Seagate Technology

DAT Tape Drives and Autoloaders

SCSI Manual

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Part Number 10002663–003

FCC Notice

The equipment referenced in this manual generates and uses radio frequency energy and if not installed and used properly—that is, in strict accordance with the manufacturer's instructions—may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment on and off, you are encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna.
- Relocate the computer with respect to the receiver.
- Move the computer into a different outlet so that the computer and receiver are on different branch circuits.

If necessary, you should consult the dealer or an experienced radio/television technician for additional suggestions. You may find the following booklet prepared by the Federal Communications Commission helpful:

How to Identify and Resolve Radio-TV Interference Problems

This booklet (Stock No. 004-000-00345-4) is available from the U.S. Government Printing Office, Washington, DC 20402.

Warning: Changes or modifications made to this equipment which have not been expressly approved by Conner Peripherals, Inc. may cause radio and television interference problems that could void the user's authority to operate the equipment.

Further, this equipment complies with the limits for a Class B digital apparatus in accordance with Canadian Radio Interference Regulations.

Cet appareil numérique de la classe B est conforme au Règlement sur brouillage radioélectrique, C. R. C., ch. 1374.

Document No. 10002663-003

Important Information About This Manual

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Introduction 1

Overview

The Seagate Digital Audio Tape (DAT) drives are designed for computer environments requiring high performance, high capacity data storage. DAT drives are available as an internal device in either a 3.5-inch or half-high 5.25-inch configuration or as an external subsystem. The DAT Autoloaders contain a DAT drive internal to the box which acts as the drive mechanism.

The drives contain an embedded, single-ended Small Computer Systems Interface (SCSI) controller that supports SCSI (*ANSI X3.131, 1986)* and SCSI-2 (*ANSI X3.T92).* These drives provide synchronous or asynchronous SCSI and a high speed burst rate of 5 MB/second. The internal drive form factors are tailored for easy installation in today's computers, and the full-featured embedded SCSI controller facilitates easy integration into a variety of systems.

Drive Models

This manual provides detailed information about the SCSI interface and SCSI commands that apply to all models of DAT drives and DAT Autoloaders.

These drives offer electronically erasable, programmable, read-only memory (flash EEPROM) for SCSI firmware, which enables qualified Seagate OEMs to download revised firmware to the drive via two methods: using the SCSI bus or using a specialized Seagate firmware tape cartridge.

About This Manual

The information in this manual applies to all DAT drive models. For specific installation and operational information—including SCSI connection information—refer to the Installation Guide or Product Description Manual for the specific model of your drive or Autoloader. The following table outlines the chapters in this manual.

Number	*Title*	*Description*
1	Introduction	Introduces the SCSI interface and explains the structure of this manual.
2	Interface	Provides general information about the SCSI interface for the DAT drives.
3	Commands	Lists and describes the SCSI-2 commands.

Interface 2

Overview

The Seagate DAT drives are designed to operate with the Small Computer System Interface (SCSI) bus. This chapter discusses SCSI bus operation as it pertains to drive functions.

SCSI is a standard interface established to support peripheral equipment such as printers, tape drives, magnetic disks, optical disks for microcomputers and other computer systems. The SCSI bus can support up to eight devices consisting of any multiple of host adapters and peripheral devices.

The DAT drives comply with SCSI-1 (ANSI Standard X3.131-1986) and SCSI-2 (ANSI SCSI Draft Revision 10H). In a few cases, vendor unique features are available. These features are compatible with the SCSI standards.

The interface is an eight-port, daisy-chained bus using eighteen signal lines: nine data-bit signal lines and nine control lines. The nine data-bit lines are made up of eight signal lines and one parity-bit line. The remaining nine lines provide control and status signals to coordinate data transfer operations between the host controller and the selected drive.

The drives have an internal SCSI controller integrated into the drive electronics. Each device ID on the SCSI bus may drive up to 8 logical units (LUN). The DAT drive supports only LUN 0, except for the Autoloader which also uses LUN 1.

ANSI SCSI Bus Standards

In addition to the information presented in this manual, we recommend that for SCSI-1 you read the ANSI X3.131 1986 standard and for SCSI-2, the ANSI Working Draft Revision 10 standard before writing host software drivers. Also, see the conformance statements, which are given in the Product Description Manual for the each model of DAT drive or Autoloader.

Cabling and Connectors

The cabling requirements and pinouts for the SCSI connector for the internal drive models are given in the respective installation guide and Product Description Manual for each model of DAT drive or Autoloader..

Signal Descriptions

The drive SCSI interface consists of eighteen signals. Nine are control lines and nine are data lines. Data lines include the parity signal option. These signals are described in the following table.

Signal	Name	Description
-BSY	Busy	OR-tied signal used to show that the data bus is in use
-SEL	Select	Signal used by an Initiator to select a Target or by a Target to reselect an Initiator. SEL is driven by the Initiator during the Selection Phase and driven by the Target during a Reselection Phase.
-C/D	Control/Data	Target-driven signal used to indicate whether Control or Data information is on the data bus. True (low) indicates Control, and false (high) indicates Data.
-I/O	Input/Output	Target-driven signal used to control data movement direction on the data bus with respect to an Initiator. This signal is also used to distinguish between the Selection and Reselection Phases. True (low) indicates input to the Initiator, and false (high) indicates output from the Initiator.
-MSG	Message	Target-driven signal used to indicate the presence of a Message Phase on the bus. True (low) indicates Message Phase, and false (high) indicates Data, Command, or Status Phase.
-REQ	Request	Target-driven signal used to indicate a request for a REQ/ACK data transfer handshake.
-ACK	Acknowledge	Initiator-driven signal used to indicate an acknowledgment for a REQ/ACK data transfer handshake.
-ATN	Attention	Initiator-driven signal used to indicate the Initiator has a message to communicate to the Target.
-RST	Reset	OR-tied signal used to indicate a Reset condition.
DB(7-0)	Data Bus	Eight data-bit signals plus a parity-bit signal that form the data bus. DB (7) is the MSB and has the highest priority (ID 7) during the Arbitration Phase.
DB(P)	Data Bus	Data parity is odd and is a jumper-selectable option. Parity is not valid during the Arbitration Phase. DB (P) is not to be driven False (high) during the Arbitration Phase.

NOTE: The BSY and RST signals are the only OR-tied signals. In ordinary bus operation, these signals may be simultaneously driven by two or more drivers. There is no operational problem in mixing OR-tied and three-state drivers on signals other than BSY and RST.

Command Set Description

The following table shows the SCSI-1 X3.131 commands for sequential access devices implemented by the DAT drive.

Code	Type	Command
00h	O	TEST UNIT READY
01h	M	REWIND
02h	V	REQUEST BLOCK ADDRESS
03h	M	REQUEST SENSE
05h	E	READ BLOCK LIMITS
08h	M	READ
0Ah	M	WRITE
0Ch	V	SEEK BLOCK
10h	M	WRITE FILEMARKS
11h	O	SPACE
12h	E	INQUIRY
13h	O	VERIFY
15h	O	MODE SELECT
16h	O	RESERVE UNIT
17h	O	RELEASE UNIT
19h	O	ERASE
1Ah	O	MODE SENSE
1Bh	O	LOAD/UNLOAD
1Dh	O	SEND DIAGNOSTIC
1Eh	O	PREVENT/ALLOW MEDIUM REMOVAL
40h	*	CHANGE DEFINITION

M = Mandatory Command O = Optional Command

V = Vendor Unique Command * = Defined in SCSI-2

E = Required for device-independent self-configuring software

The following table shows the SCSI-2 commands for sequential access devices implemented by the drive.

Code	*Type*	*Command*	*Group*
00h	M	TEST UNIT READY	0
01h	M	REWIND	0
02h	V	REQUEST BLOCK ADDRESS	0
03h	M	REQUEST SENSE	0
05h	M	READ BLOCK LIMITS	0
07h	A	INITIALIZE ELEMENT STATUS	0
08h	M	READ	0
0Ah	M	WRITE	0
0Ch	V	SEEK BLOCK	0
10h	M	WRITE FILEMARKS	0
11h	M	SPACE	0
12h	M	INQUIRY	0
13h	O	VERIFY	0
15h	M	MODE SELECT	0
16h	M	RESERVE UNIT	0
17h	M	RELEASE UNIT	0
19h	M	ERASE	0
1Ah	M	MODE SENSE	0
1Bh	O	LOAD/UNLOAD	0
1CH	O	RECEIVE DIAGNOSTIC RESULTS	0
1Dh	M	SEND DIAGNOSTIC	0
1Eh	O	PREVENT/ALLOW MEDIUM REMOVAL	0
2Bh	O	LOCATE	1
34h	O	READ POSITION	1
3Bh	O	WRITE DATA BUFFER	1
3Ch	O	READ DATA BUFFER	1
40h	O	CHANGE DEFINITION	2
4Ch	O	LOG SELECT	2
4Dh	O	LOG SENSE	2
A5H	A	MOVE MEDIUM	5
A6H	A	EXCHANGE MEDIUM	5
B8H	A	READ ELEMENT STATUS	5

M = Mandatory Command V = Vendor Unique Command

O = Optional Command A = Autoloader Command Only

ANSI X3.131, 199x Conformance Statement (SCSI-2)

GENERAL FEATURES

1. Disconnect/reconnect, arbitration (required in SCSI-2).
2. Single-ended drivers.
3. Termination power supplied to cable (jumper option).
4. Supports both single and multi-initiator systems.
5. Fixed and variable block transfer lengths.
6. Hard reset.
7. Synchronous data transfers
8. Parity implemented (switch option).
9. Space blocks, filemarks, EOD, and setmarks..
10. Supports third-party reservation.
11. Log Sense and Log Select for managing soft errors reporting.
12. MODE SENSE/SELECT page to control and report operation of data compression in sequential access devices and to read from and write to the configuration EEPROM.
13. Complies with SCSI-2, Section 16, Medium Changer Devices*.

COMMANDS

1. Change Definition
2. Erase
3. Exchange Medium*
4. Initialize Element Status*
5. Inquiry
6. Load/Unload
7. Locate
8. Log Select
9. Log Sense
10. Mode Select
11. Mode Sense
12. Move Medium*
13. Prevent/Allow Media Removal
14. Read
15. Read Block Limits
16. Read Data Buffer
17. Read Element Status*
18. Read Position
19. Release Unit
20. Receive Diagnostic Results
21. Request Block Address
22. Request Sense
23. Reserve Unit
24. Rewind
25. Seek Block
26. Send Diagnostic
27. Space
28. Test Unit Ready
29. Verify
30. Write
31. Write Data Buffer
32. Write Filemarks

MESSAGES

1. Save Data Pointer
2. Disconnect
3. Message Reject
4. Identify
5. Abort
6. Bus Device Reset
7. No Operation
8. Parity Error Message
9. Linked Command Complete
10. Linked Command Complete with flag
11. Initiator Detected Error
12. Synchronous Data Transfer Request

VENDOR UNIQUE COMMANDS

1. Seek Block
2. Request Block Address

SCSI Bus Protocol

Communication on the SCSI bus occurs between a host computer's SCSI controller and a peripheral controller. The host controller is the *Initiator*, and the peripheral device is the *Target*.

Some SCSI bus functions are assigned to the Initiator and others to the Target. The Initiator arbitrates (enters the Arbitration Phase of operation) for control of the SCSI bus and enters the Selection Phase to select a specific Target such as a DAT drive.

The Target drive can request transfer of command, data, status, information, or disconnect from the bus. While the DAT drive is disconnected, the bus is free to accomplish other tasks. While disconnected, the Target drive can process information obtained from the bus. If the Target wants to reconnect, it arbitrates for bus control. For example, a Target can reselect an Initiator or another Target to continue an operation.

At times, the Target actually becomes an Initiator and arbitrates for control of the SCSI bus. This situation occurs only during a COPY operation.

Data-transfer operations on the SCSI bus are either asynchronous or synchronous. Asynchronous data transfer operations follow a defined request/acknowledge (REQ/ACK) handshake protocol. One eight-bit byte of information can be transferred with each REQ/ACK handshake. The default data transfer mode is asynchronous.

Synchronous data transfer operations are initiated through the SYNCHRONOUS DATA TRANSFER REQUEST message from the Initiator.

The SCSI bus protocol is divided into three modes or phases of operation: Waiting Phases, Control Phases, and Information Transfer Phases. These phases are further subdivided into the eight operational phases as listed in the following table. Information on these operational phases is contained in the following paragraphs.

Waiting Phases	***Control Phases***	***Information Phases***
1. Bus Free	2. Arbitration	5. Command
	3. Selection	6. Data (Data In/Data Out)
	4. Reselection	7. Status
		8. Message (Message In/ Message Out)

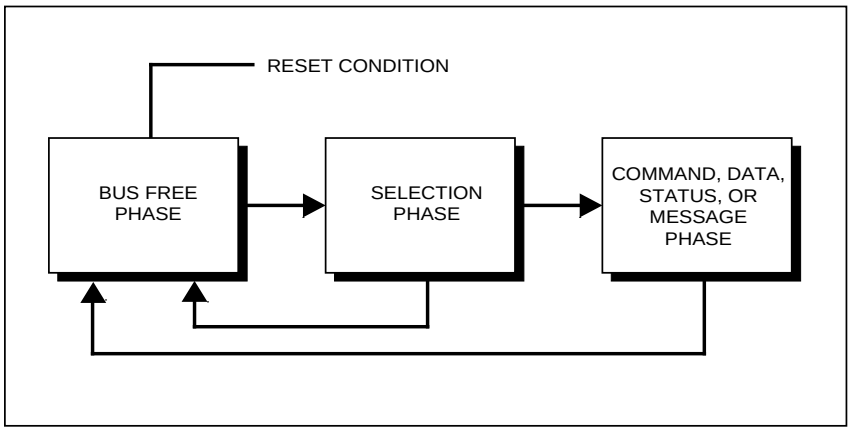
Waiting and Control Phases

The status of the SCSI bus is a function of the control signals. These signals define the SCSI as in the Waiting Phase (Bus Free Phase), the Control Phases (Arbitration, Selection, or Reselection), or the Information Transfer Phases (Command, Data, Status, or Message). DAT drives support both a SCSI system with Arbitration Phase and a SCSI system without Arbitration Phase (nonarbitrating system).

Nonarbitrating Systems

In systems where the Arbitration Phase is not implemented (SCSI-1 only), the allowable sequences are shown in Figure 2-1. The normal progression is from the Bus Free Phase to the Selection Phase and from the Selection Phase to one or more of the Information Transfer Phases. See the ANSI SCSI X1.31-1986 standard for detailed discussions of bus timing.

