summarizes the values you should specify to return the different types of Inquiry data.

Table 9-1 Values to Specify for the Return of 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 Table	0	00h	any value (from 0 to FFh)	0 to 106 bytes (0h to 6Ah)
Supported Vital Product Data Page	1	00h	06h	6 bytes (06h)
Unit Serial Number Page	1	80h	0Eh	14 bytes (0Eh)

9.2 Standard Inquiry Data

<table>
<tr><th>Bit
Byte</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>00</td><td colspan="3">Peripheral Qualifier</td><td colspan="5">Peripheral Device Type</td></tr>
<tr><td>01</td><td>RMB</td><td colspan="7">Device-Type Modifier</td></tr>
<tr><td>02</td><td colspan="2">ISO Version</td><td colspan="3">ECMA Version</td><td colspan="3">ANSI Version</td></tr>
<tr><td>03</td><td>AENC</td><td>TrmIOP</td><td colspan="2">Reserved</td><td colspan="4">Response Data Format</td></tr>
<tr><td>04</td><td colspan="8">Additional Length</td></tr>
<tr><td>05</td><td colspan="8" rowspan="2">Reserved</td></tr>
<tr><td>06</td></tr>
<tr><td>07</td><td>RelAdr</td><td>WBus32</td><td>WBus16</td><td>Sync</td><td>Linked</td><td>RSVD</td><td>CmdQue</td><td>SftRe</td></tr>
<tr><td>08
⋮
15</td><td colspan="8">Vendor Identification</td></tr>
<tr><td>16
⋮
31</td><td colspan="8">Product Identification</td></tr>
<tr><td>32
⋮
35</td><td colspan="8">Product Revision Level</td></tr>
<tr><td>36
⋮
55</td><td colspan="8">Vendor Specific</td></tr>
<tr><td>56
⋮
95</td><td colspan="8">Reserved</td></tr>
<tr><td>96
⋮
105</td><td colspan="8">Unit Serial Number</td></tr>
</table>

Field Definitions

The Standard Inquiry Data is returned to the initiator when EVPD (Byte 01, Bit 0 of the CDB) is set to 0. The 106 bytes of Standard Inquiry Data are defined as follows.

Byte 00, Bits 7 through 5 - Peripheral Qualifier
This field, in combination with the Peripheral Device Type field (byte 00, bits 4 through 0), identifies the device currently connected to the logical unit. The value returned for this field is 0, which indicates that the specified device is currently connected to the selected logical unit. If the LUN in the CDB or in the Identify message is not 0, the value returned for these fields is 7Fh, which indicates that the LUN is invalid.

Byte 00, Bits 4 through 0 - Peripheral Device Type
This field, in combination with the Peripheral Qualifier field (byte 00, bits 7 through 5), identifies the device currently connected to the logical unit. The value returned for this field is 01h, which identifies the EXB-8500 as a sequential access device. If the LUN in the CDB or in the Identify message is not 0, the value returned these fields is 7Fh, which indicates that the LUN is invalid.

Byte 01, Bit 7 - RMB
The value returned for this field is 1, which indicates that the media is removable.

Byte 01, Bits 6 through 0 - Device-Type Modifier
The value returned for this field is 00h, which indicates that there are no vendor-specific qualification codes.

Byte 02, Bits 7 and 6 - ISO Version
The value returned for this field is 0h, which indicates that the EXB-8500 does not claim compliance with the ISO standards.

Byte 02, Bits 5 through 3 - ECMA Version
The value returned for this field is 0h, which indicates that the EXB-8500 does not claim compliance with the ECMA standards.

Byte 02, Bits 2 through 0 - ANSI Version
The value returned for this field is 2h, which indicates that the EXB-8500 supports the current version of the ANSI SCSI-2 standard (X3T9/89-042).

Byte 03, Bit 7 - AENC
The value returned for this field is 0, which indicates that the EXB-8500 does not support the AENC bit.

Byte 03, Bit 6 - TrmIOP
The value returned for this field is 0, which indicates that the EXB-8500 does not support the Terminate I/O Process message.

Byte 03, Bits 3 through 0 - Response Data Format
The value returned for this field is 2h, which indicates that the data found is in accordance with the ANSI SCSI-2 standard.

Byte 04 - Additional Length
The value returned for this field is 65h, which indicates that there are 65h (101) additional bytes of Inquiry data available to be returned to the initiator. These bytes are defined as follows.

Byte 05 and 06 - Reserved
These bytes are reserved.

Byte 07, Bit 7 - RelAdr
The value returned for this field is 0, which indicates that the EXB-8500 does not support relative addressing (RelAdr).

Byte 07, Bit 6 - WBus32
The value returned for this field is 0, which indicates that the EXB-8500 does not support 32-bit-wide bus transfers.

Byte 07, Bit 5 - WBus16
The value returned for this field is 0, which indicates that the EXB-8500 does not support 16-bit-wide bus transfers.

Byte 07, Bit 4 - Sync
The value returned for this field is 1, which indicates that the EXB-8500 supports synchronous data transfer.

Byte 07, Bit 3 - Linked
The value returned for this field is 0, which indicates that the EXB-8500 does not support linked commands.

Byte 07, Bit 2 - RSVD
This bit is reserved.

Byte 07, Bit 1 - CmdQue
The value returned for this field is 0, which indicates that the EXB-8500 does not support tag command queuing.

Byte 07, Bit 0 - SftRe
The value returned for this field is 0, which indicates that the EXB-8500 does not support the soft reset alternative in response to a reset condition.

Bytes 08 through 15 - Vendor Identification
The value contained in these bytes are the ASCII representation of “EXABYTE”, followed by a single space.

Bytes 16 through 31 - Product Identification
The values contained in these bytes are the ASCII representation of the product name followed by a space and the default configuration identifier (for example, “EXB-8500 85QANXR0”).

Bytes 32 through 35 - Product Revision Level
The values contained in these bytes are the ASCII representation of the revision level (for example, “1000” or other EXABYTE revision levels).

Bytes 36 through 55 - Vendor Specific
The values contained in these bytes are the ASCII representation of blanks. The values for these bytes may be customized for specific OEM requirements.

Bytes 56 through 95 - Reserved
These bytes are reserved.

Bytes 96 through 105 - Unit Serial Number
The value contained in these bytes is the actual serial number of the EXB-8500, as listed on the serial number label. The MSB is contained in byte 96. Serial numbers of less than 10 characters contain trailing blanks (20h).

9.3 Vital Product Data Page

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							

Field Definitions

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 EXB-8500 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 02h, which indicates the number of additional bytes available to be transferred, excluding this byte.

Byte 04 - First Page Code Supported
The value returned 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.

9.4 Unit Serial Number Page

Bit Byte	7	6	5	4	3	2	1	0
00	Device Type Code							
01	Page Code							
02	Reserved							
03	Page Length							
04 ⋮ 13	Unit Serial Number							

Field Definitions

Byte 00 - Device Type Code
The value returned for this field is 01h, which identifies the EXB-8500 as a sequential access device. If the LUN in the CDB is not 0, the value returned is 7Fh, which indicates that the LUN is invalid.

Byte 01 - Page Code
The value returned for this field is 80h, which is the Page Code for the Unit Serial Number page.

Byte 03 - Page Length
The value returned for this field is 0Ah, which is the number of additional bytes available to be transferred, excluding this byte.

Bytes 04 through 13 - Unit Serial Number
The value returned for this field is the actual serial number of the EXB-8500, as listed on the serial number label. The MSB is contained in byte 04. Serial numbers of less than 10 characters contain trailing blanks (20h).

10 LOAD/UNLOAD (1Bh)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	1	0	1	1
01	Logical Unit Number			Reserved				Immed
02	Reserved							
03								
04	Reserved					EOT	Re-Ten	Load
05	Vendor Unique		Reserved				0	0

The LOAD/UNLOAD command causes the EXB-8500 to load or unload a data cartridge. Loading a data cartridge involves the following:

1. Loading the tape in the tape path.
2. Positioning the tape to the logical beginning of tape (LBOT).

Unloading a data cartridge involves the following:

1. If necessary, writing any buffered data and filemarks to tape.
2. Rewinding the tape to the physical beginning of tape (PBOT).
3. Unloading the tape from the tape path.
4. Ejecting the data cartridge.

Note: If there is data in the buffer because an earlier WRITE (0Ah) command was terminated with Check Condition status, that data is discarded before the LOAD/UNLOAD command is executed.

10.1 Field Definitions

Byte 01, Bit 1 - Immed
The Immed bit is used to determine when command status is returned to the initiator, as follows:

0 – Status is reported to the initiator when the load/unload operation is complete.

1 – Status is reported to the initiator when the command is initiated by the EXB-8500.

If the buffer contains data from a previous WRITE command, the EXB-8500 disconnects from the SCSI bus (if disconnect was enabled by the Identify message) and writes the data in the buffer to the tape.

- If the Immed bit is set to 1, the EXB-8500 reconnects to the initiator when the write operation has been completed successfully. It then returns Good status and performs the load or unload operation.

  Note: Completing the write operation includes emptying the buffer and writing the EOD mark (EXB-8500 format tapes only). This can take up to 12 seconds.

- If the Immed bit is set to 0, the EXB-8500 reconnects and returns status when the load or unload operation is complete.

If an error occurs during the writing of the data from the buffer to the tape, the EXB-8500 reconnects to the initiator and returns Check Condition status. The load or unload operation is not performed. The initiator should issue a REQUEST SENSE (03h) command to determine the cause of the error.

Byte 04, Bit 2 - EOT
This bit is ignored by the EXB-8500.

Byte 04, Bit 1 - Re-Ten
This bit is ignored by the EXB-8500.

Byte 04, Bit 0 - Load
The Load bit indicates which operation, load or unload, is to be performed as follows:

0 – Perform an unload operation.
1 – Perform a load operation.

Table 10-1 indicates what action occurs based on the setting of the Load bit and the status of the data cartridge:

Table 10-1 Action Occurring Based on Load Bit and Data Cartridge Status

If the Load bit is set to...	And the data cartridge is...	The following action occurs...
0	Out	The door on the EXB-8500 is opened.[a]
1	Out	Check Condition status is returned with the sense key set to Illegal Request (5h).
0	In	The data cartridge is unloaded.[b] If there is data in the write buffer, the data is written to tape. Then, the tape is rewound to PBOT and unloaded from the tape path, and the data cartridge is ejected from the EXB-8500.
1	In	The data cartridge is loaded and positioned at LBOT. If the data cartridge is already loaded and there is data in the write buffer, the data is written to the tape before performing the operation. **Note:** If the tape is already loaded, positioned at LBOT, and there is no data in buffer, no tape motion occurs.

[a] The door is opened even if the PREVENT/ALLOW MEDIUM REMOVAL command was issued with the Prevent bit set to 1.

[b] The unload operation is performed even if the PREVENT/ALLOW MEDIUM REMOVAL command was issued with the Prevent bit set to 1; however, the data cartridge is not ejected from the EXB-8500.

Byte 05, Bits 7 and 6 - Vendor Unique

There are no vendor unique definitions for this command.

Notes:

11 LOCATE (2Bh)

<table>
<tr><td>Bit
Byte</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>00</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>01</td><td colspan="3">Logical Unit Number</td><td colspan="2">Reserved</td><td>BT</td><td>CP</td><td>Immed</td></tr>
<tr><td>02</td><td colspan="8">Reserved</td></tr>
<tr><td>03</td><td colspan="8" rowspan="4">(MSB)
Block Address
(LSB)</td></tr>
<tr><td>04</td></tr>
<tr><td>05</td></tr>
<tr><td>06</td></tr>
<tr><td>07</td><td colspan="8">Reserved</td></tr>
<tr><td>08</td><td colspan="8">Partition</td></tr>
<tr><td>09</td><td>ADE</td><td>VU</td><td colspan="4">Reserved</td><td>0</td><td>0</td></tr>
</table>

The LOCATE command causes the EXB-8500 to position the tape at the specified logical position. The LOCATE command is not supported for tapes written in EXB-8200 format and will result in Check Condition status. The sense key will be set to Illegal Request (5h).

Notes:

- If the disconnect option is enabled, the EXB-8500 can disconnect from the initiator while the LOCATE command is executing.

- If a LOCATE command in the reverse direction is received after a WRITE (0Ah) or WRITE FILEMARKS (10h) command, any buffered data and filemarks are written to the tape before the locate operation is performed.

  If an error occurs when the data in the buffer is being written, the EXB-8500 returns Check Condition status and the space operation is not performed. The initiator should issue a REQUEST SENSE (03h) command to determine the cause of the error.

- If the EXB-8500 has the EEPROM image for directory support and the EXB-8500 detects an EOD mark before the first filemark on tape, it spaces over the EOD mark (at high speed) and up to 20 MBytes of erase area until it finds the filemark it is seeking. For more information about directory support, refer to Section 3.3. For a sample application showing how to use the EXB-8500 directory support feature, refer to Appendix B.

11.1 Field Definitions

Byte 01, Bit 2 - BT (Block Type)
The BT bit determines the type of block number contained in the Block Address field (bytes 03 through 06), as follows:

0 – The Block Address field contains the SCSI logical block number, numbered sequentially from the beginning of the tape.

1 – The Block Address field contains an EXABYTE-unique block address (currently not implemented).

Byte 01, Bit 1 - CP (Change Partitions)
The EXB-8500 does not support multiple partitions. A value other than 0 for this bit results in an error.

Byte 01, Bit 0 - Immed
The Immed bit is used to determine when command status is returned to the initiator.

0 – Status is reported to the initiator when the LOCATE command is completed.

1 – Status is reported to the initiator when the LOCATE command is initiated by the EXB-8500.

If the EXB-8500 buffer contains data from a previous WRITE command and the LOCATE command is in the reverse direction, the EXB-8500 disconnects from the initiator (if disconnect was enabled by the Identify message) and writes the data in the buffer to the tape.

- If the Immed bit is set to 1, the EXB-8500 reconnects to the initiator when the write operation has completed successfully. It then returns Good status and performs the locate operation.

Note: Completing the write operation includes emptying the buffer to tape and writing the EOD mark (for EXB-8500 format tapes). This can take up to 12 seconds.

- If the Immed bit is set to 0, the EXB-8500 reconnects and returns status when the locate operation is complete.

Bytes 03 through 06 - Block Address
The Block Address field contains the address of the block on which to position.

Byte 08 - Partition
The EXB-8500 does not support multiple partitions. This field is ignored.

Byte 05, Bit 7 - ADE (Always Detect EOD)
The ADE bit is used only for those EXB-8500s that include the EEPROM image for directory support. By setting this bit, you can force the EXB-8500 to detect the first EOD mark on the tape, effectively disabling directory support for that command. The values for the ADE bit are as follows:

0 - The EXB-8500 should ignore the first EOD mark (as long as the EOD is located before the first filemark on the tape).

1 - The EXB-8500 should detect the first EOD mark on the tape and should stop when the first EOD is encountered.

If you are using a LOCATE command to locate information within the directory on a directory support tape, set the ADE bit to 1 to prevent the EXB-8500 from crossing from the directory to the data area of the tape. Similarly, set this bit to 1 if you are using an EXB-8500 with the directory support feature to locate data on a tape that does not include a directory.

Note: The ADE bit is ignored if the EXB-8500 does not include the directory support feature.

Byte 09, Bit 6 - Vendor Unique
There is no vendor unique definition for this bit.

11.2 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the LOCATE command.

EOD Detected

If the EOD mark is detected during the locate operation, the EXB-8500 returns Check Condition status. The Valid bit is set in the extended sense data, with the sense key set to Blank Check (8h). When the LOCATE command terminates, the logical position is after the last recorded data block or filemark. The Information bytes are set to the difference between the requested logical position and the actual logical position.

Note: If the EXB-8500 has the EEPROM image for directory support, you can issue a LOCATE command with the ADE bit set to 0 to move from the directory to the data area of the tape. In this case, the EXB-8500 spaces over the first EOD mark (as long as it is located before the first filemark) and does not return Check Condition status. However, when the EXB-8500 detects the second EOD mark at the end of data, it returns Check Condition status with the sense key set to Blank Check (8h).

PEOT Encountered

If the physical end of tape (PEOT) is encountered, the EXB-8500 returns Check Condition status. The EOM and PEOT bits are set in the extended sense data, with the sense key set to Medium Error (3h).

When the LOCATE command terminates, the logical position is the last logical position the EXB-8500 detected on tape. If the Valid bit is set to 1, the Information bytes are set to the difference between the requested logical position and the last logical position detected.

Locating Past the Last Data or Filemark

If you attempt to locate past the last data or filemark on the tape, the EXB-8500 returns Check Condition status. The sense key is set to Blank Check (8h).

Unrecoverable Error

If an unrecoverable media or hardware error occurs during the locate operation, the EXB-8500 terminates the LOCATE command and returns Check Condition status. The sense key indicates a Medium Error (3h) or Hardware Error (4h). Indicators in the extended sense data can be used to isolate the error condition.

When the LOCATE command is terminated, the position of the EXB-8500 depends on whether the locate operation was in the forward or reverse direction:

- If the error occurred during a locate operation in the forward direction, the EXB-8500 is positioned after the unrecovered block.
- If the error occurred during a locate operation in the reverse direction, the EXB-8500 is positioned before or after the unrecovered block.

If the Valid bit is set to 1, the Information bytes indicate the difference between the requested logical position and the actual logical position. Note that the Information bytes may be positive or negative.

Illegal Requests

The following conditions cause the EXB-8500 to return Check Condition status with the sense key set to Illegal Request (5h):

- A locate operation in the forward direction is attempted immediately after a WRITE or WRITE FILEMARKS command has been executed
- A LOCATE command is attempted on a tape written in EXB-8200 format.

Notes:

12 MODE SELECT (15h)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	0	1	0	1
01	Logical Unit Number			PF	Reserved			SP
02	Reserved							
03								
04	Parameter List Length							
05	Vendor Unique		Reserved				0	0

The MODE SELECT command allows the initiator to specify medium, logical unit, or device parameters. These values apply to all initiators in a multi-initiator environment.

12.1 Field Definitions

Byte 01, Bit 4 - PF (Page Format)
The PF bit indicates in which format the MODE SELECT parameters are specified, as follows:

0 – MODE SELECT parameters after the Block Descriptor are vendor specific (non-page format)

1 – MODE SELECT parameters after the Block Descriptor are structured as pages of related parameters (page format)

Non-page format is the same as that defined for the EXB-8200.

Byte 01, Bit 0 - SP
The EXB-8500 does not support the saved page function. The valid value for this bit is 0.

Byte 04 - Parameter List Length (Non-Page Format)

The Parameter List Length byte indicates the length of the parameter list that will be transferred from the initiator to the EXB-8500 during the Data Out phase. When the PF bit is set to 0 (non-page format), all parameters after the Block Descriptor are vendor specific and the Parameter List Length byte can contain values ranging from 00h to 11h. The value for this byte must represent the total number of bytes to be transferred from the initiator to the EXB-8500.

Table 12-1 lists the valid lengths for the Parameter List Length byte for non-page format. When the value for the Parameter List Length byte is 0, no data is transferred from the initiator. A value of 0 for this byte is not an error.

Table 12-1 Parameter List Lengths: Non-Page Format

To transfer these parameters...	Specify this Parameter List Length
No parameter list data	00h
Parameter List Header only	04h
Parameter List Header and 1 to 5 bytes of vendor-unique parameters	05h, 06h, 07h, 08h, or 09h
Parameter List Header and Block Descriptor	0Ch
Parameter List Header, Block Descriptor, and 1 to 5 bytes of vendor-unique parameters	0Dh, 0Eh, 0Fh, 10h, or 11h

Restrictions for MODE SELECT Data in Non-Page Format The following restrictions apply to transfers of MODE SELECT parameters when the PF bit is 0 (non-page format):

- For data transfers greater than 0 bytes, the entire 4-byte Parameter List Header must be transferred. That is, the entire 4-byte Parameter List Header must be transferred before the Block Descriptor or any vendor-unique parameters can be transferred.
- If the Block Descriptor is transferred, it must be transferred in its entirety (that is, all 8 bytes); partial transfers of this data segment are not allowed.

  Note: If the Block Descriptor is to be transferred, set the Block Descriptor Length byte in the Parameter List Header to 08h. Otherwise, set this byte to 00h.

- Valid transfer lengths for the vendor-unique parameters are 0, 1, 2, 3, 4, and 5 bytes. All transfers of the vendor-unique parameters must start with byte 0.

Byte 04 - Parameter List Length (Page Format)
The Parameter List Length byte indicates the length of the parameter list that will be transferred from the initiator to the EXB-8500 during the Data Out phase. When the PF bit is set to 1 (page format), all parameters after the Block Descriptor are transferred as pages of related parameters. The value of the Parameter List Length byte depends on which combination of parameter pages is being transferred. The value for this byte must represent the total number of bytes to be transferred from the initiator to the EXB-8500.

Table 12-2 shows the number of bytes that should be designated to transfer the various types of MODE SELECT parameter segments. When the value for the Parameter List Length byte is 0, no data is transferred from the initiator. A value of 0 for this byte is not an error.

Table 12-2 Parameter List Lengths: Page Format

To transfer these parameters...	Designate this amount
No parameter list data	0 bytes (0h)
Parameter List Header	4 bytes (4h)
Block Descriptor	8 bytes (8h)
Read-Write Error Recovery Page (Page Code=01h)	+ 9 bytes (09h)
Disconnect-Reconnect Page (Page Code=02h)	+ 12 bytes (0Ch)
Data Compression Page (Page Code=0Fh)	+ 16 bytes (10h)
Device Configuration Page (Page Code=10h)	+ 15 bytes (0Fh)
Vendor Unique Parameters Page 1 (Page Code=20h)	+ 6 bytes (06h)
Vendor Unique Parameters Page 2 (Page Code=21h)	+ 6 bytes (06h)

Examples To transfer the Parameter List Header, the Block Descriptor, and the Vendor Unique Parameters Page 1:

1. Specify 12h for the Parameter List Length byte (04h for the Parameter List Header + 08h for the Block Descriptor + 06h for the Vendor Unique Parameters Page 1).

2. Set the Block Descriptor Length byte in the Parameter List Header to 08h.

To transfer the Parameter List Header and the Read-Write Error Recovery page:

1. Specify 0Dh for the Parameter List Length byte (04h + 09h).
2. Set the Block Descriptor Length byte in the Parameter List Header to 00h.

Table 12-3 summarizes the values you should designate for the Parameter List Length byte when you want to transfer the Parameter List Header, the Block Descriptor, and only one of the parameter pages. You can use this table as a quick reference when you are interested in changing the parameters for only one of the MODE SELECT pages.

Table 12-3 Values to Designate for Parameter List Length (Page Format)

Designate this amount...	For this page plus the Parameter List Header and Block Descriptor
15h	Read-Write Error Recovery Page (Page Code=01h)
18h	Disconnect-Reconnect Page (Page Code=02h)
1Ch	Data Compression Page (Page Code=0Fh)
1Bh	Device Configuration Page (Page Code=10h)
12h	Vendor Unique Parameters Page 1 (Page Code=20h)
12h	Vendor Unique Parameters Page 2 (Page Code=21h)

Restrictions for MODE SELECT Data in Page Format The following restrictions apply to transfers of parameter list data when the PF bit is 1:

- For any data transfer greater than 0 bytes, the entire 4-byte Parameter List Header must be transferred. That is, the entire 4-byte Parameter List Header must be transferred before the Block Descriptor or any parameter page can be transferred.
- The Block Descriptor and any parameter pages must be transferred in their entirety; partial transfers of these data segments are not allowed.

Note: Any value for the Parameter List Length that causes the Parameter List Header, Block Descriptor, or one of the parameter pages to be truncated will terminate the command with Check Condition status. The sense key will be set to Illegal Request and the Additional Sense Code will be set to Parameter List Length Error.

- Various combinations of the Parameter List Header, Block Descriptor, and parameter pages can be transferred based on these restrictions.

Byte 05, Bits 7 and 6 - Vendor Unique
There are no vendor unique definitions for these bits.

12.2 Parameter List Header (Non-Page and Page Formats)

Byte \ Bit	7	6	5	4	3	2	1	0
00	Reserved							
01								
02	RSVD	Buffered Mode			Speed			
03	Block Descriptor Length							

Field Definitions

The Parameter List Header is the same for both non-page and page formats.

Byte 02, Bits 6 through 4 - Buffered Mode
The EXB-8500 supports two data transfer modes, as follows:

000 – Unbuffered mode
001 – Buffered mode

In buffered mode, data from a WRITE command and filemarks from a WRITE FILEMARKS command (EXB-8500 format only) are held in the EXB-8500's buffer until one of the following events causes the data and filemarks to be written to the tape:

- The motion threshold is reached.
- The EXB-8500 receives one of the following commands:
  - REWIND (01h)
  - WRITE FILEMARKS (10h) non-immediate
  - SPACE (11h) in either direction
  - ERASE (19h)
  - LOAD/UNLOAD (1Bh)
  - LOCATE (2Bh) in the reverse direction.
- The operator presses the unload button.
- The time specified for the Write Delay Time field elapses (note, however, if the Write Delay Time field is 0, a partially full buffer is not flushed to tape).

Note: The Write Delay Time field can be set for page format only; see Section 12.8 for more information.

In buffered mode, status is returned when the last block of data has been transferred to the EXB-8500's buffer. In unbuffered mode, status is returned only after the data has actually been written to the tape.

The power-on default value for the Buffered Mode field is 001.

Byte 02, Bits 3 through 0 - Speed
The EXB-8500 does not support any operations at different speeds. All operations have a defined speed that cannot be modified by this command. The valid value for this field is 0.

Byte 03 - Block Descriptor Length
This byte contains the length of the Block Descriptor in bytes. The EXB-8500 does not support multiple block descriptions. The valid values for this byte are 00h and 08h.

12.3 Block Descriptor
(Non-Page and Page Formats)

Bit / Byte	7	6	5	4	3	2	1	0
00	Density Code							
01	(MSB)							
02	Number of Blocks							
03								(LSB)
04	Reserved							
05	(MSB)							
06	Block Length							
07								(LSB)

Field Definitions

The Block Descriptor is the same for both non-page and page formats.

Byte 00 - Density Code
The Density Code field specifies whether the EXB-8500 writes data in EXB-8500 format or EXB-8200 format. Table 12-4 on the next page lists the valid values for the Density Code field.

Note: Refer to Section 12.12 on page 12-36 for examples for using the EXB-8500 to write, read, and append to EXB-8200 and EXB-8500 format tapes. Refer to page 12-40 in that section if you want to change the Density Code and you cannot issue MODE SELECT commands.

Table 12-4 Values for Density Code Field in MODE SELECT Command

Density Code	Format of Data Written to Tape	Usage Notes
00h	EXB-8500 format (error checking suppressed)	Use this Density Code at LBOT if you want to write EXB-8500 format tapes. This Density Code is ignored (does not return Check Condition status) if you attempt to use it to change the tape format from EXB-8200 to EXB-8500 when the tape is not positioned at LBOT.
14h	EXB-8200 format (full error checking)	Use this Density Code at LBOT if you want to write EXB-8200 format tapes. The EXB-8500 returns Check Condition status with the sense key set to Illegal Request (5h) if you attempt to use this Density Code to change the tape format from EXB-8500 to EXB-8200 when the tape is not positioned at LBOT.
15h	EXB-8500 format (full error checking)	Use this Density Code at LBOT if you want to write EXB-8500 format tapes. The EXB-8500 returns Check Condition status with the sense key set to Illegal Request (5h) if you attempt to use this Density Code to change the tape format from EXB-8200 to EXB-8500 when the tape is not positioned at LBOT.
7Fh	No change in the format is desired (error checking suppressed)	Use this Density Code if you do not want to change the tape format. The format will remain the same as it was before the MODE SELECT command was sent to the EXB-8500.

Restrictions for Setting the Density Code

- The entire tape must be written in the same density. That is, the Density Code applies to the entire tape, not to individual blocks and files. You can change the Density Code only when the tape is positioned at LBOT.

- For read operations, the EXB-8500 automatically determines the correct density.

- A blank tape written before you issue the first MODE SELECT command will be written in the power-on default format.

For more information about EXB-8500 format and EXB-8200 format, refer to the *EXB-8500 8mm Cartridge Tape Subsystem Product Specification*. For information about changing the power-on default density, refer to Section 3.4.

Bytes 01 through 03 - Number of Blocks
The EXB-8500 determines the value for the Number of Blocks field when it loads a tape and then returns this value in the MODE SENSE data. This field is ignored by the MODE SELECT command.

Bytes 05 through 07 - Block Length
The Block Length field defines the length in bytes of each logical block described by the Block Descriptor. A value of 0 for the Block Length field indicates variable-length logical blocks. A value greater than 0 indicates fixed-length logical blocks.

The power-on default value for the block length is 400h (1,024) bytes. The limit on the block length is the maximum block length specified by the Read Block Limits data (see Section 16.2). That is, if the ND bit is set to 0, the maximum block length is 03C000h or 240 KBytes; if the ND bit is set to 1, the maximum block length is 28000h or 160 KBytes.

Notes:

- If you specify a value between 28001h and 03C000h for the Block Length, the EXB-8500 automatically sets the ND bit to 0. If, however, you specify a number greater than 03C000h for the Block Length, the EXB-8500 returns Check Condition status with the sense key set to Illegal Request (5h).
- If the value specified for the Block Length field is not divisible by 4 (or 2 if the EEPROM image is set for two-byte boundary disconnect), then even-byte disconnect is disabled when the EXB-8500 updates the logical block length.
- For information about changing the power-on default for the block length, refer to Section 3.4.

12.4 Vendor-Unique Parameters (Non-Page Format)

Bit / Byte	7	6	5	4	3	2	1	0
00	CT	RSVD	ND	RSVD	NBE	EBD	PE	NAL
01	Reserved							P5
02	Motion Threshold							
03	Reconnect Threshold							
04	Gap Threshold							

Field Definitions

These vendor-unique parameters apply only to non-page format (that is, when the PF bit in the CDB is set to 0).

Byte 00, Bit 7 - CT (Cartridge Type)
This bit defines what type of data cartridge is expected to be loaded as follows:

0 – P6 Cartridge Type - Domestic
1 – PI Cartridge Type - International (P5, P6 LEOT equivalency)

Note: You can set the CT bit only when the tape is positioned at LBOT.

Refer to Appendix C for information about data cartridge capacities and for an explanation of how the EXB-8500 autosizes data cartridges. For information about changing the power-on default for the cartridge type, refer to Section 3.4.

Byte 00, Bit 6 - RSVD
This bit is reserved.

Byte 00, Bit 5 - ND (No Disconnect During Data Transfer)
This bit indicates whether the EXB-8500 can disconnect from the initiator during the data transfer phase.

0 – The EXB-8500 can disconnect from the initiator during the data transfer phase.

1 – The EXB-8500 will not disconnect during the data transfer phase.

The power-on default for the ND bit is 0.

Restrictions when the ND bit is 0

- The maximum logical block size allowed, in fixed or variable mode, is 240 KBytes (3C000h).

Restrictions when the ND bit is 1

- If the logical block size specified by the Block Length field in the Block Descriptor is greater than 160 KBytes (28000h), setting the ND bit to 1 causes the EXB-8500 to return Check Condition status with the sense key set to Illegal Request (5h).

- The total number of bytes that can be transferred as a result of a single WRITE or READ command, in fixed or variable mode, is 160 KBytes (28000h). That is, the total transfer length specified by the CDB must be 160 KBytes or less.

- During a write operation, the data transfer from the initiator does not start until the number of bytes of available space in the EXB-8500's buffer is greater than or equal to the total transfer length specified by the CDB.

- During a read operation, the data transfer to the initiator does not start until all of the data requested by the CDB, up to a total transfer length of 160 KBytes, is resident in the EXB-8500's buffer.

- If the Reconnect Threshold byte is set to a value less than A0h or greater than C0h, it will be changed to A0h. This is necessary for proper buffer management.

Byte 00, Bit 4 - RSVD
This bit is reserved.

Byte 00, Bit 3 - NBE (No Busy Enable)
This bit is included for EXB-8200 compatibility only. This bit is set to 1 in the MODE SENSE data and is ignored by the MODE SELECT command.

Byte 00, Bit 2 - EBD (Even Byte Disconnect)
This bit is used to enable disconnects on even-byte boundaries. Two options are available from EXABYTE to control what happens when the EBD bit is set to 1. Depending on EXB-8500's EEPROM image, setting the EBD bit to 1 allows disconnects to occur on two-byte boundaries or on four-byte boundaries.

0 – Disconnect on any byte
1 – Disconnect on even-byte (two-byte or four-byte) boundaries

Notes:

- If the logical block length specified by the Block Length field in the Block Descriptor is not divisible by 4 (or 2 if the EEPROM image is set for two-byte boundary disconnect), setting the EBD bit to 1 causes the EXB-8500 to return Check Condition status with the sense key set to Illegal Request (5h).

- For information about changing the power-on default for even-byte disconnect, refer to Section 3.4.

Byte 00, Bit 1 - PE (Parity Enable)
This bit is used to enable parity checking on the SCSI bus. When this bit is set to 1, every byte received by the EXB-8500 is checked for parity.

0 – Parity checking disabled
1 – Parity checking enabled.

The power-on default value for PE is 1.

Note: For information about changing the power-on default for parity checking, refer to Section 3.4.

Byte 00, Bit 0 - NAL (No Auto Load)
This bit is used to disable the automatic loading of the tape into the tape path when a data cartridge is inserted into the EXB-8500.

0 – Auto loading enabled
1 – Auto loading disabled.

The power-on default value for NAL is 0.

Byte 01, Bits 7 through 1 - Reserved
These bits are reserved.

Byte 01, Bit 0 - P5

This bit is set to indicate that the data cartridge loaded in the EXB-8500 is expected to be a P5, European data cartridge. When set to 1, this bit overrides the CT bit.

Note: You can set the P5 bit only when the tape is positioned at LBOT.

Refer to Appendix C for information about data cartridge capacities and for an explanation of how the EXB-8500 autosizes data cartridges. For information about changing the power-on default for the cartridge type, refer to Section 3.4.

Byte 02 - Motion Threshold

The value in the Motion Threshold byte indicates the amount of data that must be in the buffer before tape motion is started for a buffered write or read operation. The value is expressed in 4-KByte increments. The default is 80h (512 KBytes). Valid values range from 20h to D0h (128 to 832 KBytes).

When the buffer is filled to this point during a buffered write operation, tape motion begins and data is written to the tape.

When the buffer is emptied to this point during a buffered read operation, tape motion begins and data is read, filling the empty portion of the buffer with new data from the tape.

Byte 03 - Reconnect Threshold

The value in the Reconnect Threshold byte indicates the amount of data that must be in the buffer before the EXB-8500 reconnects to the initiator for a buffered write or read operation. The value is expressed in 4-KByte increments. The default is 80h (512 KBytes). Valid values range from 20h to D0h (128 to 832 KBytes).

When this amount of free space is available in the buffer during a buffered write operation, the EXB-8500 reconnects to the initiator to accept additional data. When the buffer fills to this level during a buffered read operation, the EXB-8500 reconnects to the initiator and data is transferred.

Note: If the ND bit is 1 and you set the Reconnect Threshold byte to a value less than A0h or greater than C0h, the value will automatically be changed to A0h. If, however, you set the Reconnect Threshold byte to a value between A0h and C0h, that value will take effect. If the ND bit is 0, the Reconnect Threshold byte can have any value from 20h to D0h (128 to 832 KBytes).

For more information about the motion and reconnect thresholds, see Section 3.2.

Byte 04 - Gap Threshold

The Gap Threshold byte specifies the maximum number of consecutive gap blocks that the EXB-8500 will write on the current track while determining whether an empty buffer exists during a write operation. After writing the number of gap blocks specified by this byte, the EXB-8500 will either continue the write operation (if there is new data in the buffer) or begin the process to stop tape motion (if the buffer is still empty).

Before actually stopping tape motion, the EXB-8500 writes additional gap blocks to complete the current track and then writes one or two complete gap tracks. (See the *EXB-8500 8mm Cartridge Tape Subsystem Product Specification* for more information.)

The Gap Threshold byte should be changed only when the average data transfer rate is slow and is impacting the capacity of the tape by forcing excessive start/stop activity. The Gap Threshold byte should be used in combination with the motion and reconnect thresholds described in this section.

Valid values for the Gap Threshold byte are 00h to FFh. Any value greater than 07h is treated as 07h by the EXB-8500. The default value for the Gap Threshold byte is 07h.

12.5 Read-Write Error Recovery Page
(Page Code=01h, Page Format)

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code					
01	Page Length							
02	Reserved		TB	RSVD	EER	PER	DTE	DCR
03	Read Retry Count							
04 ⋮ 07	Reserved							
08	Write Retry Count							

Field Definitions

The Read-Write Error Recovery Page specifies error recovery parameters used during read-write operations. These parameters apply only to page format (that is, when the PF bit in the CDB is set to 1).

Byte 00, Bits 5 through 0 - Page Code
The Page Code identifies the type of MODE SELECT page being transferred. This is the Read-Write Error Recovery Page. The valid value for Page Code is 01h.

Byte 01 - Page Length
The Page Length byte indicates the number of bytes in the Read-Write Error Recovery Page that follow this byte. The valid value for this byte is 07h.

Byte 02, Bit 5 - TB (Transfer Block)
The TB bit is not supported by the EXB-8500. The valid value for this bit is 0.

Byte 02, Bit 3 - EER (Enable Early Recovery)
The EER bit is not supported by the EXB-8500. The valid value for this bit is 0.

Byte 02, Bit 2 - PER (Post Error)
The PER bit is not supported by the EXB-8500. The valid value for this bit is 0.

Byte 02, Bit 1 - DTE (Disable Transfer on Error)
The DTE bit is not supported by the EXB-8500. The valid value for this bit is 0.

Byte 02, Bit 0 - DCR (Disable Correction)
The DCR bit is not supported by the EXB-8500. The valid value for this bit is 0.

Byte 03 - Read Retry Count
The Read Retry Count field specifies how many times the EXB-8500 should attempt its read recovery algorithms before an unrecoverable read error is reported. The Read Retry Count can be set to any value between 00h and 0Bh. The default value for this field is 0Bh.

Note: Before you read a tape that may have been written without retries, issue a MODE SENSE command and check the value returned for the WWR bit in the Vendor Unique Parameters Page 2. If the WWR bit is set to 1, specify 0 for this field; otherwise, specify a non-zero value. (You can disable write retries by setting the Write Retry Count field to 0 at LBOT.)

Bytes 04 through 07 - Reserved
These bytes are reserved.

Byte 08 - Write Retry Count
The Write Retry Count field specifies how many times the EXB-8500 should rewrite a physical block before an unrecoverable write error is reported. The value for this field can only be changed when the tape is positioned at LBOT. The valid values for this field are 00h and 0Bh. The default value is 0Bh.

Specify 0 for this field to set the Write Retry Count to 00h. Specify any other nonzero value to set the Write Retry Count to 0Bh. A value of 0 for the Write Retry Count indicates that the EXB-8500 will not rewrite any physical blocks during a write operation and will continue to write additional data. If this value is used, the EXB-8500 may not be able to recover the data written on the tape since its write integrity cannot be guaranteed.

Note: If this field was set to 00h when the tape was written, the WWR field in the MODE SENSE Vendor Unique Parameters Page 2 will be set to 1.

12.6 Disconnect-Reconnect Page
(Page Code=02h, Page Format)

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code					
01	Page Length							
02	Buffer Full Ratio							
03	Buffer Empty Ratio							
04	(MSB) Bus Inactivity Limit							
05								(LSB)
06	(MSB) Disconnect Time Limit							
07								(LSB)
08	(MSB) Connect Time Limit							
09								(LSB)
10	(MSB) Maximum Burst Size							
11								(LSB)

Field Definitions

The Disconnect-Reconnect Page specifies parameters for disconnects and reconnects. These parameters apply only to page format (that is, when the PF bit in the CDB is set to 1).

Byte 00, Bits 5 through 0 - Page Code
The Page Code identifies the type of MODE SELECT page being transferred. This is the Disconnect-Reconnect Page. The valid value for Page Code is 02h.

Byte 01 - Page Length
The Page Length indicates the number of bytes in the Disconnect-Reconnect Page that follow this byte. The valid value for this byte is 0Ah.

Byte 02 - Buffer Full Ratio

The Buffer Full Ratio represents the amount of data that must be present in the buffer during a buffered read operation before the EXB-8500 will attempt to reconnect to the initiator. The value is expressed in 4-KByte increments.

The default value for the Buffer Full Ratio is 80h (512 KBytes). Valid values range from 20h to D0h (128 to 832 KBytes).

Note: If the ND bit is 1 and you set the Buffer Full Ratio to a value less than A0h or greater than C0h, the value will automatically be changed to A0h. If, however, you set the Buffer Full Ratio to a value between A0h and C0h, that value will take effect. If the ND bit is 0, the Buffer Full Ratio can have any value from 20h to D0h (128 to 832 KBytes).

Byte 03 - Buffer Empty Ratio

The Buffer Empty Ratio represents how empty the buffer must be during a buffered write operation before the EXB-8500 will attempt to reconnect to the initiator. The value is expressed in 4-KByte increments. The default value for this byte is 80h (512 KBytes). Valid values range from 20h to D0h (128 to 832 KBytes).

The Buffer Empty Ratio must equal the Buffer Full Ratio. If these values are not equal, the EXB-8500 returns Check Condition status with the sense key set to Illegal Request (5h).

Note: The Buffer Full Ratio and the Buffer Empty Ratio in the Disconnect-Reconnect Page for page format are equivalent to the Reconnect Threshold byte in the vendor-unique parameters for non-page format.

Bytes 04 and 05 - Bus Inactivity Limit

The EXB-8500 does not recognize any values other than 0 for the Bus Inactivity Limit. It uses 0 as a default value, meaning that there is no limit to the amount of time that the EXB-8500 can assert a BSY signal without a REQ/ACK handshake.

Bytes 06 and 07 - Disconnect Time Limit

The only value supported by the EXB-8500 for the Disconnect Time Limit field is 0. This value cannot be changed.

Note: The disconnect time limit is determined by the minimum time it takes the EXB-8500 to disconnect from the SCSI bus and then initiate a reselection sequence. The minimum disconnect time for the EXB-8500 is 265 µsec. The initiator cannot change this field, so the value returned for this field by the MODE SENSE command is 0.

Bytes 08 and 09 - Connect Time Limit

The EXB-8500 does not recognize any values other than 0 for the Connect Time Limit. It uses 0 as a default value, meaning that the EXB-8500 will disconnect from the bus after the amount of data defined by Maximum Burst Size has been transferred.

Bytes 10 and 11 - Maximum Burst Size

The Maximum Burst Size defines the amount of data to be transferred before disconnecting. The value is expressed in increments of 512 bytes. A value of 0 indicates that there is no limit to the amount of data transferred before disconnecting. The EXB-8500 supports all values for this field. The default value is 0, which means that disconnects and reconnects are performed using the value specified by the Buffer Full and Buffer Empty Ratios.

Note: If you set the Maximum Burst Size field to a non-zero value, the EXB-8500 will automatically set the ND bit to 0 to allow disconnects during the data transfer phase. That is, Maximum Burst Size field has precedence over the ND bit. For more information about the ND bit, see Section 12.9.

12.7 Data Compression Page (Page Code=0Fh, Page Format)

Bit Byte	7	6	5	4	3	2	1	0
00	RSVD		Page Code					
01	Page Length							
02	DCE	DCC	Reserved					
03	DDE	RED		Reserved				
04 ⋮ 07	(MSB) Compression Algorithm (LSB)							
08 ⋮ 11	(MSB) Decompression Algorithm (LSB)							
12 ⋮ 15	Reserved							

Field Definitions

The Data Compression Page is used only for page format (that is, when the PF bit in the CDB is set to 1). This page specifies parameters for the control of data compression.

> **Important**
>
> The EXB-8500 does not support data compression. This page is included to enable EXB-8500 drivers to be upwardly compatible with products supporting data compression, such as the EXB-8500c.

Byte 00, Bits 5 through 0 - Page Code
The Page Code identifies the type of MODE SELECT page being transferred. This is the Data Compression Page. The valid value for the Page Code is 0Fh.

Byte 01 - Page Length
The Page Length indicates the number of bytes in the Data Compression Page that follow this byte. The valid value for this byte is 0Eh.

Byte 02, Bit 7 - DCE (Data Compression Enable)
The EXB-8500 does not support data compression, so the valid value for the Data Compression Enable bit is 0.

Byte 02, Bit 6 - DCC (Data Compression Capable)
The Data Compression Capable bit is used by the MODE SENSE command to indicate that the EXB-8500 does not support data compression. The valid value for this bit is 0.

Byte 02, Bits 5 through 0 - Reserved
These bits are reserved.

Byte 03, Bit 7 - DDE (Data Decompression Enable)
The EXB-8500 does not support data decompression, so the valid value for the Data Decompression Enable bit is 0.

Byte 03, Bits 6 and 5 - RED (Report Exception on Decompression)
The EXB-8500 does not support data compression, so the valid value for the Report Exception on Decompression field is 00.

Byte 03, Bits 4 through 0 - Reserved
These bits are reserved.

Bytes 04 through 07 - Compression Algorithm
The only valid value for the Compression Algorithm field is 0.

Bytes 08 through 11 - Decompression Algorithm
The only valid value for the Decompression Algorithm field is 0.

Bytes 12 through 15 - Reserved
These bytes are reserved.

12.8 Device Configuration Page (Page Code= 10h, Page Format)

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code					
01	Page Length							
02	RSVD	CAP	CAF	Active Format				
03	Active Partition							
04	Write Buffer Full Ratio							
05	Read Buffer Empty Ratio							
06	(MSB) Write Delay Time							
07								(LSB)
08	DBR	BIS	RSmk	AVC	SOCF		RBO	REW
09	Gap Size							
10	EOD Defined			EEG	SEW	Reserved		
11	(MSB) Buffer Size at Early Warning							
12								
13								(LSB)
14	Select Data Compression Algorithm							

Field Definitions

The Device Configuration Page is used only for page format (that is, when the PF bit in the CDB is set to 1).

Byte 00, Bits 5 through 0 - Page Code
The Page Code identifies the type of MODE SELECT page being transferred. This is the Device Configuration Page. The valid value for Page Code is 10h.

Byte 01 - Page Length
The Page Length indicates the number of bytes in the Device Configuration Page that follow this byte. The valid value for this byte is 0Dh.

Byte 02, Bit 6 - CAP (Change Active Partition)
The CAP bit is not supported by the EXB-8500. The valid value for this bit is 0.

Byte 02, Bit 5 - CAF (Change Active Format)
The CAF bit indicates that the active format is to be changed and to use the values in the Active Format field.

0 – Do not change active format
1 – Change active format.

Byte 02, Bits 4 through 0 - Active Format
The Active Format field contains data that modify the media format parameters.

The definition for the active format field is:

4	3	2	1	0
Reserved		Gap Threshold		

Byte 02, Bits 4 and 3 - Reserved These bits are reserved.

Byte 02, Bits 2 through 0 - Gap Threshold The Gap Threshold byte specifies the maximum number of consecutive gap blocks that the EXB-8500 will write on the current track while determining whether an empty buffer exists during a write operation. After writing the number of gap blocks specified by this byte, the EXB-8500 will either continue the write operation (if there is new data in the buffer) or begin the process to stop tape motion (if the buffer is still empty).

Before actually stopping tape motion, the EXB-8500 writes additional gap blocks to complete the current track and then writes one or two complete gap tracks. (See the *EXB-8500 8mm Cartridge Tape Subsystem Product Specification* for more information.)

The Gap Threshold byte should be changed only when the average data transfer rate is slow and is impacting the capacity of the tape by forcing excessive start/stop activity. The Gap Threshold byte should be used in combination with the motion and reconnect thresholds described in this section.

Valid values for the Gap Threshold byte are 00h to FFh. Any value greater than 07h is treated as 07h by the EXB-8500. The default value for the Gap Threshold byte is 07h.

Note: The Gap Threshold in the Device Configuration Page has the same function as the Gap Threshold in the Vendor Unique Parameters Page 1. If both pages are sent, the value that is received last by the EXB-8500 takes precedence.

Byte 03 - Active Partition

The Active Partition byte is not supported by the EXB-8500. The valid value for this byte is 0.

Byte 04 - Write Buffer Full Ratio

The Write Buffer Full Ratio represents the amount of data that must be present in the buffer during a buffered write operation before that data is written to the tape. The value is expressed in 4-KByte increments. The default value for this byte is 80h (512 KBytes). Valid values range from 20h to D0h (128 to 832 KBytes).

Byte 05 - Read Buffer Empty Ratio

The Read Buffer Empty Ratio represents how empty the buffer must be during a buffered read operation before additional data will be read from the tape. The value is expressed in 4-KByte increments. The default value for this byte is 80h (512 KBytes). Valid values range from 20h to D0h (128 to 832 KBytes).

The Read Buffer Empty Ratio must equal the Write Buffer Full Ratio. If these values are not equal, the EXB-8500 returns Check Condition status with the sense key set to Illegal Request (5h).

Note: The Write Buffer Full Ratio and the Read Buffer Empty Ratio in the Device Configuration Page have the same function as the Motion Threshold in the Vendor Unique Parameters Page 1. If both pages are sent, the value that is received last by the EXB-8500 takes precedence.

Bytes 06 and 07 - Write Delay Time

If a WRITE command completes without transferring enough data to exceed the value specified for the Write Buffer Full Ratio, the value specified by the Write Delay Time field is used to determine the maximum amount of time, in units of 100 msec, that the data will remain in the buffer. When the time specified by Write Delay Time elapses, the data in the buffer is automatically written to tape. A value of 0 for this field indicates that a partially full buffer will not be flushed to tape.

The default value for this byte is 0. Valid values for this field are 0000h to 3FFFh. A value greater than 3FFFh is not an error and will be truncated to 3FFFh.

Byte 08, Bit 7 - DBR (Data Buffer Recovery)

The DBR bit is not supported by the EXB-8500. The valid value for this bit is 0.

Byte 08, Bit 6 - BIS (Block Identifier Supported)
The BIS bit indicates that block IDs are written on the tape relative to the single partition. This bit is set to 1 in the MODE SENSE data and is ignored by the MODE SELECT command.

Byte 08, Bit 5 - RSmk (Report Setmarks)
The RSmk bit is not supported by the EXB-8500. The valid value for this bit is 0.

Byte 08, Bit 4 - AVC (Automatic Velocity Control)
The AVC bit is not supported by the EXB-8500. The valid value for this bit is 0.

Byte 08, Bits 3 and 2 - SOCF (Stop on Consecutive Filemarks)
The SOCF bit is not supported by the EXB-8500. The valid value for this bit is 0.

Byte 08, Bit 1 - RBO (Recover Buffer Order)
The RBO bit is not supported by the EXB-8500. The valid value for this bit is 0.

Byte 08, Bit 0 - REW (Report Early Warning)
The REW bit is used to enable or disable reporting of the early-warning condition (LEOT) during a read operation.

0 – Do not report early-warning condition for read operations (default).

1 – Report early-warning condition for read operations after completion of the current READ command.

The early-warning condition is reported as a Check Condition status with the sense key set to No Sense. The EOM bit is set to 1, and the LBOT and PEOT bits are set to 0 in the extended sense data.

Byte 09 - Gap Size
The Gap Size field is not supported by the EXB-8500. The valid value for this field is 0.

Byte 10, Bits 7 through 5 - EOD Defined
The EOD Defined field is not supported by the EXB-8500. The valid value for this field is 0.

Byte 10, Bit 4 - EEG (Enable EOD Generation)
The EEG bit indicates that the EXB-8500 will generate an EOD mark. The EEG bit is set to 1 in the MODE SENSE data and is ignored by the MODE SELECT command.

Byte 10, Bit 3 - SEW (Synchronize at Early Warning)
The SEW bit indicates that the EXB-8500 will cause any buffered data to be written to the tape when the early-warning condition (LEOT) is detected during a write operation. This bit is set to 1 in the MODE SENSE data and is ignored by the MODE SELECT command.

Bytes 11 through 13 - Buffer Size at Early Warning
The Buffer Size at Early Warning field is not supported by the EXB-8500. The valid value for this field is 0.

Byte 14 - Select Data Compression Algorithm
The Select Data Compression Algorithm is not supported by the EXB-8500. The valid value for this field is 0.

12.9 Vendor Unique Parameters Page 1
(Page Code=20h, Page Format)

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code					
01	Page Length							
02	CT	RSVD	ND	RSVD	NBE	EBD	PE	NAL
03	RTF			WTF			RSVD	P5
04	Motion Threshold							
05	Gap Threshold							

Field Definitions

This page applies only to page format (that is, when the PF bit in the CDB is set to 1).

Byte 00, Bits 5 through 0 - Page Code
The Page Code identifies the type of MODE SELECT page being transferred. This is the Vendor Unique Parameters Page 1. The valid value for Page Code is 20h.

Byte 01 - Page Length
The Page Length indicates the number of bytes in the Vendor Unique Parameters Page 1 that follow this byte. The valid value for this byte is 04h.

Byte 02, Bit 7 - CT (Cartridge Type)
This bit defines what type of data cartridge is expected to be loaded.

0 – P6 Cartridge Type - Domestic
1 – PI Cartridge Type - International (P5, P6 LEOT equivalency).

Note: You can set the CT bit only when the tape is positioned at LBOT.

Refer to Appendix C for information about data cartridge capacities and for an explanation of how the EXB-8500 autosizes data cartridges. For information about changing the power-on default for the cartridge type, refer to Section 3.4.

Byte 02, Bit 5 - ND
This bit indicates whether the EXB-8500 can disconnect from the initiator during the data transfer phase.

0 – The EXB-8500 can disconnect from the initiator during the data transfer phase.

1 – The EXB-8500 will not disconnect during the data transfer phase.

The power-on default for the ND bit is 0.

Restrictions when the ND bit is 0

- The maximum logical block size allowed, in fixed or variable mode, is 240 KBytes (3C000h).

Restrictions when the ND bit is 1

- If the logical block size specified by the Block Length field in the Block Descriptor is greater than 160 KBytes (28000h), setting the ND bit to 1 causes the EXB-8500 to return Check Condition status with the sense key set to Illegal Request (5h).

- The total number of bytes that can be transferred as a result of a single WRITE or READ command, in fixed or variable mode, is 160 KBytes (28000h). That is, the total transfer length specified by the CDB must be 160 KBytes or less.

- During a write operation, the data transfer from the initiator does not start until the number of bytes of available space in the EXB-8500's buffer is greater than or equal to the total transfer length specified by the CDB.

- During a read operation, the data transfer to the initiator does not start until all of the data requested by the CDB, up to a total transfer length of 160 KBytes, is resident in the EXB-8500's buffer.

- If the Buffer Full Ratio and Buffer Empty Ratio (see Section 12.6) are set to values less than A0h or greater than C0h, they will be changed to A0h. This is necessary for proper buffer management.

- The Maximum Burst Size field (see Section 12.6) has precedence over the ND bit. For this reason, if the Maximum Burst Size has already been set to a non-zero value, attempting to set the ND bit to 1 causes the EXB-8500 to return Check Condition status with the sense key set to Illegal Request. The ASC will be set to 1Ah.

Byte 02, Bit 4 - RSVD
This bit is reserved.

Byte 02, Bit 3 - NBE (No Busy Enable)
This bit is included for EXB-8200 compatibility only. This bit is set to 1 in the MODE SENSE data and is ignored by the MODE SELECT command.

Byte 02, Bit 2 - EBD (Even Byte Disconnect)
This bit is used to enable disconnects on even-byte boundaries. Two options are available from EXABYTE to control what happens when the EBD bit is set to 1. Depending on EXB-8500's EEPROM image, setting the EBD bit to 1 allows disconnects to occur on two-byte boundaries or on four-byte boundaries.

0 – Disconnect on any byte
1 – Disconnect on even-byte (two-byte or four-byte) boundaries

Notes:

- If the logical block length specified by the Block Length field in the Block Descriptor is not divisible by 4 (or 2 if the EEPROM image is set for two-byte boundary disconnect), setting the EBD bit to 1 causes the EXB-8500 to return Check Condition status with the sense key set to Illegal Request (5h).
- For information about changing the power-on default for even-byte disconnect, refer to Section 3.4.

Byte 02, Bit 1 - PE (Parity Enable)
This bit is used to enable parity checking on the SCSI bus. When this bit is set to 1, every byte received by the EXB-8500 is checked for parity.

0 – Parity checking disabled
1 – Parity checking enabled

The power-on default for PE is 1.

Note: For information about changing the power-on default for parity checking, refer to Section 3.4.

Byte 02, Bit 0 - NAL (No Auto Load)
This bit is used to disable the automatic loading of the tape into the tape path when a data cartridge is inserted into the EXB-8500.

0 – Auto loading enabled
1 – Auto loading disabled

The power-on default value for NAL is 0.

Byte 03, Bits 7 through 5 - RTF (Read Tape Format)
These bits are ignored by the MODE SELECT command. They are returned by the MODE SENSE command to indicate the current tape format.

Byte 03, Bits 4 through 2 - WTF (Write Tape Format)
These bits are ignored by the MODE SELECT command. They are returned by the MODE SENSE command to indicate the format that will be used when the EXB-8500 writes data to the tape.

Byte 03, Bit 1 - RSVD
This bit is reserved.

Byte 03, Bit 0 - P5
This bit is set to indicate that the data cartridge loaded in the EXB-8500 is expected to be a P5, European data cartridge. When set to 1, this bit overrides the CT bit.

Note: You can set the P5 bit only when the tape is positioned at LBOT.

Refer to Appendix C for information about data cartridge capacities and for an explanation of how the EXB-8500 autosizes data cartridges. For information about changing the power-on default for the cartridge type, refer to Section 3.4.

Byte 04 - Motion Threshold
The value in the Motion Threshold byte indicates the amount of data that must be in the buffer before tape motion is started for a buffered write or read operation. The value is expressed in 4-KByte increments. The default is 80h (512 KBytes). Valid values range from 20h to D0h (128 to 832 KBytes).

When the buffer is filled to this point during a buffered write operation, tape motion begins and data is written to the tape.

When the buffer is emptied to this point during a buffered read operation, tape motion begins and data is read, filling the empty portion of the buffer with new data from the tape.

For more information about the motion threshold, see Section 3.2.

Byte 05 - Gap Threshold

The Gap Threshold byte specifies the maximum number of consecutive gap blocks that the EXB-8500 will write on the current track while determining whether an empty buffer exists during a buffered write operation. After writing the number of gap blocks specified by this byte, the EXB-8500 will either continue the write operation (if there is new data in the buffer) or begin the process to stop tape motion (if the buffer is still empty).

Before actually stopping tape motion, the EXB-8500 writes additional gap blocks to complete the current track and then writes one or two complete gap tracks. (See the *EXB-8500 8mm Cartridge Tape Subsystem Product Specification* for more information.)

The Gap Threshold byte should be changed only when the average data transfer rate is slow and is impacting the capacity of the tape by forcing excessive start/stop activity. The Gap Threshold byte should be used in combination with the motion and reconnect thresholds described in this section.

Valid values for the Gap Threshold byte are 00h to FFh. Any value greater than 07h is treated as 07h by the EXB-8500. The default value for the Gap Threshold byte is 07h.

12.10 Vendor Unique Parameters Page 2 (Page Code=21h, Page Format)

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code					
01	Page Length							
02	Reserved							
03	Reserved							WWR
04	Reserved							
05	Reserved							

Field Definitions

This page applies only to page format (that is, when the PF bit in the CDB is set to 1).

Byte 00, Bits 5 through 0 - Page Code
The Page Code identifies the type of MODE SELECT page being transferred. This is Vendor Unique Parameters Page 2. The valid value for the Page Code is 21h.

Byte 01 - Page Length
The Page Length indicates the number of bytes in the Vendor Unique Parameters Page 2 that follow this byte. The valid value for this byte is 04h.

Byte 02 - Reserved
This byte is reserved.

Byte 03, Bits 7 through 1- Reserved
These bits are reserved.

Byte 03, Bit 0 - WWR (Write Without Retries)
This bit is ignored by the MODE SELECT command. It is returned by the MODE SENSE command to indicate whether the tape was written with retries, as follows:

0 - Tape was written with retries
1 - Tape was written with no retries

Bytes 04 and 05 - Reserved
These bytes are reserved.

12.11 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the MODE SELECT command.

Illegal Value in MODE SELECT Data

If one of the bytes sent with the MODE SELECT data contains an illegal value or if a reserved bit is set, the EXB-8500 returns Check Condition status. To determine which byte contains the error, issue a REQUEST SENSE command. The sense key will be set to Illegal Request (5h) and the Fault Symptom Code field (byte 28) will indicate which of the consecutively received bytes is in error. For example, if the Block Descriptor Length field (byte 03) in the Parameter List Header is invalid, the value for the Fault Symptom Code byte would be 04h. Note that the first byte received is byte 1 (not byte 0).

12.12 Tape Format Examples

This section provides examples for using the EXB-8500 to write, append to, and read tapes in the following formats:

- EXB-8200 format
- EXB-8500 format

As you review and use the examples in this section, keep the following four rules in mind:

- The EXB-8500 allows only one format on any one tape.

- If you are writing data, you must decide the tape's format at LBOT. This is because the LBOT blocks define the format for the tape. If you do not select a format, the EXB-8500 writes in the power-on default format.

  Note: To rewrite the tape in a different format, you must overwrite the previously written LBOT pattern by issuing a WRITE (0Ah) or WRITE FILEMARKS (10h) command at LBOT.

- If you are appending to a previously written tape at a location other than LBOT, the EXB-8500 automatically writes in the format of the data already on the tape.

- If you are reading a previously written tape, the EXB-8500 automatically determines the tape's format for you. However, you can determine the format for yourself by following these steps:

  1. Load the data cartridge in the EXB-8500.

  2. Issue a MODE SENSE (1Ah) command.

  3. Look at the Density Code in the Block Descriptor or the RTF field in the Vendor Unique Parameters Page 1 (Page Code=20h).

Writing and Reading in EXB-8200 Format

This section describes how to use the EXB-8500 to write, append to, and read tapes in EXB-8200 format. This format is compatible with the following EXABYTE products:

- EXB-8200
- EXB-8200SX
- EXB-8500
- EXB-8500c
- EXB-8205

Writing EXB-8200 Format Tapes

To write tapes in EXB-8200 format, follow these steps:

1. Load a blank data cartridge in the EXB-8500 (or load a previously written data cartridge that you want to overwrite).

2. Issue a MODE SELECT command at LBOT. Set the Density Code in the Block Descriptor to 14h.

   Note: Refer to page 12-40 if you cannot issue MODE SELECT commands.

3. Issue a WRITE or WRITE FILEMARKS command to write the data.

Appending to EXB-8200 Format Tapes

If a tape has already been written in EXB-8200 format and you want to write additional data on the tape, follow these steps:

1. Load the data cartridge in the EXB-8500.

   Note: If you issue a MODE SELECT command at LBOT, be sure that the Density Code in the Block Descriptor is set to 14h.

2. Issue a READ (08h) or SPACE (11h) command to move away from LBOT and to a legal position for appending.

   Note: Legal positions for appending in EXB-8200 format are the beginning-of-tape side of a long filemark and at the end of data (blank tape).

3. Issue a WRITE or WRITE FILEMARKS command to write the additional data. The EXB-8500 automatically sets the Density Code to EXB-8200 format.