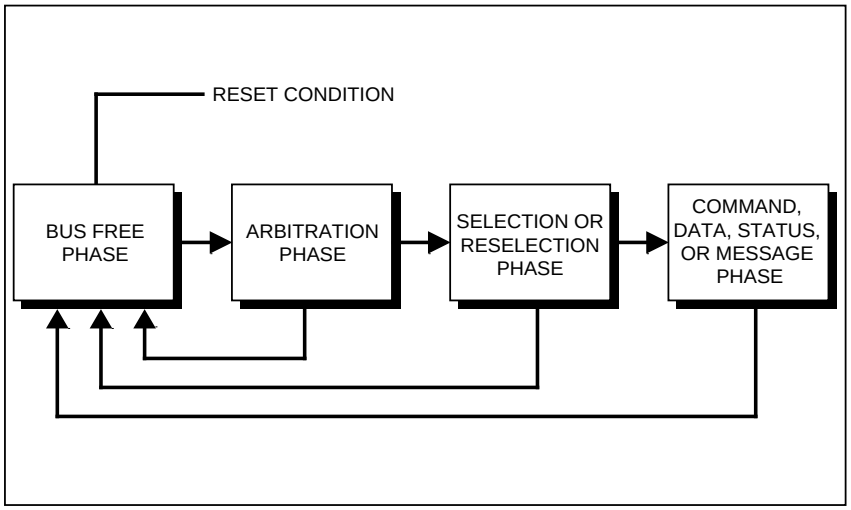
Figure 2-1
Phase Sequencing with Nonarbitration



Arbitrating Systems

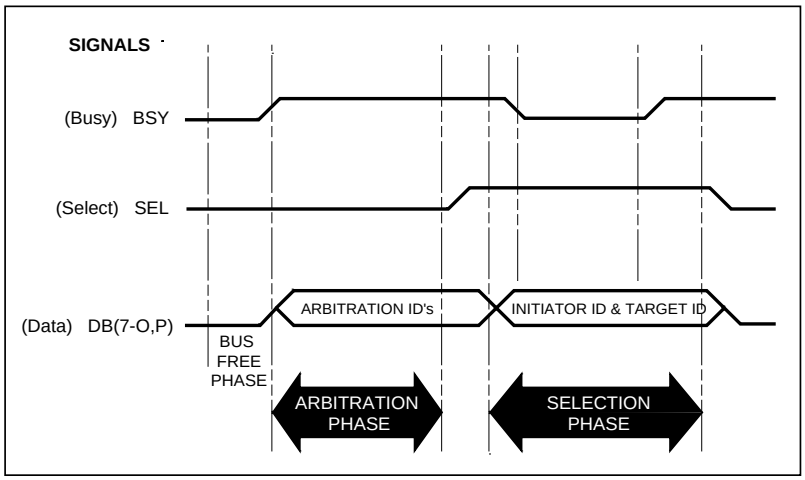
In arbitration systems (required in SCSI-2), the sequence of SCSI bus phases follows the sequence shown in Figure 2-2. Operation begins with the Bus Free Phase. Normal progression is from the Bus Free to the Arbitration Phase. During Arbitration, Initiators and Targets assert for control of the SCSI bus. The bus is awarded to the device with the highest priority SCSI bus address.

Figure 2-2
Phase Sequencing with Arbitration



Arbitration is won by the highest priority SCSI device when both BSY and SEL are asserted and a delay of at least 1200 nSec (1 bus clear delay + 1 bus settle delay) occurs before the Arbitration Phase ends and the Selection Phase begins. Signal timing is shown in Figure 2-3 and the complete Arbitration Phase protocol is described in the following table.

Figure 2-3
Arbitration and Selection Phase Signal Timing



Step	Procedure
1.	The SCSI device first waits for a Bus Free Phase to occur. The Bus Free Phase is detected when both the BSY and SEL signals are simultaneously and continuously false for a minimum of a bus settle delay of 400 nSec.
2.	The SCSI device waits a minimum of one bus free delay of 800 nSec after detection of a Bus Free Phase before driving any signal. The Bus Free Phase occurs after BSY and SEL are both false for a bus settle delay of 400 nSec.
3.	Following the 800 nSec Bus Free Delay in Step 2, the SCSI device Arbitrates for the SCSI bus by asserting both BSY and its own SCSI ID; however, the SCSI device does not assert a BSY and its SCSI ID if more than a bus settle delay (1.8 Sec) has passed since the Bus Free Phase was last observed.
4.	After waiting at least an Arbitration delay (2.2 Sec) measured after asserting a BSY signal, the SCSI device examines the data bus. If a higher priority SCSI ID bit is true, then the SCSI device loses the Arbitration. The SCSI device releases its signals and returns to Step 1. If no higher priority SCSI ID bit is true on the bus, then the SCSI drive wins the Arbitration and asserts the SEL signal. Any other device that participated in the Arbitration Phase and lost Arbitration releases BSY and its SCSI ID bit within a bus clear delay after SEL becomes true. A SCSI device that loses Arbitration returns to Step 1.
5.	The SCSI device that wins Arbitration waits at least one bus clear delay plus a bus settle delay of 1,200 nSec after asserting the SEL signal and changing the condition of other signals.

NOTE: The single SCSI ID bit on the data bus corresponds to the unique ID code of the SCSI device. All other SCSI data bus bits are released by the SCSI device. Parity is not valid during the Arbitration Phase. During the Arbitration Phase, DB(P) may be undriven or driven true, but not false.

Selection and Reselection Phases

The Selection and Reselection Phases provide a method for establishing a link between the Initiator and Target. When selected by an Initiator that supports disconnects, the Target has the option of disconnecting from the SCSI bus. When the Target needs to again establish the link to its original Initiator, the Target reselects that Initiator.

When selection is made, no restrictions on the sequences between Information Transfer Phases exist. A phase type may be followed by the same phase type. For example, a data phase may be followed by another data phase.

A device that wins Arbitration assumes the roll of Initiator by releasing the I/O signal. The Initiator sets the data bus to a value that is the OR of its SCSI ID bit and the Targets ID bit. The Initiator waits at least two deskew delays (90 nSec) before releasing the BSY signal and an additional bus settle delay (400 nSec) before looking for a response from the Target.

A device that loses Arbitration must release the Select ID and BSY.

Operation enters the Selection or Reselection Phases when a particular device wins a request in Arbitration and gains control of the SCSI bus. These phases allow the device in control of the bus to select another specific device connected to the SCSI bus for communication.

For example, the Initiator can select a DAT drive to begin an operation, or the DAT drive can reselect an Initiator to continue an operation previously disconnected. The DAT drive does not disconnect from the bus unless the host asserted the host ID bit during selection and the host sent an Identify message of C0h.

The Selection and Reselection Phases can be terminated for either of the following reasons:

- A Selection/Reselection time-out occurs. A Target or Initiator did not respond to a Selection or Reselection Phase within a maximum abort time of 200 Sec.

- A reset signal occurs on the SCSI bus. All sequences are terminated, and signals are released by all Targets and Initiators.

The Initiator can use the ATN signal to notify the DAT drive that an IDENTIFY message from the Initiator is ready. To ensure that the Target recognizes the Attention condition before the Command Phase is entered, the ATN signal must be low before SEL is asserted and BSY deasserted.

Select With Attention

The host system can select the DAT drive in one of two ways: a simple Select or a Select With Attention. The Select With Attention allows the host to send the Identify message to specify that the host supports disconnects.

The host can also use the Select With Attention to send messages other than the Identify message. For example, a Bus Device Reset or Abort message can be sent to cause the drive to reset itself without affecting any other device on the SCSI bus. The DAT drive responds appropriately to the host messages.

If the DAT drive receives an illegal message, it enters the Message Out Phase and sends the Reject message to the host. If any reserved bit (bits 5, 4, or 3) is set, an Identify message is rejected.

Responses to Identify messages with a non-zero LUN are described in the following subsection.

Identify Message

Because the DAT drive only supports Logical Unit 0, the Identify message is used solely to specify the Disconnect option. The bit map for the Identify message is as follows:

Bits	7	6	5	4	3	2	1	0
	I	DIS	|	RESERVED	|		LUN	

If bit 7 is set, the Identify message is indicated. Bit 6 (shown as DIS) is set as follows:

0 The host does not support disconnects. The DAT drive does not disconnect from the SCSI bus during the current command.

1 The host supports disconnects. The DAT drive disconnects from the SCSI bus appropriately for the command in progress to relinquish the bus for other units.

LUN = 1 is legal for Autoloader drives only.

Information Transfer Phases

The Command, Data, Status, and Message Phases are grouped together as the Information Transfer Phases because they are all used to transfer data or control information on the SCSI bus.

The following table shows the Control Data (C/D), Input/Output (I/O), and Message (MSG) signals used to distinguish between the various Information Transfer Phases. The Target drives these three signals and thereby controls all changes from one phase to another.

Signals	-MSG	-C/D	-I/O	Phases	Direction of Transfer
-I/O	1	1	1	Data	Initiator to Target
	1	1	0	Data	Target to Initiator
-C/D	1	0	1	Command	Initiator to Target
	1	0	0	Status	Target to Initiator
-MSG	0	0	1	Message	Initiator to Target
	0	0	0	Message	Target to Initiator
Key: 1 = False, 0 = True					

Information Transfer Phases use one or more REQ/ACK handshakes to control the information transfer. Each REQ/ACK handshake allows the transfer of one byte of information. During the information transfer phases, BSY remains true and SEL remains false. C/D, I/O, and MSG control signals are valid for a bus settle delay of 400 nSec before assertion of REQ signal at the first handshake and remain valid until negation of ACK at the end of the last handshake.

Asynchronous Data Transfer

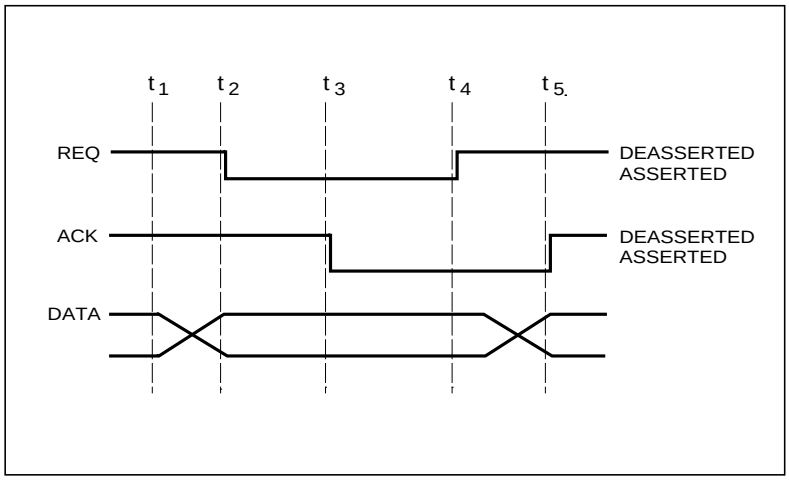
The Target controls the direction of information transfer with the I/O signal. When I/O is asserted (low), information is transferred from the Target to the Initiator. When I/O is deasserted (high), information is transferred from the Initiator to the Target. Figure -4 shows the data transfer signals for information transfer from Target to Initiator, and Figure 2-5 shows the data transfer signals for information transfer from Initiator to Target. Each direction of information transfer is discussed in detail in the following paragraphs.

Transfer from Target to Initiator

The transfer from Target to Initiator is described in the following table and illustrated in Figure 2-4.

Timing Point	Action
t_1	The I/O signal is asserted; the Target drives the data (DB7-0) and parity signals to their desired values.
t_2	The Target then asserts the REQ signal.
t_3	The Initiator reads the data and parity signals after REQ is asserted and then signals its acceptance of the data by asserting the ACK.
t_4	ACK goes low at the Target, and the Target deasserts REQ.
t_5	The REQ signal is false. The Initiator deasserts ACK. After the ACK signal is high, the Target can continue the transfer by repeating the steps from t_1.

Figure 2-4
Signals Used in Transfer from Target to Initiator

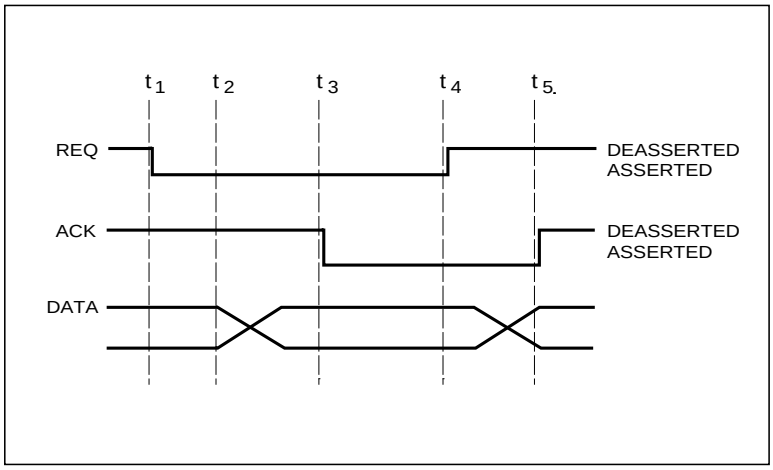


Transfer from Initiator to Target

Transfer from Initiator to Target is described in the following table and illustrated in Figure 2-5.

Timing Point	*Action*
t_1	The I/O signal is deasserted, and the Target asserts REQ to request information.
t_2	The Initiator drives the data and parity signals to their desired values.
t_3	The Initiator asserts the ACK .
t_4	The Target deasserts REQ, signaling its acceptance of data. The Initiator then releases the data and parity signals.
t_5	The Initiator deasserts ACK. The Target can then continue to transfer by asserting the REQ signal.

Figure 2-5
Signals Used in Transfer from Initiator to Target



Synchronous Data Transfer

Both the Initiator and Target must send a SYNCHRONOUS DATA TRANSFER REQUEST (SDTR) message in order to set up synchronous data transfer parameters. The SDTR is the only extended (multibyte) message supported. The host may initiate an SDTR to establish a new synchronous data transfer agreement or to end a previously arranged synchronous data transfer agreement and return to asynchronous data transfer mode.

The following table shows the format for the SDTR message.

Byte	Value	Description
0	01h	Extended message
1	03h	Extended message length
2	01h	Synchronous Data Transfer Request Code
3	m*	Transfer Period (m x 4 nsec)
4	**	REQ/ACK Offset

* Transfer Period can be any value between 32h and 15Eh.
** REQ/ACK Offset can be any value between 0 and Fh.

The *Transfer Period* is the minimum time allowed between leading edges of successive REQ pulses and of successive ACK pulses to meet the requirements of the DAT drive for successful reception of data. The host and DAT drive can transfer data with larger, but never smaller, Transfer Period than specified in the SDTR message.

The minimum value of the Transfer Period (200 nSec) is determined by the maximum burst transfer rate of the SCSI interface hardware of the DAT drive and is 5 MB/sec (32h). The host must specify a Transfer Period that allows it to successfully receive data from the DAT drive during the Data In Phase. Transfer Period represents the actual transfer period, in nanoseconds, divided by 4.

The *REQ/ACK Offset* is the maximum number of pulses that can be sent by the DAT drive in advance of the number of ACK pulses received from the host, establishing a pacing mechanism. If the number of REQ pulses is greater than the number of ACK pulses by the REQ/ACK Offset, the DAT drive stops sending data until after the leading edge of the next ACK is received.

The ACK/REQ Offset is used to prevent an overflow condition in the host's reception buffer during the Data In Phase. The REQ/ACK Offset should be set to the size of the host's reception buffer minus one.

To set up a new synchronous data transfer agreement, the host asserts the ATN signal and sends an SDTR message. The Transfer Period must be set to a value equal to or greater than 32h and less than the maximum rate of the host's reception buffer. The ACK/REQ Offset will be set to a nonzero value between 1 and the size of the host's reception buffer minus 1, but it should not exceed 0Fh.