   Note: The WTF bit in the MODE SENSE command indicates that the EXB-8500 is writing in EXB-8200 format (001b).

Reading EXB-8200 Format Tapes

To use the EXB-8500 to read an EXB-8200 format tape, follow these steps:

1. Load the data cartridge in the EXB-8500.

2. Issue a READ command to read the data. The EXB-8500 automatically determines the tape's format.

Writing and Reading in EXB-8500 Format

This section describes how to use the EXB-8500 to write, append to, and read tapes in EXB-8500 format. This format is compatible with the following EXABYTE products:

- EXB-8500
- EXB-8500c

Writing EXB-8500 Format Tapes

To write tapes in EXB-8500 format, follow these steps:

1. Load a blank data cartridge in the EXB-8500 (or load a previously written data cartridge that you want to overwrite).

2. Issue a MODE SELECT command at LBOT. Set the Density Code in the Block Descriptor to 15h (or 00h).

   Note: Refer to page 12-40 if you cannot issue MODE SELECT commands.

3. Issue a WRITE or WRITE FILEMARKS command to write the data.

Appending to EXB-8500 Format Tapes

If a tape has already been written in EXB-8500 format and you want to write additional data on the tape, follow these steps:

1. Load the data cartridge in the EXB-8500.

   Note: If you issue a MODE SELECT command at LBOT, be sure that the Density Code in the Block Descriptor is set to 15h.

2. Issue a READ or SPACE command to move away from LBOT and to a legal position for appending.

   Note: Legal positions for appending in EXB-8500 format are either side of a long filemark and at the end-of-data (EOD) mark.

3. Issue a WRITE or WRITE FILEMARKS command to write the additional data. The EXB-8500 automatically sets the Density Code to EXB-8500 format.

   Note: The WTF bit in the MODE SENSE command indicates that the EXB-8500 is writing in EXB-8500 format (000b).

Reading EXB-8500 Format Tapes

To use the EXB-8500 to read an EXB-8500 format tape, follow these steps:

1. Load the data cartridge in the EXB-8500.
2. Issue a READ command to read the data. The EXB-8500 automatically determines the tape's format.

If You Cannot Issue MODE SELECT Commands

This section describes how to write tapes in different formats if you cannot issue MODE SELECT commands to set the Density Code.

1. Obtain a tape that has already been written in the desired format (that is, either in EXB-8200 format or in EXB-8500 format). This tape must include an LBOT pattern plus data or at least one filemark.

2. Load the previously written tape in the EXB-8500.

3. Issue a SPACE or READ command to move the tape away from LBOT. The EXB-8500 automatically sets the Density Code to 14h for EXB-8200 format tapes or to 15h for EXB-8500 format tapes.

4. Issue a WRITE or WRITE FILEMARKS command to write data or a filemark.

   Note: After you complete steps 2, 3, and 4, the Density Code remains 14h (for EXB-8200 format tapes) or 15h (for EXB-8500 format tapes) for as long as that tape is loaded.

5. Rewind the tape to LBOT.

6. Issue a WRITE or WRITE FILEMARKS command to write data or a filemark to the tape and to overwrite the existing data or filemark. The tape will be written in desired format.

7. To change the format, repeat steps 1 through 6 with a tape written in the new format. Or, load a blank tape to write in the EXB-8500's power-on default format.

13 MODE SENSE (1Ah)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	1	0	1	0
01	Logical Unit Number			RSVD	DBD	Reserved		
02	PC		Page Code					
03	Reserved							
04	Allocation Length							
05	Vendor Unique		Reserved				0	0

The MODE SENSE command enables the EXB-8500 to report medium, logical unit, or device parameters to the initiator. These values apply to all initiators in a multi-initiator environment. Depending on the value specified for the Page Code field, the EXB-8500 can return these parameters in either of two formats: non-page format or page format.

Non-Page Format

In non-page format, the MODE SENSE parameters after the Block Descriptor are vendor unique. This format is the same as that defined for the EXB-8200 (that is, SCSI-1 format). It is equivalent to non-page format for the MODE SELECT parameters.

In non-page format, the MODE SENSE parameters are returned in the following order:

1. Parameter List Header (4 bytes)
2. Block Descriptor (8 bytes—optional)
3. One to five bytes of vendor-unique parameters.

Page Format
In page format, the MODE SENSE parameters after the Block Descriptor are structured as pages of related parameters. This format is equivalent to page format for the MODE SELECT parameters (that is, SCSI-2 format).

In page format, the MODE SENSE parameters are returned in the following order:

1. Parameter List Header (4 bytes)

2. Block Descriptor (8 bytes—optional)

3. One or six pages of related parameters (page format)

13.1 Field Definitions

Byte 01, Bit 4 - RSVD
This bit is reserved.

Byte 01, Bit 3 - DBD (Disable Block Descriptor)
The Disable Block Descriptor bit indicates whether the initiator wants the 8-byte Block Descriptor returned as part of the MODE SENSE parameter data. This bit is defined as follows:

0 – Send the Block Descriptor
1 – Do not send the Block Descriptor

Note: The DBD bit must be 0 if the Page Code is 0 (non-page format). Otherwise, the EXB-8500 will return Check Condition status with the sense key set to Illegal Request (5h). When the Page Code is 0, use the Allocation Length byte to specify whether the Block Descriptor is returned (see Table 13-2).

Byte 02, Bits 7 and 6 - PC (Page Control)
The Page Control field indicates the type of MODE SENSE parameter data to be returned. The EXB-8500 supports only current values (00h), indicating that the values returned are one of the following:

- The parameters set by the last successful MODE SELECT command

- The power-on default values if a MODE SELECT command has not been executed since the last power-on reset, SCSI bus reset, or Bus Device Reset message

Note that this field is used only for page format and must be 0 for non-page format.

Byte 02, Bits 5 through 0 - Page Code

The Page Code field indicates which MODE SENSE parameter page or pages the initiator is requesting. A value of 0 for this field indicates that the parameters will be returned in non-page format.

Table 13-1 lists the values supported by the EXB-8500 for the Page Code field.

Table 13-1 Values for Page Code Field in the MODE SENSE Command

To return the parameters in...	Specify this Page Code...	And this information will be returned...
Non-page format	00h*	1 to 5 bytes of vendor-unique parameters in non-page format
Page format	01h	Read-Write Error Recovery Page
	02h	Disconnect/Reconnect Page
	0Fh	Data Compression Page
	10h	Device Configuration Page
	20h	Vendor Unique Parameters Page 1
	21h	Vendor Unique Parameters Page 2
	3Fh	All six available pages

* If you specify 0 for the Page Code field, ensure that the DBD bit is also set to 0. Otherwise, the EXB-8500 will return Check Condition status with the sense key set to Illegal Request (5h).

When the Page Code is set to 3Fh (all six available pages), the pages are returned in the following order, as specified in the ANSI SCSI-2 standard:

- Read-Write Error Recovery Page
- Disconnect/Reconnect Page
- Data Compression Page
- Device Configuration Page
- Vendor Unique Parameters Page 1
- Vendor Unique Parameters Page 2

Byte 04 - Allocation Length (Non-Page Format)
The Allocation Length byte indicates the amount of memory in bytes that the initiator has allocated for the return of MODE SENSE parameters from the EXB-8500. When the Page Code field is set to 0, all parameters after the Block Descriptor are vendor unique and the Allocation Length byte can contain values ranging from 0 to 11h.

Table 13-2 lists the valid values for the Allocation Length byte when the Page Code is 0 (non-page format).

Table 13-2 Allocation Lengths: Non-Page Format

To return these parameters...	Allocate this length...
No parameter list data	0
Parameter List Header data	04h
Parameter List Header data and 1 to 5 bytes of vendor-unique parameters	05h, 06h, 07h, 08h, or 09h
Parameter List Header and Block Descriptor	0Ch
Parameter List Header, Block Descriptor, and 1 to 5 bytes of vendor-unique parameters	0Dh, 0Eh, 0Fh, 10h, or 11h

Restrictions for MODE SENSE Data in Non-Page Format The following restrictions apply to the return of MODE SENSE data in non-page format:

- For any data transfer greater than 0 bytes, the entire 4-byte Parameter List Header must be transferred. That is, the entire 4-byte Parameter List Header must be transferred before the Block Descriptor or any vendor-unique parameters can be transferred.
- If the Block Descriptor is transferred, it must be transferred in its entirety (that is, all 8 bytes); partial transfers of this data segment are not allowed.
- Valid transfer lengths for vendor-unique parameters are 0, 1, 2, 3, 4, and 5 bytes. All transfers of the vendor-unique parameters start with byte 0.

Byte 04 - Allocation Length (Page Format)
The Allocation Length byte indicates the amount of memory in bytes that the initiator has allocated for the return of MODE SENSE parameters from the EXB-8500. When the Page Code field is set to a non-zero value, the EXB-8500 returns either one or six pages of related parameters plus the Parameter List Header and the Block Descriptor (if specified).

Table 13-3 shows the minimum values you can specify for the Allocation Length when the Page Code field is set to a non-zero value. Note that specifying FFh for the Allocation Length is not an error. As indicated in the table, values for the Allocation Length byte depend on the following:

- Which parameter page is being returned
- Whether you want the Block Descriptor to be returned (that is, whether you set the DBD bit to 0 or 1)

Note: To return the Parameter List Header or the Block Descriptor without pages, set the Page Code to 0 (non-page format) and refer to Table 13-2 to determine what to specify for the Allocation Length field.

Table 13-3 Allocation Lengths: Page Format

To return this page...	Length of page in bytes (hex)	Specify at least this amount for the Allocation Length...	
		... if DBD=0 (return 8-byte Block Descriptor)	**...if DBD=1 (do not return 8-byte Block Descriptor)**
Read-Write Error Recovery Page (Page Code=01h)*	9 (9h)	15h	0Dh
Disconnect-Reconnect Page (Page Code=02h)*	12 (Ch)	18h	10h
Data Compression Page (Page Code=0Fh)*	16 (10h)	1Ch	14h
Device Configuration Page (Page Code=10h)*	15 (Fh)	1Bh	13h
Vendor Unique Parameters Page 1 (Page Code=20h)*	6 (6h)	12h	0Ah
Vendor Unique Parameters Page 2 (Page Code=21h)*	6 (6h)	12h	0Ah
All six available pages (Page Code=3Fh)*	64 (40h)	4Ch	44h

* The transfer must include the 4-byte Parameter List Header.

Examples To return the Parameter List Header, the Block Descriptor, and the Vendor Unique Parameters Page 1:

1. Set the DBD bit to 0.

2. Set the Page Code to 20h.

3. Specify at least 12h for the Allocation Length byte (04h for the Parameter List Header + 08h for the Block Descriptor + 06h for the Vendor Unique Parameters Page 1).

To return all possible MODE SENSE data:

1. Set the DBD bit to 0.

2. Set the Page Code to 3Fh.

3. Specify at least 4Ch for the Allocation Length byte.

Restrictions for MODE SENSE Data in Page Format The following restrictions apply to the return of MODE SENSE parameters in page format:

- The value for the Allocation Length byte must be equal to or greater than the total number of bytes to be transferred from the EXB-8500 to the initiator. When the value for this byte is 0, no data is transferred from the initiator. A value of 0 for this byte is not an error.

- For any data transfer greater than 0 bytes, the entire 4-byte Parameter List Header must be transferred. That is, the entire 4-byte Parameter List Header must be transferred before the Block Descriptor or any parameter page can be transferred.

- The Block Descriptor and any parameter pages must be transferred in their entirety; partial transfers of these data segments are not allowed.

Note: Any value for the Allocation Length that causes the Parameter List Header, Block Descriptor, or one of the parameter pages to be truncated will terminate the command with Check Condition status. The sense key will be set to Illegal Request and the Additional Sense Code will be set to Parameter List Length Error. The partial page will be transferred.

Byte 05, Bits 7 and 6 - Vendor Unique

There are no vendor unique definitions for these bits.

13.2 Parameter List Header (Non-Page and Page Formats)

Bit / Byte	7	6	5	4	3	2	1	0
00	Mode Data Length							
01	Medium Type							
02	WP	Buffered Mode			Speed			
03	Block Descriptor Length							

Field Definitions

The Parameter List Header is the same for both non-page and page formats.

Byte 00 - Mode Data Length
The Mode Data Length byte represents the total number of bytes of MODE SENSE parameter data available to be transferred excluding this byte. The value returned for this field is 03h plus the number of bytes of parameter data to be returned based on the field settings in the CDB.

Byte 01 - Medium Type

The value returned in the Medium Type byte represents the type of data cartridge currently loaded in the EXB-8500. The values that can be returned are shown in Table 13-4.

Table 13-4 Values Returned for Medium Type Byte in MODE SENSE Data

Value Returned	Type of Data Cartridge Loaded*	EXATAPE Equivalent
00h	None	
C1h	P5-15	
C2h	P5-30	
C3h	P5-60*	
C4h	P5-90*	112m
81h	P6-15	15m
82h	P6-30	
83h	P6-60	54m
84h	P6-90*	
85h	P6-120*	

* As described in Appendix C, the EXB-8500 initially uses the settings of the CT and P5 bits in the MODE SELECT command to autosize P5-60, P5-90, P6-90, and P6-120 tapes. The EXB-8500 accurately resizes these longer-length tapes as the tape position approaches LEOT. For this reason, if the CT and P5 bits are incorrectly set, the value returned for the Medium Type byte may change when the tape is resized.

Byte 02, Bit 7 - WP

The Write Protect bit indicates if the data cartridge loaded in the EXB-8500 is write protected. This bit is defined as follows:

0 – The data cartridge loaded in the EXB-8500 is not write protected.
1 – The data cartridge loaded in the EXB-8500 is write protected.

Byte 02, Bits 6 through 4 - Buffered Mode

The EXB-8500 supports two data transfer modes, as follows:

000 – Unbuffered mode
001 – Buffered mode

In buffered mode, data from a WRITE command and filemarks from a WRITE FILEMARKS command (EXB-8500 format only) are held in the EXB-8500's buffer until one of the following events causes the data and filemarks to be written to the tape:

- The motion threshold is reached.
- The EXB-8500 receives one of the following commands:
  - REWIND (01h)
  - WRITE FILEMARKS (10h) non-immediate
  - SPACE (11h) in either direction
  - ERASE (19h)
  - LOAD/UNLOAD (1Bh)
  - LOCATE (2Bh) in the reverse direction
- The operator presses the unload button.
- The time specified for the Write Delay Time field elapses (note, however, if the Write Delay Time field is 0, a partially full buffer is not flushed to tape).

Note: The Write Delay Time field can be set using page format only; see Section 12.8 for more information.

In buffered mode, status is returned when the last block of data has been transferred to the EXB-8500's buffer. In unbuffered mode, status is returned only after the data has actually been written to the tape.

The power-on default value for the Buffered Mode field is 001.

Byte 02, Bits 3 through 0 - Speed

The EXB-8500 does not support any operations at different speeds. All operations have a defined speed that cannot be modified. The value returned for this field is 0.

Byte 03 - Block Descriptor Length

This byte contains the length of the Block Descriptor in bytes. The EXB-8500 does not support multiple block descriptions. The values for this byte are 00h and 08h.

13.3 Block Descriptor
(Non-Page and Page Formats)

Bit Byte	7	6	5	4	3	2	1	0
00	Density Code							
01	(MSB)							
02	Number of Blocks							
03								(LSB)
04	Reserved							
05	(MSB)							
06	Block Length							
07								(LSB)

Field Definitions

The Block Descriptor is the same for both non-page and page formats.

Byte 00 - Density Code
As described in Section 3.1, the EXB-8500 can read and write data in EXB-8500 format or in EXB-8200 format. The Density Code field reported by the MODE SENSE command identifies the current operating density of the EXB-8500. As described in Table 13-5 on the next page, the value reported for the Density Code field depends on the most recent activity; that is, the value reported for this field can be changed by loading a new tape or by issuing a MODE SELECT command, a READ command, or a WRITE command.

Notes:

- Refer to Section 12.12 on page 12-36 for examples for using the EXB-8500 to write, read, and append to EXB-8200 and EXB-8500 format tapes.
- The RTF field on the Vendor Unique Parameters Page 1 (Page Code 20h) indicates the format of the data on the currently loaded data cartridge. The WTF field on Page 20h indicates the format that will be used when the EXB-8500 writes data. The values returned for these fields do not depend on the last operation performed by the EXB-8500.

Table 13-5 Effect of Various Actions on the Density Code Reported by MODE SENSE

If the most recent activity was a...	**...then the value reported for the Density Code is the...**	
	... actual format of the data on the tape (format for reading tape)	**...power-on default or format set with the most recent MODE SELECT (format for writing tape)[a]**
Power on (tape not loaded)		✔
Load operation complete (previously written tape)[b]	✔	
MODE SELECT command		✔
READ command	✔	
WRITE command		✔

[a] The Density Code reported in these cases reflects the format set by the most recent MODE SELECT command that set the Density Code to a non-7Fh value.

[b] After the EXB-8500 loads a blank tape, the Density Code reported by the MODE SENSE command will always indicate EXB-8500 format (that is, the Density Code will be set to either 00h or 15h).

Note: When the EXB-8500 appends new data to existing data, it writes the new data in the same format as the data already on the tape. In this case, the writing format is automatically changed to the reading format (no user intervention is required). Once this automatic density change has occurred, it remains in effect for all operations on the particular tape—including the rewriting of LBOT.

For more information about how you can use this feature to change the tape format without issuing a MODE SELECT command, refer to page 12-40.

Table 13-6 lists the possible values for the Density Code byte.

Table 13-6 Values for the Density Code Byte in MODE SENSE Command

Density Code	Tape Format	Approximate Capacity[a]
00h[b]	EXB-8500 format	5.0 GBytes
14h	EXB-8200 format	2.5 GBytes
15h	EXB-8500 format	5.0 GBytes

[a] Approximate capacity based on a 112m EXATAPE.
[b] This Density Code is included to enable EXB-8500 drivers to be downwardly compatible with EXB-8200 drivers. This field is reserved in EXB-8200 drivers.

For more information about using the MODE SELECT command to change the data format, refer to Section 12.3. For more information about the differences between EXB-8500 format and EXB-8200 format, refer to the *EXB-8500 8mm Cartridge Tape Subsystem Product Specification*.

Bytes 01 through 03 - Number of Blocks

The value for the Number of Blocks field indicates the total capacity of the tape in 1-KByte physical blocks (LBOT to LEOT). The value returned for this field depends on the setting of the Density Code; if the Density Code is set for EXB-8500 format, the Number of Blocks will be two times larger than if the Density Code is set for EXB-8200 format.

Note: If the tape has been previously written, the value returned for the Number of Blocks field represents the tape's present format, not the format set with the Density Code field. That is, the format of any data already on tape has precedence over the format set with the Density Code.

Bytes 05 through 07 - Block Length

The Block Length field defines the length in bytes of each logical block described by the Block Descriptor. A value of 0 for the Block Length field indicates variable-length logical blocks. A value greater than 0 indicates fixed-length logical blocks.

The power-on default value for the block length is 400h (1,024) bytes. The limit on the block length is the maximum block length specified in the READ BLOCK LIMITS (05h) command.

13.4 Vendor-Unique Parameters (Non-Page Format)

Bit / Byte	7	6	5	4	3	2	1	0
00	CT	RSVD	ND	RSVD	NBE	EBD	PE	NAL
01	Reserved							P5
02	Motion Threshold							
03	Reconnect Threshold							
04	Gap Threshold							

Field Definitions

These vendor-unique parameters apply only to non-page format (Page Code field in the CDB is 0).

Byte 00, Bit 7 - CT (Cartridge Type)
This bit reports what type of data cartridge is expected to be loaded in the EXB-8500.

0 – P6 Cartridge Type - Domestic
1 – PI Cartridge Type - International (P5, P6 LEOT equivalency).

See Appendix C for information about data cartridge capacities and for an explanation of how the EXB-8500 autosizes data cartridges.

Byte 00, Bit 6 - RSVD
This bit is reserved.

Byte 00, Bit 5 - ND (No Disconnect During Data Transfer)
This bit indicates whether the EXB-8500 can disconnect from the initiator during the data transfer phase.

0 – The EXB-8500 can disconnect from the initiator during the data transfer phase.

1 – The EXB-8500 will not disconnect during the data transfer phase.

The power-on default for ND is 0.

Restrictions when the ND bit is 0

- The maximum logical block size allowed, in fixed or variable mode, is 240 KBytes (3C000h).

Restrictions when the ND bit is 1

- The total number of bytes that can be transferred as a result of a single WRITE or READ command, in fixed or variable mode, is 160 KBytes (28000h). That is, the total transfer length specified by the CDB must be 160 KBytes or less.
- The maximum logical block size allowed, in fixed or variable mode, is 160 KBytes.
- During a write operation, the data transfer from the initiator does not start until the number of bytes of available space in the EXB-8500's buffer is greater than or equal to the total transfer length specified by the CDB.
- During a read operation, the data transfer to the initiator does not start until all of the data requested by the CDB, up to a total transfer length of 160 KBytes, is resident in the EXB-8500's buffer.
- If the Reconnect Threshold byte is set to values less than A0h or greater than C0h, it will be changed to A0h. This is necessary for proper buffer management.

Byte 00, Bit 4 - RSVD

This bit is reserved.

Byte 00, Bit 3 - NBE (No Busy Enable)

This bit is included for EXB-8200 compatibility only. This bit is set to 1 in the MODE SENSE data and is ignored by the MODE SELECT command.

Byte 00, Bit 2 - EBD (Even Byte Disconnect)

This bit indicates whether disconnects on even-byte boundaries are enabled. Two options are available from EXABYTE to control what happens when the EBD bit is set to 1. Depending on EXB-8500's EEPROM image, when the EBD bit is set to 1, disconnects can occur either on two-byte boundaries or on four-byte boundaries.

0 – Disconnect on any byte
1 – Disconnect on even-byte (two-byte or four-byte) boundaries

Byte 00, Bit 1 - PE (Parity Enable)
This bit indicates whether parity checking on the SCSI bus is enabled. When this bit is set to 1, every byte received by the EXB-8500 is checked for parity.

0 – Parity checking is disabled
1 – Parity checking is enabled

The power-on default for PE is 1.

Byte 00, Bit 0 - NAL (No Auto Load)
This bit indicates whether the automatic loading of the tape into the tape path is disabled when a data cartridge is inserted into the EXB-8500.

0 – Auto loading is enabled
1 – Auto loading is disabled

The power-on default value for NAL is 0.

Byte 01, Bits 7 through 1 - Reserved
These bits are reserved.

Byte 01, Bit 0 - P5
This bit is set to 1 to indicate that the data cartridge expected by the EXB-8500 is a P5, European data cartridge. When set to 1, this bit overrides the CT bit.

See Appendix C for information about data cartridge capacities and for an explanation of how the EXB-8500 autosizes data cartridges.

Byte 02 - Motion Threshold
The value in the Motion Threshold byte indicates the amount of data that must be in the buffer before tape motion is started for a buffered write or read operation. The value is expressed in 4-KByte increments. The default is 80h (512 KBytes). Values range from 20h to D0h (128 to 832 KBytes).

When the buffer is filled to this point during a buffered write operation, tape motion begins and data is written to the tape.

When the buffer is emptied to this point during a buffered read operation, tape motion begins and data is read, filling the empty portion of the buffer with new data from the tape.

Byte 03 - Reconnect Threshold

The value in the Reconnect Threshold byte indicates the amount of data that must be in the buffer before the EXB-8500 reconnects to the initiator for a buffered write or read operation. The value is expressed in 4-KByte increments. The default is 80h (512 KBytes). Values range from 20h to D0h (128 to 832 KBytes).

When this amount of free space is available in the buffer during a buffered write operation, the EXB-8500 reconnects to the initiator to accept additional data.

When the buffer fills to this level during a buffered read operation, the EXB-8500 reconnects to the initiator and data is transferred.

Byte 04 - Gap Threshold

The Gap Threshold byte indicates the maximum number of consecutive gap blocks that the EXB-8500 will write on the current track while determining whether an empty buffer exists during a write operation. After writing the number of gap blocks specified by this byte, the EXB-8500 will either continue the write operation (if there is new data in the buffer) or begin the process to stop tape motion (if the buffer is still empty).

Before actually stopping tape motion, the EXB-8500 writes additional gap blocks to complete the current track and then writes one or two complete gap tracks. (See the *EXB-8500 8mm Cartridge Tape Subsystem Product Specification* for more information.)

Values returned for the Gap Threshold byte range from 00h to 07h. The default value is 07h.

13.5 Read-Write Error Recovery Page (Page Code=01h)

Bit / Byte	7	6	5	4	3	2	1	0
00	PS	RSVD	Page Code					
01	Page Length							
02	Reserved		TB	RSVD	EER	PER	DTE	DCR
03	Read Retry Count							
04 ⋮ 07	Reserved							
08	Write Retry Count							

Field Definitions

The Read-Write Error Recovery Page indicates the error recovery parameters used during read-write operations. This page is returned only when the Page Code field in the CDB is set to 01h or 3Fh.

Byte 00, Bit 7 - PS
The Parameters Savable bit indicates if the MODE SENSE parameter data contained in this page is savable. The EXB-8500 does not support this feature. The value returned for this bit is 0.

Byte 00, Bits 5 through 0 - Page Code
The Page Code identifies the type of MODE SENSE data being transferred. This is the Read-Write Error Recovery Page. The value returned for the Page Code is 01h.

Byte 01 - Page Length
The Page Length indicates the number of Read-Write Error Recovery Page bytes that follow this byte. The value returned for this byte is 07h.

Byte 02, Bit 5 - TB (Transfer Block)
The TB bit is not supported by the EXB-8500. The value returned for this bit is 0.

Byte 02, Bit 3 - EER (Enable Early Recovery)
The EER bit is not supported by the EXB-8500. The value returned for this bit is 0.

Byte 02, Bit 2 - PER (Post Error)
The PER bit is not supported by the EXB-8500. The value returned for this bit is 0.

Byte 02, Bit 1 - DTE (Disable Transfer on Error)
The DTE bit is not supported by the EXB-8500. The value returned for this bit is 0.

Byte 02, Bit 0 - DCR (Disable Correction)
The DCR bit is not supported by the EXB-8500. The value returned for this bit is 0.

Byte 03 - Read Retry Count
The Read Retry Count indicates how many times the EXB-8500 will attempt its read recovery algorithms before an unrecoverable read error is reported. The values returned this field can range from 00h to 0Bh. The default is 0Bh.

Byte 08 - Write Retry Count
The Write Retry Count field specifies how many times the EXB-8500 should rewrite a physical block before an unrecoverable write error is reported. The values for this field are 00h and 0Bh. The default value is 0Bh.

A value of 0 for the Write Retry Count indicates that the EXB-8500 will not rewrite any physical blocks during a write operation and will continue to write additional data. If this value is used, the EXB-8500 may not be able to recover the data written on the tape since its write integrity cannot be guaranteed.

13.6 Disconnect-Reconnect Page (Page Code=02h)

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code					
01	Page Length							
02	Buffer Full Ratio							
03	Buffer Empty Ratio							
04	(MSB) Bus Inactivity Limit							
05								(LSB)
06	(MSB) Disconnect Time Limit							
07								(LSB)
08	(MSB) Connect Time Limit							
09								(LSB)
10	(MSB) Maximum Burst Size							
11								(LSB)

Field Definitions

The Disconnect-Reconnect Page specifies parameters for disconnects and reconnects. This page is returned only when the Page Code field in the CDB is set to 02h or 3Fh.

Byte 00, Bits 5 through 0 - Page Code
The Page Code identifies the type of MODE SENSE data being transferred. This is the Disconnect-Reconnect Page. The value returned for the Page Code is 02h.

Byte 01 - Page Length
The Page Length indicates the number of Disconnect-Reconnect Page bytes that follow this byte. The value returned for this byte is 0Ah.

Byte 02 - Buffer Full Ratio
The Buffer Full Ratio represents the amount of data that must be present in the buffer during a buffered read operation before the EXB-8500 will attempt to reconnect to the initiator. The value is expressed in 4-KByte increments. The default value for this byte is 80h (512 KBytes). Values range from 20h to D0h (128 to 832 KBytes).

Byte 03 - Buffer Empty Ratio
The Buffer Empty Ratio indicates how empty the buffer must be during a buffered write operation before the EXB-8500 will attempt to reconnect to the initiator. The value is expressed in 4-KByte increments. The default value for this byte is 80h (512 KBytes). Values range from 20h to D0h (128 to 832 KBytes).

The Buffer Empty Ratio equals the Buffer Full Ratio.

Note: The Buffer Full Ratio and the Buffer Empty Ratio in the Disconnect-Reconnect Page (page format) are equivalent to the Reconnect Threshold byte in the vendor-unique parameters for non-page format.

Bytes 04 and 05 - Bus Inactivity Limit
The value returned for the Bus Inactivity Limit is 0. The EXB-8500 uses 0 as a default value, meaning that there is no limit to the amount of time that the EXB-8500 can assert a BSY signal without a REQ/ACK handshake.

Bytes 06 and 07 - Disconnect Time Limit
The disconnect time limit is determined by the minimum time it takes the EXB-8500 to disconnect from the SCSI bus and then initiate a reselection sequence. The minimum disconnect time for the EXB-8500 is 265 μsec. This field cannot be changed by the initiator, so the value returned for this field is 0.

Bytes 08 and 09 - Connect Time Limit
The value returned for the Connect Time Limit is 0. The EXB-8500 uses 0 as a default value, meaning that it disconnects from the bus after the amount of data defined by Maximum Burst Size has been transferred.

Bytes 10 and 11 - Maximum Burst Size
The Maximum Burst Size defines the amount of data to be transferred before disconnecting. The value is expressed in increments of 512 bytes. A value of 0 indicates that there is no limit on the amount of data transferred before disconnecting. The EXB-8500 supports all values for this field. The default value is 0, which means that disconnects and reconnects are performed using the value specified by the Buffer Full and Buffer Empty Ratios.

13.7 Data Compression Page (Page Code=0Fh)

Bit / Byte	7	6	5	4	3	2	1	0
00	PS	RSVD	Page Code					
01	Page Length							
02	DCE	DCC	Reserved					
03	DDE	RED		Reserved				
04 ⋮ 07	(MSB) Compression Algorithm (LSB)							
08 ⋮ 11	(MSB) Decompression Algorithm (LSB)							
12 ⋮ 15	Reserved							

Field Definitions

The Data Compression Page specifies parameters for the control of data compression.

Important

The EXB-8500 does not support data compression. This page is included to enable EXB-8500 drivers to be upwardly compatible with products supporting data compression, such as the EXB-8500c.

This page is returned when the Page Code in the CDB is set to 0Fh or 3Fh.

Byte 00, Bit 7 - PS (Parameters Savable)
The Parameters Savable bit indicates if the MODE SENSE parameter data contained in this page is savable. The EXB-8500 does not support this feature. The value returned for this bit is 0.

Byte 00, Bit 6 - Reserved
This bit is reserved.

Byte 00, Bits 5 through 0 - Page Code
The Page Code identifies the type of MODE SENSE data being transferred. This is the Data Compression Page. The value returned for this field is 0Fh.

Byte 01 - Page Length
The Page Length indicates the number of Data Compression Page bytes that follow this byte. The value returned for this byte is 0Eh.

Byte 02, Bit 7 - DCE (Data Compression Enable)
The EXB-8500 does not support data compression, so the value returned for the Data Compression Enable bit is 0.

Byte 02, Bit 6 - DCC (Data Compression Capable)
The Data Compression Capable bit indicates whether the device supports data compression. The EXB-8500 does not support data compression, so the value returned for this bit is 0.

Note: The initiator can use the setting of this bit to determine if the device is an EXB-8500 (DCC=0) or an EXB-8500c (DCC=1).

Byte 02, Bits 5 through 0 - Reserved
These bits are reserved.

Byte 03, Bit 7 - DDE (Data Decompression Enable)
The EXB-8500 does not support data decompression, so the value returned for the Data Decompression Enable bit is 0.

Byte 03, Bits 6 and 5 - RED (Report Exception on Decompression)
The EXB-8500 does not support data decompression, so the value returned for the Report Exception on Decompression field is 00.

Byte 03, Bits 4 through 0 - Reserved
These bits are reserved.

Bytes 04 through 07 - Compression Algorithm
The value returned for the Compression Algorithm field is 0.

Bytes 08 through 11 - Decompression Algorithm
The value returned for the Decompression Algorithm field is 0.

Bytes 12 through 15 - Reserved
These bytes are reserved.

13.8 Device Configuration Page (Page Code=10h)

<table>
<tr><td>Bit
Byte</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>00</td><td colspan="2">Reserved</td><td colspan="6">Page Code</td></tr>
<tr><td>01</td><td colspan="8">Page Length</td></tr>
<tr><td>02</td><td>RSVD</td><td>CAP</td><td>CAF</td><td colspan="5">Active Format</td></tr>
<tr><td>03</td><td colspan="8">Active Partition</td></tr>
<tr><td>04</td><td colspan="8">Write Buffer Full Ratio</td></tr>
<tr><td>05</td><td colspan="8">Read Buffer Empty Ratio</td></tr>
<tr><td>06</td><td colspan="8" rowspan="2">(MSB)
Write Delay Time
(LSB)</td></tr>
<tr><td>07</td></tr>
<tr><td>08</td><td>DBR</td><td>BIS</td><td>RSmk</td><td>AVC</td><td colspan="2">SOCF</td><td>RBO</td><td>REW</td></tr>
<tr><td>09</td><td colspan="8">Gap Size</td></tr>
<tr><td>10</td><td colspan="3">EOD Defined</td><td>EEG</td><td>SEW</td><td colspan="3">Reserved</td></tr>
<tr><td>11</td><td colspan="8" rowspan="3">(MSB)
Buffer Size at Early Warning
(LSB)</td></tr>
<tr><td>12</td></tr>
<tr><td>13</td></tr>
<tr><td>14</td><td colspan="8">Select Data Compression Algorithm</td></tr>
</table>

Field Definitions

The Device Configuration Page specifies configuration parameters for the EXB-8500. This page is returned only when the Page Code in the CDB set to 10h or 3Fh.

Byte 00, Bits 5 through 0 - Page Code
The Page Code identifies the type of MODE SENSE data being transferred. This is the Device Configuration Page. The value returned for the Page Code is 10h.

Byte 01 - Page Length
The Page Length indicates the number of Device Configuration Page bytes that follow this byte. The value returned for this byte is 0Dh.

Byte 02, Bit 6 - CAP (Change Active Partition)
The CAP bit is not supported by the EXB-8500. The value returned for this bit is 0.

Byte 02, Bit 5 - CAF (Change Active Format)
The value returned for CAF bit is 0.

Byte 02, Bits 4 through 0 - Active Format
The Active Format field contains data that modify the media format parameters.

The definition for the active format field is:

4	3	2	1	0
Reserved		Gap Threshold		

Byte 02, Bits 4 and 3 - Reserved These bits are reserved.

Byte 02, Bits 2 through 0 - Gap Threshold The Gap Threshold byte specifies the maximum number of consecutive gap blocks that the EXB-8500 will write on the current track while determining whether an empty buffer exists during a write operation. After writing the number of gap blocks specified by this byte, the EXB-8500 will either continue the write operation (if there is new data in the buffer) or begin the process to stop tape motion (if the buffer is still empty).

Before actually stopping tape motion, the EXB-8500 writes additional gap blocks to complete the current track and then writes one or two complete gap tracks. (See the *EXB-8500 8mm Cartridge Tape Subsystem Product Specification* for more information.)

Values returned for the Gap Threshold byte range from 00h to 07h. The default value is 07h.

Byte 03 - Active Partition
The Active Partition byte is not supported by the EXB-8500. The value returned for this byte is 0.

Byte 04 - Write Buffer Full Ratio
The Write Buffer Full Ratio represents the amount of data that must be present in the buffer during a buffered write operation before that data is written to the tape. The value is expressed in 4-KByte increments. The default value for this byte is 80h (512 KBytes). Values range from 20h to D0h (128 to 832 KBytes).

Byte 05 - Read Buffer Empty Ratio

The Read Buffer Empty Ratio represents how empty the buffer must be during a buffered read operation before additional data will be read from the tape. The value is expressed in 4-KByte increments. The default value for this byte is 80h (512 KBytes). Values range from 20h to D0h (128 to 832 KBytes).

The Read Buffer Empty Ratio equals the Write Buffer Full Ratio.

Note: The Write Buffer Full Ratio and the Read Buffer Empty Ratio in the Device Configuration Page have the same function as the Motion Threshold in the Vendor Unique Parameters Page 1.

Bytes 06 and 07 - Write Delay Time

If a WRITE command completes without transferring enough data to exceed the Write Buffer Full Ratio, the value specified by the Write Delay Time field is used to determine the maximum amount of time, in units of 100 msec, that the data will remain in the buffer. When the time specified by Write Delay Time expires, the data in the buffer is automatically written to tape. A value of 0 for this field indicates that a partially full buffer will not be flushed to tape.

The default value for this byte is 0. Values returned for this field range from 0000h to 3FFFh.

Byte 08, Bit 7 - DBR (Data Buffer Recovery)

The DBR bit is not supported by the EXB-8500. The value returned for this bit is 0.

Byte 08, Bit 6 - BIS (Block Identifier Supported)

The BIS bit indicates that block IDs are written on the tape relative to the single partition. This bit is set to 1 in the MODE SENSE data and is ignored by the MODE SELECT command.

Byte 08, Bit 5 - RSmk (Report Setmarks)

The RSmk bit is not supported by the EXB-8500. The value returned for this bit is 0.

Byte 08, Bit 4 - AVC (Automatic Velocity Control)

The AVC bit is not supported by the EXB-8500. The value returned for this bit is 0.

Byte 08, Bits 3 and 2 - SOCF (Stop on Consecutive Filemarks)

The SOCF field is not supported by the EXB-8500. The value returned for this field is 0.

Byte 08, Bit 1 - RBO (Recover Buffer Order)
The RBO bit is not supported by the EXB-8500. The value returned for this bit is 0.

Byte 08, Bit 0 - REW (Report Early Warning)
The REW bit indicates whether the reporting of the early-warning condition (LEOT) is enabled or disabled during a read operation.

0 – Do not report early-warning condition for read operations (default)

1 – Report early-warning condition for read operations after completion of the current READ command.

The early-warning condition is reported as a Check Condition status with the sense key set to No Sense. The EOM bit is set to 1, and the LBOT and PEOT bits are set to 0 in the extended sense data.

Byte 09 - Gap Size
The Gap Size field is not supported by the EXB-8500. The value returned for this field is 0.

Byte 10, Bits 7 through 5 - EOD Defined
The EOD Defined field is not supported by the EXB-8500. The value returned for this field is 0.

Byte 10, Bit 4 - EEG (Enable EOD Generation)
The EEG bit indicates that the EXB-8500 will generate an EOD mark. The EEG bit is set to 1 in the MODE SENSE data and is ignored by the MODE SELECT command.

Byte 10, Bit 3 - SEW (Synchronize at Early Warning)
The SEW bit indicates that the EXB-8500 will cause any buffered data to be written to the tape when the early-warning condition (LEOT) is detected during a write operation. This bit is set to 1 in the MODE SENSE data and is ignored by the MODE SELECT command.

Bytes 11 through 13 - Buffer Size at Early Warning
The Buffer Size at Early Warning is not supported by the EXB-8500. The value returned for this field is 0.

Byte 14 - Select Data Compression Algorithm
The Select Data Compression Algorithm field is not supported by the EXB-8500. The value returned for this field is 0.

13.9 Vendor Unique Parameters Page 1 (Page Code=20h)

Byte \ Bit	7	6	5	4	3	2	1	0
00	PS	RSVD	Page Code					
01	Page Length							
02	CT	RSVD	ND	RSVD	NBE	EBD	PE	NAL
03	RTF		WTF				RSVD	P5
04	Motion Threshold							
05	Gap Threshold							

Field Definitions

The Vendor Unique Parameters Page 1 is returned only when the Page Code field in the CDB is set to 20h or 3Fh.

Byte 00, Bit 7 - PS
The Parameters Savable bit indicates if the MODE SENSE parameter data contained in this page is savable. The EXB-8500 does not support this feature. The value returned for this bit is 0.

Byte 00, Bits 5 through 0 - Page Code
The Page Code identifies the type of MODE SENSE data being transferred. This is the Vendor Unique Parameters Page 1. The value returned for the Page Code is 20h.

Byte 01 - Page Length
The Page Length indicates the number of Vendor Unique Parameters Page 1 bytes that follow this byte. The value returned for this byte is 04h.

Byte 02, Bit 7 - CT (Cartridge Type)
This bit reports what type of cartridge is expected to be loaded in the EXB-8500.

0 – P6 Cartridge Type - Domestic
1 – PI Cartridge Type - International (P5, P6 LEOT equivalency).

See Appendix C for information about data cartridge capacities and for an explanation of how the EXB-8500 autosizes data cartridges.

Byte 02, Bit 5 - ND (No Disconnect During Data Transfer)
This bit indicates whether the EXB-8500 can disconnect from the initiator during the data transfer phase.

0 – The EXB-8500 can disconnect from the initiator during the data transfer phase

1 – The EXB-8500 will not disconnect during the data transfer phase.

The power-on default for ND is 0.

Restrictions when the ND bit is 0

- The maximum logical block size allowed, in fixed or variable mode, is 240 KBytes (3C000h).

Restrictions when the ND bit is 1

- The maximum logical block size, in fixed or variable mode, is 160 KBytes (28000h).
- The total number of bytes that can be transferred as a result of a single WRITE or READ command, in fixed or variable mode, is 160 KBytes (28000h). That is, the total transfer length specified by the CDB must be 160 KBytes or less.
- During a write operation, the data transfer from the initiator does not start until the number of bytes of available space in the EXB-8500's buffer is greater than or equal to the total transfer length specified by the CDB.
- During a read operation, the data transfer to the initiator does not start until all of the data requested by the CDB, up to a total transfer length of 160 KBytes, is resident in the EXB-8500's buffer.
- If the Buffer Full Ratio and the Buffer Empty Ratio are set to values less than A0h or greater than C0h, they will be changed to A0h. This is necessary for proper buffer management.

Byte 02, Bit 4 - RSVD
This bit is reserved.

Byte 02, Bit 3 - NBE (No Busy Enable)
This bit is included for EXB-8200 compatibility only. This bit is set to 1 in the MODE SENSE data and is ignored by the MODE SELECT command.

Byte 02, Bit 2 - EBD (Even Byte Disconnect)
This bit indicates whether disconnects on even-byte boundaries are enabled. Two options are available from EXABYTE to control what happens when the EBD bit is set to 1. Depending on EXB-8500's EEPROM image, when the EBD bit is set to 1, disconnects can occur either on two-byte boundaries or on four-byte boundaries.

0 – Disconnect on any byte
1 – Disconnect on even-byte (two-byte or four-byte) boundaries

Byte 02, Bit 1 - PE (Parity Enable)
This bit indicates whether parity checking on the SCSI bus is enabled. When this bit is set to 1, every byte received by the EXB-8500 is checked for parity.

0 – Parity checking is disabled
1 – Parity checking is enabled

The power-on default for PE is 1.

Byte 02, Bit 0 - NAL (No Auto Load)
This bit indicates whether the automatic loading of the tape into the tape path is disabled when the data cartridge is inserted into the EXB-8500.

0 – Auto loading is enabled
1 – Auto loading is disabled

The power-on default value for NAL is 0.

Byte 03, Bits 7 through 5 - RTF (Read Tape Format)
These bits indicate the format of the data on the currently loaded data cartridge. This is the format that the EXB-8500 will use when it reads the tape.

000b – The data on the tape is in EXB-8500 format, or there is no data on the tape.

001b – The data on the tape is in EXB-8200 format.

For more information about using the MODE SELECT command to change the data format, refer to Section 12.3. For more information about the differences between EXB-8500 format and EXB-8200 format, refer to the *EXB-8500 8mm Cartridge Tape Subsystem Product Specification*.

Byte 03, Bits 4 through 2 - WTF (Write Tape Format)
These bits indicate the format that will be used when the EXB-8500 writes data to the tape. The value returned for these bits reflects the default density, the density set with the most recent MODE SELECT command, or the density of the data already on the tape.

000b – EXB-8500 format
001b – EXB-8200 format

For more information about using the MODE SELECT command to change the data format, refer to Section 12.3. For more information about the differences between EXB-8500 format and EXB-8200 format, refer to the *EXB-8500 8mm Cartridge Tape Subsystem Product Specification*.

Byte 03, Bit 1 - Reserved
This bit is reserved.

Byte 03, Bit 0 - P5
This bit is set to 1 to indicate that the data cartridge loaded in the EXB-8500 is expected to be a P5, European data cartridge. When set to 1, this bit overrides the CT bit.

See Appendix C for information about data cartridge capacities and for an explanation of how the EXB-8500 autosizes data cartridges.

Byte 04 - Motion Threshold
The value in the Motion Threshold byte indicates the amount of data that must be in the buffer before tape motion is started for a buffered write or read operation. The value is expressed in 4-KByte increments. The default is 80h (512 KBytes). Values range from 20h to D0h (128 to 832 KBytes).

When the buffer is filled to this point during a buffered write operation, tape motion begins and data is written to the tape.

When the buffer is emptied to this point during a buffered read operation, tape motion begins and data is read, filling the empty portion of the buffer with new data from the tape.

Byte 05 - Gap Threshold

The Gap Threshold byte indicates the maximum number of consecutive gap blocks that the EXB-8500 will write on the current track while determining whether an empty buffer exists during a write operation. After writing the number of gap blocks specified by this byte, the EXB-8500 will either continue the write operation (if there is new data in the buffer) or begin the process to stop tape motion (if the buffer is still empty).

Before actually stopping tape motion, the EXB-8500 writes additional gap blocks to complete the current track and then writes one or two complete gap tracks. (See the *EXB-8500 8mm Cartridge Tape Subsystem Product Specification* for more information.)

Values returned for the Gap Threshold byte range from 00h to 07h. The default value is 07h.

13.10 Vendor Unique Parameters Page 2 (Page Code=21h)

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved		Page Code					
01	Page Length							
02	Reserved							
03	Reserved							WWR
04	Reserved							
05	Reserved							

Field Definitions

The Vendor Unique Parameters Page 2 is returned only when the Page Code field in the CDB is set to 21h or 3Fh.

Byte 00, Bits 5 through 0 - Page Code
The Page Code identifies the type of MODE SENSE page being transferred. This is Vendor Unique Parameters Page 2. The value returned for the Page Code is 21h.

Byte 01 - Page Length
The Page Length indicates the number of bytes in the Vendor Unique Parameters Page 2 that follow this byte. The value returned for this byte is 04h.

Byte 02, Byte 03, Bits 7 through 1 - Reserved
These bits and bytes are reserved.

Byte 03, Bit 0 - WWR (Write without Retries)
The WWR bit indicates whether the tape was written with retries, as follows:

0 - The tape was written with retries
1 - The tape was written with no retries.

Note: The EXB-8500 writes a tape without retries when you issue a MODE SELECT command at LBOT and set the Write Retry Count field (located on the Read-Write Error Recovery Page) to 00h. If the tape was written without retries, it should be read without retries. For this reason, if the WWR bit is 1, issue a MODE SELECT command to set Read Retry Count field (also located on the Read-Write Error Recovery Page) to 00h.

14 PREVENT/ALLOW MEDIUM REMOVAL (1Eh)

Bit Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	1	1	1	0
01	Logical Unit Number			Reserved				
02	Reserved							
03								
04								Prevent
05	Vendor Unique		Reserved				0	0

The PREVENT/ALLOW MEDIUM REMOVAL command is used to allow or disallow the removal of the data cartridge from the EXB-8500.

14.1 Field Definitions

Byte 04, Bit 0 - Prevent
The Prevent bit is used to prevent the removal of the data cartridge from the EXB-8500, as follows:

0 – Allow the data cartridge to be removed
1 – Prevent the data cartridge from being removed.

The prevent-data-cartridge-removal condition terminates when any of the following conditions occur:

- A PREVENT/ALLOW MEDIUM REMOVAL command with the Prevent bit set to 0 is received from all initiators that set the prevent condition

- The EXB-8500 is reset by a Bus Device Reset message, SCSI bus reset, or power-on reset.

Byte 05, Bits 7 and 6 - Vendor Unique
There are no vendor unique definitions for this command.

Effect of Prevent Bit on Unload Button

When the Prevent bit is set to 1, the unload button on the EXB-8500 is disabled; pressing this button does not cause the tape to be rewound or ejected.

Note: If the EXB-8500's EEPROM image includes the "super fast" unload button setting, pressing the unload button overrides the Prevent bit. That is, the EXB-8500 will eject the tape whether or not media removal has been prevented with the PREVENT/ALLOW MEDIUM REMOVAL command. Refer to Section 3.8 for more information.

Effect of Prevent Bit on UNLOAD (1Bh) Command

When the Prevent bit is set to 1, issuing an UNLOAD (1Bh) command causes the data cartridge to be unloaded but not ejected from the EXB-8500. If there is data in the write buffer, the data is written to tape. Then, the tape is rewound to PBOT and unloaded from the tape path.

15 READ (08h)

Bit Byte	7	6	5	4	3	2	1	0
00	0	0	0	0	1	0	0	0
01	Logical Unit Number			Reserved			SILI	Fixed
02	(MSB)							
03				Transfer Length				
04								(LSB)
05	Vendor Unique		Reserved				0	0

The READ command transfers one or more bytes or blocks of data from the EXB-8500 to the initiator, beginning with the next logical block.

Notes:

- For a read operation, the EXB-8500 automatically sets itself to the data format used when the tape was written (that is, to either EXB-8500 format or EXB-8200 format).
- The EXB-8500 can read tapes that have a combination of fixed-length and variable-length data blocks.
- The EXB-8500 will report the early-warning condition (LEOT reached) if the REW bit is set with the MODE SELECT command (byte 8, bit 0 in the Device Configuration Page for PF=1 format).
- If the disconnect option is enabled, the EXB-8500 can disconnect from the initiator while the READ command is executing.

15.1 Field Definitions

Byte 01, Bit 1 - SILI

The SILI (Suppress Illegal Length Indication) bit is used to suppress an illegal length Check Condition status for read operations that read logical blocks that do not contain the defined number of bytes. This bit is valid only when the read operation is for variable-length logical blocks (that is, when the Fixed bit is set to 0).

0 – Do not suppress illegal length indication Check Condition status
1 – Suppress illegal length indication Check Condition status.

Note: If the Fixed bit is 1 (fixed-length logical blocks) and the SILI bit is 1, the EXB-8500 returns Check Condition status with the sense key set to Illegal Request (5h). The ASC and ASCQ fields are set to 24h and 00h.

Byte 01, Bit 0 - Fixed

The Fixed bit defines the type of read operation being performed, as follows:

0 – A single logical block is read, and the length of this block is specified in the Transfer Length field.

1 – One or more fixed-length logical blocks are read, and the number of blocks is specified in the Transfer Length field. The length of each block is either the power-on default block length or the length specified with the currently active MODE SELECT parameters (bytes 5 through 7 of the Block Descriptor).

Note: The EXB-8500 returns Check Condition status with the sense key set to Illegal Request (5h) in the following cases:

- The Fixed field in the READ command is 0 (variable-length logical block) and the Block Length field in the current MODE SELECT data is greater than 0 (fixed-length logical blocks)
- The Fixed field in the READ command is 1 (fixed-length logical blocks) and the Block Length field in the current MODE SELECT data is 0 (variable-length logical block).

The ASC and ASCQ bits are set to 81h and 00h (fixed/variable mismatch).

Bytes 02 through 04 - Transfer Length

The Transfer Length field defines the amount of data to be read, as follows:

- When the Fixed bit is set to 0, the Transfer Length field contains the length of the logical block in bytes. The logical block can be any size from 0 to 240 Kbytes.

Note: If the ND (No Disconnect During Data Transfer) bit is set, the logical block can be any size from 0 to 160 KBytes. See Chapter 12 for more information about the ND bit.

- When the Fixed bit is set to 1, the Transfer Length field contains the number of logical blocks to be read. The block length is the length specified with the MODE SELECT command.

The allowable block sizes are defined by the READ BLOCK LIMITS (05h) command.

The data is read from the next logical block on the EXB-8500 and transferred to the initiator.

Note: When the value for the Transfer Length field is 0, no data is transferred and the current position of the EXB-8500 is not changed. A value of 0 for these bytes is not an error.

Byte 05, Bits 7 and 6 - Vendor Unique

There are no vendor unique definitions for this command.

15.2 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the READ command.

Filemark Detected

If a filemark is detected before the transfer is finished, the EXB-8500 returns Check Condition status. The Filemark bit and the Valid bit are set in the extended sense data, with the sense key set to No Sense. When the READ command terminates, the logical position is at the EOT side of the filemark encountered.

- If the Fixed bit is set to 0, the Information bytes are set to the requested transfer length.
- If the Fixed bit is set to 1, the Information bytes are set to the difference between the requested transfer length and the actual number of blocks read.

EOD Detected

If the end of data (blank tape) is detected during the read operation, the EXB-8500 returns Check Condition status. The Valid bit is set in the extended sense data, with the sense key set to Blank Check (8h). When the READ command terminates, the logical position is after the last recorded data block or filemark.

- If the Fixed bit is set to 0, the Information bytes are set to the requested transfer length.
- If the Fixed bit is set to 1, the Information bytes are set to the difference between the requested transfer length and the actual number of blocks read.

PEOT Encountered

If the physical end of tape (PEOT) is encountered, the EXB-8500 returns Check Condition status. The EOM and PEOT bits are set in the extended sense data, with the sense key set to Medium Error (3h).

When the READ command terminates, the logical position is not defined. If the Valid bit is set to 1, the Information bytes are set to either of the following:

- The requested transfer length (if the Fixed bit is set to 0).
- The difference between the requested transfer length and the actual number of blocks read (if the Fixed bit is set to 1).

Unrecoverable Error

If an unrecoverable media or hardware error occurs during the read operation, the EXB-8500 terminates the READ command and returns Check Condition status. The sense key indicates a Medium Error (3h) or Hardware Error (4h). Indicators in the extended sense data can be used to isolate the error condition.

When the READ command is terminated, the EXB-8500 is positioned after the unrecovered block for a Medium Error or in an undefined position for a Hardware Error. If the Valid bit is set to 1, the Information bytes are set to either of the following:

- The requested transfer length (if the Fixed bit is set to 0)
- The difference between the requested transfer length and the actual number of blocks read (if the Fixed bit is set to 1). The actual number does not include the unrecovered block.

In both fixed and variable block modes, the EXB-8500 may have entered the Data Phase before reporting this error.

Transfer Length Incorrect

If the actual transfer length does not match the requested transfer length, the information reported depends on the setting of the Fixed bit.

Variable Length Mode

If the Fixed bit is set to 0 and the actual length of the block on the tape does not match the transfer length requested, the EXB-8500 transfers the number of bytes available up to the transfer length requested. Then, the EXB-8500 terminates the READ command and returns Check Condition status (if the SILI bit is set to 0). The Illegal Length Indicator (ILI) bit and the Valid bit are set in the extended sense data, with the sense key set to No Sense (0h). The Information bytes indicate the difference between the actual and the requested lengths, as follows:

- If the requested length is greater than the actual length, the Information bytes are positive.
- If the requested length is less than the actual length, the Information bytes are negative (2s complement notation).

When the READ command terminates in variable mode, the tape is positioned after the block with the incorrect length (at the start of the next logical block).

Fixed Length Mode

If the Fixed bit is set to 1 and the actual length of any one block does not match the requested block length, the EXB-8500 transfers the number of blocks requested until it encounters the block with the incorrect length. Then, the EXB-8500 terminates the READ command and returns Check Condition status. The Illegal Length Indicator (ILI) bit and the Valid bit are set in the extended sense data, with the sense key set to No Sense. The Information bytes indicate the number of blocks not transferred to the initiator, including the block with the incorrect length.

When the READ command terminates in fixed mode, the tape is positioned after the block with the incorrect length (at the start of the next logical block).

Illegal Requests

The following conditions cause the EXB-8500 to return Check Condition status with the sense key set to Illegal Request (5h):

- The requested block length is greater than 240 KBytes (or 160 KBytes if the ND bit is set).
- The Fixed bit is set to 0 and the block length in the MODE SELECT command is not 0.
- The Fixed bit is set to 1 and the block length in the MODE SELECT command is 0.
- The Fixed bit is set to 1 and the SILI bit is set to 1.
- The tape is in an invalid position to perform a read operation (a READ command was issued after a WRITE or WRITE FILEMARKS command).
- The EXB-8500 is not ready or no data cartridge is loaded.

Notes:

16 READ BLOCK LIMITS (05h)

Bit Byte	7	6	5	4	3	2	1	0
00	0	0	0	0	0	1	0	1
01	Logical Unit Number			Reserved				
02	Reserved							
03								
04								
05	Vendor Unique		Reserved				0	0

The READ BLOCK LIMITS command requests that the EXB-8500 return data identifying the maximum and minimum logical block lengths supported.

The data returned by the READ BLOCK LIMITS command applies to both the variable and fixed block lengths for the READ and WRITE commands.

16.1 Field Definitions

Byte 05, Bits 7 and 6 - Vendor Unique
There are no vendor unique definitions for this command.

16.2 Read Block Limits Data

Bit / Byte	7	6	5	4	3	2	1	0
00	Reserved							
01	(MSB)							
02	Maximum Block Length							
03								(LSB)
04	(MSB)							
05	Minimum Block Length							(LSB)

The READ BLOCK LIMITS command returns to the initiator the maximum and minimum block lengths supported by the EXB-8500. The field definitions are as follows:

Bytes 01 through 03 - Maximum Block Length
The value returned for the Maximum Block Length field is 03C000h (240 KBytes). If the ND (No Disconnect During Data Transfer) bit is set to 1, the value returned is 28000h (160 KBytes). See Chapter 12 for more information about the ND bit.

Bytes 04 and 05 - Minimum Block Length
The value returned for the Minimum Block Length field is 0001h (1 byte).

17 READ BUFFER (3Ch)

Byte \ Bit	7	6	5	4	3	2	1	0
00	0	0	1	1	1	1	0	0
01	Logical Unit Number			Reserved		Mode		
02	Buffer ID							
03	(MSB)							
04	Buffer Offset							
05								(LSB)
06	(MSB)							
07	Allocation Length							
08								(LSB)
09	Vendor Unique		Reserved				0	0

The READ BUFFER command is used to copy the EXB-8500's microcode across the SCSI bus to the initiator. This command is used with the WRITE BUFFER (3Bh) command to copy the microcode from one EXB-8500 to other EXB-8500s.

To copy microcode from one EXB-8500 to another EXB-8500, follow these steps:

1. Issue a READ BUFFER command to place the EXB-8500's microcode into the correct format and to transfer the microcode image across the SCSI bus to the initiator.

2. Issue a WRITE BUFFER command to copy the microcode from the initiator to other EXB-8500s. For information about using the WRITE BUFFER command, refer to Chapter 29.

17.1 Field Definitions

Byte 01, Bits 2 through 0 - Mode
The Mode field determines the type of operation to be performed. The only operation supported by the EXB-8500 is reading the microcode image. The bits in this field must be set to 001b.

Byte 02 - Buffer ID
This field must be 0.

Bytes 03 through 05 - Buffer Offset
This field must be 0.

Bytes 06 through 08 - Allocation Length
The Allocation Length field specifies the number of bytes to be transferred across the SCSI bus. The valid value for this field is 2AE28h (175,656).

Byte 09, Bits 7 and 6 - Vendor Unique
There are no vendor unique definitions for this command.

17.2 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the READ BUFFER command.

Hardware or SCSI Bus Error

If a hardware or SCSI bus error occurs while the microcode is being transferred from the EXB-8500 to the initiator, the EXB-8500 terminates the command and returns Check Condition status. The sense key is set to Aborted Command (Bh). If this occurs, retry the operation.

Allocation Length Incorrect

If the initiator specifies a value other than 2AE28h (175,656) for the Allocation Length field, the EXB-8500 returns Check Condition status. The sense key is set to Illegal Request (5h).

18 READ POSITION (34h)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	1	1	0	1	0	0
01	Logical Unit Number			Reserved				BT
02 ⋮ 08	Reserved							
09	Vendor Unique		Reserved				0	0

The READ POSITION command reports the current position of the EXB-8500 but does not cause tape motion to occur.

The READ POSITION command is not supported for tapes written in EXB-8200 format and will result in Check Condition status with the sense key set to Illegal Request (5h). If the READ POSITION command is issued and there is no data cartridge loaded, the EXB-8500 returns Check Condition status with the sense key set to Not Ready (2h). The ASC and ASCQ fields are set to 3Ah and 00h.

18.1 Field Definitions

Byte 01, Bit 0 - BT (Block Type)
The BT bit determines the type of block number to be returned to the initiator, as follows:

0 – The SCSI logical block number is returned, numbered sequentially from the beginning of the tape

1 – An EXABYTE-unique block number is returned (currently not implemented).

Byte 09, Bits 7 and 6 - Vendor Unique
There are no vendor unique definitions for this command.

18.2 Read Position Data

Bit / Byte	7	6	5	4	3	2	1	0
00	BOP	EOP	Reserved			BPU	Reserved	
01	Partition Number							
02–03	Reserved							
04 ⋮ 07	(MSB) First Block Location (LSB)							
08 ⋮ 11	(MSB) Last Block Location (LSB)							
12	Reserved							
13 ⋮ 15	(MSB) Number of Blocks in Buffer (LSB)							
16 ⋮ 19	(MSB) Number of Bytes in Buffer (LSB)							

The data returned to the initiator by the READ POSITION command is defined as follows:

Byte 00, Bit 7 - BOP (Beginning of Partition)
When this bit is set to 1, the tape is positioned at LBOT.

Byte 00, Bit 6 - EOP (End of Partition)
When this bit is set to 1, the tape is positioned between LEOT and PEOT.

Byte 00, Bit 2 - BPU (Block Position Unknown)
When this bit is set to 1, the block position is not known and cannot be obtained without tape motion. The remainder of the data is not valid. When this bit is set to 0, the remainder of the data is valid.

Byte 01 - Partition Number
The EXB-8500 does not support multiple partitions. The value returned for this field is 0.

Bytes 04 through 07 - First Block Location

The First Block Location field indicates the block address associated with the current logical block position (that is, the block address of the next data block to be transferred between the initiator and the EXB-8500 if a READ or WRITE command is issued).

Note: If you issue a READ POSITION command immediately after issuing a REWIND immediate command (Immed bit set to 1) and you were writing data, the position returned by the EXB-8500 may still reflect where the next write operation would have occurred (not yet reset to 00 00 00 00).

Bytes 08 through 11 - Last Block Location

The Last Block Location field is not valid for the EXB-8500. The value returned for this field is 0.

Bytes 13 through 15 - Number of Blocks in Buffer

The Number of Blocks in Buffer field is not valid for the EXB-8500. The value returned for this field is 0.

Bytes 16 through 19 - Number of Bytes in Buffer

The Number of Bytes in Buffer field is not valid for the EXB-8500. The value returned for this field is 0.