If the Transfer Period and the ACK/REQ Offset are within the ranges described above, the DAT drive goes to the Message In Phase and returns an SDTR message with the same Transfer Period and ACK/REQ Offset. This return

indicates a successful completion of the SDTR message exchange. The implied synchronous data transfer agreement remains in effect until:

- A Bus Device Reset message is received.
- A hard reset condition occurs.
- The successful completion of the next SDTR message exchange.

If the Transfer Period is less than 32h and/or the REQ/ACK Offset is greater than 0Fh, the DAT drive returns an SDTR message with its maximum values—32h for Transfer period and/or 0Fh for REQ/ACK offset. Both the host and the DAT drive then go to the synchronous data transfer mode for data transfers between them.

If the host specifies a REQ/ACK offset of zero, the DAT drive operates in the asynchronous data transfer mode.

Command Phase

During the Command Phase, the Target requests command information from the Initiator. The Target asserts the C/D signal and deasserts the I/O and MSG signals thus denoting the Command Phase. The REQ/ACK then handshakes the command bytes across the SCSI bus (Figure 2-5). The command bytes are also called the Command Descriptor Block (CDB).

Data Phase

The Data Phase is subdivided into the Data-In and Data-Out Phases.

Data-In Phase

During the Data-In phase, the Target requests that data be sent to the Initiator from the Target. The Target asserts the I/O signal and deasserts the C/D and MSG signals thus denoting the Data-In Phase. The REQ/ACK handshakes (Figure 2-4) then transfer the requested byte count.

Data-Out Phase

During a Data-Out phase, the Target requests that data be sent from the Initiator to the Target. The Target deasserts the C/D, I/O, and MSG signals thus denoting the Data-Out Phase. The REQ/ACK handshakes (Figure 2-5) then transfer the requested byte count across the SCSI bus.

Status Phase

During a Status Phase, the Target requests that status information be sent to the Initiator from the Target. The Target asserts the C/D and I/O signals and deasserts the MSG signal thus denoting the Status Phase. The REQ/ACK handshakes the one byte status code across the SCSI bus (refer to Figure 2-4).

Message Phase

The Message Phase consists of either the Message-In or Message-Out Phases. The DAT drive supports one-byte messages.

Message-In Phase

During the Message-In Phase, the Target requests that messages be sent to the Initiator from the Target. The Target asserts the C/D, I/O, MSG signals thus denoting the Message-In Phase. The REQ/ACK handshakes the one-byte message across the SCSI bus.

Message-Out Phase

During the Message-Out Phase, the Target requests that messages be sent from the Initiator to the Target. The Target invokes this phase in response to the Attention (ATTN) signal asserted by the Initiator. The DAT drive responds to the ATTN signal at every phase change. The Target asserts the C/D and MSG signals and deasserts the I/O signal, denoting the Message-Out Phase. The REQ/ACK handshakes the one byte message across the SCSI bus. The Target uses REQ/ACK handshakes (Figure 2-5) until the ATN signal becomes false, unless an error occurs and the message is rejected.

Command Descriptor Block

A request to a peripheral device is performed by sending a Command Descriptor Block (CDB) to the Target. For several commands, the request is accompanied by a list of parameters sent during a Data Out Phase. If an invalid parameter is contained in the CDB, the DAT drive terminates the command without altering the medium.

The DAT implementation supports Group 0 and selected Group 1 and Group 2 commands. Group 0 CDBs are six-bytes; Group 1 and 2 CDBs are ten-bytes.

The CDB contains both reserved bit fields and defined bit fields. Defined bit fields are: Group Code, Command Code, Logical Unit Number (LUN), Vendor Unique (VU), Flag, and Link, whereas reserved bit fields are defined by zeros such as those appearing on the last line of the following table. This table shows a typical Group 0, six-byte, Command Descriptor Block.

	Bits							
Byte	***7***	***6***	***5***	***4***	***3***	***2***	***1***	***0***
0		Group Code			Command Code			
1		LUN	Command Dependent					
2			Command Dependent					
3			Command Dependent					
4			Command Dependent					
5	VU	VU	0	0	0	0	Flag	Link

The following table shows a typical Command Descriptor Block for Group 1 and 2 commands.

	Bits							
Byte	***7***	***6***	***5***	***4***	***3***	***2***	***1***	***0***
0		Group Code			Command Code			
1		LUN	Command Dependent					
2			Command Dependent					
3			Command Dependent					
4			Command Dependent					
5			Command Dependent					
6			Command Dependent					
7			Command Dependent					
8			Command Dependent					
9	VU	VU	0	0	0	0	Flag	Link

The following table describes the CDB fields common to all Group 0, 1, and 2 commands.

CDB Field	***Description***
Group Code*	This field indicates which of eight possible SCSI command groups is specified. DAT drives support Group 0.
Command Code*	This field indicates which of 32 possible command codes for a particular group code is specified.
Logical Unit	The LUN must be set to zero.
Vendor Unique	When set, these bits select vendor unique functions in specified commands.
Flag bit	The Flag bit is used only in conjunction with the Link bit and must be set to zero if the Link bit is zero. When the Link bit is set, the value of the Flag bit determines the appropriate message to send to the Initiator when a linked command completes successfully. A 0 value indicates that the Linked Command Complete message is required. A 1 value indicates that the Linked Command Complete with Flag message is required. Typically, the Flag bit is used to cause an interrupt in the Initiator at the end of, or at logical intervals in, linked command processing.
Link bit**	The Link bit is used to indicate that the Initiator desires automatic linking to the next command on successful completion of the current command. When the Link bit is one, on successful termination of the command, the drive returns an Intermediate Status followed by one of the two Command Complete messages as determined by the Flag bit. (Refer to description of Flag bit above.)

* Together, group code and command code make up the op code.

** If the Link bit is used, all applicable commands must have the Immed bit set to zero or a Check Condition status is returned and Extended Sense Key is set to Illegal Request.

Logical Unit Support

The DAT drive only supports Logical Unit (LUN) 0, except for the Autoloader, which supports both LUN 0 and LUN 1. However, it responds to a host command that tries to select or identify any other LUN. The response of the drive to illegal LUNs varies depending on the command and the manner in which the host specifies the LUN.

The host can specify an LUN in one of two ways:

- By sending an Identify message after the Selection Phase
- By specifying the LUN in byte 1 of the CDB (host did not send an Identify message)

Because of the redundancy of specifying the LUN, the DAT drive responds appropriately if the LUN is specified in both the Identify message and in the CDB. If the drive is selected and a valid Identify message is received with LUN = 0 (or LUN = 1 if the drive is an Autoloader), the LUN field of the CDB is ignored. Thus, the Identify message overrides the CDB LUN specification.

Because the SCSI INQUIRY command determines what LUNs a particular SCSI device supports, the response from the drive to this command is unique. With the INQUIRY command when the drive receives an unsupported LUN, the command completes normally. The drive indicates that it does not support the specified LUN by returning a 7F hexadecimal value in byte 0 of the INQUIRY data. Regardless of what method is used to specify the LUN, the 7F hex value is returned.

If an unsupported LUN is specified for a REQUEST SENSE command, the command completes normally with Good Status, and the sense data is set to Illegal Request.

For all other commands, the illegal LUN is detected in both the Identify message out and CDB methods, as follows:

- If an illegal LUN is specified in the Identify message, the drive enters the Command Phase and accepts the CDB. It immediately skips to the Status Phase and posts a Check Condition. The Sense data is set to Illegal Request. If the Identify message is correct, the CDB LUN is ignored.
- If the DAT drive is selected without Attention (no Identify message sent), then the CDB LUN must be 0. In that case if an illegal LUN is specified in the CDB, the drive skips to the Status Phase and posts a Check Condition. The Sense data is set to Illegal Request.

SCSI Message Descriptions and Definitions

The SCSI message codes, descriptions, and directions are given in the following table. Each of these SCSI messages are supported by the DAT drive.

þ **Note:** If a message parity error is detected, the drive terminates the I/O process and goes bus free.

Code	Description	Direction*
00h	Command Complete	In
02h	Save Data Pointer	In
04h	Disconnect	In
05h	Initiator Detected Error	Out
06h	Abort	Out
07h	Message Reject	In/Out
08h	No Operation	Out
0Ah	Linked Command Complete	In
0Bh	Linked Command Complete with Flag	In
0Ch	Bus Device Reset	Out
80h	Identify (when sent by host, disables Disconnect/Reconnect)	In/Out
C0h	Identify (enable Disconnect/Reconnect)	Out
01h**	Extended Message	In/Out

* Direction: In = Drive to host; Out = Host to drive.

** Supports only one extended message: Synchronous Data Transfer Request.

The following table provides the SCSI message definitions.

Hex Code	***Message***	***Definition***
00h	Command Complete	This message is sent from the DAT drive to inform an Initiator that execution of a command terminated and that valid status was sent to the Initiator. After successfully sending this message, the drive goes to the Bus Free Phase by releasing BSY. **NOTE:** The command may have been executed successfully or unsuccessfully as indicated in the status.
02h	Save Data Pointer	This message is sent from the DAT drive to direct the Initiator to save a copy of the present active data pointer for the DAT drive.
03h	Restore Data Pointer	Never sent by the drive.
04h	Disconnect	This message is sent from the DAT drive to inform an Initiator that the present physical path is going to be broken (DAT drive plans to disconnect by releasing BSY) and, a later reconnect is required to complete the current operation. If the Initiator detects the Bus Free Phase, other than as the result of a Reset condition, without first receiving a Disconnect or Command Complete message, the Initiator considers this as a catastrophic error condition. The Disconnect message does not cause the Initiator to save the data pointer. If Disconnect messages are used to break a long data transfer into two or more shorter transfers, then a Save Data Pointer message is issued by the DAT drive before each Disconnect.
05h	Initiator Detected Error	This message is sent from an Initiator to inform the DAT drive that an error, such as a parity error, occurred.
06h	Abort	This message is sent from an Initiator to clear the present drive operation. All pending data and status for the issuing Initiator are cleared, and the drive goes back to Bus Free Phase. No status or ending message is sent for the operation. Any previously set modes are not changed.
07h	Message Reject	This message is sent from the DAT drive to indicate the last message it received was inappropriate or was not implemented. The DAT drive sends Message Reject and then goes to the Message-In phase prior to requesting additional message bytes from the Initiator. This sequence provides an interlock so the Initiator can determine which message was rejected.
08h	No Operation	This message is sent from an Initiator in response to a DAT drive request for a message, when the Initiator does not currently have any other valid message to send.
09h	Parity Error	This message is sent from the host to indicate that incorrect parity was detected. See the following table.
0Ah	Linked Command Complete	This message is sent from the DAT drive to inform an Initiator that execution of a linked command is completed and that status was sent. The Initiator can then set the pointers to the initial state for the next linked command.

Hex Code	***Message***	***Definition***
0Bh	Linked Command complete with Flag	This message is sent from the DAT drive to inform an Initiator that execution of a linked command with the Flag bit set to one, is completed and that status was sent. The Initiator then sets the current pointers to the initial state of the next linked command. Typically, this message is used to cause an interrupt in the Initiator between two linked commands.
0Ch	Bus Device Reset	This message is sent from an Initiator to direct the drive to clear all current commands; it forces the drive to an initial state with no operations pending for any Initiator. On recognizing this message, the drive moves to the Bus Free Phase. All modes are reset to the default state.
	Identify (80h disable Disconnect/ Reconnect) (C0h enable Disconnect/ Reconnect)	These messages are sent by either the Initiator or DAT drive to establish the physical path between them. The physical path connection indicates that both the Initiator and DAT drive have message passing capability. Bit 7 is set to one to distinguish these messages from other messages. Bit 6 is set to one by the Initiator indicating the Initiator has the ability to accommodate disconnection and reconnection. Bits 5 through 3 are reserved (set to zero). Bits 2 through 0 specify the logical unit number that must be 0 for the DAT drive. When Identify is sent from the drive to an Initiator during reconnection, an implied Restore Pointers message is performed by the Initiator prior to completion of this message.

The following table describes the operation for each of the possible cases of parity error.

State or Phase	**Description**
Bus Free State	The drive does not detect nor react to parity errors on the SCSI bus while the drive is in a bus free state.
Arbitration Phase	The drive does not detect nor react to parity errors on the SCSI bus while arbitration is being performed.
Selection Phase	The drive does not detect nor react to parity errors on the SCSI bus while the drive is being selected.
Selection, Message Out Phase (Identify Message)	If the drive detects a parity error while the host is sending an Identify message, the drive goes to Bus Free.
Reselection, Message In Phase (Identify Message)	If the drive is attempting to reconnect to the host and the host asserts ATN because it detected an error, the drive • Switches the host to the Message Out Phase. • Waits for the host to send a 09 (Parity Error Message) The drive then performs the retry option by: • Switching the host to the Message In Phase. • Resending the Identify Message
Command Phase	If the drive detects a parity error while the host is transferring a CDB, the drive • Terminates the transfer. • Switches the host to the Status Phase and sends a Check Condition. • Switches the host to the Message In Phase and sends a Command Complete. • Sets the Sense Key = B and ASC/ASCQ = 47-00 (SCSI-2 only).

State or Phase	Description
Data In Phase	If the host detects a parity error while data is being transferred from the drive and asserts ATN, the drive • Terminates the transfer of data. • Switches the host to the Message In Phase and sends a 02 (Save Data Pointer). • Switches the host to the Message Out Phase. • Waits for the host to send an 05 (Host Detected Error). • Switches the host to the Status Phase and sends a Check Condition. • Switches the host to the Message In Phase and sends a Command Complete. • Sets the Sense Key = B and ASC/ASCQ = 48-00 (SCSI-2 only).
Data Out Phase	If the drive detects a parity error while the host is transferring data, the drive • Terminates the transfer of data. • Switches the host to the Status Phase and sends a Check Condition. • Switches the host to the Message In Phase and sends Command Complete. • Sets the Sense Key = B and ASC/ASCQ = 47-00 (SCSI-2 only).
Status Phase	If the host is in the Status phase and detects an error in the status byte and asserts ATN, the drive • Switches the host to the Message Out Phase and waits for the host to send 05 (Initiator Detected Error). • Switches the host to the Status Phase and sends a Check Condition. • Sets the Sense Key = B and ASC/ASCQ = 48-00 (SCSI-2 only).
Message In Phase	If the host is in the Message In Phase and detects an error on a message bytes an asserts ATN, the drive • Switches the host to the Message Out Phase. • Waits for the host to send 09 (Parity Error Message). • Switches the host to the Message In Phase and resends the message.
Message In Phase (Command Complete message)	If the host is in the Message In Phase and detects an error on the command complete message byte and asserts ATN, the drive goes to Bus Free.
Message Out Phase	If the host is in the Message Out Phase and sends a message bytes and the drive detects a parity error, the drive • Switches the host to the Status Phase and sends a Check Condition. • Switches the host to the Message In Phase and sends a Command Complete. • Sets the Sense Key = B and ASC/ASCQ = 47-00 (SCSI-2 only).

An Initiator that accommodates disconnect/reconnect can indicate this capability to the DAT drive during the Selection phase by asserting both its own Initiator SCSI ID bit as well as the DAT SCSI ID bit (allows the DAT drive to know with which Initiator to reconnect). The Initiator must also assert ATN before exiting the Selection phase (prior to releasing SEL) and send an Identify message out of C0h to the DAT drive. This sequence causes the drive to enter the Message-Out phase when the Selection phase completes.