Notes:

19 RECEIVE DIAGNOSTIC RESULTS (1Ch)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	1	1	0	0
01	Logical Unit Number			Reserved				
02	Reserved							
03	(MSB)			Allocation Length				
04								(LSB)
05	TD	VU	Reserved				0	0

You can use the RECEIVE DIAGNOSTIC RESULTS command for either of the following purposes:

- Obtaining the results of the tests requested by a previous SEND DIAGNOSTIC (1Dh) command.

  or

- Obtaining a trace of SCSI and servo command activity for the EXB-8500.

Note: To ensure that the diagnostic results are up-to-date and accurate, be sure that the RECEIVE DIAGNOSTIC RESULTS command immediately follows the SEND DIAGNOSTIC command and that the EXB-8500 is reserved for the initiator's exclusive use.

As described in this chapter, the bit and byte settings for the RECEIVE DIAGNOSTIC RESULTS command descriptor block depend on whether you are using the command to obtain diagnostic results data or command trace data.

19.1 Field Definitions

Bytes 03 and 04 - Allocation Length
The Allocation Length field specifies the number of bytes that the initiator has allocated for the return of RECEIVE DIAGNOSTICS RESULTS data.

- **If you are using the command to obtain diagnostic data,** the number of bytes of diagnostic data available from the EXB-8500 depends on the type of SEND DIAGNOSTIC test that was performed (see Section 19.2 for more information).

  To receive all available diagnostic information, the value in the Allocation Length field should equal the Page Length for the diagnostic page requested plus 4 bytes. A value of 0 for the Allocation Length field indicates that no diagnostic data will be returned and is not an error.

  or

- **If you are requesting a trace of SCSI and servo activity,** specify 500h for the Allocation Length field.

The EXB-8500 terminates the Data In phase when the number of bytes specified in the Allocation Length field has been transferred or when all available data has been transferred to the initiator, whichever is less.

Byte 05, Bit 7 - TD (Trace Dump)
This bit indicates whether you are requesting diagnostic data or a trace dump, as follows:

0 – Return diagnostic data (see Section 19.2 for more information).

1 – Return a trace of SCSI and servo activity (see Section 19.3 for more information).

Byte 05, Bit 6 - VU (Vendor Unique)
There is no vendor unique definition for this bit.

19.2 Returning SEND DIAGNOSTIC Data

When the initiator issues a RECEIVE DIAGNOSTIC RESULTS command with the TD bit set to 0, the EXB-8500 returns a diagnostic page. This page reports the results of the previous SEND DIAGNOSTIC command. Three types of diagnostic pages can be returned; the type of page depends on which diagnostic test was performed by the SEND DIAGNOSTIC command. As described in Section 19.3, no diagnostic page is returned if the TD (Trace Dump) bit is set to 1; rather, a trace dump is returned.

Note: To ensure that data in the diagnostic page is valid, be sure that the RECEIVE DIAGNOSTIC RESULTS command immediately follows the SEND DIAGNOSTIC command and that the EXB-8500 is reserved for the initiator's exclusive use.

Block Diagram for the Diagnostic Page

Bit / Byte	7	6	5	4	3	2	1	0
00	Page Code							
01	Reserved							
02	(MSB)			Page Length				
03								(LSB)
04 ⋮ *nn*	Diagnostic Parameters							

Field Definitions for the Diagnostic Page

Byte 00 - Page Code
The Page Code field identifies which of the three types of diagnostic pages is being returned. The EXB-8500 supports the Page Codes listed in Table 19-1.

Table 19-1 Page Codes for RECEIVE DIAGNOSTIC RESULTS Command

Page Code	Returned for...
90h	Test 100 or Test 110 (Power-on test)
91h	Test 101 or Test 111 (Power-on, write/read, and load tests)
94h	Memory Dump

Bytes 02 and 03 - Page Length

The Page Length field indicates the number Diagnostic Parameter bytes that follow this field. Table 19-2 indicates the Page Length values for each Page Code supported by the RECEIVE DIAGNOSTIC RESULTS command.

Table 19-2 Page Lengths for RECEIVE DIAGNOSTIC RESULTS Command

Page Code	Value for Page Length field	Total length of page
90h	0001h (1 byte)	5 bytes
91h	0001h (1 byte)	5 bytes
94h	0000h to 9060h (0 to 36,960 bytes)	0 to 36,964 bytes

Bytes 04 through *nn* - Diagnostic Parameters

The Diagnostic Parameters bytes start with byte 04 and are defined for each Diagnostic Page as follows:

Page Code 90h (Test 100 or Test 110)

Byte 04 - Pass/Fail Code This field indicates if the EXB-8500 passed or failed Test 100 or Test 110 (power-on test). The following are the values and meanings for this field:

00h – Passed test
01h to FFh – Failed test.

If the EXB-8500 failed the test, the value returned for the Pass/Fail Code corresponds to a Fault Symptom Code. These codes are described in Appendix E.

Page Code 91h (Test 101 and Test 111)

Byte 04 - Pass/Fail Code This field indicates if the EXB-8500 passed or failed Test 101 or Test 111 (power-on, write/read, and load tests). The following are the values and meanings for this field:

00h – Passed test
01h to FFh – Failed test.

If the EXB-8500 failed the test, the value returned for the Pass/Fail Code corresponds to a Fault Symptom Code. These codes are described Appendix E.

Page Code 94h (Memory Dump Information)

Bytes 04 through *nn* (up to 36,960 bytes) - Memory Dump Information

These bytes contain memory dump information as shown in Table 19-3.

Table 19-3 Location of Memory Dump Information

Bytes...	Contain this data...
0 to FFh	Processor on chip data
100h to 7FFFh	External RAM data
8000h to 97FFh	LSI hardware registers

Receiving a Memory Dump

This section describes the steps and bit settings for receiving complete and partial memory dumps:

Complete Memory Dump (Monitor Dump)

To receive a complete memory dump (Monitor dump), follow these steps:

1. Issue a SEND DIAGNOSTIC command with the SelfTest, DevOfL, and UnitOfL bits set to 000; the Parameter List Length set to 0000; and the MD bit set to 1.

2. Issue a RECEIVE DIAGNOSTIC RESULTS command with the Allocation Length field set to 9064h and the TD bit set to 0.

Partial Memory Dump

To receive a partial memory dump, follow these steps:

1. Issue a SEND DIAGNOSTIC command with the SelfTest, DevOfL, and UnitOfL bits set to 000 and the MD bit set to 1. Indicate the desired starting address in the Parameter List Length field (0000 to 97FFh).

2. Issue a RECEIVE DIAGNOSTIC RESULTS command with the Allocation Length field set to the desired number of bytes (less than 9064h) and the TD bit set to 0.

   Note: Nonexistent registers or uninitialized bytes will be returned as FFh.

19.3 Receiving a Trace Dump

This section describes the steps and bit settings for receiving a trace dump. Trace dumps are used for detailed fault analysis and include a history of SCSI and servo command activity for the EXB-8500.

To receive a trace dump, follow these steps:

1. Issue a SEND DIAGNOSTIC command with the SelfTest, DevOfL, and UntOfL bits set to 0 and the MD bit set to 1. The Parameter List Length field is ignored and can have any value.

2. Immediately issue a RECEIVE DIAGNOSTIC RESULTS command with the Allocation Length field set to 500h (1,280 bytes) and the TD bit set to 1.

Note: To ensure that data in the trace dump is valid, be sure that the RECEIVE DIAGNOSTIC RESULTS command immediately follows the SEND DIAGNOSTIC command and that the EXB-8500 is reserved for the initiator's exclusive use.

As shown in Table 19-4, 1,280 bytes of information are returned in the trace dump.

Table 19-4 Bytes Returned in a Trace Dump

Bytes...	Contain this data...
0 to 255	SCSI Instruction Trace Table
256 to 511	SCSI State Trace Table
512 to 1,279	Servo Instruction, Status, Extended Status Tables

As described in the next section, you can use the SCSI instruction trace table (bytes 0 to 255) to analyze SCSI command execution sequences. Interpreting the other two sections of the trace dump (bytes 256 to 1,279), however, requires more sophisticated analysis procedures that are beyond the scope of this manual.

Format of SCSI Instruction Trace Table

As shown in Figure 19-1, the first 256 bytes of the trace dump include information about SCSI commands that have been issued to the EXB-8500.

000000000000000000000000**F700E702**F712E700F716E700F71AE700F715E700
F701E700F70AE700F710E700F70AE700F70AE700F70AE700F70AE700F710E700
F717E700F600E602F61AE600F616E600F60AE600F60AE600F60AE600F60AE600
F60AE600F60AE600F60AE600F60AE600F60AE600F617E600F400E402F412E400
F416E400F401E400F408E400F408E402F408E400F408E400F716E700F71DE700**F71C**

Figure 19-1 Example SCSI Instruction Trace Table

Eight hexadecimal characters (four bytes) are returned for each command.

The first two characters or first byte (F*n*):	Indicate the SCSI ID (*n*) of the host issuing the command.
The second two characters or second byte:	Indicate the command's OP code in hexadecimal form.
The third two characters or third byte (E*n*):	Indicate the SCSI ID (*n*) of the host receiving the returned status.
The final two characters or fourth byte:	Indicate the returned status in hexadecimal form.

In the example shown in Figure 19-1, F700E702 on the first line indicates that host 7 (F7) issued a TEST UNIT READY command (OP code 00h) and received Check Condition status (02h). Similarly, F416E400 at the beginning of the fifth line indicates that host 4 issued a RESERVE UNIT command (OP code 16h) and received Good status (00h).

Note: Refer to Table 7-1 for a list of SCSI commands in OP code order. Refer to Table 7-2 for the hexadecimal values for the returned status.

Note that the command information in the SCSI instruction trace table is listed in chronological order, with information about the most recently issued SCSI command listed last. For this reason, the RECEIVE DIAGNOSTIC RESULTS (1Ch) command that resulted in the trace dump is always listed last (F71C at the end of the last line in Figure 19-1), and it does not include a returned status.

Notes:

20 RELEASE UNIT (17h)

Bit Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	0	1	1	1
01	Logical Unit Number			3rdPty	Third Party Dev ID			RSVD
02	Reserved							
03								
04								
05	Vendor Unique		Reserved				0	0

The RELEASE UNIT command releases an EXB-8500 from an initiator's exclusive use or, if third-party reservations are in effect, from another SCSI device's use. To have effect, the command must be issued by the initiator that reserved the EXB-8500 with a RESERVE UNIT (16h) command.

It is not an error to attempt to release an EXB-8500 that is not currently reserved by the current initiator, but if the EXB-8500 is reserved by another initiator, then that reservation remains in effect.

20.1 Field Definitions

Byte 01, Bit 4 - 3rdPty
The 3rdPty bit is used to release a third-party reservation, as follows:

0 – Do not release the third-party reservation
1 – Release the third-party reservation.

Byte 01, Bits 3 through 1 - Third Party Device ID
The Third Party Dev ID field indicates the SCSI ID of the device for which the EXB-8500 is reserved.

Byte 05, Bits 7 and 6 - Vendor Unique
There are no vendor unique definitions for this command.

Notes:

21 REQUEST SENSE (03h)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	0	0	0	1	1
01	Logical Unit Number			Reserved				
02	Reserved							
03								
04	Allocation Length							
05	CLRCNT	VU	Reserved				0	0

The REQUEST SENSE command requests that the EXB-8500 transfer sense data to the initiator. The EXB-8500 returns a total of 29 (1Dh) bytes of sense data to the initiator.

The sense data is valid for the Check Condition status just presented to the initiator. This sense data is preserved in the EXB-8500 for the initiator receiving the Check Condition status. Sense data is cleared when any subsequent command that is not a REQUEST SENSE or an INQUIRY (12h) command is received from the initiator receiving the Check Condition status.

21.1 Field Definitions

Byte 04 - Allocation Length
The Allocation Length field specifies the number of bytes that the initiator has allocated for returned sense data. The EXB-8500 provides a total of 29 (1Dh) bytes of sense data.

Byte 05, Bit 7 - CLRCNT
The CLRCNT bit enables the initiator to reset the Read/Write Data Error counter, the Tracking Retry counter, the Read/Write Retry counter, and the Underrun/Overrun counter. Values for the CLRCNT bit are as follows:

0 – Do not reset counters
1 – Reset counters.

If the CLRCNT bit is set to 1, the counters are reset when the REQUEST SENSE command completes. The initiator must allocate 29 (1Dh) bytes for sense data to be read in order to reset the counters.

Byte 05, Bit 6 - VU (Vendor Unique)
There is no vendor unique definition for this bit.

21.2 Extended Sense Bytes

Bit / Byte	7	6	5	4	3	2	1	0
00	Valid	Error Code						
01	Segment Number							
02	FMK	EOM	ILI	RSVD	Sense Key			
03 ⋮ 06	(MSB) Information (LSB)							
07	Additional Sense Length							
08	Reserved							
09								
10	Reserved							
11	Underrun/Overrun Counter							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Reserved							
15								
16	(MSB) Read/Write Data Error Counter (LSB)							
17								
18								
19	PF	BPE	FPE	ME	ECO	TME	TNP	LBOT
20	RSVD	TMD	WP	FMKE	URE	WEI	SSE	FE
21	RSVD	RSVD	RRR	CLND	CLN	PEOT	WSEB	WSEO
22	Reserved							
23	(MSB) Remaining Tape (LSB)							
24								
25								
26	Tracking Retry Counter							
27	Read/Write Retry Counter							
28	Fault Symptom Code							

The EXB-8500 supports the standard extended sense bytes, which are defined as follows:

Byte 00, Bit 7 - Valid
This bit is set to 1 when the data in the Information bytes (bytes 03 through 06) is valid for the command receiving the Check Condition status. The value of the Information bytes is undefined when this bit is 0.

Byte 00, Bits 6 through 0 - Error Code
A value of 70h for the Error Code field indicates that the sense data is associated with the command that received the Check Condition status. A value of 71h for the Error Code field indicates that the sense data is for a deferred error condition and is associated with an earlier command.

Byte 01 - Segment Number
Byte 01 is always 0.

Byte 02, Bit 7 - FMK (Filemark)
When set to 1, this bit indicates that the current command detected a filemark.

Byte 02, Bit 6 - EOM (End of Medium)
When set to 1, this bit indicates that the tape is at or past the early warning (logical end of tape).

Byte 02, Bit 5 - ILI (Illegal Length Indicator)
When set to 1, this bit indicates that the logical block length requested did not match the actual logical block length of the data recorded on the tape.

Byte 02, Bit 4 - RSVD
This bit is reserved.

Byte 02, Bit 3 through 0 - Sense Key
The values contained in the Sense Key field are defined in Table 21-1.

Table 21-1 Sense Key Values

Sense Key	Meaning	Explanation
0h	No Sense	Indicates that there is no specific sense key information to be reported for the designated logical unit. This occurs when a command completes successfully or returns Check Condition status with the FMK, EOM, or ILI bits set to 1.
1h	Recovered Error	This sense condition is not supported by the EXB-8500.
2h	Not Ready	Indicates that the EXB-8500 does not contain a data cartridge or that the data cartridge is not loaded. Operator intervention may be required to correct this condition.
3h	Medium Error	Indicates that the command terminated with a non-recoverable error condition that may have been caused by a flaw in the tape.
4h	Hardware Error	Indicates that the EXB-8500 detected a non-recoverable hardware failure while performing the command or during a self-test.
5h	Illegal Request	Indicates that there was an illegal parameter in the CDB or in the additional parameters supplied as data for some commands or that the EXB-8500 is in the wrong mode to execute the command.
6h	Unit Attention	Indicates that the EXB-8500 has been reset (by a power-on reset, a Bus Device Reset message, or a SCSI bus reset); that an initiator changed the MODE SELECT parameters since the last command was issued to the EXB-8500; or that the data cartridge was changed. This sense key is reported the first time any command is issued by each initiator after the condition is detected, and the requested command is not performed. This sense key is cleared when the next command other than INQUIRY or REQUEST SENSE is received by the EXB-8500.
7h	Data Protect	Indicates that a command that writes to tape was attempted on a write-protected data cartridge. The write operation is not performed.
8h	Blank Check	Indicates that EOD (blank tape) was encountered during a read, space, or locate operation.
9h	EXABYTE	This is a vendor unique sense key used by EXABYTE to indicate that a positioning error has occurred. The actual position of the EXB-8500 is undetermined and is not the expected position.
Ah	Copy Aborted	This sense condition is not supported by the EXB-8500.

Sense Key	Meaning	Explanation
Bh	Aborted Command	Indicates that the EXB-8500 aborted the command. This condition occurs when an Initiator Detected Error (05h) message is received during command execution or when a Message Reject (07h) or SCSI bus parity error is detected by the EXB-8500 during Command or Data Out phase. The initiator may be able to recover by trying the command again.
Ch	Equal	This sense condition is not supported by the EXB-8500.
Dh	Volume Overflow	Indicates that the last WRITE or WRITE FILEMARKS command reached PEOT and that data may remain in the buffer.
Eh	Miscompare	This sense condition is not supported by the EXB-8500.
Fh	Reserved	Reserved for future implementation in the ANSI SCSI standard.

Bytes 03 through 06 - Information
The Information bytes contain a value that represents the number of unprocessed blocks or bytes of data resulting from a Check Condition status for the LOCATE, READ, SPACE, VERIFY, WRITE, or WRITE FILEMARKS commands.

The value in the Information bytes is valid only when the Valid bit (byte 00, bit 7) is set to 1. When the Valid bit is set to 0, any data in these bytes is invalid.

Byte 07 - Additional Sense Length
This byte indicates the Additional Sense Length provided by the EXB-8500 excluding this byte. The value is 21 (15h) bytes.

Bytes 08 through 10 - Reserved
These bytes are reserved.

Byte 11 - Underrun/Overrun Counter

The Underrun/Overrun Counter is a dual-function counter for logging write underruns and read overruns. This counter is used to determine the number of times the initiator failed to maintain the EXB-8500 in streaming mode. It will increment any time the EXB-8500 repositions the tape after encountering an empty data buffer during a write operation or a full data buffer during a read operation.

The counter is reset to 0 after any of the following:

- A REQUEST SENSE command is issued with the CLRCNT bit (byte 05, bit 7) set to 1. Note that in order for the reset to be performed, 29 (1Dh) bytes of sense data must be read by the REQUEST SENSE command.
- The tape is loaded or rewound.
- The mode changes from write to read or from read to write.
- The EXB-8500 is reset.

The counter does not roll over from FFh to 0 but remains at FFh until reset.

Byte 12 - Additional Sense Code (ASC)

The Additional Sense Code, in conjunction with the Additional Sense Code Qualifier (byte 13), provides additional information about each sense key. Appendix D lists the possible combinations of this byte and the ASCQ byte for each sense key. Only those ASC values used by the EXB-8500 are shown in the appendix.

Byte 13 - Additional Sense Code Qualifier (ASCQ)

The Additional Sense Code Qualifier, in conjunction with the Additional Sense Code (byte 12), provides additional information about each sense key. Appendix D lists the possible combinations of this byte and the ASC byte for each sense key. Only those ASCQ values used by the EXB-8500 are shown in the appendix.

Bytes 14 and 15 - Reserved

These bytes are reserved.

Bytes 16 through 18 - Read/Write Data Error Counter
The Read/Write Data Error Counter is a dual-function counter for logging rewrites and read ECCs for recovered physical blocks (physical block size is 1KByte). The mode of operation determines what is being counted. The counter is incremented in write mode when a specific physical block is rewritten following a read-after-write failure. The counter is incremented in read mode when the physical block was reconstructed in the formatter by the Error Correction Code (ECC) operation.

The counter is reset to 0 after any of the following:

- A REQUEST SENSE command is issued with the CLRCNT bit (byte 05, bit 7) set to 1. Note that in order for the reset to be performed, 29 (1Dh) bytes of sense data must be read by the REQUEST SENSE command.
- The tape is loaded or rewound.
- The mode changes from write to read or from read to write.
- The EXB-8500 is reset.

The counter does not roll over from FFFFFFh to 0 but remains at FFFFFh until reset.

Bytes 19 through 21 - Unit Sense
For each status bit defined in the Unit Sense bytes, the normal or Good status is 0. When set to 1, these bytes indicate the condition defined for that bit, as follows. Note that the effective value for the RSVD bits is 0.

Byte 19, Bit 7 - PF (Power Fail) The EXB-8500 has been reset since the last status, or the EXB-8500 has performed an internal reset due to power-up.

Byte 19, Bit 6 - BPE (SCSI Bus Parity Error) The EXB-8500 detected a SCSI bus parity error.

Byte 19, Bit 5 - FPE (Formatted Buffer Parity Error) The EXB-8500 has detected an internal data buffer parity error.

Byte 19, Bit 4 - ME (Media Error) In write mode, this indicates a permanent write error. In read mode, this indicates an uncorrectable read error.

Byte 19, Bit 3 - ECO (Error Counter Overflow) The Read/Write Retry Counter (byte 27) has overflowed to 0.

Byte 19, Bit 2 - TME (Tape Motion Error) The EXB-8500 has detected an error while attempting to acquire tracking.

Byte 19, Bit 1 - TNP (Tape Not Present) The EXB-8500 does not have a data cartridge inserted.

Byte 19, Bit 0 - LBOT (Logical Beginning of Tape) If the cartridge is at logical beginning of tape, this bit is set for any REQUEST SENSE command.

Byte 20, Bit 7 - RSVD This bit is reserved.

Byte 20, Bit 6 - TMD (Tape Mark Detect Error) An error occurred while attempting to perform a space filemark operation, resulting in an invalid location relative to the requested location. The valid bit is set to 1, and the Information bytes (bytes 03 through 06) indicate the difference between the number of filemarks specified by the initiator and the actual number of filemarks processed by the EXB-8500. This may be a host recoverable error. The initiator needs to re-send the SPACE command with the correct number of filemarks.

This bit is valid for tapes written in EXB-8200 format only.

Byte 20, Bits 5 - WP (Write Protect) If the data cartridge is write protected, this bit is set for any REQUEST SENSE command.

Byte 20, Bit 4 - FMKE (Filemark Error) A write error occurred when the EXB-8500 was attempting to write a filemark.

Byte 20, Bit 3 - URE (Under Run Error) Hardware data formatter underrun error. (Byte 20, bit 0 also set to 1.)

Byte 20, Bit 2 - WE1 (Write Error 1) Maximum number of rewrites attempted. Media error.

Byte 20, Bit 1 - SSE (Servo System Error) Catastrophic hardware error. Servo system detected an error.

Byte 20, Bit 0 - FE (Formatter Error) Catastrophic hardware error. Data formatter detected an error.

Byte 21 - Bits 7 through 6 - RSVD These bits are reserved.

Byte 21 - Bit 5 - RRR (Reverse Retries Required) This bit is set to 1 when the EXB-8500 is forced to invoke retries in order to move the tape properly. It is reset to 0 when a new tape is loaded.

Byte 21 - Bit 4 - CLND This bit is set to 1 when the EXB-8500 has been cleaned. It is reset to 0 when the next REQUEST SENSE command is received.

Byte 21 - Bit 3 - CLN This bit is set to 1 when it is time to clean the EXB-8500. It is reset to 0 when a successful cleaning cycle is performed.

Byte 21 - Bit 2 - PEOT (Physical End of Tape) If the cartridge is at PEOT, this bit is set for any REQUEST SENSE command.

Byte 21, Bit 1 - WSEB (Write Splice Error) Write splice error. Encountered blank tape when trying to splice. Hardware error.

Byte 21, Bit 0 - WSEO (Write Splice Error) Write splice error. Overshot position when trying to splice. Hardware error.

Byte 22 - Reserved
This byte is reserved.

Bytes 23 through 25 - Remaining Tape
The Remaining Tape field indicates the amount of tape remaining in 1,024-byte physical blocks. This is the LEOT position minus the current physical position. If the position is past the LEOT, the value is negative, indicating the number of physical blocks past LEOT. If there is no data cartridge loaded, the value is 0.

Byte 26 - Tracking Retry Counter
The Tracking Retry Counter field increments when a tracking error occurs during tape motion start-up. This counter is reset to 0 after any of the following:

- A REQUEST SENSE command is issued with the CLRCNT bit (byte 05, bit 7) set to 1. Note that in order for the reset to be performed, 29 (1Dh) bytes of sense data must be read by the REQUEST SENSE command.
- The tape is loaded or rewound.
- The mode changes from write to read or from read to write.
- The EXB-8500 is reset.

Byte 27 - Read/Write Retry Counter
The Read/Write Retry Counter field increments whenever a read or write operation is unsuccessful and a recovery/retry action is performed. The counter is reset to 0 after any of the following:

- A REQUEST SENSE command is issued with the CLRCNT bit (byte 05, bit 7) set to 1. Note that in order for the reset to be performed, 29 (1Dh) bytes of sense data must be read by the REQUEST SENSE command.
- The tape is loaded or rewound.
- The mode changes from write to read or from read to write.
- The EXB-8500 is reset.

Byte 28 - Fault Symptom Code
The Fault Symptom Code field is an EXABYTE-unique byte used to indicate the specific nature of hardware and software errors or other events. Appendix E lists the errors indicated by the Fault Symptom Code byte.

Note: The Fault Symptom Code field can also be used to determine the location of errors in the MODE SELECT (15h) command. If one of the bytes sent with the MODE SELECT command contains an illegal value or if a reserved bit is set, the EXB-8500 returns Check Condition status. To determine which byte contains the error, issue a REQUEST SENSE command. The sense key will be set to Illegal Request (5h) and the Fault Symptom Code field will indicate which of the consecutively received bytes is in error.

For example, if the Block Descriptor Length field (byte 03) in the Parameter List Header is invalid, the value for the Fault Symptom Code byte would be 04h (the first byte received is byte 1 not byte 0). Note that this use of the Fault Symptom Code byte applies to the MODE SELECT command only and is not described in Appendix E.

Priorities of Sense Bytes

Multiple errors can occur simultaneously in the EXB-8500. The sense key reflects the most catastrophic error of all those occurring simultaneously. For example, if a Medium Error and a SCSI bus parity error occur simultaneously, the sense key will be set to Aborted Command (for the SCSI bus parity error).

Sense Byte Pending Status

When the EXB-8500 reports Check Condition status in response to a command from an initiator, the EXB-8500 retains the sense byte pending status, including error information and Check Condition status, for the initiator until one of the following occurs:

- Error information is reset by the next command execution that is not an INQUIRY or REQUEST SENSE command for the same initiator
- Error information is reset by a power-on reset, a Bus Device Reset message, or a SCSI bus reset condition.

Notes:

22 RESERVE UNIT (16h)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	0	1	1	0
01	Logical Unit No			3rdPty	Third Party Dev ID			RSVD
02	Reserved							
03								
04								
05	Vendor Unique		Reserved				0	0

The RESERVE UNIT command reserves the EXB-8500 for an initiator's exclusive use or, if third-party reservations are in effect, for another SCSI device's use. The reservation remains in effect until a RELEASE UNIT (17h) command is received from the same initiator or until the EXB-8500 is reset by a SCSI bus reset, a Bus Device Reset message, or a power-on reset.

It is not an error for the initiator that made the last reservation to send another identical RESERVE UNIT command.

If the EXB-8500 is reserved and any command (other than an INQUIRY (12h) or a REQUEST SENSE (03h) command) is received from another initiator, the command will not be honored. Reservation Conflict (18h) status is returned to the initiator that sent the command.

22.1 Field Definitions

Byte 01, Bit 4 - 3rdPty
The 3rdPty bit is used to request third-party reservations, as follows:

0 – A third-party reservation is not requested
1 – A third-party reservation is requested.

Byte 01, Bits 3 through 1 - Third Party Dev ID
The Third Party Dev ID field indicates the SCSI ID of the device for which the initiator is making the third-party reservation.

Byte 05, Bits 7 and 6 - Vendor Unique
There are no vendor unique definitions for this command.

Notes:

23 REWIND (01h)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	0	0	0	0	1
01	Logical Unit Number			Reserved				Immed
02	Reserved							
03								
04								
05	Vendor Unique		Reserved				0	0

The REWIND command causes the EXB-8500 to rewind the tape to the logical beginning of tape (LBOT).

Notes:

- If the disconnect option is enabled, the EXB-8500 disconnects from the initiator while the REWIND command is executing.
- If the REWIND command is received after a WRITE (0Ah) or WRITE FILEMARKS (10h) command, buffered data and filemarks are written to the tape before it is rewound.
- If an error occurs during the writing of the data in the buffer to the tape, the EXB-8500 returns Check Condition status. The rewind operation is not performed. The initiator should issue a REQUEST SENSE (03h) command to determine the cause of the error.
- If the tape is already at LBOT and there is no data in the buffer, no tape motion results.
- If a command is received by the EXB-8500 while the tape is rewinding, the EXB-8500 executes the command after LBOT is reached (default).
- If there is data in the buffer because an earlier WRITE (0Ah) command was terminated with Check Condition status, that data is discarded before the tape is rewound.

23.1 Field Definitions

Byte 01, Bit 0 - Immed
The Immed bit is used to determine when command status is returned to the initiator, as follows:

0 – Status is reported to the initiator when the REWIND command is completed

1 – Status is reported to the initiator when the REWIND command is initiated by the EXB-8500.

If the EXB-8500 buffer contains data from a previous WRITE command, the EXB-8500 disconnects from the initiator (if disconnect was enabled by the Identify message) and writes the data in the buffer to the tape.

- If the Immed bit is set to 1, the EXB-8500 reconnects to the initiator when the write operation has completed successfully. It then returns Good status and performs the rewind operation.

  Note: Completing the write operation includes emptying the buffer to tape and writing the EOD mark (EXB-8500 format tapes only). This can take up to 12 seconds.

- If the Immed bit is set to 0, the EXB-8500 reconnects and returns status when the rewind operation is complete.

Byte 05, Bit 7 and 6 - Vendor Unique
There are no vendor unique definitions for this command.

24 SEND DIAGNOSTIC (1Dh)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	1	1	0	1
01	Logical Unit Number			PF	RSVD	SelfTest	DevOfL	UntOfL
02	Reserved							
03	(MSB) Parameter List Length							
04								(LSB)
05	MD	VU	Reserved				0	0

The SEND DIAGNOSTIC command causes the EXB-8500 to perform certain self-diagnostic tests. If a test is successful, the EXB-8500 returns Good status; otherwise, it returns Check Condition status. When this command is followed by a RECEIVE DIAGNOSTIC RESULTS (1Ch) command or a REQUEST SENSE (03h) command, detailed results of these diagnostic tests are reported to the initiator.

Notes:

- To ensure that the diagnostic data returned is valid, the SEND DIAGNOSTIC command must be immediately followed by the RECEIVE DIAGNOSTIC RESULTS command.

- To ensure that the results of the diagnostic test are not destroyed by a command sent by another initiator, the EXB-8500 should be reserved for the initiator’s exclusive use.

- The initiator must support the disconnect option if you plan to use the SEND DIAGNOSTIC command because the EXB-8500 will disconnect from the initiator while the command is executing.

- The SEND DIAGNOSTIC command returns Check Condition status with the sense key set to Illegal Request (5h) and the ASC and ASCQ fields set to 53h and 02h under either of the following conditions:

  - The Prevent bit in the PREVENT/ALLOW MEDIA REMOVAL (1Eh) command is set to 1 (prevent media removal)

  - The NAL bit in MODE SELECT (15h) is set to 0 (autoloading disabled).

24.1 Field Definitions

Byte 01, Bit 4 - PF (Page Format)
The Page Format bit specifies the format of the parameter list for the SEND DIAGNOSTIC command. The EXB-8500 does not support any pages, so the valid value for this field is 0.

Byte 01, Bits 2 through 0 - SelfTest, DevOfL, UntOfL
The SelfTest, DevOfL (Device Offline), and UntOfL (Unit Offline) bits are used together to determine the test to be performed and the data to be returned to the initiator. Refer to Table 24-1 for the valid combinations of these three bits.

Bytes 03 and 04 - Parameter List Length
The Parameter List Length field is used only when the MD bit (byte 05, bit 7) is 1. If the MD bit is 0, the Parameter List Length field must be set to 0000.

As shown in Table 24-1, if the MD bit is 1 and the SelfTest, DevOfL, and UntOfL bits are set to 000, the Parameter List Length field specifies the starting address for the memory dump. Valid values for the memory dump starting address are 0000h to 97FFh.

Byte 05, Bit 7 - MD (Memory Dump)
This bit indicates if a memory dump is requested, as follows:

0 – Memory dump not requested
1 – Memory dump requested.

If the MD bit is 1, the SelfTest, DevOfL, and UntOfL bits must be 000.

Note: If the MD bit is 1 and the SelfTest, DevOfL, and UntOfL bits are not 000, the SEND DIAGNOSTIC command is rejected with Check Condition status. The sense key is set to Illegal Request (5h), and the ASC and ASCQ fields are set to 24h and 00h.

Byte 05, Bit 6 - VU (Vendor Unique)
There is no vendor unique definition for this bit.

24.2 Diagnostic Tests

Table 24-1 lists the valid combinations of the SelfTest, DevOfL, UntOfL, Parameter List Length, and MD fields in the SEND DIAGNOSTIC command and the resulting actions performed by the EXB-8500. Note that all other combinations of settings for these fields are undefined and will result in Check Condition status with the sense key set to Illegal Request.

Table 24-1 Valid Combinations of SEND DIAGNOSTIC Fields

SelfTest	DevOfL	UntOfL	Parameter List Length	MD	Type of Test
0	0	0	0 to 97FFh	1	Memory dump
1	0	0	0	0	Test 100 (Power-on tests without tape)
1	0	1	0	0	Test 101 (Power-on, write/read, and load tests without tape)
1	1	0	0	0	Test 110 (Power-on tests with tape)
1	1	1	0	0	Test 111 (Power-on, write/read, and load tests with tape)

24.3 Test Descriptions

This section describes the memory dump and each type of diagnostic test.

Memory Dump

The memory dump returns the current information from specified locations in the EXB-8500's memory. To perform a memory dump, set the SelfTest, DevOfL, and UntOfL bits to 000 and the MD bit to 1. Specify the starting address for the dump in the Parameter List Length field. Then, immediately issue a RECEIVE DIAGNOSTIC RESULTS command. Specify the number of bytes to be returned in the Allocation Length field.

Note: If the starting address specified in the Parameter List Length field combined with the number of bytes specified in the Allocation Length field results in a reference to an address greater than 97FFh, the EXB-8500 resets (wraps) the address to 0000h.

Table 24-2 indicates the values to specify for the Parameter List Length field to reference the three types of EXB-8500 memory.

Table 24-2 Values for SEND DIAGNOSTIC Command Parameter List

Memory Address	Type of Memory
0 to FFh	Processor on chip memory
100h to 7FFFh	External RAM
8000h to 97FFh	LSI hardware registers

Note: If the initiator requests more bytes than are available (that is, more than 9064h bytes), the EXB-8500 will send all available bytes and then terminate. This is not an error.

Test 100 (Power-on Tests without Tape)

During this test, the EXB-8500 performs its power-on RAM and servo diagnostic tests. The EXB-8500 returns Good status if it finds no errors. Incorrect test setup causes the EXB-8500 to return Check Condition status with the sense key set to Illegal Request.

The EXB-8500 disconnects during this test.

Note: Test 100 cancels all synchronous negotiations and erases the trace tables. In addition, the unload button is disabled during this test.

Setup for Test 100

Before starting this test, power the EXB-8500 on but do not insert a data cartridge. Issue a TEST UNIT READY (00h) command. The EXB-8500 must return Check Condition status. Then, issue a REQUEST SENSE command. The sense key should be set to Not Ready (no data cartridge present).

Test 101 (Power-on, Write/Read, and Load Tests without Tape)

During this test, the EXB-8500 first performs its power-on RAM and servo diagnostic tests. If no failures are found, the amber LED on the front panel flashes to prompt you to insert a write-enabled, “scratch” data cartridge. The EXB-8500 then loads the tape and performs the following operations:

- Writes internally generated data to the buffer
- Writes buffered data to the tape
- Rewinds the tape
- Reads data from the tape to the buffer
- Reads and verifies the data in the buffer
- Rewinds the tape.

If these operations complete successfully, the EXB-8500 returns Good status and unloads and ejects the data cartridge. (If the PREVENT MEDIUM REMOVAL command has been issued, it is overridden.) Improper test setup causes the EXB-8500 to return Check Condition status with the sense key set to Illegal Request.

The EXB-8500 disconnects during this test.

Note: Test 101 cancels all synchronous negotiations and erases the trace tables. In addition, the unload button is disabled during this test.

Setup for Test 101

Before starting this test, power the EXB-8500 on but do not insert a data cartridge. Issue a TEST UNIT READY (00h) command. The EXB-8500 must return Check Condition status. Then, issue a REQUEST SENSE command. The sense key must be set to Not Ready (no data cartridge present).

CAUTION

When performing this test, be sure to use a data cartridge that does not contain needed data (“scratch” data cartridge). Data on the tape will be destroyed during the write portion of this test.

Test 110 (Power-on Tests with Tape)

During this test, the EXB-8500 performs its power-on RAM and servo diagnostic tests. If these tests complete successfully, the EXB-8500 returns Good status and positions the tape at LBOT. Improper test setup causes the EXB-8500 to return Check Condition status with the sense key set to Illegal Request.

The EXB-8500 disconnects during this test.

Note: Test 110 cancels all synchronous negotiations and erases the trace tables. In addition, the unload button is disabled during this test.

Setup for Test 110

Before starting this test, power the EXB-8500 on and insert a write-enabled, "scratch" data cartridge. Issue a TEST UNIT READY (00h) command. The EXB-8500 must return Good status.

Test 111 (Power-on, Write/Read, and Load Tests with Tape)

During this test, the EXB-8500 first performs its power-on RAM and servo diagnostic tests. If these tests complete successfully, the EXB-8500 continues by performing the following operations:

- Writes internally generated data to the buffer
- Writes buffered data to the tape
- Rewinds the tape
- Reads data from the tape to the buffer
- Reads and verifies the data in the buffer
- Rewinds the tape.

If these operations complete successfully, the EXB-8500 returns Good status and unloads and ejects the data cartridge. (If the PREVENT MEDIUM REMOVAL command has been issued, it is overridden.) Improper test setup causes the EXB-8500 to return Check Condition status with the sense key set to Illegal Request.

The EXB-8500 disconnects during this test.

Note: Test 111 cancels all synchronous negotiations and erases the trace tables. In addition, the unload button is disabled during this test.

Setup for Test 111

Before starting this test, power the EXB-8500 on and insert a write-enabled, “scratch” data cartridge. Issue a TEST UNIT READY (00h) command. The EXB-8500 must return Good status. Then, issue a REQUEST SENSE command. The EOM and LBOT bits must be set to indicate that the tape is positioned at LBOT.

CAUTION

When performing this test, be sure to use a data cartridge that does not contain needed data. Data on the tape will be destroyed during the write portion of this test.

Note: Data created during SEND DIAGNOSTIC tests cannot be interpreted by normal EXB-8500 read operations. However, the tape can be reused for normal use.

Notes:

25 SPACE (11h)

Bit Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	0	0	0	1
01	Logical Unit Number			Reserved		Code		
02	(MSB)							
03				Count				
04								(LSB)
05	ADE	VU	Reserved				0	0

The SPACE command enables the EXB-8500 to perform forward or backward searches. The EXB-8500 can space over both fixed and variable blocks; it determines the type of spacing to use according to the type of block found on the tape.

Notes:

- If the disconnect option is enabled, the EXB-8500 can disconnect from the initiator while the SPACE command is executing.

- If a SPACE command in the reverse direction is received after a WRITE (0Ah) or WRITE FILEMARKS (10h) command, any buffered data or filemarks are written to tape before the space operation is performed. Completing the write operation includes emptying the buffer to tape and writing the EOD mark (EXB-8500 format tapes only). This can take up to 12 seconds.

  If an error occurs when the data in the buffer is being written, the EXB-8500 returns Check Condition status and the space operation is not performed. The initiator should issue a REQUEST SENSE (03h) command to determine the cause of the error.

- If the EXB-8500 has the EEPROM image for directory support and the EXB-8500 detects an EOD mark before the first filemark on tape, it spaces over the EOD mark (at high speed) and up to 20 MBytes of erase area until it finds the filemark it is seeking. For more information about directory support, refer to Section 3.3. For a sample application showing how to use the EXB-8500 directory support feature, refer to Appendix B.

25.1 Field Definitions

Byte 01, Bits 2 through 0 - Code
The Code field determines the type of space operation to be performed. Table 25-1 lists the three combinations of bit settings in the Code field that are supported by the EXB-8500.

Table 25-1 Code Values for the SPACE Command

Bit 2	Bit 1	Bit 0	Meaning
0	0	0	Space over *n* fixed- or variable-length blocks
0	0	1	Space over *n* filemarks
0	1	1	Space to end of data (valid for tapes written in EXB-8500 format only)

Bytes 02 through 04 - Count
The Count field represent the number of blocks or filemarks to be spaced over. The value of *n* determines the direction of spacing, as follows:

- A positive value of *n* in the Count field causes the EXB-8500 to space forward *n* blocks or filemarks. When the space operation is complete, the tape is logically positioned on the EOT side of the *n*th block or filemark.
- A negative value of *n* (in 2s complement notation) in the Count field causes the EXB-8500 to space backward over *n* blocks or filemarks. When the space operation is complete, the tape is logically positioned on the BOT side of the *n*th block or filemark.
- A value of 0 in the Count field causes no change in the tape position and is not an error.

Note: The Count field is ignored when spacing to end of data.

Byte 05, Bit 7 - ADE (Always Detect EOD)
The ADE bit is used only for those EXB-8500s that include the EEPROM image for directory support. By setting this bit, you can force the EXB-8500 to detect the first EOD mark on the tape, effectively disabling directory support for that command. The values for the ADE bit are as follows:

0 - The EXB-8500 should ignore the first EOD mark (as long as it is located before the first filemark on the tape).

1 - The EXB-8500 should detect the first EOD mark on the tape and should stop when the first EOD is encountered.

If you are using a SPACE command to space forward within the directory on a directory support tape, set the ADE bit to 1 to prevent the EXB-8500 from crossing from the directory to the data area of the tape. Similarly, set this bit to 1 if you are using an EXB-8500 with the directory support feature to space forward on a tape that does not include a directory.

Note: The ADE bit is ignored if the EXB-8500 does not include the directory support feature.

Byte 09, Bit 6 - Vendor Unique
There is no vendor unique definition for this bit.

25.2 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the SPACE command.

Filemark Detected

If the Code field has a value of 000 (space over *n* fixed- or variable-length blocks) and a filemark is detected during a forward search, the tape is logically positioned on the EOT side of the filemark. If a filemark is detected during a backward search, the tape is logically positioned on the BOT side of the filemark. In both cases, the EXB-8500 returns Check Condition status. The Valid and Filemark bits are set in the extended sense data, with the sense key set to No Sense (0h). The Information bytes are set to the difference between the requested number of blocks and the actual number of blocks spaced over.

Note: If an unrecoverable media error is encountered during a space backward operation, the value in the Information bytes may be a negative number (2s complement notation), indicating how many blocks toward BOT were unreadable.

EOD (Blank Tape) Detected

If the Code field has a value of 000 (space over *n* fixed- or variable-length blocks) or 001 (space over *n* filemarks) and EOD (blank tape) is detected during a search, the EXB-8500 returns Check Condition status. The Valid bit is set in the extended sense data, with the sense key set to Blank Check. The Information bytes are set to the difference between the requested number of blocks or filemarks and the actual number of blocks or filemarks spaced over. The tape is positioned so that a subsequent WRITE command can append data after the last block or filemark written before EOD (blank tape).

Note: If the EXB-8500's directory support feature is enabled, you can issue a SPACE command with the ADE bit set to 0 to move from the directory to the data area of the tape. In this case, the EXB-8500 spaces over the first EOD mark (as long as it is located before the first filemark) and does not return Check Condition status. However, when the EXB-8500 detects the second EOD mark at the end of data, it returns Check Condition status with the sense key set to Blank Check (8h).

PEOT Encountered

If the Code field has a value of 000, 001b, or 011b and the physical end of tape (PEOT) is encountered, the EXB-8500 returns Check Condition status. The EOM, Valid, and PEOT bits are set in the extended sense data, with the sense key set to Medium Error (3h). The Information bytes are set to the difference between the requested number of blocks or filemarks and the actual number of blocks or filemarks spaced over.

Note: If the Code field has a value of 011b, the Information bytes are invalid.

PBOT Encountered

If the Code field has a value of 000 or 001b and the physical beginning of tape (PBOT) is encountered, the EXB-8500 returns Check Condition status. The EOM, LBOT, and Valid bits are set in the extended sense data, with the sense key set to No Sense. The tape is positioned at LBOT. The Information bytes are set to the difference between the requested number of blocks or filemarks and the actual number of blocks or filemarks spaced over. Note that since the error was encountered during a space backward operation, the value in the Information bytes is a negative number (2s complement notation).

Unrecoverable Error

If an unrecoverable media or hardware error occurs during the space operation, the EXB-8500 terminates the SPACE command and returns Check Condition status. The sense key indicates a Medium Error (3h) or Hardware Error (4h). Indicators in the extended sense data can be used to isolate the error condition.

When the SPACE command is terminated, the position of the EXB-8500 depends on whether a forward or backward space was attempted:

- If the error occurred during a forward space, the EXB-8500 is positioned after the unrecovered block.
- If the error occurred during a backward space, the EXB-8500 is positioned before or after the unrecovered block.

If the Valid bit is set to 1, the Information bytes indicate the difference between the requested number of blocks or filemarks and the actual number of blocks or filemarks spaced over. The actual length does not include the unrecovered block. Note that the Information bytes may be positive or negative.

Illegal Requests

The following conditions cause the EXB-8500 to return Check Condition status with the sense key set to Illegal Request (5h):

- A forward space is attempted immediately after a WRITE or WRITE FILEMARKS command has been executed
- A space to EOD is attempted on a tape written in EXB-8200 format.

25.3 Spacing to EOD

If the tape is written in EXB-8500 format and the Code field has a value of 011b (space to end of data), the Count field is ignored. The forward search continues until the EXB-8500 encounters EOD. The tape is positioned so that a subsequent WRITE command can append data after the last block or filemark written before EOD.

Note: Attempting to space to EOD on a tape written in EXB-8200 format results in Check Condition status. The sense key will be set to Illegal Request (5h).

Notes:

26 TEST UNIT READY (00h)

<table>
<tr><th>Bit
Byte</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>00</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>01</td><td colspan="3">Logical Unit Number</td><td colspan="5">Reserved</td></tr>
<tr><td>02</td><td colspan="8" rowspan="3">Reserved</td></tr>
<tr><td>03</td></tr>
<tr><td>04</td></tr>
<tr><td>05</td><td colspan="2">Vendor Unique</td><td colspan="4">Reserved</td><td>0</td><td>0</td></tr>
</table>

The TEST UNIT READY command provides a means for determining if the EXB-8500 is ready to accept an appropriate medium access command.

The TEST UNIT READY command returns Good status if the EXB-8500 is ready to accept a medium access command without returning Check Condition status. The TEST UNIT READY command returns Check Condition status with the sense key set to Not Ready (2h) if the EXB-8500 is not ready to accept a medium access command.

Note: The TEST UNIT READY command is not a request for a unit self-test.

26.1 Field Definitions

Byte 05, Bits 7 and 6 - Vendor Unique
There are no vendor unique definitions for this command.

Notes:

27 VERIFY (13h)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	0	0	1	1
01	Logical Unit Number			Reserved		Immed	BytCmp	Fixed
02	(MSB)							
03	Verification Length							
04								(LSB)
05	Vendor Unique		Reserved				0	0

The VERIFY command enables the EXB-8500 to verify one or more logical blocks of data on the tape, beginning with the next logical block. When the VERIFY command is completed, the tape is positioned on the EOT side of the last block of data verified.

27.1 Field Definitions

Byte 01, Bit 2 - Immed
The immediate bit determines when command status is returned to the initiator, as follows:

0 – Status is returned to the initiator when the verify operation is complete

1 – Status is returned to the initiator when the VERIFY command is initiated by the EXB-8500.

Byte 01, Bit 1 - BytCmp
The EXB-8500 does not support byte comparison operations. The valid value for the BytCmp bit is 0.

Byte 01, Bit 0 - Fixed
The Fixed bit defines the type of verify operation to be performed, as follows:

0 – A single logical block is verified and the length of this block is specified in the Verification Length field.

1 – One or more fixed-length logical blocks are verified and the number of blocks is specified in the Verification Length field. The length of each block is either the power-on default block length or the length specified with the currently active MODE SELECT command (bytes 5 through 7 of the Block Descriptor).

Note: The EXB-8500 returns Check Condition status with the sense key set to Illegal Request (5h) in the following cases:

- The Fixed field in the VERIFY command is 0 (variable-length logical block) and the Block Length field in the current MODE SELECT data is greater than 0 (fixed-length logical blocks)
- The Fixed field in the VERIFY command is 1 (fixed-length logical blocks) and the Block Length field in the current MODE SELECT data is 0 (variable-length logical block).

The ASC and ASCQ bits are set to 81h and 00h (fixed/variable mismatch).

Bytes 02 through 04 - Verification Length
The Verification Length field defines the amount of data to be verified, as follows:

- When the Fixed bit is set to 0, the Verification Length field contains the length of the logical block in bytes. The logical block can be any size from 0 to 240 Kbytes.

  Note: If the No Disconnect During Data Transfer (ND) bit is set, the logical block can be any size from 0 to 160 KBytes. See Chapter 12 for more information.

- When the Fixed bit is set to 1, the Verification Length field contains the number of logical blocks to be verified. The block length is the length specified with the MODE SELECT command.

Note: When the value for the Verification Length field is 0, no data is verified and the current position of the EXB-8500 is not changed.

Byte 05, Bits 7 and 6 - Vendor Unique
There are no vendor unique definitions for this command.

27.2 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the VERIFY command.

Filemark Detected

If a filemark is detected before the verify operation is completed, the EXB-8500 returns Check Condition status. The Filemark bit and the Valid bit are set in the extended sense data, with the sense key set to No Sense. When the VERIFY command terminates, the logical position is on the EOT side of the filemark.

- If the Fixed bit is set to 0, the Information bytes are set to the requested verification length.
- If the Fixed bit is set to 1, the Information bytes are set to the difference between the requested verification length and the actual number of blocks verified.

EOD Detected

If EOD (blank tape) is detected during the verify operation, the EXB-8500 returns Check Condition status. The Valid bit is set in the extended sense data, with the sense key set to Blank Check. When the VERIFY command terminates, the logical position is after the last recorded data block or filemark.

- If the Fixed bit is set to 0, the Information bytes are set to the requested verification length.
- If the Fixed bit is set to 1, the Information bytes are set to the difference between the requested verification length and the actual number of blocks verified.

PEOT Encountered

If the physical end of tape (PEOT) is encountered, the EXB-8500 returns Check Condition status. The EOM and PEOT bits are set in the extended sense data, with the sense key set to Medium Error (3h).

When the VERIFY command terminates, the logical position is not defined. If the Valid bit is set to 1, the Information bytes are set to either of the following:

- The requested verification length (if the Fixed bit is set to 0)
- The difference between the requested verification length and the actual number of blocks verified (if the Fixed bit is set to 1).

Unrecoverable Error

If an unrecoverable media or hardware error occurs during the verify operation, the EXB-8500 terminates the VERIFY command and returns Check Condition status. The sense key indicates a Medium Error (3h) or Hardware Error (4h). Indicators in the extended sense data can be used to isolate the error condition.

When the VERIFY command is terminated, the EXB-8500 is positioned after the unrecovered block for a media error or in an undefined position for a hardware error. If the Valid bit is set to 1, the Information bytes are set to either of the following:

- The requested verification length (if the Fixed bit is set to 0)
- The difference between the requested verification length and the actual number of blocks verified (if the Fixed bit is set to 1). Note that the actual number does not include the unrecovered block.

In both fixed and variable block modes, the EXB-8500 may have entered the Data Phase before reporting this error.

Verification Length Incorrect

If the actual verification length does not match the requested verification length, the information reported depends on the setting of the Fixed bit.

Variable Length Mode

If the Fixed bit is set to 0 and the actual length of the block on the tape does not match the verification length requested, the EXB-8500 verifies the number of bytes available up to the verification length requested. Then, the EXB-8500 terminates the VERIFY command and returns Check Condition status. The Illegal Length Indicator (ILI) bit and the Valid bit are set in the extended sense data, with the sense key set to No Sense. The Information bytes indicate the difference between the actual and the requested lengths, as follows:

- If the requested length is greater than the actual length, the Information bytes are positive.
- If the requested length is less than the actual length, the Information bytes are negative (2s complement notation).

Fixed Length Mode

If the Fixed bit is set to 1 and the actual length of any one block does not match the requested block length, the EXB-8500 verifies the number of blocks requested until it encounters the block with the incorrect length. Then, the EXB-8500 terminates the VERIFY command and returns Check Condition status. The Illegal Length Indicator (ILI) bit and the Valid bit are set in the extended sense data, with the sense key set to No Sense. The Information bytes indicate the number of blocks not verified, including the block with the incorrect length.

When the VERIFY command terminates in either fixed or variable mode, the tape is positioned after the block with the incorrect length.

Illegal Requests

The following conditions cause the EXB-8500 to return Check Condition status with the sense key set to Illegal Request (5h):

- The Fixed bit is set to 0 and the requested block length is greater than 240 KBytes (or 160 KBytes if the ND bit is set).
- The Fixed bit is set to 0 and the block length in the MODE SELECT command is not 0.
- The Fixed bit is set to 1 and the block length in the MODE SELECT command is 0.
- A VERIFY command is issued immediately after a WRITE or WRITE FILEMARKS command has been executed.

28 WRITE (0Ah)

Bit / Byte	7	6	5	4	3	2	1	0
00	0	0	0	0	1	0	1	0
01	Logical Unit Number			Reserved				Fixed
02	(MSB)							
03				Transfer Length				
04								(LSB)
05	Vendor Unique		Reserved				0	0

The WRITE command transfers one or more bytes or blocks of data from the initiator to the EXB-8500. As described in Section 3.1, the EXB-8500 can write data in EXB-8500 format or in EXB-8200 format. The data format is set with the MODE SELECT (15h) command. Only one data format can be written on a data cartridge.

Note: If the disconnect option is enabled, the EXB-8500 can disconnect from the initiator while the WRITE command is executing.

28.1 Field Definitions

Byte 01, Bit 0 - Fixed

The Fixed bit defines the type of write operation being performed, as follows:

0 – A single logical block is written and the length of this block in bytes is specified in the Transfer Length field.

1 – One or more fixed-length logical blocks are written and the number of blocks is specified in the Transfer Length field. The length of each block is either the power-on default block length or the length specified with the currently active MODE SELECT parameters (bytes 5 through 7 of the Block Descriptor).

Note: The EXB-8500 returns Check Condition status with the sense key set to Illegal Request (5h) in the following cases:

- The Fixed field in the WRITE command is 0 (variable-length logical block) and the Block Length field in the current MODE SELECT data is greater than 0 (fixed-length logical blocks)
- The Fixed field in the WRITE command is 1 (fixed-length logical blocks) and the Block Length field in the current MODE SELECT data is 0 (variable-length logical block).

The ASC and ASCQ bits are set to 81h and 00h (fixed/variable mismatch).

Bytes 02 through 04 - Transfer Length

The Transfer Length field defines the amount of data to be written, as follows:

- When the Fixed bit is set to 0 (variable length), the Transfer Length field contains the length of the logical block in bytes. The logical block can be any size from 0 to 240 KBytes.

  Note: If the No Disconnect During Data Transfer (ND) bit is set, the logical block can be any size from 0 to 160 KBytes. See Chapter 12 for more information.

- When the Fixed bit is set to 1 (fixed length), the Transfer Length field contains the number of logical blocks to be written. The block length is the length specified with the MODE SELECT command. The allowable block sizes are defined by the READ BLOCK LIMITS (05h) command.

Note: When the value for the Transfer Length field is 0, no data is transferred and the current position of the EXB-8500 is not changed.

Byte 05, Bits 7 and 6 - Vendor Unique

There are no vendor unique definitions for this command.

28.2 Tape Positioning

This section describes the legal tape positions for a write operation.

Tape Positioned at LBOT
When writing to tape positioned at LBOT in EXB-8500 or EXB-8200 format, the EXB-8500 automatically writes a new LBOT pattern and then writes the data from the buffer. The data is written in the power-on default density or in the density specified with the currently active MODE SELECT command.

Appending Data—EXB-8500 Format Tapes
When writing to tape in EXB-8500 format, the EXB-8500 can append new data to existing data if the tape is positioned at any of the following locations:

- The beginning (BOT side) of a long filemark
- The end (EOT side) of a long filemark
- The end-of-data mark (EOD)

If the tape is not positioned at one of these locations, the EXB-8500 returns Check Condition status with the sense key set to Illegal Request.

Appending Data—EXB-8200 Format Tapes
When writing to tape in EXB-8200 format, the EXB-8500 can append new data to existing data if the tape is positioned at either of the following locations:

- The beginning (BOT side) of a long filemark
- The end of data (blank tape)

If the tape is not positioned at either of these locations, the EXB-8500 returns Check Condition status with the sense key set to Illegal Request.

28.3 Data Buffering

The EXB-8500 provides two modes of operation for the WRITE command: unbuffered and buffered. The mode of operation is set with the MODE SELECT command (byte 02, bits 6 through 4, in the Parameter List Header).

Unbuffered Write Operation
When the EXB-8500 is set for an unbuffered write operation, it returns Good status as soon as all data blocks are written to tape.

Buffered Write Operation
When the EXB-8500 is set for a buffered write operation, it returns Good status as soon as all data blocks are successfully transferred to the buffer. The data in the buffer is written to tape when one of the following conditions occurs:

- The motion threshold is reached during a WRITE command (see Section 3.2).
- The EXB-8500 receives one of the following commands:
  - REWIND (01h)
  - WRITE FILEMARKS (10h) non-immediate
  - SPACE (11h) in either direction
  - ERASE (19h)
  - LOAD/UNLOAD (1Bh)
  - LOCATE (2Bh) in the reverse direction
- The operator presses the unload button.
- The time specified for the Write Delay Time field in the MODE SELECT command elapses (note, however, if the Write Delay Time field is 0, a partially full buffer is not flushed to tape).

  Note: The Write Delay Time field can be set for PF=1 format only; see Section 12.8 for more information.

28.4 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the WRITE command.

LEOT Encountered

As described in Table 28-1 on the next page, if LEOT is encountered during a WRITE command, the action of the EXB-8500 depends on:

- The setting of the Fixed bit in the current CDB
- Whether LEOT was encountered during the current write operation or during a previous write operation (buffered mode).

Table 28-1 Action of EXB-8500 If LEOT Is Encountered during a WRITE Command

	Setting of Fixed bit in current CDB	
	Fixed=0 (variable-length logical block)	**Fixed=1 (fixed-length logical blocks)**
LEOT encountered during current write operation	The EXB-8500 returns Check Condition status after all data has been written to tape. The extended sense data is set as follows: Error Code=70h EOM=1 Sense Key=0h (No Sense) LBOT=0	The EXB-8500 returns Check Condition status after all data in the buffer and the block currently being transferred has been written to tape. The extended sense data is set as follows: Valid=1 Error Code=70h EOM=1 Sense Key=0h (No Sense) Information bytes=requested transfer length – actual number of blocks written to tape LBOT=0
LEOT encountered during previous write operation (buffered mode)	The EXB-8500 returns Check Condition status after all data has been written to tape. The extended sense data is set as follows: Error Code=70h EOM=1 Sense Key=0h (No Sense) LBOT=0	The EXB-8500 returns Check Condition status but does not transfer any data. The extended sense data is set as follows: Valid=1 Error Code=71h (error associated with previous command) EOM=1 Sense Key=0h (No Sense) Information bytes=requested transfer length ASC and ASCQ=00h 00h LBOT=0

Encountering LEOT Because of a Previous WRITE Command

To understand how LEOT can be encountered because of a previous WRITE command, consider the following hypothetical situation.

> **Important**
>
> If LEOT is encountered as a result of a previous WRITE command, the EXB-8500 may write as much as 1 MByte of data after LEOT before reporting this condition (this represents the full contents of the buffer). As a result, the tape may be as much as 1 MByte closer to PEOT than it would be if LEOT had been encountered during the current WRITE operation.

Assumptions For the purposes of this example, assume the following:

- The initiator is issuing a series of buffered WRITE commands. Each WRITE command transfers 100 fixed-length blocks, and each block is 1-KByte long (that is, each WRITE command transfers 100 KBytes of data).
- The motion threshold is set to its default value of 512 KBytes (80h).
- The EXB-8500's buffer is empty.
- Tape tension has been released, but drum motion has not been suspended. It will take approximately 1.5 seconds to re-tension the tape before data can be written.
- Less than 2 KBytes of space exist between the current tape position and LEOT.

Example

1. The initiator issues five buffered WRITE commands to the EXB-8500 (WRITE 1 through WRITE 5). The 500 KBytes of data associated with these commands is transferred to EXB-8500's buffer, but it does not cause tape motion to begin (this is because the 512-KByte motion threshold has not been exceeded).

   After receiving the data for each command, the EXB-8500 returns Good status to the initiator, indicating that the command completed successfully.

2. The initiator issues a sixth buffered WRITE command to the EXB-8500 (WRITE 6). The 100 KBytes of data associated with this command exceeds the motion threshold and causes the EXB-8500 to re-tension the tape.

   The EXB-8500 returns Good status to the initiator, indicating that the command completed successfully.

3. While the tape is being re-tensioned, the initiator issues two more buffered WRITE commands to the EXB-8500 (WRITE 7 and WRITE 8). The data associated with these commands is transferred to the EXB-8500's buffer; however, none of the data in the buffer has been written to tape yet.

   These commands also receive Good status.

4. After the tape is re-tensioned, the data associated with the first two WRITE commands (WRITE 1 and WRITE 2) is transferred from the buffer to tape.

5. As the EXB-8500 writes the data associated with WRITE 2 to tape, it encounters LEOT. As a result, the next WRITE command (WRITE 9) terminates abnormally and receives Check Condition status. The extended sense data is set as follows:

   - Valid = 1
   - Error Code = 71h (error associated with previous command)
   - EOM = 1
   - Sense Key = 0h (No Sense)
   - Information bytes = requested transfer length
   - ASC and ASCQ = 00h 00h. This indicates that no error occurred, but the initiator should note that PEOT is closer than would otherwise be expected. See "Important" on the previous page.
   - LBOT = 0.

6. The remaining data in the buffer (from WRITE 3 through WRITE 8) is written to tape. Thus, the tape is between 600 and 700 KBytes closer to PEOT than it would be if LEOT had been encountered during the current write operation.

WRITE Command Issued after LEOT Encountered

Issuing a WRITE command after LEOT is encountered causes the EXB-8500 to go into unbuffered mode and to return Check Condition status after all of the data is written to tape. The EOM bit is set to 1 and the LBOT bit is set to 0 in the extended sense data, with the sense key set to No Sense. The Valid bit is not set, which indicates that all data was written to tape.

PEOT Encountered

If the physical end of tape (PEOT) is encountered, the EXB-8500 returns Check Condition status and terminates the WRITE command. The PEOT bit (byte 21, bit 02) is set in the extended sense data and the sense key is set to Volume Overflow (Dh).

If the Valid bit is set to 1, the Information bytes are set to either of the following:

- The requested transfer length (if the Fixed bit is set to 0)
- The difference between the requested transfer length and the actual number of blocks written (if the Fixed bit is set to 1).