The first message sent by the host after the Selection phase is an Identify message. Under normal conditions, the first message sent by the DAT drive after a Reselection phase is also Identify. Under certain exceptional conditions, the host may send the Abort message or the Bus Device Reset message instead of Identify as the first message.

SCSI Status Code Descriptions and Definitions

The status code format is shown in the following table. A status byte is sent from the DAT drive to the Initiator during the Status phase at the termination of each command unless the command is cleared by an Abort message, by a Bus Device Reset message, or by a Reset condition.

BITS	7	6	5	4	3	2	1	0
CONTENT	0	0	0		Status Code			0

The DAT drive uses the 4-bit status codes shown in the following table.

Bits	4	3	2	1	0	Definition
	0	0	0	0	X	Good Status
	0	0	0	1	X	Check Condition
	0	1	0	0	X	Busy
	1	0	0	0	X	Intermediate Status
	1	1	0	0	X	Reservation Conflict

Descriptions of the five supported SCSI status codes are given in the following table.

Message	Status Code	Byte 0 Status Phase	Definition
Busy	4h	08h	This status (DAT drive busy) is returned when the drive is unable to accept a command from the Initiator. (For example, it is returned during an intermediate disconnect or after an immediate command has completed and the request function is not done.) The normal Initiator recovery action is to issue the command at a later time.
Check Condition	1h	02h	Any error, exception, or abnormal condition that causes the sense data to be set, causes a Check Condition status. A REQUEST SENSE command should be issued following a Check Condition status, to determine the nature of the condition.
Good Status	0h	10h	This status indicates that the DAT drive successfully completed the command.
Intermediate Status	8h	10h	This status is returned for every command in a series of linked commands except the last command unless an error, exception, or abnormal condition causes either Check Condition or Reservation Conflict status to be set. If this status is not returned, the chain of linked commands is broken, and no further commands in the series are executed.
Reservation Conflict	Ch	18h	This status is returned when a device attempts to access a DAT drive when it is reserved for access to another device.

Attention Condition

The Attention Condition allows an Initiator to inform a Target that the Initiator has a message to send. The DAT drive may read this message at its convenience by performing a Message-Out phase. The Initiator creates the Attention Condition by asserting the ATN signal at any time except during the Arbitration or Bus Free phases. The DAT drive checks to see if ATN is set at every phase change. If ATN is set, the drive goes into the Message-Out phase. The Initiator may deassert the ATN signal at any time. Normally, the Initiator deasserts ATN during or before the last REQ/ACK handshake of the Message-Out phase. The Attention signal must be present prior to a phase change to allow the DAT drive time to respond with a Message-Out phase at the phase change.

Reset Condition

The Reset Condition takes precedence over all phases and conditions and is used to immediately terminate operation and clear all SCSI devices from the bus. Any SCSI device can create a reset condition by asserting a RST signal for a minimum reset hold time of 25 microseconds. The DAT drive never asserts reset. During the Reset Condition, all SCSI devices release all SCSI signals (except RST) within a Clear Reset Delay (800 nSec) of the transition of RST to low. The Bus Free phase always follows the Reset Condition.

When a reset is issued to the DAT drive, the SCSI bus clears all uncompleted commands, releases all SCSI device reservations, sets the DAT drive to default modes, and returns to the Bus Free phase.

Unit Attention Condition

The Unit Attention condition in the DAT drive typically results from the following conditions:

- A Reset was previously issued to the DAT drive.
- The DAT drive has just been powered on.
- The cartridge was removed when the tape is positioned away from BOT.
- The cartridge was removed when the tape is positioned at BOT following a LOAD command.
- A cartridge has been inserted since the previous bus reset or power-on.
- A log exception condition occurred.

The Unit Attention Condition persists for each Initiator until that Initiator issues a command other than Inquiry for which the DAT drive returns with a Check Condition Status. If the next command from that Initiator following the Check Condition Status is Request Sense, then the unit attention sense key is returned.

If the Inquiry Command is received from an Initiator with a pending Unit Attention Condition before the DAT drive reports Check Condition Status, the DAT drive performs the Inquiry Command and does not clear the Unit Attention Condition.

If the Request Sense Command is received from an Initiator with a pending Unit Attention Condition before the DAT drive reports Check Condition Status, the DAT drive reports unit attention sense key and clears the Unit Attention Condition for that Initiator.

Buffered Mode

Buffered Mode allows the most efficient operation of the DAT drive. the drive defaults to Buffered mode. In this mode, the drive signals Command Complete when all requested data for a WRITE command has been transferred from the host to the DAT buffer. This mode provides data to maintain operation while the host readies a new WRITE Command.

If an error occurs in writing data to the tape after the DAT drive signals Command Complete, an error status is sent on the next Command issued.

Immediate Function

For Initiators that do not support the disconnect feature, the Immediate bit provides a means of releasing the bus while the drive is busy completing a function such as repositioning the tape. If a command is sent by the Initiator after a previous Immediate Command was accepted, the drive continues the Immediate Function it is currently performing and returns a Busy Status for the new command.

An immediate bit of zero means that the status is returned to the Initiator when the operation is completed. (For example, the status is returned when the tape has been repositioned.) An Immediate bit of one means that the status is returned to the Initiator as soon as the function is started.

Residual Length Function

When performing a WRITE command, the drive returns a Good Status and Command Completion Message when the last byte requested by the command is placed in the Data Buffer, rather than when it is written onto tape. If an error occurs while data is being written onto tape, the drive calculates the Residual Length and places this value in the information bytes of the Sense Data Block. Also, the Residual Length functions for other commands, such as READ and SPACE.

Residual Length is calculated by: RL = TL - AL

Where :

AL (Actual Length) = Blocks transferred from the host to the DAT drive across the SCSI bus.

TL (Transfer Length) = The Transfer Length from bytes 2-4 of the WRITE command (Request Transfer Length).

RL (Residual Length) = The amount of blocks or bytes not written to tape.

Disconnect/Reconnect Function

When the drive is performing a task not requiring communication with the Initiator or when the DAT drive determines that a relatively long time has passed with no bus activity, it disconnects from the SCSI bus. Examples are:

- When rewinding the tape.
- When writing to the tape and the buffer is full.
- When reading from the tape and the buffer is empty.
- When spacing, locating, or generally performing any tape motion when data cannot be transferred on the SCSI bus.

During the time the Target is disconnected for one of these functions, the bus is free for use by other devices. Both disconnect and reconnect are initiated by the Target.

When the Initiator first selects the drive, it sends an Identify Message indicating that it is allowing the drive to disconnect and reconnect and to be capable of supporting messages other than Command Complete (and the host set its own ID during selection). To disconnect from the bus, the DAT drive performs the following procedure:

1. The drive can send a Save Data Pointers Message if the disconnection function was a data transfer.
2. The drive sends a Disconnect Message indicating it is going to disconnect.
3. The drive disconnects from the bus by deasserting BSY and releasing control of all bus signals.

The bus is now free for an Initiator to select any device on the bus, including the drive that initiated the disconnect. The drive will respond to selection by another Initiator.

If the DAT drive is selected while disconnected, it only allows the following actions:

- If the command is from a different initiator or is from the same initiator but to a different LUN, the DAT drive accepts the command and immediately returns Busy Status.
- Immediately following the selection, the Initiator may send the Identify, No Op, Abort, or Bus Device Reset messages to the drive.
- If the command is from the same initiator to the same LUN, the current command terminates with a Check Condition and an Abort Sense Key.

When the disconnected drive is ready to reconnect with the Initiator, it does the following.

1. It monitors the bus waiting for a Bus Free Phase to occur. When a Bus Free Phase is sensed, the DAT drive arbitrates for the bus.
2. If it wins arbitration, the DAT drive then attempts to reselect the Initiator. If the Initiator fails to respond in 250 mSec, the drive drops all bus signals and allows the bus to again enter the Bus Free Phase. The drive then repeats the attempted Arbitration.
3. When the DAT drive has successfully reselected the Initiator, it sends an Identify Message to reestablish the path between the drive and the Initiator. This message is always 80h because the DAT drive is initiating the reselection and is always LUN 0. A Restore Pointers Message is implied when the DAT drive sends an Identify Message to the Initiator. The Initiator responds accordingly.

SCSI Memory Address Pointers

SCSI provides for two sets of three pointers within each Initiator. When a physical path is established with a host, and this path can accommodate disconnection and reconnection, the host must ensure that its Current Pointers for the path are equal to the Saved Pointers in the DAT drive. An implied Restore Pointers Operation occurs in the host as a result of a connect or reconnect.

Current Data Pointers

Current data pointers, also known as Active Pointers, are used to represent the state of the interface and point to the next Command, Status or Data byte to be transferred between the memory of the Initiator and the Target. Each Initiator may have only one set of Current Pointers. The Current Pointers are used by the Target currently connected to the Initiator.

Saved Data Pointers

Whether or not a currently active device is currently connected, it has one set of Saved Data Pointers. This set includes Command, Status and Data Pointers that point to the Command Descriptor Block, Status Area and Data Area, respectively, for that device.

The Saved Pointer continues to point to the start of the Data Area until the Target reconnects to the Initiator. In response to the implied Save Data Pointer message, the Initiator replaces the Current (active) Data Pointer with the value of the Saved Data Pointer.

Early Warning Function

Early Warning on the DAT drive is a logical warning given when ten megabytes of storage space remain on the tape. The position is calculated by the drive. When this physical position is reached on a tape, the following occurs.

1. Data transfers from the host are terminated at the next block boundary.

2. All data remaining in the drive buffer is written to the tape if the Synchronize at EW bit is set.

3. The command completes with a Check Condition and a 40h Sense data meaning EOM and no Sense Key.

4. Subsequent WRITE commands write data and complete with check condition with EOM Status and No Sense Key until the physical tape end is encountered.

Error Reporting

Soft Errors

Soft errors are generally tape-quality related and occur more frequently during write operations than during read operations. Soft errors indicate repeated attempts by the drive to read or write data on the tape. Some soft errors are normal, but an increase in the usual count can indicate deteriorating tape quality. If the soft error count remains higher than normal, clean the read/write heads. If this procedure does not clear the problem, change to a new tape cartridge.

Hard Errors

If a hard error (unrecoverable error) occurs during operation, the drive terminates operation immediately and returns a Check Condition. The Initiator should cease any further read or write functions and issue a Request Sense Command to determine the type of error.

When the drive detects a write error, it attempts to rewrite the data up to 127 times. After the 127th attempt, the error is considered unrecoverable and the

operation terminates. In that case, the appropriate LED on the drive front panel flashes rapidly. When a hard error is encountered, replace the tape with a new cartridge and repeat the function or clean the heads with a cleaning cartridge.

SCSI Bus Timing

The following table shows the SCSI Bus timing requirements. Except where noted, the delay time measurements for each SCSI device is calculated from signal conditions existing at the SCSI bus connection for that device. Normally these measurements do not consider delays in the SCSI bus cable.

Status	Duration	Description
Arbitration Delay	2.2 mSec	The minimum time (no maximum time) an Initiator or DAT drive needs from the time the BSY signal is asserted for Arbitration until the DAT drive can examine the Data Bus to determine if Arbitration has been won.
Bus Clear Delay	*800 nSec	The minimum time an Initiator or DAT requires to stop driving all SCSI bus signals after either (1) a Bus Free Phase is detected, or (2) the SEL signal is received from another SCSI bus Initiator during the Arbitration Phase.
Bus Free Delay	*800 nSec	The minimum time an Initiator or DAT waits after detecting the Bus Free Phase until it asserts BSY signal when going to the Arbitration Phase.
Bus Set Delay	1.8 mSc	The minimum time an Initiator or DAT is allowed after it detects a Bus Free Phase to assert the BSY signal and the SCSI ID bit on the data bus as a requirement for entering the Arbitration Phase.
Bus Settle Delay	400 nSec	The time the SCSI bus needs to settle after changing certain control signals.
Cable Skew Delay	10 nSec	The maximum difference allowed in propagation time between any two SCSI bus signals when measured between any two SCSI bus devices.
Deskew Delay	45 nSec	This time is used to calculate the minimum time required for deskew delay of certain signals.
Reset Hold Time	25 msec	The minimum time (no maximum time) for which the RST signal is to be asserted.
Selection Abort Time	200 mSc	The maximum time-out duration before asserting a BSY signal that the drive or Initiator takes after the most recent detection of Select or Reselect. This timeout is required to ensure that a drive or Initiator does not assert the BSY signal after a Selection or Reselection Phase has been aborted. This timeout is not the same thing as the Selection Timeout Delay.
Selection Timeout Delay	250 mSec	The minimum recommended time during the Selection or Reselection Phase that an Initiator or drive should wait for a BSY response before starting the time-out procedure.

* In the Bus Clear Delay for condition (1), the maximum time allowed for a SCSI device to clear the SCSI bus is 1200 nSec from the time the BSY and SEL signals both first become false. If a SCSI device requires more than a Bus Settle Delay to detect the Bus Free Phase, it clears the SCSI bus within the time duration of the Bus Clear Delay minus excess time.

Variable and Fixed Mode Recording

The DAT drive can write either fixed or variable block sizes. The recording mode is determined by the Fixed bit in the SCSI WRITE and READ commands.

If the Fixed bit is set, the MODE SELECT command sets the size of the next block or multiple blocks to be written with the next WRITE command. When a WRITE command is issued with the Fixed bit set, the current block size is implemented. The transfer length specifies the number of blocks to be written with this size. If a WRITE command is issued with the Fixed bit set and the current block size set to 0, the DAT drive returns a Check Condition with Illegal Request Sense Key. When writing with the Fixed bit set, each WRITE command specifies the number of contiguous blocks to be written of a fixed size, resulting in fixed-mode blocks.

If the Fixed bit is reset, then only one block can be written on the tape per SCSI WRITE command CDB. In that case, the WRITE command CDB transfer length specifies the size of the block to be written in bytes. With the Fixed bit reset, the current block size specified with the last MODE SELECT command is ignored. Setting the block size to 0 in the MODE SELECT page descriptor is not required. Therefore, with the Fixed bit reset, each SCSI WRITE command may specify a different byte count, resulting in variable-mode blocks.

The host may switch between fixed and variable mode recording. By issuing the MODE SELECT command to specify different block sizes, blocks can be written to the tape with different block sizes in the fixed mode. Also, the host may change the block size after BOM, allowing on-the-fly block-size changes.

The READ command Fixed bit also specifies fixed or variable mode.

When reading in variable mode, the host must know the size of the block to be read from the tape in advance in order to avoid causing the DAT drive to return a Check Condition with Incorrect Length indicated in the Sense data (ILI). Also, the data transfer may be truncated (cut off) when the recorded block does not match the transfer length in variable mode or the current block size in fixed mode.

The SCSI-2 READ command includes a SILI bit to Suppress ILI Check conditions. When the SILI bit is set, the host usually specifies the maximum block size before reading so that the data blocks are not truncated, and no Check Conditions are generated.

The SCSI READ BLOCK LIMITS command returns the minimum and maximum block sizes that the DAT drive can support. The Block Limits data is not modified to reflect the current mode of writing—fixed or variable. The Block Limits returned data is not modified to reflect the current block size for the next fixed-mode WRITE. The MODE SENSE command is used for that purpose.