Write-Protected Data Cartridge

If a write operation is attempted on a data cartridge that is write protected, the EXB-8500 returns Check Condition status with the sense key set to Data Protect (7h).

Unrecoverable Error

If an unrecoverable media or hardware error occurs during the write operation, the EXB-8500 terminates the WRITE command and returns Check Condition status. The sense key indicates a Medium Error (3h) or Hardware Error (4h). Indicators in the extended sense data can be used to isolate the error condition.

If the Valid bit is set to 1, the Information bits are set to either of the following:

- The requested transfer length (if the Fixed bit is set to 0)
- The difference between the requested transfer length and the actual number of blocks written to the tape (if the Fixed bit is set to 1).

If another WRITE command is issued after an unrecoverable error occurs, the EXB-8500 returns Check Condition status with the sense key set to Medium or Hardware error and the command is not executed.

Illegal Requests

The following conditions cause the EXB-8500 to return Check Condition status with the sense key set to Illegal Request (5h):

- The Fixed bit is set to 0 and the requested block length is greater than 240 KBytes (or greater than 160 KBytes with the ND bit set to 1).
- The Fixed bit is set to 0 and the block length in the MODE SELECT command is not 0.
- The Fixed bit is set to 1 and the block length in the MODE SELECT command is 0.
- The tape position is invalid.
- A READ (08h), LOCATE (2Bh) in a forward direction, or VERIFY (13h) command is issued after the WRITE command is issued.

29 WRITE BUFFER (3Bh)

<table>
<tr><th>Bit
Byte</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>00</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>01</td><td colspan="3">Logical Unit Number</td><td colspan="2">Reserved</td><td colspan="3">Mode</td></tr>
<tr><td>02</td><td colspan="8">Buffer ID</td></tr>
<tr><td>03</td><td colspan="8" rowspan="3">(MSB)
Buffer Offset
(LSB)</td></tr>
<tr><td>04</td></tr>
<tr><td>05</td></tr>
<tr><td>06</td><td colspan="8" rowspan="3">(MSB)
Parameter List Length
(LSB)</td></tr>
<tr><td>07</td></tr>
<tr><td>08</td></tr>
<tr><td>09</td><td>WBF</td><td>VU</td><td colspan="4">Reserved</td><td>0</td><td>0</td></tr>
</table>

The WRITE BUFFER command allows you to load new microcode from the SCSI bus into the EXB-8500's control memories. By setting the WBF bit (byte 09, bit 7), you can specify that you are using one or more WRITE BUFFER commands to download new microcode.

Note: You may want to issue more than one WRITE BUFFER command if the initiator has less than 176 KBytes of buffer space available.

When the WRITE BUFFER command or command sequence is executed, the microcode is transferred from the SCSI bus to the EXB-8500's RAM buffer. Then, the image in the buffer is validated. During validation, the microcode is checked for the following:

- Correct header format.
- Proper number of files.
- Correct format for each "line." Each line of code bytes must have a proper address, data type, and checksum.
- CRC match.
- Hardware/boot code support for new microcode version.

If the new microcode passes these tests, it is loaded into the EXB-8500's control memories.

Once the microcode is downloaded, the machine state (including MODE SELECT parameters) is set to the new power-on defaults, and the EXB-8500 performs its power-on self-test.

Cautions for Using the WRITE BUFFER Command

Be sure to follow these cautions when issuing the WRITE BUFFER command.

CAUTION

- The WRITE BUFFER command allows you to load new microcode from the SCSI bus into the EXB-8500. It is not intended to be used for testing EXB-8500 functionality (that is, do not issue this command unless you are actually loading new microcode).
- Be sure that the EXB-8500 is reserved for the initiator's exclusive use while the WRITE BUFFER command or command sequence is executing.
- Do not send other SCSI commands, such as TEST UNIT READY, to the EXB-8500 while the WRITE BUFFER command or command sequence is executing.
- Do not power off or reset the EXB-8500 while this command is executing.

If a reset, hardware failure, or power failure occurs during the execution of this command, the EXB-8500 may not be able to operate. If this occurs, use the CTS Monitor program to reload microcode (from a *.BIN file) through a serial cable attached to the Monitor port. (See the *Monitor User's Guide for the 8mm Cartridge Tape Subsystem* for complete instructions.)

Note: If there is a tape in the EXB-8500, it will be unloaded and ejected.

Time Required to Load Code with WRITE BUFFER

As shown in Table 29-1, just over one minute is required to load new microcode from the SCSI bus using a single WRITE BUFFER command.

Note: Slightly more time may be required to load new microcode using several WRITE BUFFER commands. This increase in time is related to host overhead.

Table 29-1 Time Required to Load Code with WRITE BUFFER Command

Step	Time required (seconds)
Transfer the data across the SCSI bus	4
Validate image in buffer	19
Load new code into flash EPROMs	16
Perform a power-on reset and self-test	32
TOTAL	**71 (approx.)**

After the new code has been downloaded successfully, the EXB-8500 returns Good status to the initiator that issued the WRITE BUFFER command. It returns Check Condition status with the sense key set to Unit Attention (6h) to commands sent by other initiators. The ASC and ASCQ fields will be set to 3Fh and 01h, and the Fault Symptom Code will be C3h.

29.1 Field Definitions

Byte 01, Bits 2 through 0 - Mode
The Mode field determines the type of operation to be performed. The only operation supported by the EXB-8500 is downloading and saving the microcode. The bits in this field must be set to 101b.

Byte 02 - Buffer ID
This field must be 0.

Bytes 03 through 05 - Buffer Offset

The value you specify for the Buffer Offset field depends on whether you are issuing one WRITE BUFFER command or several WRITE BUFFER commands, as follows:

- If you are using one WRITE BUFFER command, set this field to 0.
- If you are using more than one WRITE BUFFER command, set this field to the total number of bytes sent by the previous WRITE BUFFER commands in the command sequence.

Bytes 06 through 08 - Parameter List Length

The Parameter List Length field specifies the number of bytes to be transferred by the current WRITE BUFFER command. The value you specify for this field depends on whether you are issuing one WRITE BUFFER command or several WRITE BUFFER commands, as follows:

- If you using only one WRITE BUFFER command to download new microcode, specify exactly 2AE28h (175,656 bytes) for the Parameter List Length.
- If you are using more than one WRITE BUFFER command to download new microcode, specify a multiple of 400h for each Parameter List Length (must be greater than 0). Be sure to set the WBF bit to 1. Then, for the last WRITE BUFFER command in the sequence, set the Parameter List Length to the remaining length (that is, set it to 2AE28h minus the total of the previous Parameter List Lengths). Set the WBF bit to 0.

Note: The Parameter List Length for the last WRITE BUFFER command does not need to be a multiple of 400h, but it must be greater than 0.

Byte 09, Bit 7 - WBF (WRITE BUFFERs Follow)

The WBF bit specifies whether the new microcode is being sent using one or more WRITE BUFFER commands, as follows:

0 – This is the only WRITE BUFFER command, or this is the last WRITE BUFFER command in a sequence.

1 – This is one of several (but not the last) WRITE BUFFER commands in a sequence.

For each setting of the WBF bit, the Parameter List Length field (bytes 06-08) specifies the number of bytes to be transferred by the current command.

Byte 09, Bit 6 - VU (Vendor Unique)

There is no vendor unique definition for this bit. This bit must be 0.

29.2 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the WRITE BUFFER command.

Aborting a WRITE BUFFER Command or Command Sequence

To terminate a WRITE BUFFER command or an entire sequence of WRITE BUFFER commands, send an Abort message to the EXB-8500. This will reset the EXB-8500. Then, reissue the WRITE BUFFER command or the entire sequence of WRITE BUFFER commands.

Microcode Not Valid

If the data downloaded from the SCSI bus is not valid, the EXB-8500 returns Check Condition status with the sense key set to Medium Error (3h). The EXB-8500 will not attempt to load the new code. If this occurs, make sure you have the correct file and try again or load new microcode using a microcode update tape (refer to Chapter 5) or the CTS Monitor program (refer to the *Monitor User's Guide*).

Fatal Load Error

Once the load process is started, it is irreversible. If a hardware or power failure occurs during the load operation, the EXB-8500 may not be able to operate. In this event, use the CTS Monitor program to reload the microcode through the Monitor port. (Refer to the *Monitor User's Guide* for complete instructions.)

Illegal Request

If you issue a command other than WRITE BUFFER, INQUIRY, or REQUEST SENSE to the EXB-8500 during a WRITE BUFFER command sequence, the EXB-8500 terminates the command with Check Condition status. The sense key is set to Illegal Request (5h), and the ASC and ASCQ are set to 00h 00h. The Fault Symptom Code is set to EBh.

Notes:

30 WRITE FILEMARKS (10h)

Bit Byte	7	6	5	4	3	2	1	0
00	0	0	0	1	0	0	0	0
01	Logical Unit Number			Reserved			WSmk	Immed
02	(MSB)							
03	Number of Filemarks							
04								(LSB)
05	Short	VU	Reserved				0	0

The WRITE FILEMARKS command causes the EXB-8500 to write any data remaining in the buffer to tape and then to write one or more filemarks to tape.

Note: If the disconnect option is enabled, the EXB-8500 can disconnect from the initiator while the WRITE FILEMARKS command is executing.

30.1 Field Definitions

Byte 01, Bit 1 - WSmk
This bit is not supported by the EXB-8500. The valid value for this bit is 0.

Byte 01, Bit 0 - Immed
The Immediate bit is used to determine when command status is returned to the initiator, as follows:

0 – Status is reported to the initiator when the WRITE FILEMARKS command is completed. All buffered data and filemarks are written to the tape before the command is completed.

> **Note:** In EXB-8500 format, filemarks can be buffered. Each buffered filemark uses 1 KByte of the EXB-8500’s 1-MByte buffer.

1 – Status is reported to the initiator when the WRITE FILEMARKS command is initiated by the EXB-8500. This mode is valid only if buffered mode is returned in the MODE SENSE parameter header.

> **Note:** When the Density Code indicates EXB-8200 format, the Immediate bit is ignored and assumed to be 0.

Bytes 02 through 04 - Number of Filemarks

The Number of Filemarks field specifies the number of filemarks to be written to tape. A value of 0 for the Number of Filemarks field is not an error and results in either of the following:

- If the value for the Number of Filemarks field is 0 and the Immed bit is set to 0, no filemarks are transferred and the data in the buffer is written to the tape.
- If the value of the Number of Filemarks field is 0 and the Immed bit is set to 1, no operation is performed and Good status is returned.

Byte 05, Bit 7 - Short

The Short bit determines the size of the filemark written to tape by the EXB-8500, as follows:

- If the EXB-8500 is writing information in EXB-8500 format, set the Short bit to 0 to write an EXB-8500 long filemark (48 KBytes). Set the Short bit to 1 to write an EXB-8500 short filemark (1 KByte).
- If the EXB-8500 is writing information in EXB-8200 format, set the Short bit to 0 to write an EXB-8200 long filemark (2,160 KBytes). Set the Short bit to 1 to write an EXB-8200SX short filemark (184 KBytes).

Refer to Table 3-2 for more information about long, short, and EXB-8200SX short filemarks.

Byte 05, Bit 6 - VU (Vendor Unique)

There are no vendor unique definitions for this bit.

30.2 Tape Positioning

This sections describes the legal tape positions for a write filemarks operation.

Tape Positioned at LBOT
When writing to tape positioned at LBOT in EXB-8500 or EXB-8200 format, the EXB-8500 automatically writes a new LBOT pattern and then writes the requested number of filemarks.

Appending Filemarks—EXB-8500 Format Tapes
When writing to tape in EXB-8500 format, the EXB-8500 can append filemarks to existing data if the tape is positioned at any of the following locations:

- The beginning (BOT side) of a long filemark
- The end (EOT side) of a long filemark
- The end-of-data mark (EOD)

If the tape is not positioned at one of these locations, the EXB-8500 returns Check Condition status with the sense key set to Illegal Request (5h).

Appending Filemarks—EXB-8200 Format Tapes
When writing to tape in EXB-8200 format, the EXB-8500 can append filemarks to existing data if the tape is positioned at either of the following locations:

- The beginning (BOT side) of a long filemark
- The end of data (blank tape)

If the tape is not positioned at either of these locations, the EXB-8500 returns Check Condition status with the sense key set to Illegal Request (5h).

30.3 Exceptions and Error Conditions

The following exceptions and error conditions can occur with the WRITE FILEMARKS command.

Write-Protected Data Cartridge

If a write filemarks operation is attempted on a data cartridge that is write protected, the EXB-8500 returns Check Condition status with the sense key set to Data Protect (7h).

LEOT Encountered

If the logical end of tape (LEOT) is encountered, the EXB-8500 attempts to write all of the filemarks requested and then returns Check Condition status. The EOM bit is set to 1 and the LBOT bit is set to 0 in the extended sense data, with the sense key set to No Sense. If the EXB-8500 has successfully written all of the data in the buffer and the requested number of filemarks to tape, the Valid bit is not set.

Issuing a WRITE FILEMARKS command after LEOT is encountered causes the EXB-8500 to return Check Condition status after the command is completed. The EOM bit is set to 1 and the LBOT bit is set to 0 in the extended sense data, with the sense key set to No Sense. If the EXB-8500 has successfully written all of the data in the buffer and the requested number of filemarks to tape, the Valid bit is set.

PEOT Encountered

If the physical end of tape (PEOT) is encountered, the EXB-8500 terminates the WRITE FILEMARKS command and returns Check Condition status. The EOM and PEOT bits are set in the extended sense data, with the sense key set to Volume Overflow (Dh).

If the Valid bit is set to 1, the Information bytes contain the difference between the requested number of filemarks and the actual number of filemarks written.

Unrecoverable Error

If an unrecoverable media or hardware error occurs during the write filemarks operation, the EXB-8500 terminates the WRITE FILEMARKS command and returns Check Condition status. The sense key indicates a Medium Error (3h) or Hardware Error (4h). Indicators in the extended sense data can be used to isolate the error condition.

If the Valid bit is set to 1, the Information bytes contain the difference between the requested number of filemarks and the actual number of filemarks written.

If another WRITE FILEMARKS command is issued after an unrecoverable error occurs, the EXB-8500 returns Check Condition status with the sense key set to Medium Error or Hardware Error and the command is not executed.

Notes:

Appendixes

Appendix A Cable Requirements

This appendix lists the requirements for the SCSI cable and the power cable for the EXB-8500. It also lists the power supply requirements.

Requirements for the SCSI Cable

The SCSI cable for connecting the EXB-8500 to the host is not provided with the EXB-8500. You must provide a cable that complies with the appropriate safety and regulatory agency requirements. To comply with FCC, CSA, and VDE rules, the EXB-8500 requires shielded cables when the cables are external to the mounting enclosure.

Note: The SCSI cable requirements depend on whether you are using a single-ended or differential SCSI configuration.

General Requirements

Ideally, to match the cable terminators, the cable should have a characteristic impedance of 122 ohms (differential) or 132 ohms (single-ended). However, since cables with this high of a characteristic impedance are not generally available, somewhat lower impedances are acceptable. A characteristic impedance of 100 ohms ± 10% is recommended for unshielded flat or twisted-pair ribbon cable. A characteristic impedance greater than 90 ohms is recommended for shielded cables.

Note: To minimize discontinuities and signal reflections, ensure that cables used on the same bus have the same impedances.

A minimum conductor size of 28 AWG is recommended to minimize noise effects and ensure proper distribution of terminator power.

Table A-1 shows the recommended general specifications for the cable.

Table A-1 Specifications for the SCSI Cable

Standard Construction	50-conductor (25 twisted pairs)
Primary Conductors	#28 AWG minimum
Fast Synchronous Data Transfer	
Signal Attenuation	Less than 6 dB per 100 feet 0.095 dB max per meter at 5 MHz
Pair-to-pair Propagation Delay Delta	0.20 nanoseconds maximum per meter
DC Resistance	0.230 ohms maximum per meter at 20° C

Cables for Differential SCSI Configurations

For differential SCSI configurations, use a 50-conductor flat cable or 25-signal twisted-pair bus. Ensure that the length of the cable does not exceed 25.0 meters (82.02 feet).

A stub length of no more than 0.2 meters (8 inches) is allowed off the mainline interconnection within any connected equipment.

Cables for Single-Ended SCSI Configurations

For single-ended SCSI configurations, use a 50-conductor flat cable or 25-signal twisted-pair bus. Ensure that the length of the cable does not exceed 6.0 meters (19.68 feet).

A stub length of no more than 0.1 meters (4 inches) is allowed off the mainline interconnection within any connected equipment.

Requirements for the SCSI Cable Connector

The SCSI connector (labeled P3) is located at the rear of the EXB-8500. The connector is a 50-pin male ribbon cable connector, consisting of two rows of 25 pins with adjacent pins 2.54 mm (0.1 inch) apart. The connector has locking/ejector tabs. The stub length within the device is less than 50 mm.

To connect the EXB-8500 to the SCSI bus, use a 50-pin female ribbon cable connector (Amphenol® No. 1-7462855-0 or equivalent). Table A-2 shows the connector pin assignments for differential EXB-8500s; Table A-3 shows the connector pin assignments for single-ended EXB-8500s.

Table A-2 Connector Pin Assignments for Differential EXB-8500s

Signal	Pin Number		Signal
SHIELD GROUND	1	2	GROUND
+DB(0)	3	4	–DB(0)
+DB(1)	5	6	–DB(1)
+DB(2)	7	8	–DB(2)
+DB(3)	9	10	–DB(3)
+DB(4)	11	12	–DB(4)
+DB(5)	13	14	–DB(5)
+DB(6)	15	16	–DB(6)
+DB(7)	17	18	–DB(7)
+DB(P)	19	20	–DB(P)
DIFFSENS	21	22	GROUND
GROUND	23	24	GROUND
TERMPWR	25	26	TERMPWR
GROUND	27	28	GROUND
+ATN	29	30	–ATN
GROUND	31	32	GROUND
+BSY	33	34	–BSY
+ACK	35	36	–ACK
+RST	37	38	–RST
+MSG	39	40	–MSG
+SEL	41	42	–SEL
+C/D	43	44	–C/D
+REQ	45	46	–REQ
+I/O	47	48	–I/O
GROUND	49	50	GROUND

Table A-3 Connector Pin Assignments for Single-ended EXB-8500s

Signal	**Pin Number***
+DB(0)	2
+DB(1)	4
+DB(2)	6
+DB(3)	8
+DB(4)	10
+DB(5)	12
+DB(6)	14
+DB(7)	16
+DB(P)	18
GROUND	20
GROUND	22
GROUND	24
TERMPWR	26
GROUND	28
GROUND	30
–ATN	32
GROUND	34
–BSY	36
–ACK	38
–RST	40
–MSG	42
–SEL	44
–C/D	46
–REQ	48
–I/O	50

* All odd pins except pin 25 are connected to ground. Pin 25 is left open.

Requirements for the Power Cable Connector

The power connector used in the EXB-8500 is compatible with the power connector used for standard 5.25-inch devices. To connect the EXB-8500 to a power cable, use an AMP 1-480424-0 series or equivalent female connector.

Table A-4 lists the pin assignments for the EXB-8500's power connector (AMP 641737-1).

Table A-4 Pin Assignments for the EXB-8500 Power Connector

Pin No.	Assignment
1	+12 VDC
2	Ground, 12 VDC return
3	Ground, 5 VDC return
4	+5 VDC

Notes:

Appendix B EXB-8500 Directory Support

The EXB-8500's directory support feature enables you to maintain a directory that indicates where various data sets are located on the tape. You can use this directory to find out what data is on the tape and to locate that data quickly and efficiently.

The sample application in this appendix provides information about using the EXB-8500's directory support feature. The application uses the READ POSITION (34h) and LOCATE (2Bh) commands to implement directory support, but you can use the SPACE (11h) command as well.

Note: The EXB-8500 directory support feature is an option requiring a special EEPROM image available from EXABYTE. This EEPROM image is not included in standard EXB-8500s.

Overview of EXB-8500 Directory Support

The sample application in this appendix shows one method for creating a tape that uses the EXB-8500's directory support feature. Figure B-1 shows how the information will be arranged on a tape that was created using this method.

Figure B-1 Typical Arrangement of Information on a Directory Support Tape

The components in Figure B-1 are as follows:

- **LBOT** is the logical beginning of tape.
- **MASTER DIR** is the master directory for the tape. The master directory contains data from READ POSITION commands that points to the locations of other directories on the tape.
- **EOD 1** is the first end-of-data mark on the tape. This EOD is automatically written at the end of the master directory when you rewind the tape to LBOT.
- **PAD** is an area on tape that accounts for the space required to create and update the master directory.
- **LFM** is a long filemark separating the master directory and pad space from the data sets written to the tape.

- **DS 1** through **DS *n*** are data sets containing groups of data files.
- **DIR 1** through **DIR *n*** are directories for data sets DS 1 through DS *n*. These directories contain data from READ POSITION commands that points to the locations of the individual files within each data set.
- **EOD 2** is the second end-of-data mark on the tape. This EOD is automatically written after the last data set directory when you rewind the tape.

Sample Application for Directory Support

The step-by-step description that follows explains how to create this data structure and access the data using the READ POSITION and LOCATE commands.

Restrictions on Similar Applications

The sample application in this appendix demonstrates only a suggested implementation of directory support. You may choose to implement directory support in any manner that fits your needs, with the following restrictions:

- Do not include filemarks in the master directory. The first filemark on the tape must be the one written at the end of the pad created after the space for the master directory.
- The master directory must be 20 MBytes or less in length.
- To ensure that no two logical blocks on a directory support tape have the same logical block address, the number of logical blocks (records) in the master directory must be less than the number of logical blocks used to create the pad areas. For this reason, you may find it helpful to write fixed-length blocks of 1 KByte (or less) in length when you are creating the pad areas.

Converting EXB-8200 Drivers

EXB-8200 directory support drivers should work for EXB-8500 directory support with only a few modifications. These modifications include the following:

- Any filemarks in the directory must be removed.
- Directories must be less than 20 MBytes.
- More logical blocks must be used to create the pad areas than are actually used to write the master directory. (Note that this restriction does not apply if you use SPACE commands only.)
- Any references to the EXB-8200SX's SHOW BLOCK and FIND BLOCK commands should be changed to READ POSITION and LOCATE.

Writing Data for Directory Support

To write data to make use of the EXB-8500's directory support feature and the READ POSITION and LOCATE commands, follow these steps:

1. At LBOT, create a directory pad by writing "filler" data (data that you do not intend to store) to tape. This reserves an area of tape for the master directory that will list the location of the data sets on tape.

LBOT	DIRECTORY PAD

   The directory pad can be up to 20 MBytes in length. It should be big enough to store the following:

   — The names of all of the data sets you plan to store on the tape (plan for the maximum number of data sets and assume that each data set will use the longest allowable name)

   — Four bytes of READ POSITION data for each data set on tape

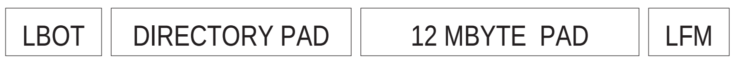
Note: For best results, use 1 KByte (or smaller) fixed-length blocks to create the directory pad.

   Eventually, this directory pad will be overwritten by the master directory for the tape.

2. Using additional “filler” data, create a second pad after the directory pad. The minimum size for the second pad is 12 MBytes. This pad allows room for the erase head position and the EOD mark written when you rewind the tape after updating the master directory.

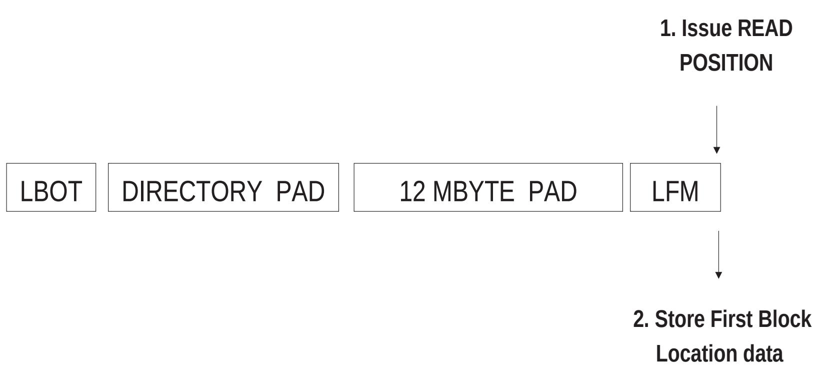
Note: For best results, use 1 KByte (or smaller) fixed-length blocks to create the second pad.

3. Write a long filemark after the 12-MByte pad. This filemark provides a clear separation between the pad area and the data area.



4. Issue a READ POSITION command to determine the EXB-8500’s current position. This will be the starting location for the first file in the first data set (DS 1).

   In the initiator’s memory, store the information returned for the First Block Location field (bytes 04 through 07) of the READ POSITION data. This information will be used later to update the directory for the data set (DIR 1).



5. Write the first data set (DS 1) to the tape. While the data set is being written, issue additional READ POSITION commands as desired to obtain the locations of individual files, blocks, and so on contained in the data set.

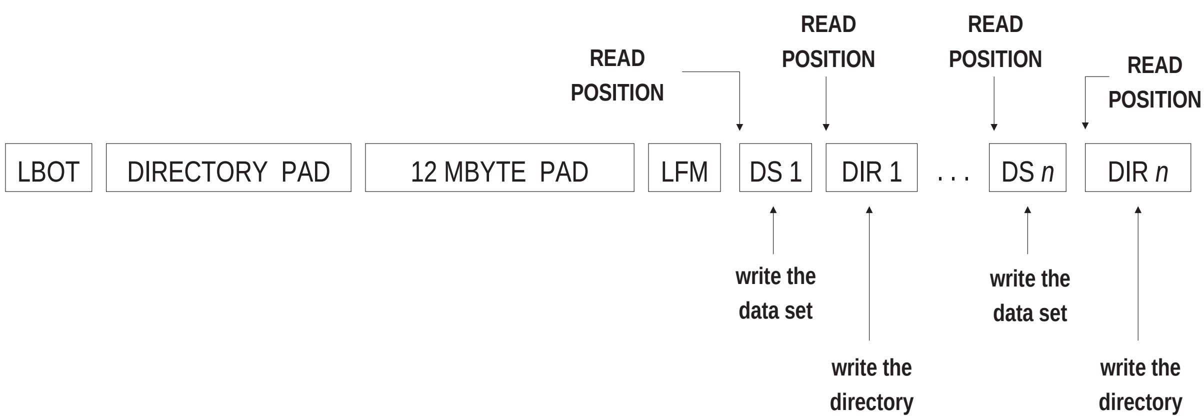
   Save the data returned for each READ POSITION command; it will be written later to the data set's directory (DIR 1).

6. Once the first data set (DS 1) has been written, issue another READ POSITION command to obtain the starting location for the first data set's directory (DIR 1).

   Save the information returned for the First Block Location field (bytes 04 through 07) of the READ POSITION data. This information will be used later to update the master directory at the beginning of the tape.

7. Write the READ POSITION data obtained for the various files and blocks in the first data set (DS 1) to the first data set's directory (DIR 1).

8. Repeat steps 4 through 7 for successive data sets until the tape is full or until there is no more data to be written.

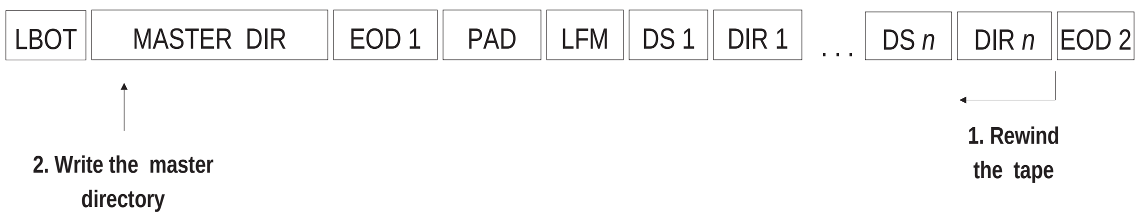


9. Rewind the tape to LBOT. This creates an EOD mark after the last data on the tape (EOD 2).

10. Create a master directory in the directory pad at the beginning of the tape. Write the data returned from the READ POSITION command issued in step 6 (and each iteration of that step) to this directory. The amount of data you can write to this directory is limited to the size of the directory pad (no more than 20 MBytes).

    The resulting master directory lists the starting location of the directory (DIR *n*) for each data set on the tape.

11. Rewind the tape to LBOT. This creates an EOD mark at the end of the master directory (EOD 1) that overwrites most of the 12-MByte pad.

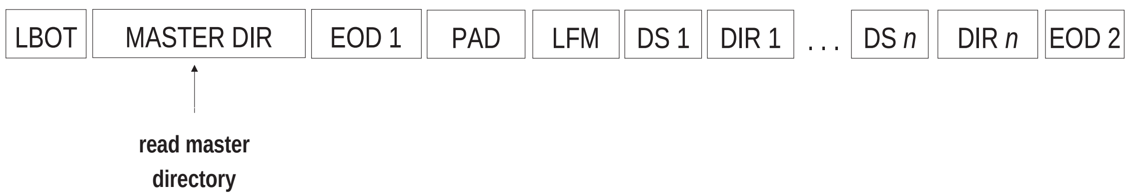


Note: After writing the master directory, be sure to rewind the tape or perform a space backward operation. Otherwise, attempting a space forward or locate operation to a position outside of the master directory will cause the command to fail with Check Condition status.

Accessing Data on a Directory Support Tape

To use the LOCATE command to access the data written in the previous section, follow these steps:

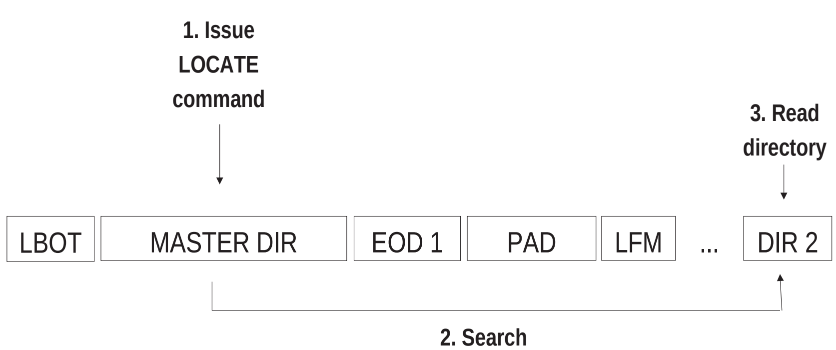
1. Read the master directory to determine the locations of the data set directories on the tape.



Note: If you are using a LOCATE or SPACE command to position to data within the master directory, be sure to set the ADE bit to 1 to prevent the EXB-8500 from crossing from the directory to the data area of the tape.

2. Using the READ POSITION data from the master directory, issue a LOCATE command to locate a specific data set directory (for example, DIR 2). Set the ADE bit to 0 so that the EXB-8500 will skip over the first EOD mark.

   Read the data set directory to determine what files are contained in the data set. If this directory does not list the file you want to locate, continue issuing LOCATE commands and reading directories until you find the directory listing the file you need.



3. Once you have found a directory that lists the file you need, issue another LOCATE command to reach that file, using the READ POSITION data from the directory.

Notes:

Appendix C Data Cartridge Capacities

This appendix describes how the EXB-8500 autosizes tapes and lists track and physical block counts for the different types and sizes of data cartridges supported by the EXB-8500. It also compares EXATAPE data cartridges with industry-standard cartridge sizes and lists the approximate capacities of EXATAPE data cartridges. Information is provided for tapes written in EXB-8500 format and in EXB-8200 format.

Note: Refer to the *EXB-8500 8mm Cartridge Tape Subsystem Product Specification* for detailed information about the recording format for the EXB-8500, including information about recording parameters, physical track structure, and the logical arrangement of data on the tape.