Autoloader Operation

When you insert the magazine in the magazine holder, you hear a click signifying that the magazine is correctly mounted. The Autoloader initializes the magazine when

- Power is applied with the magazine already mounted in the Autoloader.
- When power is applied, a magazine is then mounted in the Autoloader; and the load/unload push button is pressed.
- An INITIALIZE ELEMENT STATUS SCSI command is received.

Initialization causes the magazine to move from one end to the other end through all the cartridge slots so the Autoloader can determine which slots of the magazine contain cartridges (full) and which slots do not contain cartridges (empty).

Once magazine initialization completes, the magazine is positioned such that the cartridge in the number 1 location (uppermost cartridge slot of the magazine) is directly in front of the drive. If the initialization occurred because the load/unload push button was pressed, the first cartridge may be inserted in the drive depending on the switch settings. Otherwise, no cartridge is inserted until the host computer directs the Autoloader to insert a cartridge.

When the load/unload push button on the front panel of the Autoloader is pressed and a cartridge is inserted, the cartridge (if any) in the drive internal to the unit is ejected by the drive, and placed in the cartridge slot positioned in front of the drive; the magazine is then moved to its dismount position.

When the magazine is mounted or ejected, the appropriate Unit Attention, Not Ready, and Busy conditions occur as in the DAT drive.

A Bus Device Reset or SCSI Bus Reset is the same for the Autoloader as for the DAT drive. No magazine movement occurs.

The following two cases apply when the DAT drive internal to the Autoloader contains a cartridge and the magazine is mounted and positioned:

- If an empty magazine slot is positioned in front of the drive prior to magazine initialization, the cartridge is ejected and placed in the empty slot.
- If an empty magazine slot is not positioned in front of the drive, the magazine is moved to the dismount position and no cartridges are moved.

When a cartridge is loaded in the internal drive at power-up without a magazine mounted (as in single-cartridge operation), and then a magazine is mounted, the magazine is ignored and remains in its dismount position without an error.

Normally, the magazine is locked in place. If the host computer issues a PREVENT MEDIA REMOVAL command, the cartridge does not eject and the

magazine remains locked in place. The host computer must issue an ALLOW MEDIA REMOVAL command to allow cartridge ejection, which allows removal of the magazine.

Sequential Operation

In sequential operation, the internal electronics of the unit sequentially select cartridges--retrieving a cartridge from the magazine and inserting it in the drive internal to the Autoloader. The drive then loads the cartridge, completes the read or write operation as normal to early-warning or end-of-recorded data. When the UNLOAD command is received by the drive, it ejects the cartridge, and the loader mechanism returns the cartridge to the magazine; then automatically retrieves the next cartridge in sequence.

This method of operation enables the Autoloader to run with current software that notifies an operator to insert a new cartridge and then polls for Unit Ready. Host software that awaits operator response that the new cartridge has been inserted (for example, that waits to receive a Carriage Return character) must be modified to eliminate this operator intervention for the Autoloader to perform unattended back-up functions.

SCSI Direct-Access Operation

SCSI direct-access operation of the Autoloader complies with SCSI-2 10c, Section 16, Medium Changer Devices. The information in the remainder of this document describes aspects of the SCSI implementation for the Autoloader that pertains to the referenced SCSI section. Using this information, a software developer can tailor host software to directly control any movement of the Autoloader.

General SCSI Information

Some terms used in SCSI-2 that are applicable to the Autoloader are defined in the following paragraphs.

Each component of the Autoloader used for cartridge handling is referred to as an *element*. Each element has its own unique *element address*, consecutively numbered from zero through maximum. The Autoloader elements are as follows:

- *Medium transport element* (element address 0—the cartridge changer)
- *Data transfer element* (element address 1—the DAT drive)
- *Storage elements* (element address 2 through max). These elements are the actual cartridge slots of the magazine. Element address 2 is always the number 1 location slot. The number 1 location is the uppermost cartridge slot if the Autoloader is positioned such that the magazine travels vertically.

SCSI commands move cartridges by informing the medium transport element (element address 0) from which element address to fetch a cartridge (for

example, element address 3, a storage slot) and which element address to place the cartridge (for example, element address 1, the DAT drive).

Information available to the host includes

- How many element addresses exist.
- Which types of elements belong to the addresses.
- If the elements are full or empty.

Addressing

The loader mechanism of the Autoloader unit is considered a medium changer SCSI device type. The DAT drive internal to the Autoloader unit is a sequential access SCSI device type. Both the DAT drive and loader mechanism share the same SCSI ID.

Both the loader mechanism and the DAT drive can be addressed with LUN 0 or LUN 1 of the current SCSI ID switch setting of the Autoloader unit (switch setting on the switchbank accessed through the cutout at the rear of the unit or a remote connector). When addressed with LUN 0, all existing DAT SCSI commands (for example, READ, WRITE, SPACE, etc.) are accepted and all loader-specific commands are accepted (for example, READ ELEMENT STATUS, INITIALIZE ELEMENT STATUS, and so forth.).

The only difference between LUN 0 and LUN 1 operation is the INQUIRY data returned to the initiator in response to an INQUIRY command and the returned data from a MODE SENSE command. With LUN 0 the device type is 01h, sequential access device. With LUN 1 the device type is 08h, medium changer device.

Addressing with LUN1 allows initiator, automatic self-configuration software to determine that a medium changer device exists on the bus which is capable of accepting medium changer commands.

General Operation

The following points describe the general operation of the Autoloader.

1. The RESERVE/RELEASE commands affect the Autoloader as one unit. A RESERVE/RELEASE issued to LUN 0 reserves/releases LUN 1, and vice versa.

2. Busy status affects the Autoloader as one unit. LUN 0 is busy when LUN 1 is busy, and vice versa.

   Busy status is posted by the Autoloader the same as for the DAT unit. Additionally, any medium changer process that is being executed (for example, a MOVE MEDIUM and EXCHANGE MEDIUM) causes Busy status to be posted.

3. The Ready and Not-ready conditions of the Autoloader operate the same as the DAT unit. The MOVE MEDIUM command is accepted and executed when no media is contained in the drive. The Ready and Not-ready conditions affect the Autoloader as one unit. When LUN 0 is not ready LUN 1 is not ready, and vice versa.

4. Reset conditions affect the Autoloader as one unit. A Bus Device Reset or SCSI Bus Reset initializes both LUN 0 and LUN 1.

5. Unit Attention conditions affect the Autoloader as one unit for LUN 0 and LUN 1. Unit Attention conditions for the Autoloader are defined in the SCSI-2 commands in Section 4 with the following conditions:

   — All initiators except the initiator issuing the MOVE or EXCHANGE command receives a Unit Attention (06) sense key and an additional sense code/qualifier of 28/00.

   — All initiators receive a Unit Attention (06) sense key and an additional sense code/qualifier of 28/00 when the Autoloader magazine is mounted.

6. An UNLOAD command ejects the cartridge from the drive into the storage element positioned in front of the drive and then inserts the next cartridge in sequence. Otherwise, the command operates similarly to operation for the other DAT drives.

7. Some REQUEST SENSE additional sense codes/qualifiers particular to the medium changer part of the Autoloader are given below. For a complete list, refer to the REQUEST SENSE command in Chapter 3.

21/01	Invalid Element address
3B/0D	Destination Element Full
3B/0E	Source Element Empty
3A/00	Medium Not Present (used only if the drive is empty during an EXCHANGE MEDIUM command)
28/00	Not Ready to Ready Transition (media change) Unit Attention after media movement or when magazine is mounted

Notes

Commands 3

Introduction

This chapter describes the SCSI-2 commands for the DAT drive.

Command Reference List

This chapter describes the DAT implementation of the ANSI SCSI-2 specifications. The following table lists the commands numerically by code. Commands specific for the AutoLoader are noted.

Code	SCSI-2	Autoloader	Command
00h	X		TEST UNIT READY
01h	X		REWIND
02h	X		REQUEST BLOCK ADDRESS
03h	X		REQUEST SENSE
05h	X		READ BLOCK LIMITS
07h	X	X	INITIALIZE ELEMENT STATUS
08h	X		READ
0Ah	X		WRITE
0Ch	X		SEEK BLOCK
10h	X		WRITE FILEMARKS
11h	X		SPACE
12h	X		INQUIRY
13h	X		VERIFY
15h	X		MODE SELECT
16h	X		RESERVE UNIT
17h	X		RELEASE UNIT
19h	X		ERASE
1Ah	X		MODE SENSE
1Bh	X		LOAD/UNLOAD

Code	SCSI-2	Autoloader	Command
1CH	X		RECEIVE DIAGNOSTIC RESULTS
1Dh	X		SEND DIAGNOSTIC
1Eh	X		PREVENT/ALLOW MEDIUM REMOVAL
2Bh	X		LOCATE
34h	X		READ POSITION
3Bh	X		WRITE DATA BUFFER
3Ch	X		READ DATA BUFFER
40h	X		CHANGE DEFINITION
4Ch	X		LOG SELECT
4Dh	X		LOG SENSE
A5h	X	X	MOVE MEDIUM
A6h	X	X	EXCHANGE MEDIUM
B8H	X	X	READ ELEMENT STATUS

Conventions

The commands in this chapter are listed in alphabetical order. Each command is described; its Command Descriptor Block (CDB) illustrated; and the Completion Status is given. Bits and fields defined in the ANSI SCSI-2 document that are not used by the drive are not described in this document. Rather, those bits and fields are shown as 0, 1, or X (ignores), as appropriate. Bits and fields that are supported by the drive are described.

Command Descriptor Blocks (CDBs)

A host makes request of the DAT drives by sending a command descriptor block (CDB); some commands also require a parameter list. If the CDB or the parameter list contains an invalid parameter, the drive terminates the command without altering the medium.

Command Descriptor Block Formats

The SCSI-2 six-byte CDBs are arranged in the format shown in the following table.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Group Code				Command Code			
1	LUN				Command Dependent			
2	Command Dependent							
3	Command Dependent							
4	Command Dependent							
5	X	X	0	0	0	0	Flag	Link

The SCSI-2 ten-byte CDBs are arranged in the format shown in the following table.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0		Group Code			Command Code			
1		LUN			Command Dependent			
2	Command Dependent							
3	Command Dependent							
4	Command Dependent							
5	Command Dependent							
6	Command Dependent							
7	Command Dependent							
8	Command Dependent							
9	Vendor Unique		0	0	0	0	Flag	Link

Command Descriptor Block Field Descriptions

The command descriptor block fields are described in the following table.

Field Name	Byte	Bits	Description
Group Code	0	5-7	This field indicates the SCSI command groups used
Command Code *	0	0-4	This field indicates which of 32 command codes is sent. **NOTE:** The Group Code and Command Code are used together to indicate the operation code.
Logical Unit	1	5-7	The LUN must be set to zero.
Command Dependent	1 2-4	0-4 0-7	See specific command.
Vendor Unique	5	6-7	These bits are ignored. In the following command sections, these bits are shown by Xs.
Flag and Link bits	5	0-1	These bits are used by all commands and described in the following subsection, Flag and Link Bit Descriptions.

Flag and Link Bit Descriptions

The Link bit enables a chain of commands to execute sequentially without the initiator reselecting the target. By setting the Link bit, the Initiator desires an automatic link to the next command on successful completion of the current command.

The Flag bit allows the initiator to track milestones in the linked command process by requesting a linked Command Complete (with flag) message from the drive.

If the CDB has the Link bit set, the drive completes the command and takes the following actions:

1. Goes to the Status phase and posts Intermediate Good status.

2. Goes to the Message-In phase and posts one of two possible messages according to the setting of the Flag bit.

3. Proceeds to the Command Out phase to request the next CDB.

Command linking continues as long as the Link bit is set in successive CDBs. Linking stops when the drive detects an error and posts a Busy or Check Condition.

The Flag and Link bits are used by all commands. These bits are defined in the following table.

If the Link bit is . . .	***and the Flag bit is . . .***	***the result is . . .***
1	0	The Target sends an Intermediate Good Status, then a Linked Command Complete message, and then requests the next command.
1	1	The Target returns Immediate Status and then sends a Linked Command Complete (with flag) message, then requests the next command.
0	0	The Target performs normal termination and goes to Bus Free.
0	1	Invalid, the Target returns Illegal Request.

CHANGE DEFINITION (40h)

The CHANGE DEFINITION command lets the host switch between the two operating SCSI specification levels—SCSI-1 (ANSI X3.131-1986) and SCSI-2 (ANSI Working Draft, Revision 10).

The default SCSI level for the DAT drive is SCSI-2. The default SCSI level is in effect after the drive is powered on, after a hard reset, or after a bus device reset.

Once the CHANGE DEFINITION command is accepted, the new SCSI operating definition remains in effect until a hard reset condition occurs or until the host selects a new operating definition by issuing another CHANGE DEFINITION command. The new operating definition is specific to each initiator, allowing each initiator to use the drive in any desired mode. Thus, no Unit Attention is posted to other initiators when the current definition is changed.

CHANGE DEFINITION Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	1	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0 |			Definition Parameter				
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Description

The following table defines the fields in the CDB.

Field Name	Bytes	Bits	Description
Definition Parameter	3	0-6	If this field is 00h, the current operating definition is not changed. This condition is not considered an error. If this field is 01h, the current operating definition changes to SCSI-1. If this field is 03h, the current operating definition changes to SCSI-2.

Conditions for Changing Definitions

When executing the CHANGE DEFINITION command, the drive follows these rules:

- If the new SCSI specification level is the same as the current specification level, Good Status is returned.
- If the current SCSI specification is different than the new specification level and no commands are pending, the drive changes the SCSI specification level to the new specification level and returns Good Status.
- If the current SCSI specification is different than the new specification level and immediate commands are in progress, the drive returns a Busy status and does not change the SCSI specification level to the new specification level.

Completion Status

The Completion Status for the CHANGE DEFINITION command is shown in the following table.

Code	Message	Description		
00h	Good Status	• The new operating definition is accepted. • The current operating definition and new definition are the same. • The drive is ready to accept any appropriate command.		
08h	Busy	An immediate command is in progress.		
02h	**Check Condition**	**Extended Sense Byte 02h**		
		Code	**Message**	**Description**
		04h	Hardware Error	Parity error on SCSI bus or drive hardware failure detected.
		05h	Illegal Request	• The CDB contains an invalid bit. • Illegal definition parameter.
		06h	Unit Attention	• Cartridge was changed prior to accepting this command. • Drive was reset prior to this command.

ERASE (19h)

The ERASE command creates an EOD (end-of-recorded data) marker at the current position of the tape when the command is issued, thus rendering the remainder of the tape unreadable.

ERASE Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	1	0	0	1
1	0	0	0	0	0	0	IMMED	Long
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Description

The following table defines the fields in the CDB.

Field Name	Bytes	Bits	Description
IMMED	1	1	If the IMMED (Immediate) Bit is 1, status is to be returned as soon as the ERASE command is accepted and verified. If the IMMED bit is 0, status is not returned until the tape is erased.
Long	1	0	If the Long bit is 0, a short ERASE is performed, and EOD is recorded at the current tape position. If this bit is 1, a long data-security ERASE is performed, and EOD is recorded at the current tape position until the end of the partition.

Completion Status

The Completion Status for the ERASE command is shown in the following table.