Autosizing of Data Cartridges

Autosizing is the process that occurs during a load operation when the EXB-8500 spaces forward from the physical beginning of tape (PBOT) to the logical beginning of tape (LBOT) and determines the length of the tape in use. The method the EXB-8500 uses for autosizing depends on the length of the tape.

Shorter Tape Sizes

If the tape is relatively short, its length can be accurately determined by the EXB-8500 during the load operation. Shorter tape sizes that can be reliably autosized at LBOT include the following:

- P5-15
- P5-30
- P6-15
- P6-30
- P6-60

For these shorter-length tapes, the EXB-8500 ignores the settings of the CT and P5 bits in the MODE SELECT (15h) command.

Longer Tape Sizes

If the tape is relatively longer, its length cannot be accurately determined during the load operation. Longer tape sizes that cannot be reliably autosized at LBOT include the following:

- P5-60
- P5-90
- P6-90
- P6-120

For these longer-length tapes, the EXB-8500 initially uses the settings of the CT and P5 bits in the MODE SELECT command to estimate the size of the data cartridge. As shown in Table C-1, these bits can be set in various combinations to indicate the type of cartridge that is expected to be loaded in the EXB-8500.

Table C-1 Combinations of CT and P5 Bits in MODE SELECT (15h) Command

Setting of CT bit	Setting of P5 bit	Expected cartridge type
0	0	P6
1	0	Unknown (use PI)*
0 or 1	1**	P5

* If the expected data cartridge type is unknown (that is, if the data cartridge loaded in the EXB-8500 could be either a P5 or a P6), set the CT bit to 1 and the P5 bit to 0. In this case, the EXB-8500 will use the international equivalency mode (PI) to size the data cartridge. The PI mode uses the smaller of two comparable P5 and P6 data cartridge sizes.

** When set to 1, the P5 bit overrides the CT bit.

Using the settings of the CT and P5 bits in conjunction with its initial determinations of tape length, the EXB-8500 estimates the data cartridge type and size as shown in Table C-2.

Table C-2 Initial Autosizing Estimates Made by the EXB-8500

Type of cartridge actually loaded	Setting of CT bit	Setting of P5 bit	Cartridge initially sized as...
P5-60 or P6-90	0	0	P6-90
	1	0	P5-60*
	0 or 1	1	P5-60
P5-90 or P6-120	0	0	P6-120
	1	0	P6-120**
	0 or 1	1	P5-90

* When the CT bit is 1 and the P5 bit is 0, the EXB-8500 uses the PI mode. In this case, P5-60 is the smaller of the two comparable data cartridges.

** P6-120 is the smaller of the two comparable data cartridges.

Then, as the tape position approaches LEOT, the EXB-8500 accurately resizes these longer-length tapes.

If the CT and P5 bits are incorrectly set for the type of cartridge loaded, the EXB-8500 may increase or decrease the estimated block count when it resizes the tape. This ensures that LEOT is always detected correctly and prevents tape capacity errors.

Track and Physical Block Counts

Table C-3 and Table C-4 list the following information for tapes written in EXB-8500 format and EXB-8200 format:

- The number of tracks and 1,024-byte physical blocks between LBOT and LEOT
- The approximate number of tracks and 1,024-byte physical blocks between LEOT and PEOT.

Note that the number of tracks and physical blocks between LBOT and LEOT and between LEOT and PEOT depends on the data cartridge type and size as well as on whether the tape is written in EXB-8500 format or EXB-8200 format.

The track and physical block counts are based on the definitions of the following:

- Physical beginning of tape (PBOT)
- Logical beginning of tape (LBOT)
- Logical end of tape (LEOT)
- Physical end of tape (PEOT).

Physical Beginning of Tape (PBOT)

The physical beginning of tape (PBOT) is located at the point on the tape where the translucent leader material is attached to the media. This position is detected by an optical sensor in the tape transport mechanism.

Logical Beginning of Tape (LBOT)

The logical beginning of tape (LBOT) is automatically recorded on the tape by a write operation that is issued at the beginning of tape. LBOT is recorded 735 ± 10 mm (28.9 ± 0.39 inches) from PBOT.

LBOT consists of a series of tracks that are used to indicate LBOT's location and to calibrate the servo system. The first track containing data blocks is recorded directly after the last track containing the LBOT information. You cannot alter or access the data contained in the LBOT blocks.

The tape can be repositioned and a write operation can be performed to erase the LBOT and record a new LBOT in the same space. This process occurs, for example, when a write operation is performed at LBOT on a previously written tape.

If a read-after-write check indicates an error while the EXB-8500 is writing LBOT, the blocks are not rewritten. Errors in writing the LBOT blocks are not reported to the initiator. If excessive read-after-write checks occur, the tape is rewound and the entire process is repeated. If the retry fails, a media error is reported.

During read operations, LBOT blocks are not transferred to the initiator.

Logical End of Tape (LEOT)

The logical end of tape (LEOT) is determined by the number of recorded tracks that occur after LBOT. For this purpose, lengths of erased segments are converted into an equivalent number of tracks.

Physical End of Tape (PEOT)

The physical end of tape (PEOT) is located at the point on the tape where the translucent trailer material is attached to the media. This position is detected by an optical sensor in the tape transport mechanism.

Table C-3 Track and Physical Block Counts for EXB-8500 Format

Cartridge Type	Cartridge Size	LBOT to LEOT		LEOT to PEOT*	
		Track	Block	Track	Block
P5	P5-15	199AAh	CCD50h	21ECh	10F60h
	P5-30	31D10h	18E880h	22B3h	11598h
	P5-60	623DAh	311ED0h	25D0h	12E80h
	P5-90	93568h	49AB40h	22A2h	11510h
P6	P6-15	11888h	8C440h	954h	4AA0h
	P6-30	23052h	118290h	1F71h	FB88h
	P6-60	45FE4h	22FF20h	229Eh	114F0h
	P6-90	68F78h	347BC0h	2452h	12290h
	P6-120	8BF08h	45F840h	233Bh	119D8h
PI	P5-15**	199AAh	CCD50h	21ECh	10F60h
	P5-30**	31D10h	18E880h	22B3h	11598h
	P6-15**	11888h	8C440h	954h	4AA0h
	P6-30**	23052h	118290h	1F71h	FB88h
	P6-60**	45FE4h	22FF20h	229Eh	114F0h
	P6-90, P5-60	623DAh	311ED0h	25D0h	12E80h
	P6-120, P5-90	8BF08h	45F840h	233Bh	119D8h

* Track and block counts from LEOT to PEOT are approximate.
** As described in this section, the EXB-8500 can accurately determine the lengths of these tape sizes at LBOT.

Table C-4 Track and Physical Block Counts for EXB-8200 Format

Cartridge Type	Cartridge Size	LBOT to LEOT		LEOT to PEOT*	
		Track	Block	Track	Block
P5	P5-15	CCD5h	666A8h	10F5h	87A8h
	P5-30	18E88h	C7440h	1159h	8AC8h
	P5-60	311EDh	188F68h	12E7h	9738h
	P5-90	49AB4h	24D5A0h	1150h	8A80h
P6	P6-15	8C44h	46220h	11A9h	8D48h
	P6-30	11829h	8C148h	FB8h	7DC0h
	P6-60	22FF2h	117F90h	114Eh	8A70h
	P6-90	347BCh	1A3DE0h	1228h	9140h
	P6-120	45F84h	22FC20h	119Dh	8CE8h
PI	P5-15**	CCD5h	666A8h	10F5h	87A8h
	P6-60**	22FF2h	117F90h	114Eh	8A70h
	P5-30**	18E88h	C7440h	1159h	8AC8h
	P6-15**	8C44h	46220h	11A9h	8D48h
	P6-30**	11829h	8C148h	FB8h	7DC0h
	P6-90, P5-60	311EDh	188F68h	12E7h	9738h
	P6-120, P5-90	45F84h	22FC20h	119Dh	8CE8h

* Track and block counts from LEOT to PEOT are approximate.

** As described in this section, the EXB-8500 can accurately determine the lengths of these tape sizes at LBOT.

EXATAPE™ Capacities

Table C-5 compares EXATAPE data cartridges with industry-standard cartridge sizes and lists the approximate capacities of these data cartridges in EXB-8500 format and in EXB-8200 format.

EXATAPE data cartridges are available from EXABYTE in the following three sizes:

- EXATAPE 15m (approximately 608 MBytes of EXB-8500 formatted data capacity to the physical end of tape)
- EXATAPE 54m (approximately 2,421 MBytes of EXB-8500 formatted data capacity to PEOT)
- EXATAPE 112m (approximately 5,016 MBytes of EXB-8500 formatted data capacity to PEOT)

Table C-5 Approximate Capacities of EXATAPE Data Cartridges

Size of EXATAPE[a]	Equivalent Cartridge Size	Old Identifier	Approximate Capacity to LEOT[b]	
			EXB-8500 format	EXB-8200 format
15m	P6-15	256	588 MBytes	294 MBytes
	P6-30	512	1,175 MBytes	588 MBytes
54m	P6-60	1024	2,348 MBytes	1,174 MBytes
	P6-90	1536	3,522 MBytes	1,761 MBytes
	P6-120	2048	4,695 MBytes	2,348 MBytes
112m	P5-90		4,944 MBytes	2,472 MBytes

[a] The column labeled EXATAPE lists the current data cartridges available for purchase from EXABYTE. These data cartridges are recommended for use with all EXABYTE products.
[b] Refer to Table C-3 and Table C-4 for detailed information about data cartridge capacities.

Appendix D Sense Key Information

This appendix lists the possible combinations of values for the Additional Sense Code (ASC) and the Additional Sense Code Qualifier (ASCQ) fields in the Extended Sense Bytes returned by the REQUEST SENSE (03h) command. It correlates each ASC and ASCQ combination with one or more of the EXABYTE-unique Fault Symptom Codes (FSC) that are returned as byte 28 in the Extended Sense Bytes.

Note: For more information about the FSCs listed, refer to Appendix E. Appendix E also describes the recommended error recovery procedures for each Fault Symptom Code.

For ease of reference, the information in this appendix is listed in numerical order for each sense key (byte 2, bits 3 through 0).

Sense Key = 0h (No Sense)

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
00h	00h	No additional sense information.	06h, 0Ah
00h	01h	A filemark was encountered during a read, space, or locate operation. The tape is positioned at the EOT-side of the filemark.	0Dh, 32h
00h	02h	LEOT was encountered during a read, write, or write filemarks operation.	04h, 09h, 28h
00h	04h	PBOT was encountered during a space or locate operation.	35h

Sense Key = 2h (Not Ready)

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
04h	00h	Logical unit not ready. Cause unknown.	C6h, C8h
04h	01h	Logical unit not ready, but is in process of becoming ready (rewinding or loading tape).	C7h
3Ah	00h	Logical unit not ready. Command requires a tape, and no tape is present.	C9h

Sense Key = 3h (Medium Error)

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
00h	02h	PEOT was encountered during a space or locate operation.	34h
03h	02h	Excessive write errors.	96h, 97h, 9Dh-9Fh, B3h
09h	00h	Tracking error.	AEh
0Ch	00h	LBOT failure—unable to write tape-marks tracks in EXB-8200 mode.	B4h
11h	00h	An uncorrectable block was encountered during a read, space, or locate operation.	37h, B5h
11h	01h	An uncorrectable block was encountered during a read operation.	0Bh
11h	03h	Too many permanent read errors—can't sync.	11h
14h	00h	A Medium Error was detected during a read, space, or locate operation.	16h, 38h
26h	01h	Parameter not supported. The boot code did not allow a load from tape, or the code version was not supported by the boot code.	66h
26h	02h	A write buffer parameter value was invalid.	61h-65h 69h
30h	00h	The data on the tape is compressed, but the hardware cannot decompress it. (Note: This error is included for upward compatibility with products that support data compression.)	1Ch
31h	00h	A tape format error was encountered during a space or locate operation.	36h
3Bh	02h	PEOT encountered. Tape position error at end of medium.	14h
50h	01h	Write failure after retry limit (specified with MODE SELECT) exceeded.	95h

Sense Key = 4h (Hardware Error)

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
00h	00h	Undetermined hardware error.	58h, 5Ah 67h, 68h 6Dh, FAh FCh, FDh
08h	01h	Logical unit communication time-out.	9Ah, 9Ch ABh
08h	02h	Logical unit communication parity error.	A3h-A8h
0Ch	00h	Hardware failure—Head sync error during write.	A1h
11h	00h	A Hardware Error was detected during a read operation.	17h
15h	01h	Servo hardware failure.	ADh
44h	00h	Internal software failure.	8Ch, 98h, 99h, A2h, ACh

Sense Key = 5h (Illegal Request)

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
00h	05h	The EXB-8500 was not in a legal mode to read (in write mode or not ready).	0Eh
1Ah	00h	Illegal transfer length in the CDB.	CCh, D4h
20h	00h	Illegal operation code.	CDh
21h	00h	Logical block out of range.	D9h
24h	00h	Invalid field in the CDB.	CEh
25h	00h	Logical unit not supported.	CFh, D1h
26h	00h	Invalid field in parameter list.	D0h
30h	02h	Cannot read the tape position—Incompatible format.	D7h
3Dh	00h	Illegal bit set in Identify message.	DAh
4Eh	00h	Overlapped commands attempted—Bad ITL nexus.	D8h
50h	01h	Write append position error.	02h, 26h, 4Bh
53h	02h	Media removal prevented.	D2h
81h	00h	Mode mismatch. Fixed/variable.	D3h
82h	00h	The command requires no tape, but a tape is loaded (SEND DIAGNOSTICS).	D5h
84h	00h	Could not change the MODE SELECT parameters since the tape was not at LBOT.	D6h

Sense Key = 6h (Unit Attention)

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
28h	00h	A new tape load has occurred, and the media may have been changed.	C1h
29h	00h	Power-on reset, SCSI bus reset, or device reset has occurred.	C0h
2Ah	01h	MODE SELECT parameters have been changed.	C2h
3Fh	01h	New microcode (firmware) was loaded.	C3h
5Ah	01h	Operator requested media removal.	C4h

Sense Key = 7h (Data Protect)

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
27h	00h	The tape is write protected.	03h, 27h 4Ch

Sense Key = 8h (Blank Check)

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
00h	05h	End of data encountered on a read operation.	0Ch, 0Fh 33h

Sense Key = 9h (EXABYTE)

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
15h	02h	Positioning error detected by read of medium during a space or locate operation.	15h, 3Ah

Sense Key = Bh (Aborted Command)

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
00h	00h	No additional sense information	05h, 10h 3Bh, 4Eh E7h, EBh
43h	00h	Message error.	E0h-E5h
47h	00h	The command was aborted because of a SCSI bus parity error.	E6h

Sense Key = Dh (Volume Overflow)

ASC (Byte 12)	ASCQ (Byte 13)	Explanation	Related FSC
00h	02h	EOT encountered.	AFh, B6h

Notes:

Appendix E Fault Symptom Codes

This appendix lists the Fault Symptom Codes that may be returned by the REQUEST SENSE (03h) command. The Fault Symptom Code is returned as byte 28 in the Extended Sense Bytes. It is an EXABYTE-unique byte that specifies the reason for the most recent Check Condition status.

Note: You can also use the Fault Symptom Code field to determine the location of errors in the bytes sent with the MODE SELECT (15h) command descriptor block. For more information about this use of the Fault Symptom Code, refer to Section 12.11.

For ease of reference, the Fault Symptom Codes (FSC) are listed in hexadecimal order. The information provided for each code includes the sense key (SK) associated with the code, an error recovery procedure (ERP) code, and a brief description of the problem or event.

Note: For more information about the suggested actions for each ERP code, refer to “EXB-8500 Error Recovery Procedures” on page E-7.

Important

The Fault Symptom Codes may change as new revisions of the EXB-8500 firmware become available. For this reason, be sure to check the documentation provided with new firmware releases for the most current list of codes.

Table E-1 Fault Symptom Codes

FSC	SK	ERP	Description
02h	5h	11	A WRITE command was received when the tape was not at a legal position to write.
03h	7h	5	A WRITE command was received when the data cartridge was write protected.
04h	0h	11	LEOT was encountered during the current write operation (the command may have terminated early).
05h	Bh	11	The write operation was aborted, as requested.
06h	0h	10	LEOT was encountered during the last write operation (the command completed successfully).
09h	0h	11	LEOT was encountered during a read operation.
0Ah	0h	11	The actual block size read did not match the requested block size during a read operation.
0Bh	3h	13	An uncorrectable block was encountered during a read operation.
0Ch	8h	11	EOD was encountered during a read operation.
0Dh	0h	11	A filemark was encountered during a read operation.
0Eh	5h	11	The EXB-8500 was not in a legal condition to read (in write mode or not ready).
0Fh	8h	3	Already at blank tape, so it is an error to attempt a read operation.
10h	Bh	11	The read operation was aborted, as requested.
11h	3h	13	Too many permanent read errors—can’t sync.
14h	3h	11	PEOT was encountered during a read operation.
15h	9h	3	An invalid file number was detected in a filemark during a read operation.
16h	3h	13	A Medium Error was detected during a read operation.
17h	4h	8, 3, 12	A Hardware Error was detected during a read operation.
1Ch	3h	14	The data on the tape is compressed, but the hardware cannot decompress it. (Note: This fault symptom code is include for upward compatibility with products supporting data compression.)
26h	5h	11	A WRITE FILEMARKS command was received when the tape was not at a legal position to write.
27h	7h	5	A WRITE FILEMARKS command was received when the data cartridge was write protected.
28h	0h	11	LEOT was encountered during or before the write filemarks operation—the filemark was written.
32h	0h	11	A filemark was detected during a space or locate operation.

FSC	SK	ERP	Description
33h	8h	11	EOD was encountered during a space or locate operation.
34h	3h	11	PEOT was encountered during a space or locate operation.
35h	0h	1, 3	PBOT was encountered during a space or locate operation.
36h	3h	13	A tape format error was encountered during a space or locate operation.
37h	3h	13	An uncorrectable block was encountered during a space or locate operation.
38h	3h	13	A Medium Error was detected during a space or locate operation.
3Ah	9h	3	A wrong file number was encountered in a filemark during a space operation (EXB-8200 format tapes only).
3Bh	Bh	11	The SPACE or LOCATE command was aborted, as requested.
4Bh	5h	11	The tape is not at legal place to erase or the EXB-8500 is not ready.
4Ch	7h	5	The data cartridge is write protected and cannot be erased.
4Eh	Bh	11	The ERASE command was aborted, as requested.
58h	4h	11	An error occurred during the send diagnostics operation.
5Ah	4h	11	An error occurred during the send diagnostics operation.
61h	3h	11	The code header was in the wrong format when loading firmware.
62h	3h	11	The servo load image was not valid.
63h	3h	11	Bank 0 of control load image was not valid.
64h	3h	11	Bank 1 of control load image was not valid.
65h	3h	11	The EEPROM load image was not valid.
66h	3h	11	The boot code did not allow a load from tape, or the code version was not supported by the boot code.
67h	4h	12	One of the memories could not be programmed.
68h	4h	12	A Hardware Error occurred while loading new firmware.
69h	3h	3	The CRC in the load image in the buffer was incorrect.
6Dh	4h	12	The READ BUFFER command failed.
8Ch	4h	8	Controller firmware logic error.
95h	3h	6, 9	Write failure after retry limit (specified with MODE SELECT) exceeded.
96h	3h	6	Write filemark failure after internal retry limit exceeded.[1]
97h	3h	6	Write EOD failure after internal retry limit exceeded.[1]
98h	4h	8, 12	Hardware failure—Invalid BRT.

FSC	SK	ERP	Description
99h	4h	8, 12	Hardware failure—Buffer empty.
9Ah	4h	8, 12	Hardware failure—Deformatter Intrp timeout on search.
9Ch	4h	8, 12	Hardware failure—Formatter Intrp timeout on write.
9Dh	3h	6	Permanent write error—Write recovery failure.[2]
9Eh	3h	6	Permanent write error—Rewrite threshold exceeded.[2]
9Fh	3h	6	Servo zone read-back-check failure.
A1h	4h	8, 12	Hardware failure—Head sync error during write.
A2h	4h	8, 12	Underrun error during write.
A3h	4h	8, 12	IPORT write buffer parity error.
A4h	4h	8, 12	DPORT write buffer parity error.
A5h	4h	8, 12	PPORT write buffer parity error.
A6h	4h	8, 12	IPORT read buffer parity error.
A7h	4h	8, 12	DPORT read buffer parity error.
A8h	4h	8, 12	PPORT read buffer parity error.
ABh	4h	12	Servo timed out.
ACh	4h	8, 12	Servo software error.
ADh	4h	8, 12	Servo hardware failure.
AEh	3h	6, 9	Unable to achieve or maintain tracking.
AFh	Dh	11	EOT encountered during a tape motion command.
B3h	3h	6	LBOT write failure—read-back-check criteria not met after retry limit exceeded.[1]
B4h	3h	6, 9	LBOT failure—unable to write tape-mark tracks in EXB-8200 mode.
B5h	3h	9	Physical Read Manager could not read LBOT.
B6h	Dh	11	EOT encountered during buffer flush.
C0h	6h	3	Unit Attention—Power-on reset occurred.
C1h	6h	3	Unit Attention—Data cartridge may have been changed.
C2h	6h	3	Unit Attention—MODE SELECT parameters were changed.
C3h	6h	3	Unit Attention—New microcode was loaded.
C4h	6h	3	Unit Attention—Operator requested media removal.
C6h	2h	7	Not Ready—Cause not known.

FSC	SK	ERP	Description
C7h	2h	3	Not Ready, but becoming ready.
C8h	2h	2, 3	A tape motion command is required to move the tape from its current location.
C9h	2h	7	The command requires a tape, but no tape is loaded.
CCh	5h	4	Parameter List Length error in the MODE SELECT CDB.
CDh	5h	4	Illegal Op Code.
CEh	5h	4	Invalid field or reserved bits set in the CDB.
CFh	5h	4	The LUN is not supported.
D0h	5h	4	Invalid field in Parameter List (MODE SELECT).
D1h	5h	4	The LUN in the Identify message is illegal (not zero).
D2h	5h	11	Media removal is prevented.
D3h	5h	4	A variable/fixed mismatch occurred between the CDB and the MODE SELECT parameters.
D4h	5h	4	Illegal transfer length in CDB.
D5h	5h	11	The command requires no tape, but a tape is loaded (SEND DIAGNOSTICS).
D6h	5h	11	Could not change the MODE SELECT parameters since the tape was not at LBOT.
D7h	5h	11	Cannot read the tape position—Incompatible format
D8h	5h	3	Overlapped commands attempted—Bad ITL nexus.
D9h	5h	4	Logical block out of range.
DAh	5h	4	Illegal bit set in Identify message.
E0h	Bh	3	The command was aborted in the CDB phase—Parity or other error.
E1h	Bh	3	The command was aborted before the Data phase—Received bad message.
E2h	Bh	11	The command was aborted in the Data phase—Initiator Detected Error message.
E3h	Bh	3	The command was aborted in the Data phase—Received bad message out.
E4h	Bh	3	The command was aborted after the Data phase—Received bad message out.
E5h	Bh	3	The command was aborted after the Data phase—Other error.
E6h	Bh	3	The WRITE command was aborted because of a SCSI bus parity error.

FSC	SK	ERP	Description
E7h	Bh	11	The initiator sent an Abort or Initiator Detected Error message during a read operation and the command was aborted.
EBh	Bh	3	A WRITE BUFFER command sequencing error occurred.
FAh	4h	15	The EXB-8500's serial number is invalid or blank.
FCh	4h	15	Head sync value in EEPROM is out of range.
FDh	4h	15	The EEPROM contains meaningless information.

[1] If the read-back-check criteria are not met for an LBOT, filemark, or EOD block written to tape, the EXB-8500 moves the tape backward and retries the operation once. If the read-back-check criteria are still not met, the EXB-8500 returns Check Condition status and these FSCs apply.

[2] If the read-back-check criteria are not met for a data or short filemark block (that is, if the block is not perfect), the block is rewritten. If rewrite activity is excessive, the EXB-8500 moves the tape backward, reads the tape to verify that blocks are written, and then moves the tape backward again. It then performs a write splice operation and rewrites the blocks. If the rewrite threshold is exceeded for any block, the EXB-8500 returns Check Condition status with the sense key set to Medium Error (3h) and the FSC set to 9Eh. If the recovery splice operation cannot be completed, the FSC is 9Dh.

EXB-8500 Error Recovery Procedures

Table E-2 describes the error recovery procedures (ERPs) recommended for each fault symptom code listed in Table E-1.

Note: If two or more ERP codes are listed for the Fault Symptom Code, perform the action for the first code, then perform the action for the second code, and so on.

Table E-2 Recommended Error Recovery Procedures

ERP	Recommended Error Recovery Procedure
1	Issue a REWIND command.
2	Issue a SPACE command to space backward over a block or a filemark.
3	Reissue the failed command or command sequence.
4	Correct the errors in the CDB bytes or parameter data.
5	Move the write protect switch on the data cartridge to write enable the tape.
6	Repeat the operation with a new data cartridge.
7	Insert a data cartridge into the EXB-8500.
8	Perform one of the following actions: ■ Power the EXB-8500 off and back on again. ■ Send a SCSI bus reset ("hard" reset).
9	Clean the EXB-8500 and repeat the operation.
10	No action is necessary.
11	User should determine what recovery procedure to follow.
12	The EXB-8500 requires maintenance.
13	1. Perform one of the following actions: ■ Issue a REWIND, SPACE, LOAD/UNLOAD, or LOCATE command ■ Press the unload button. ■ Power the EXB-8500 off and back on again. ■ Send a SCSI bus reset ("hard" reset). 2. Reissue the failed command or command sequence.
14	Repeat the operation with a different data cartridge; the EXB-8500 cannot read the tape.
15	Reprogram the EEPROM.

Notes:

Glossary

address A unique identifier assigned to each device or subsystem on the SCSI bus. Also referred to as the *SCSI ID*.

ATN Attention signal. This SCSI bus signal is asserted by the initiator to indicate that it has a message to transmit to the target.

b Binary (base 2) numbering system.

BOT Beginning of tape.

BSY Busy bus condition.

bus devices Initiator or target devices connected to the SCSI bus.

byte Eight bits or one character.

C Celsius (Centigrade).

CDB Command descriptor block.

cm Centimeter (0.3937 inches).

connect The establishment of communications between the initiator and the selected target.

CRC Cyclic redundancy check.

CSA Canadian Standards Association.

disconnect The termination of communications between the initiator and the target. During a disconnect, the target releases control of the SCSI bus, allowing the bus to become free.

early warning The logical end of tape (LEOT).

ECC Error correction code.

EEPROM Electrically erasable programmable read only memory.

EPROM Erasable programmable read only memory.

EOD End of data.

EOM End of medium.

EOT End of tape.

EXB-8200 The EXB-8200 8mm Cartridge Tape Subsystem. The EXB-8200 can store up to 2.5 gigabytes of data on a single 8mm data cartridge.

EXB-8200 format One of two data formats written and read by the EXB-8500. Tapes written by the EXB-8500 in EXB-8200 format can be read by any EXB-8200, EXB-8200SX, EXB-8500, EXB-8500c, or EXB-8205. See also *EXB-8500 format*.

EXB-8200SX The EXB-8200SX 8mm Cartridge Tape Subsystem. The EXB-8200SX is very similar to the EXB-8200 but offers a high-speed search capability.

EXB-8205 The EXB-8205 8mm Cartridge Tape Subsystem. The EXB-8205 is a half-high 8mm cartridge tape subsystem that can compress logical blocks of user data. Assuming an average 2:1 compression ratio, the EXB-8205 can store 5.0 gigabytes of data on a single 8mm data cartridge.

EXB-8500 The EXB-8500 8mm Cartridge Tape Subsystem. The EXB-8500 can store up to 5.0 gigabytes of data on a single 8mm data cartridge.

EXB-8500c The EXB-8500c 8mm Cartridge Tape Subsystem. The EXB-8500c is very similar to the EXB-8500, but offers data compression as an option. Assuming a 2:1 data compression ratio, the EXB-8500c can store up to 10.0 gigabytes of data on a single 8mm data cartridge.

EXB-8500 format One of two data formats written and read by the EXB-8500. Tapes written by the EXB-8500 in EXB-8500 format can be read by the EXB-8500 and EXB-8500c, but cannot be read by the EXB-8200, EXB-8200SX, or EXB-8205. See also *EXB-8200 format*.

F Fahrenheit.

FCC Federal Communications Commission.

GByte Gigabyte or one billion bytes.

h Hexadecimal (base 16) numbering system.

host The computer system that acts as the initiator of an operation.

Hz Hertz.

ID Identification.

IEC International Electrotechnical Commission.

initiator A host computer system that requests an operation to be performed by a target.

KByte Kilobyte or 1,024 bytes.

LBOT Logical beginning of tape.

LEOT Logical end of tape. Sometimes referred to as *early warning*.

LSb Least significant bit.

LSB Least significant byte.

LUN Logical unit number.

MByte Megabyte or one million bytes.

mm Millimeter (0.03937 inches).

motion threshold During a start/stop write operation, the minimum amount of data that must be in the EXB-8500's 1-MByte buffer before data in the buffer will be written to tape.

During a start/stop read operation, the minimum amount of free space that must be in the EXB-8500's buffer before data will be transferred from the tape to the buffer.

The motion threshold is measured in 4-KByte increments. See also *reconnect threshold*.

ms or msec Millisecond.

MSb Most significant bit.

MSB Most significant byte.

ns Nanosecond.

NSTA National Safe Transit Association.

PBOT Physical beginning of tape.

PEOT Physical end of tape.

ready The state of the EXB-8500 when it is ready to process commands.

reconnect The function that occurs when the target arbitrates and reconnects to an initiator after a disconnect.

reconnect threshold When a disconnect occurs during a streaming write operation, the minimum amount of free space that must be in the EXB-8500's 1-MByte buffer before the EXB-8500 reconnects to the initiator and data transfer from the initiator to the buffer continues.

When a disconnect occurs during a streaming read operation, the minimum amount of data that must be in the EXB-8500's buffer before the EXB-8500 reconnects to the initiator and data transfer from the buffer to the initiator continues.

The reconnect threshold is measured in 4-KByte increments. See also *motion threshold*.

Reserved RSVD Elements set aside for future standardization.

SCSI Small Computer System Interface.

SCSI ID A unique identifier assigned to each device or subsystem on the SCSI bus. Also referred to as the *address*.

signal assertion Driving a signal to the true state.

signal de-assertion Driving a signal to the false state or biasing the signal by the cable terminators to the false state.

signal release When a signal is not driven by a bus but is biased by the cable terminators to the false state.

status Information sent from the target to the initiator upon completion of a command.

target A bus device (usually a controller) that performs an operation requested by an initiator. The EXB-8500 is a target.

μm Micrometer (0.00003937 inches).

μs or μsec Microsecond.

Index

A

B

C

D

E

M

N

O

P

R

V

W

Reader’s Comment Form

EXB-8500 Cartridge Tape Subsystem User’s Manual
Part Number 510201

EXABYTE welcomes your comments and suggestions about this manual. To let us know how we might make our documentation more helpful, please complete and mail this form.

Rate the following on a scale of 1 to 5 (1 = very poor, 5 = outstanding):

Is the information specific enough? __________

Is the format easy to follow? __________

Is the information clear and accurate? __________

Are the drawings clear and accurate? __________

Comments:

Please provide the following information:

Today’s Date: ____________________

Company Name: ____________________

Your Title: ____________________

Reader's Comment Form

Fold and tape | Please Do Not Staple | Fold and tape

Place
stamp
here

To: EXABYTE Corporation
Attn: Product Documentation
1685 38th Street
Boulder, CO 80301

Fold and tape | Please Do Not Staple | Fold and tape

EXABYTE™