Code	Message	Description		
00h	Good Status	• The drive remains in any previously set modes. • The drive is ready to perform any appropriate command.		
02h	**Check Condition**	**Extended Sense Byte 02h**		
		Code	**Message**	**Description**
		02h	Not Ready	No cartridge is inserted in the drive.
		04h	Hardware Error	Parity error on SCSI bus or drive hardware failure detected.
		05h	Illegal Request	• The CDB contains an invalid bit. • Both IMMED bit and Link bit are set to 1.
		06h	Unit Attention	• Cartridge was changed prior to accepting this command. • Drive was reset prior to this command.
		07h	Write Protect	The cartridge in the drive is write protected.

EXCHANGE MEDIUM (AutoLoader Only) (A6h)

The EXCHANGE MEDIUM command provides a means to exchange the cartridge in the source element with the cartridge located in the drive. This command provides the initiator a single-command alternative to two MOVE MEDIUM commands when removing a cartridge from the DAT drive and inserting another cartridge into the DAT drive.

EXCHANGE MEDIUM Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	0	1	0	0	1	1	0
1		LUN		0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	Source Address							
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	1
8	0	0	0	0	0	0	0	0
9	Source Destination							
10	0	0	0	0	0	0	0	0
11	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Descriptions

The source address field specifies the location from which the cartridge is taken; the destination address field specifies the location to which the cartridge is moved.

The destination address must represent an empty storage element; the cartridge in the drive is first moved to this location. The source address must represent a full storage element; this cartridge is then moved to the drive.

The following table shows the addresses of the various elements.

Source/ Destination Address	Source/ Destination Element	Magazine Type (# Cartridges)
0	0	
1	Drive	
2	Magazine slot 1	5 or 12
3	Magazine slot 2	5 or 12
4	Magazine slot 3	5 or 12
5	Magazine slot 4	5 or 12
6	Magazine slot 5	5 or 12
7	Magazine slot 6	12 only
8	Magazine slot 7	12 only
9	Magazine slot 8	12 only
10	Magazine slot 9	12 only
11	Magazine slot 10	12 only
12	Magazine slot 11	12 only
13	Magazine slot 12	12 only
Other	Illegal Request	

Completion Status

The following table lists the completion status for the EXCHANGE MEDIUM command.

Code	Message	Description
00h	Good Status	• The cartridges have been moved to the specified destinations. the cartridge in the drive is positioned at BOT. • The drive is ready for another command.
02h	**Check Condition**	**Extended Sense Byte 02h**

Code	Message	Description
02h	Not Ready	No magazine is present.
04h	Hardware Error	Parity error on SCSI bus or drive hardware failure detected.
05h	Illegal Request	• The source element is empty. • The drive is empty. • The destination element is full
.		• The source and destination address are the same.
06h	Unit Attention	• Cartridge was changed prior to accepting this command. • Drive was reset prior to this command.

INITIALIZE ELEMENT STATUS (AutoLoader Only) (07h)

The INITIALIZE ELEMENT STATUS command causes the AutoLoader to eject the cartridge that is in the DAT drive (if any) and place it in the magazine cartridge slot positioned in front of the drive. Then the magazine is initialized, checking each element for cartridges or any other status relevant to that element. This command performs the same magazine initialization as is performed by mounting a magazine and pressing the load/unload button or powering-up the drive except that no cartridge is inserted into the drive.

INITIALIZE ELEMENT STATUS Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	1	0	0	0	1	1	1
1		LUN		0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	X	X	0	0	0	0	Flag	Link

Completion Status

The following table lists the completion status for the INITIALIZE ELEMENT STATUS command.

Code	Message	Description		
00h	Good Status	• The magazine has been initialized and positioned. • The drive is ready to accept another command.		
02h	**Check Condition**	**Extended Sense Byte 02h**		
		Code	**Message**	**Description**
		02h	Not Ready	No magazine is present.
		04h	Hardware Error	Parity error on SCSI bus or drive hardware failure detected.
		05h	Illegal Request	The CDB contains an invalid bit.
		06h	Unit Attention	• The cartridge was changed prior to accepting this command. • The drive was previously reset.

INQUIRY (12h)

The INQUIRY command requests that the drive return parameter information. If an INQUIRY command is received from an Initiator with a pending Unit Attention Condition (before the drive reports Check Condition status), the drive performs the INQUIRY command and does not clear the Unit Attention Condition.

INQUIRY Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	0	0	1	0
1	0	0	0	0	0	0	0	EVPD
2	Page Code							
3	0	0	0	0	0	0	0	0
4	Allocation Length							
5	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Description

The following table defines the fields in the CDB.

Field Name	Bytes	Bits	Description
EVPD	1	0	An Enable Vita Product Data (EVPD) bit of 1 specifies that the drive return vital product data specified in the Page Code field. An EVPD bit of 0 specifies that the drive return the standard INQUIRY data.
Page Code	2		The Page Code field specifies which page of vital product data information the target returns.
Allocation Length	4		This field specifies the number of bytes that the Initiator allocated for the response data. The drive transfers the number of bytes specified up to a maximum of 36. An Allocation Length of zero indicates that no data can be transferred. This length is not considered an error.

Standard INQUIRY Data Format

The following table shows the standard data format for the INQUIRY command.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Peripheral Device Type							
1	1	0	0	0	0	0	0	0
2	0	0	0	0	0	ANSI Version (2)		
3	0	0	0	0	0	0	1	0
4	Additional Length (1Fh)							
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	1	1	0	0	0
8	MSB—Vendor ID							
.								
15	Vendor ID—LSB							
16								
.	Product Name							
22								
23								
.	Firmware Part Number							
27								
28								
.	Product Revision Level							
31								
32								
.	Firmware Version							
35								

The VPD pages supported are as follows:

0 Peripheral Device Type
1 Page Code (00h)
2 Reserved
3 Page Length (04h)
4 Supported Pages (00h)
5 Firmware Designation Page (03h)
6 Drive Serial Number Page (80h)
7 Controller Firmware Revision Page (C0h)
8 Drive Firmware Revision Page (C1h)

Standard INQUIRY Data Format Field Descriptions

The following table describes the data format fields.

Field Name	Bytes	Bits	Description
Peripheral Device Type	0	0-7	This field is set to 01h to indicate a sequential access device. This field is set to 08h to indicate a medium changer device if the drive is an Autoloader and the LUN=1. Value 7Fh indicates that a logical unit is not present. This value is returned in the case where an invalid LUN was contained in the last Identify message sent by the Initiator, or the LUN field of the CDB.
ANSI Version	2	0-2	This field contains 2 in compliance with ANSI standard SCSI-2
Additional Length	4		This field indicates that 31 bytes of additional INQUIRY command parameters follow—beginning in Byte 05h. This value is not changed if the Allocation Length in the CDB is too small or too large to accommodate the entire response.
Vendor ID	8-15		These fields contain 8 bytes of ASCII data: SEAGATE followed by 2 spaces.
Product Name	16-22		These fields contain 7 bytes of ASCII data: "???? " followed by a space.
Firmware Part Number	23-27		These fields contain the 5-digit Seagate part number.
Product Revision Level	28-31		These fields contain 4 bytes of ASCII data: "-xxx" the xxx is the 3-digit firmware revision part number; for example, "-001".
Firmware Version	32-35		These fields contain the firmware version.

The Firmware Designation Page (03h) is defined as follows:

0 Peripheral Device type
1 Page Code (03h)
2 Reserved
3 Page Length (1Ch)
4-11 Reserved
12-15 REV Level
16-31 Reserved

The Controller Firmware Revision Page (C0h) is defined as follows:

0	Peripheral Device Type
1	Page Code (C0h)
2	Reserved
3	Page Length (0Dh)
4	ASCII Length (0Ch)
5-8	REV Level
9-16	Build Date
17-20	OEM Model Number

The Drive Firmware Revision Page (C1h) is defined as follows:

0	Peripheral Device Type
1	Page Code (C1h)
2	Reserved
3	Page Length (04h)
4	ASCII Length (03h)
5-7	Drive Firmware Revision Level

INQUIRY Drive Serial Number Data Format Page

The following table describes the drive serial number, which is sent from the drive to the host as data formatted in a parameter list.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Peripheral Device Type							
1	Page code (80h)							
2	Reserved							
3	Page Length (7)							
4	Drive Serial Number							
5	Drive Serial Number							
6	Drive Serial Number							
7	Drive Serial Number							
8	Drive Serial Number							
9	Drive Serial Number							
10	Drive Serial Number							

Drive Serial Number Data Format Field Descriptions

The following table defines the fields in the Drive Serial Number Data Format.

Field Name	Bytes	Bits	Description
Peripheral Device Type	0	0-7	This field is set to 01h to indicate a sequential access device.
Page Code	1	0-7	The Page Code field is set to 80h to indicate that the data following contain the Drive Serial Number.
Page Length	3	0-7	This field specifies the length of the Drive Serial Number.
Drive's Serial Number	4-6	0-7	These fields contain the drive's 3-digit prefix.
	7-10	0-7	These fields contain the drive's 4-digit serial number.

Completion Status

The Completion Status for the INQUIRY command is shown in the following table.

Code	Message	Description		
00h	Good Status	• The tape is not moved; the current position is maintained. • The drive remains in any previously set modes. • The drive is ready to perform any appropriate command.		
02h	**Check Condition**	**Extended Sense Byte 02h**		
		Code	**Message**	**Description**
		04h	Hardware Error	Parity error on SCSI bus or drive hardware failure detected.
		05h	Illegal Request	The CDB contains an invalid bit..

LOAD/UNLOAD (1Bh)

The LOAD/UNLOAD command requests that the DAT drive enable or disable the logical unit for further operations. In either case, the tape is positioned to BOT before loading or unloading.

When an UNLOAD command is executed, the tape positions to BOT, and the cartridge is ejected without an error condition. The UNLOAD command ejects the cartridge even if a PREVENT MEDIA REMOVAL command is in effect.

For the Autoloader, an UNLOAD command ejects the cartridge from the drive into the storage element positioned in front of the drive and then inserts the next cartridge in sequence.

LOAD/UNLOAD Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	1	0	1	1
1	0	0	0	0	0	0	0	IMMED
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	X	LOAD
5	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Description

The following table defines the fields in the CDB.

Field Name	Bytes	Bits	Description
IMMED bit	1	0	If the IMMED bit is 1, status is returned as soon as the operation is initiated. If the IMMED bit is 0, status is not returned until the tape is positioned.
LOAD bit	4	0	If the LOAD bit is 1, the tape moves to BOT. If the LOAD bit is 0, the tape repositions to BOT. The tape is then ejected. following an UNLOAD, the drive accepts and executes any valid nonmedia access commands.

Completion Status

The Completion Status for the LOAD/UNLOAD command is shown in the following table.

Code	Message	Description
00h	Good Status	
	Load = 1 (Load)	• The tape is positioned to BOT. • The drive remains in any previously set modes. • The drive is ready to perform any appropriate command.
	Load = 0 (Unload)	• The tape is position to BOT and ejected. • The drive remains in any previously set modes. • The drive is ready to perform any appropriate command.
	IMMED = 1	Good Status is returned once the command is transferred and verified. The requested action may still be in progress when another command is issued. The drive immediately completes nonmedia access commands but returns Busy otherwise.
02h	**Check Condition**	**Extended Sense Byte 02h**

Code	Message	Description
02h	Not Ready	No cartridge is inserted in the drive.
04h	Hardware Error	Parity error on SCSI bus or drive hardware failure detected.
05h	Illegal Request	• Both IMMED and Link bits are set to 1. • The CDB contains an invalid bit.
06h	Unit Attention	The cartridge was changed prior to BOT or at BOT following a LOAD command.

LOCATE (2Bh)

The LOCATE command is used to position the tape to the specified block address in the specified partition. Before the locate operation is performed, all buffered data, filemarks, and setmarks are transferred to tape. On completion, the logical position is before the specified location.

LOCATE Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	1	0	1	0	1	1
1	0	0	0	0	0	BT	CP	0
2	0	0	0	0	0	0	0	0
3	MSB—Block Address							
4	Block Address							
5	Block Address							
6	Block Address—LSB							
7	0	0	0	0	0	0	0	0
8	Partition							
9	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Description

The following table defines the fields in the CDB.

Field Name	Bytes	Bits	Description
CP bit	1	1	If the Change Partition bit is 1, the drive changes to the partition whose partition number is specified in the Partition field. If this bit is 0, the Partition field is ignored.
BT bit	1	2	If the Block Address Type bit is 1, the Block Address field is the total number of logical blocks from the beginning of partition. All filemarks and setmarks are ignored when searching the tape. If this bit is 0, the Block Address field is the total number of logical blocks, filemarks, and setmarks from the beginning of partition. Filemarks and setmarks are counted when searching the tape.
Block Address	3-6		These fields specify the logical block address of the block to which the tape is to be positioned. Block 0 is the first block in a partition.
Partition	8		This field is valid only when the CP bit is 1. In that case, the field specifies the partition to select—partition 0 (00h) or partition 1 (01h). This selection should agree with the current tape format, either single-partition or two-partition. Partition 1 is the first physical partition on a dual-partition tape.

LOCATE and the BT Bit

Assume that the data was written on the tape as shown in the following table.

Block	0	1	2	3	4	5	6	7	8	9	10	11	12	13
BOT	D	S	S	S	S	S	D	D	D	F	D	D	D	EOD
Position		A			B		C				D			

If the Block Address Type (BT) bit is set in the CDB when the LOCATE command is issued, all the setmarks and/or filemarks are logically grouped with its nearest Data Block on its BOT side to form one logical block. The following table shows the logical blocks when the BT bit is set. In the table, the data block (block number 0) and five setmarks (block numbers 1-5) are grouped together to form one logical block. the filemark (in block number 9) would be grouped with the data block (block number 8) to form another logical block.

Block	0	0	0	0	0	0	1	2	3	3	4	5	6	7
BOT	D	S	S	S	S	S	D	D	D	F	D	D	D	EOD

If the BT bit is 0 in the CDB when the LOCATE command is issued, then each filemark and setmark on the tape is counted like the logical block while searching the target. See the table that follows.

Block	0	1	2	3	4	5	6	7	8	9	10	11	12	13
BOT	D	S	S	S	S	S	D	D	D	F	D	D	D	EOD

Referring to the first table, the table below shows the tape position after each LOCATE command is complete.

LOCATE Block Address	From	BT bit	Tape Position
1	BOT	ON	C
1	EOD	ON	C
1	BOT	OFF	A
1	EPD	OFF	A
4	BOT	ON	D
4	EOD	ON	D
4	BOT	OFF	B
4	EOD	OFF	B

Completion Status

The Completion Status for the LOCATE command is shown in the following table.

<table>
<tr><th>Code</th><th>Message</th><th>Description</th></tr>
<tr><td>00h</td><td>Good Status</td><td>• The tape is positioned to the logical block address specified.
• The drive remains in any previously set mode.
• The drive is ready to perform any appropriate command.</td></tr>
<tr><td>02h</td><td>Check Condition</td><td>Extended Sense Byte 02h
<table>
<tr><th>Code</th><th>Message</th><th>Description</th></tr>
<tr><td>02h</td><td>Not Ready</td><td>No cartridge is inserted in the drive.</td></tr>
<tr><td>04h</td><td>Hardware Error</td><td>Parity error on SCSI bus or drive hardware failure detected.</td></tr>
<tr><td>05h</td><td>Illegal Request</td><td>• An illegal partition number is requested.
• The CDB contains an invalid bit.
• CP bit is set when a single-partition tape is installed.</td></tr>
<tr><td>06h</td><td>Unit Attention</td><td>• The cartridge was changed prior to accepting this command.
• The drive was reset prior to this command.</td></tr>
<tr><td>08h</td><td>Blank Check</td><td>The specified logical block address was not found on tape. Tape is positioned at EOD. That is, it is positioned after the last filemark or set mark of the current partition. The next WRITE command appends data to the tape.</td></tr>
</table></td></tr>
</table>

LOG SELECT (4Ch)

The LOG SELECT and LOG SENSE commands are used in conjunction with each other. These commands allow the host to obtain and control statistical information about cartridge usage and error rates. This information consists of counts related to particular events that occur. Count thresholds can be established which automatically generate log exception conditions.

The LOG SELECT command is used to preset counts of pages 2 and 3 to a specific value or to reset the counts if the maximum count is reached. The log sense data is also reset by a SCSI Bus Reset or a Bus Device Reset with the exception of the page 30 and 31 data. That data cannot be reset by the initiator.

Counts of pages 2 and 3 can be read by the LOG SENSE command before a reset and then restored after the reset by issuing the LOG SELECT command.

The log select data is transferred to the drive by specifying the log select page or pages to initialize. Multiple pages can be affected by a single log select CDB. However, the LOG SENSE command can only request one page at a time.

The log select parameter data is transferred to the drive to initialize page data. The parameter data is organized using structures called *log parameters*. A log parameter is made up of a parameter header that contains a parameter code that identifies the log parameter to be initialized.

The drive determines the pages used by reading log sense page 0. Any request to initialize an unused log page causes a Check Condition. The request sense data is set to Illegal Request, Invalid Field in the CDB.

The log parameter codes within each log page used by the drive are determined by reading each particular log sense page. Any attempt to specify an unused parameter causes a Check Condition. The sense data is set to Illegal Request, Invalid Field in the parameter list.

LOG SELECT Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	1	0	0	1	1	0	0
1	0	0	0	0	0	0	PCR	0
2		PC	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	MSB—Parameter List Length							
8	Parameter List Length—LSB							
9	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Description

The following table defines the fields in the CDB.

Field Name	Bytes	Bits	Description
PCR bit	1	1	The Parameter Code Reset (PCR) bit is used to reset log parameters. If the bit is set (1) and the parameter list length is set to 0, all accumulated values are set to 0. All threshold values are set to the derfaults. Pages 0, 30, and 31 are not reset with this bit. When the PCR bit is set, the PC bits in the CDB are ignored. A PCR bit of 0 does not cause the parameters to be reset.
PC bits	2	6-7	The Page Control bits select one of four possible types of log information. The settings of these bits are shown in a subsequent table.
Parameter List Length	2	6-7	The Parameter List Length field specifies the length (in bytes) of the parameter list to be transferred during the Data Out phase. A 0 length indicates that no parameter data is to be transferred to the target.

Errors Detected in the Command Descriptor Block

The following conditions constitute errors that may be detected by the drive in relation to the CDB. These errors cause a Check Condition. The request sense data is set to Illegal Request, Invalid Field in the CDB.

- If the PCR bit is set and the parameter list length is not 0.
- A parameter list length that would cause a parameter within a valid page to be truncated or otherwise incompletely initialized.
- The settings of the PC bits select the default threshold or default accumulated values and the parameter list length is nonzero.

Use of the PC Bits

The Page Control bits (byte 2, bits 6-7) define the type of parameter values that are to be sent to the drive. The following table lists the Page Control bit values for the LOG SELECT CDB.

Bit 7	Bit 6	Type	Requested Counts
0	0	0	Threshold values
0	1	1	Accumulated values
1	0	2	Default threshold values
1	1	3	Default accumulated values

USE OF DEFAULT VALUES TO SET CURRENT VALUES

The threshold values can be loaded with the default threshold values by setting the PC bits to specify the default threshold values. The Parameter List Length must be set to 0.

Likewise, the accumulated values can be loaded with the default accumulated values by setting the PC bits to specify the default accumulated values. The Parameter List Length must be set to 0.

The drive presets the values as follows:

- The default accumulated values are set to all 0s.
- The default threshold values are set to all 1s.

The default values cannot be changed. If the host issues a LOG SELECT command with the PC bit specifying default values when the parameter list length is nonzero, a Check Condition is returned. The sense data is set to Illegal Request, Invalid Field in the CDB.

The Parameter Control bytes of each parameter are preserved when the LOG SELECT command is issued with the PC bits specifying either of the default values.

SETTING ACCUMULATED VALUES DIRECTLY

The host can set the accumulated values of pages 2 and 3 to any value by specifying the accumulated values in the PC bits and transferring the log parameters containing the new values and the Parameter Control bytes.

This ability to manually set the accumulated values allows the original counts previously read with the LOG SENSE command to be restored. Thus, the Python drive can continue to accumulate counts after a Bus Reset, Bus Device Reset, or a manual power cycle.

SETTING THE THRESHOLD VALUES DIRECTLY

The host can set the threshold values of pages 2 and 3 to any value by specifying the threshold values in the PC bits and transferring the log parameters containing the new values and the Parameter Control bytes.

The threshold value is used in conjunction with the Log Parameter Control byte of the log data and the RLEC bit of the Mode Select/Sense Control Mode page to determine if, and when, a log exception Check Condition should be generated when an accumulated count is incremented.

MAXIMUM COUNTS

Threshold values are not the same as the maximum count. The maximum size of each counter is according to the size of the counter in bytes. When the maximum count is reached, the DU bit in the Parameter Control byte for the

counter is set to 1 for the Log Sense data indicating that the parameter is no longer to be updated because the maximum count has been reached.

When a counter reaches the maximum, the counter is no longer incremented. If a maximum value for the parameter size is reached, the count does NOT roll over and continue counting. When any counter of a page reaches maximum, all counters of that page are no longer incremented. A LOG SELECT command can be issued with the PC bits specifying default accumulated values to reset the accumulated values and to allow counters to continue as normal. The DU bit of the affected parameter is also reset to zero.

LOG SELECT Parameter Data

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

- Correct determination of the pages the Python drive uses.
- Determination of the parameter codes and length of each parameter.

The drive does not maintain a separate set of log parameters for each initiator. Therefore, a LOG SELECT command affects all initiators.

þ **Note:** The subsequent section discusses the LOG SENSE command. The log page codes and the log parameter codes are described in that section.

Parameter data is made up of one or more page descriptors. A page descriptor is made up of a four-byte page header and one or more log parameters. A log parameter is made up of a four-byte parameter header and one or more associated parameter data bytes.

The parameter header contains a two-byte parameter code to identify the parameter, a Parameter Control byte, and a parameter length byte.

When a counter reaches its maximum value, a log exception Check Condition is generated if the RLEC bit is set in the Mode Select Control Mode page. The sense data is set to Recovered Error key (01), Log Counter at Maximum qualifier, 5B/02. Bytes 15 - 17 of the Request Sense data specify the page, MSB and LSB of the Parameter Code respectively, which caused the Log Exception. The counters are defined in a following section.

The drive uses pages 0, 2, 3, 30, and 31. However, the LOG SELECT command can only select pages 2 and 3. The following table lists the LOG SELECT page codes.

	Page	Bits					
Page	**Information**	**5**	**4**	**3**	**2**	**1**	**0**
2	Write error counts	0	0	0	0	1	0
3	Read error counts	0	0	0	0	1	1

Pages 30 and 31 are vendor unique and refer to the DDS Tape Log and Tape Capacity, respectively. Page 0, the list of supported pages, is available only to the LOG SENSE command.

Although the counts in page 30 are similar to those in pages 2 and 3, the page 2 and 3 counts are incremented separately from those in page 30. The accumulated counts in pages 2 and 3 accumulate across cassettes after the counts are initialized by the LOG SELECT command or since the last reset or power cycle. Thus, the counts in those two pages can be used to accumulate events in a different way than the counts in the log sense page 30.

If multiple log pages are sent, they must be sent in ascending order. All log parameters of a particular page must be sent to the drive in ascending order. Not all parameter codes need to be sent with the parameter data during the Data Out phase. In that way, selected parameters of a particular page can be initialized to any value desired.

The following conditions constitute errors that cause the drive to return a Check Condition and to set sense data to Illegal Request, Invalid Parameter Data.

- If any page headers are received with unsupported page codes. (Table 4-30 lists the pages that can be set by the LOG SELECT command.)
- An incorrect log page length is specified in the page header.
- An illegal parameter code within a valid log page.
- Valid log pages are not sent in ascending order.
- Parameter codes of a supported page are not sent in ascending order.

The following table shows the log page header format.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	Page Code					
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	Page Length (n)							

The *Page Code field* indicates which page is being sent to the drive.

The *Page Length field* indicates the length of log parameters (in bytes) which follow the page header. If the LOG SELECT CDB parameter list length specified is too small to transfer complete log parameters for the specified page, an Illegal Request, Invalid Field in the CDB, is returned.

The following table shows a typical log parameter format.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	MSB—Parameter Code							
1	Parameter Code—LSB							
2	DU	1	0	ETC	TMC		0	0
3	Parameter Length (n-3)							
4	Parameter Value							
n	Parameter Value							

The *Parameter Code field* identifies which log parameter is being sent to the drive.

The parameter codes used for the page 2 (Write Error) and page 3 (Read Error) are listed in subsequent tables.

All of the bits in byte 2 of the Log Parameter are collectively referred to as the Parameter Control byte. The Parameter Control byte specifies counter controls.

The host specifies the Parameter Control byte to control

- Whether or not a counter is enabled.
- Whether or not a Check Condition is generated when a counter is incremented, and if so, how the Check Condition is generated.

Each Log Parameter contains only one control byte. This control byte is shared between the threshold and accumulated parameters. If a LOG SELECT command is issued to specify the control bytes for the threshold parameter, the accumulated Parameter Control byte is affected. The LOG SENSE data reflects the current setting of the control byte for the parameter.

The Parameter Control byte bits used by the drive are described in the following table.

Bit Name	*Bytes*	*Bits*	*Description*
Disable Update (DU)	2	7	When set (1), this bit indicates that the host does not want this counter to be updated.
Enable Threshold Comparision (ETC)	2	4	When set (1), this bit enables the generation of a Check Condition when an accumulated counter is incremented and the new value meets the threshold criteria (and MODE SELECT/SENSE Control Mode Page RLEC bit is set). See the following heading, **Use of the TMC Field and the ETC Bit**.
Threshold Met Criteria Field (TMC)	2	3-2	This field indicates when a Check condition should be generated when the ETC bit is set and a counter is updated (and MODE SELECT/SENSE Control Mode Page RLEC bit is set). See the following heading, **Use of the TMC Field and the ETC Bit**.

The *Parameter Length byte* is the byte count of the parameter value that is being sent. This length must be equal to the length returned by the LOG SENSE command.

The *Parameter Value bytes* indicate the value of the selected parameter type indicated in the CDB Parameter Code field. The initiator must select either the accumulated or threshold values by the PC bits of the LOG SELECT CDB to send Parameter Value bytes.

USE OF THE TMC FIELD AND THE ETC BIT

The Threshold Met Criteria (TMC) field specifies how and when a log exception is to be reported to the host. The Enable Threshold Comparison (ETC) bit enables or disables the generation of a Check Condition for log exceptions of individual log parameters. The Report Log Exception Condition (RLEC) bit of the MODE SELECT/SENSE Control Mode Page, when set, allows the generation of a Check Condition for log exceptions for each log parameter whose ETC bit is set.

An RLEC bit of zero globally disables all log exception Check Conditions regardless of the ETC bit value of each log parameter.

When the ETC bit is set (1) (and the RLEC bit is set in the MODE SELECT/SENSE Control Mode Page), a Check Condition is generated each time the accumulated value is incremented and the threshold condition is met as described in the following paragraphs.

When a counter is incremented by the drive, a check is made to determine if the threshold comparison is enabled (according to the ETC bit) for the counter being incremented. If comparisons are enabled, the new accumulated value is compared with the threshold value according to the Threshold Met Criteria for the counter. When the criteria is met (and the RLEC bit is set in the MODE SELECT/SENSE Control Mode Page), a log exception Check Condition is returned for the next command. The sense key is set to Unit Attention (06); the additional sense code is set to Log Exception; and the additional sense code qualifier is set to Threshold Condition Met, 5B/01.

If the counter is disabled because the DU bit is set (1), no threshold conditions are compared because the counter will not be incremented.

After the log exception is signaled by the Check Condition, the host may issue the LOG SENSE command to determine which page and which counter (by parameter code) met the criteria or may read the sense key specific field in the REQUEST SENSE data.

The criteria for generating a Check Condition is specified by the TMC field in bits 2 and 3 of byte 2 of the parameter header. The possible settings and resulting operation are as follows.

TMC Field Bits 3 2	Generate a Log Exception Check Condition
0 0	Whenever the accumulated value is incremented.
0 1	When the accumulated value equals the threshold.
1 0	Whenever the accumulated value does not equal the threshold.
1 1	Whenever the accumulated value is greater than the threshold value. This setting is the default value

LOG SENSE (4Dh)

The LOG SELECT and LOG SENSE commands are used in conjunction with each other. These commands allow the host to obtain and control statistical information. This information consists of counts related to particular events that occur.

Some tabulated events (page 3) refer to errors that have occurred since the Minicartridge drive was powered on or last cleared by a LOG SELECT command and that have accumulated across several backup or restore operations on several cartridges.

The vendor unique page 30 contains statistical information that is DDS specific. This DDS information is contained in the Tape Log area on each tape or partition. This protected reference data is tabulated and maintained for the particular tape currently being used.

For pages 2 and 3, the LOG SELECT command is used to preset counts to a specific value or to reset the counts if the maximum count is reached. The log sense data is reset on a SCSI Bus Reset or a Bus Device Reset.

Log sense data is obtained by specifying a log page in the Page code field of the LOG SENSE CDB. Only one page of data can be requested by the host of each LOG SENSE command. The pages used by the drive are found by reading Log Page 0. Any request for unused pages causes a Check Condition. The sense data are then set to Illegal Request, Invalid Field in the CDB.

LOG SENSE Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	1	0	0	1	1	0	1
1	0	0	0	0	0	0	0	0
2		PC			Page Code			
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	MSB—Parameter Pointer							
6	Parameter Pointer—LSB							
7	MSB—Allocation Length							
8	Allocation Length—LSB							
9	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Description

The following table defines the fields in the CDB.

Field Name	Bytes	Bits	Description
PC bits	2	6-7	These Page Control bits select one of four possible types of log information. These bit settings are shown in **Using Page Control Bits**.
Page Code	2	0-5	This field indicates the requested page code.
Parameter Pointer	5-6	7-0	This two-byte field specifies the beginning parameter code to be returned to the initiator. All remaining parameter codes are returned in ascending order. This field is invalid of page code 0. If the Parameter Pointer field is nonzero when page 0 is requested, a Check Condition is returned. The sense data are set to Illegal Request, Invalid Field in CDB.
Allocation Length	7-8	7-0	The Allocation Length field specifies the maximum amount of memory space (in bytes) which the initiator has reserved for log sense data. The drive returns the amount of bytes contained in the requested page or the requested Allocation Length, whichever is less. If the Allocation Length is greater than the actual page length, the transfer is truncated.

The data for only one log sense page can be transferred with any one CDB. Log sense data is organized by pages. The parameter data for each page is preceded by a four-byte page header. The page header specifies the page code returned and the length of that page in bytes.

If the Parameter Pointer field is used to specify a starting parameter code, a page header is still returned.

Following the page header are 0 or more log parameters. Each log parameter is a special data structure that contains several description bytes and the parameter value itself. (Subsequent subsections describe the log parameter fields.)

The following table details the log sense page code field.

Bits							
5	4	3	2	1	0	Page	Page Information
0	0	0	0	0	0	0	List of available pages
0	0	0	0	1	0	2	Write error counts
0	0	0	0	1	1	3	Read error counts
1	1	0	0	0	0	30	DDS tape log (vendor unique)
1	1	0	0	0	1	31	Tape capacity (vendor unique)

Using Page Control Bits

The Page Control (PC) bits specify the type of counts that the initiator is requesting. For page 0, the PC bits are ignored. For other pages, the PC bits specify the type of parameter values. The followin table lists the Page Control bit values.

Bits			
7	**6**	**Type**	**Requested Counts**
0	0	0	Threshold values
0	1	1	Accumulated values
1	0	2	Default threshold values
1	1	3	Default accumulated values

Threshold Values

The type 0 indicates the current threshold values. If threshold values are requested, the drive returns the maximum count that each parameter code can attain (the default) or the last threshold values set by the last LOG SELECT command.

Threshold values for pages 2 and 3 can by changed by the initiator through the LOG SELECT command. The drive does not change these values during normal operation.

Accumulated Values

Type 1 (accumulated vales) is the most common page control bit setting. This type requests the current counts for the page. These counts reflect the current count of events since the last power-on cycle, SCSI bus Reset, Bus Device Reset, or the last LOG SELECT command that cleared or set parameter values.

þ **Note:** For pages 30 and 31, the parameter values cannot be changed and are never reset. These values represent historical data regarding tape usage and cannot be changed by the LOG SELECT command. Page 30 data is written to the tape log when the tape is ejected either manually or through the SCSI UNLOAD command.

Accumulated values are incremented by the drive as an event occurs. These page 2 and 3 values can be updated or initialized by the initiator with the LOG SELECT command. Also, the default accumulated values (all zeros) can be loaded with the accumulated values through the LOG SELECT command.

Because the rive maintains the accumulated values in volatile memory, the values may be lost if a power cycle occurs. The values for page 30 are saved on the cassette itself and are preserved. However, if a power cycle occurs before the cassette is ejected, the current page 30 data is lost.

The tape log values cannot be updated if the cassette is write protected.

Default Threshold Values

The type 2 page control bit setting requests default threshold values. This request generally returns the maximum count that each parameter code can attain. For example, a two-byte field returns two bytes of all 1s; a three-byte field returns three bytes of all 1s. These default values cannot be changed by the LOG SELECT command. The default threshold values are loaded into the threshold values when a reset occurs or by a LOG SELECT command with the PCR bit set.

Default Accumulated Values

The type 3 page control bit setting specifies default accumulated values. The default accumulated values are all zero and cannot be changed by the LOG SELECT command. The default accumulated values are loaded into the accumulated values when a reset occurs or when a LOG SELECT command is received with the PCR bit set.

Using the Parameter Pointer Field

The Parameter Pointer field specifies the starting parameter code of the page that is to be transferred.

If the Parameter Pointer field specifies a parameter code larger than the maximum parameter code for that page, a Check Condition is generated. The sense data is set to Illegal Request, Invalid Field in the CDB.

For example, if the page uses parameter codes 2 through 6 and the parameter pointer field is set to 3, then the drive returns parameters 3 through 6. Likewise, if the parameter pointer is set to 1, parameters 2 through 6 are returned.

If the Parameter Pointer field is set to 0, all parameters for that particular page are returned up to the maximum number of bytes specified in the allocation length.

Regardless of the starting parameter code specified in the Parameter Pointer field, the page header is always returned.

Log Sense Pages

Only one log page is transferred to the host with a single LOG SENSE CDB. Byte 2 of the CDB specifies the page to be transferred. Each log page begins with a four-byte header, as shown in the following table.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	Page Code					
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	Page Length (n)							

The Page Code field indicates the page being returned. This data matches the page code requested in byte 2 of the LOG SENSE CDB.

The Page Length field indicates the length of the page in bytes that follow the page header. If the allocation length specified in the CDB is too small to transfer all of the requested page, this value is not adjusted to reflect the truncation.

However, if the Parameter Pointer field of the CDB specifies a starting parameter code other than zero, the page length is adjusted to indicate the number of bytes that follow the page header.

The following subsections describe the pages.

List of Available Pages (Page 0)

Page 0 indicates the log sense pages used by the drive. To determine the size of each page and of each parameter in the page, the individual pages must be requested.

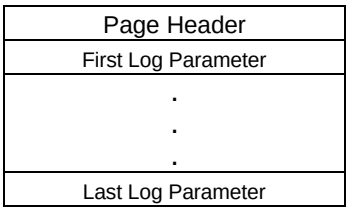
Page 0 is unique in that the parameter data returned does not contain log parameter headers. All other pages return a page header followed by zero or more variable-length log parameters.

Page 0 is valid only for the LOG SENSE command. When page 0 is requested, the four-byte page header is returned followed by the page codes used—one byte for each. the available page codes are returned in ascending order. The following table shows the page 0 data format.

Byte	*HEX Code*	*Description*
0	00	Header, page 0
1	00	Header, reserved
2	00	Header, page length MSB
3	07	Header, page length LSB
4	00	Page 0
5	02	Page 2
6	03	Page 3
7	30	Page 30
8	31	Page 31
9	3A	Page 3A
10	3B	Page 3B

Page Code Data Format for Pages 2, 3, 30, and 31

The parameter data returned consists of a four-byte page header followed by zero or more log parameters as shown in the following illustration.



A log parameter is made up of

- A two-byte parameter code followed by
- A Parameter Control byte
- A Parameter Length byte
- One or more parameter bytes

Parameter Code Field

The following table presents the Parameter Code Field format.

	Bits							
Byte	***7***	***6***	***5***	***4***	***3***	***2***	***1***	***0***
0	MSB—Parameter Code							
1	Parameter Code—LSB							
2	0	1	1	0	0	0	0	0
3	Parameter Length (n-3)							
4	Parameter Value							
n	Parameter Value							

The Parameter Code field identifies the log parameter being returned to the initiator. If the Parameter Pointer field of the CDB is zero, the parameter code of the first log parameter indicates the first parameter code supported by the drive for this log page. Parameter codes are always returned in ascending order.

All of the bits in byte 2 of the log parameter are collectively referred to as the Parameter Control byte. The bit descritptions as they are returned by the LOG SENSE command are given in the following table.

Bit Name	Bytes	Bits	Description
Disable Update (DU)	2	7	When set (1), this bit indicates that the particular parameter is not to be updated by the drive. This bit is set by the drive when the accumulated value reaches its maximum. It is also returned set if the host set the bit for the last LOG SELECT command. The default is zero. For parameter types other than threshold and accumulated values, this bit is always 0.
Enable Threshold Comparision (ETC)	2	4	This bit is returned as set by the last LOG SELECT command. The default is zero.
Threshold Met Criteria Field (TMC)	2	3-2	This field is returned as set by the last LOG SELECT command. As the default, both bits of this field are returned set.

The Parameter Length byte is the byte count of the parameter value that follows. This length is not adjusted to match any truncation.

The Parameter Value bytes are the actual data requested according to the PC bits of the CDB.

Write Error Counts (page 2)

Page 2 contains the Write Error counts, which are tabulations of the possible errors (if any) encountered during writing to tape.

The page 2 parameter codes for write errors are listed in the following table.

Parameter Code	Length	Name
0002	2	Total rewrites
0003	3	Total errors corrected
0004	2	Not applicable (always returns 0)
0005	4	Total bytes processed (written)
0006	2	Total uncorrectable errors
8007	2	Rewrites since last read-type operation

The total rewrite count is incremented each time a frame sequence is rewritten on tape. Rewrites are used to recover from media errors detected by the RAW (read-after-write) checking feature of the drive.

The total errors corrected count is the same as the total rewrite count.

The total bytes written count is incremented by the size of each group (in bytes) that is successfully written to tape. This count includes any fill bytes needed to fill a group before the group is written to tape.

However, this count does **NOT** include the count of additional bytes written during rewrites. Also, it is greater than the count of write data bytes transferred to the drive.

The total bytes written count includes a total of

- All user data
- ECC frames
- Other structures in the group data (as defined by the DDS format)

The total uncorrectable errors count is a tabulation of the times the drive could not correct a write error by any means (including the rewrite retry limit being exceeded).

The rewrites since last read-type operation count is similar to the total rewrite count (0002) except the counter is set to 0 in two cases:

- When the operation is changed to a read-type operation.
- When a rewind operation is performed.

Read Error Counts (page 3)

Page 3 contains the Read Error counts, which are tabulations of any errors encountered while reading the tape. these tabulations include possible errors from media access commands.

The page 3 parameter codes for read errors are listed in the following table.

Parameter Code	*Length*	*Name*
0002	2	Total rereads
0003	3	Total errors corrected
0004	2	Total correctable ECC C3 errors
0005	4	Total bytes processed (read)
0006	2	Total uncorrectable errors
8007	2	Rereads since last write-type operation

The total reread count is incremented each time the tape is repositioned to reread a frame from the tape.

The total errors corrected count is incremented each time the drive recovers from a read error. This count includes the reread count and all C3 ECC errors that could be corrected.

þ **Note:** This count does NOT include any frames read that were rewritten when the tape was recorded.

The total correctable ECC error count is incremented each time the ECC process corrects one to two erroneous tracks read from the tape. For performance reasons, the ECC process corrects errors rather than retrying if the tracks in error are less than three; otherwise, a reread is performed.

þ **Note:** This count is a count of the correctable C3 errors ONLY. It does NOT include the C1 or C2 ECC errors normally encountered while reading DDS-formatted cassettes.

The total bytes read count is incremented by the size of each group (in bytes) that is successfully read from the tape. This count includes overhead bytes (as defined by the DDS format specification) which were read from the group.

However, this count does **NOT** include any additional rewritten frames that were read nor any rereads. Also, it is greater than the count of read data bytes transferred.

The total uncorrectable errors count is a tabulation of the times the drive could not correct a read error by any means (including the reread retry limit being exceeded).

The rereads since last write-type operation count is similar to the total reread count (0002) except the counter is set to 0 in two cases:

- When the operation is changed to a write-type operation.
- When a rewind operation is performed.

DDS Tape Log (page 30)

Page 30, the DDS Tape Log page, allows you to obtain the information last written to the DDS Tape Log. Each time the cartridge is ejected the Tape Log is updated. This log contains two types of counts:

- The Previous counts indicate events from the previous usage cycle of the cassette. (A usage cycle is composed of a single cartridge insertion, use, and ejection.)
- The Total counts accumulate events over the life of the cassette since the cassette was first initialized by a format process.

When a cartridge is formatted, the total and previous counts are initialized to 0. The previous counts in this page are updated when a previously formatted cassette is inserted to indicate the counts from the previous usage of the tape. The previous counts remain consistent through the usage cycle. Previous counts can be inspected with the LOG SENSE command.

If no activity occurs during the usage cycle, then the previous counts are all set to 0 and the Load Count is incremented by 1.

When a previously used cartridge is inserted, the total counts are updated to the values contained in the Tape Log of the inserted cassette. The total counts can be read with the LOG SENSE command.

Also, page 30 contains a set of current counts. The current usage counts are not part of the Tape Log. They are initialized to 0 when the cartridge is inserted. While the tape is in use, the current usage counts are incremented according to the DDS format definitions as an event occurs. These counts cannot be changed by the initiator.

When the cartridge is ejected or the UNLOAD command is received, the current usage counts are saved in the previous counts. The total counts are also updated to indicate the new totals. This updated data is written to the tape in the Tape Log area. The Tape Log data is not cleared by any reset and cannot be changed with the LOG SELECT command.

þ **Note:** If power is lost before the update data is written to the tape, the Tape Log area is not updated. Also, if the cassette is write protected, the Tape Log area is not updated when the cassette is ejected. The drive does NOT post a Check Condition for this case.

Each page 30 count is a positive binary value. The counts do not overflow. Once a count reaches its maximum value, that maximum value is always returned. The counts do not roll over at the maximum value.

A single-partition tape contains one Tape Log; a dual-partition tape contains two Tape Logs. The appropriate Tape Log is returned as determined by the previously selected partition.

The page 30 parameter codes are listed in the following table.

Name	*Code*	*Length*	*Description*
Current Groups Written	0001	3*	This count is the number of groups written to the partition since the cartridge was inserted. Each group contains 126 KB of data.
Current Rewritten Frames	0002	2	This count is the number of rewritten frames withing the partitions since the cartridge was inserted. It is incremented by one each time a series of frames is rewritten. Frames are rewritten following an error detected by the RAW check. If the data written during the rewrite is also found to be bad by the RAW check, the series of frames is rewritten again, and this count is incremented by 1 again.
Current Groups Read	0003	3*	This count is the number of groups read from the cartridge since it was inserted.
Current ECC C3 Corrections	0004	2	This count is the nubmer of times the drive used the C3 ECC correction to recover data from the partition since the cartridge was inserted.
Previous Groups Written	0005	3*	This count is the number of groups written to the partition during the last cartridge usage cycle.

**Most significant 4 bits are 0.*

Name	Code	Length	Description
Previous Rewritten Frames	0006	2	This count is the number of frames rewritten in the partition during the last cartridge usage cycle. It is greater than or equal to the last current rewritten frames count prior to the Tape Log being updated when the cartridge is ejected.
Previous Groups Read	0007	3*	This count is the number of groups read from the partition during the last cartridge usage cycle.
Previous ECC C3 Corrections	0008	2	This count is the number of times the drive used C3 ECC correction to recover data from the partition during the last cartridge usage cycle.
Total Groups Written	0009	4	This count is the number of groups written since the partition was formatted. This count accumulates over the life of the cartridge but is zeroed if the tape is formatted again.
Total Rewritten Frames	000A	3	This count is the total number of times frames were rewritten within the partition since the partition was formatted. It is incremented by one each time a series of frames is rewritten following an error detected by the RAW check. It accumulates over the life of the cartridge but is zeroed if the tape is formatted again.
Total Groups Read	000B	4	This count is the number of groups read from the partition since it was formatted. It accumulates over the life of the cartridge but is zeroed if the tape is formatted again.
Total ECC C3 Corrections	000C	3	This count is the number of times the drive used C3 ECC correction to recover data from the partition since the tape was formatted. It accumulates over the life of the cartridge but is zeroed if the tape is formatted again.
Load Count	000D	2	This count is the number of times the tape has been loaded over the life of the tape since it was formatted. One load is the same as a usage cycle (inserting, using, and subsequent ejection of the cartridge). It accumulates over the life of the cartridge but is zeroed if the tape is formatted again. In a dual-partition tape, only one load count is maintained.

**Most significant 4 bits are 0.*

Tape Capacity Page (page 31)

Page 31, the Tape Capacity page, allows you to obtain information about total and remaining storage capacity for each partition.

Host software can use this page to determine cassette size and remaining capacity while writing to the tape.

The Tape Capacity Page parameter codes area given in the following table.

Parameter Code	Length	Name
0001h	4	Remaining capacity, partition 0 (KBytes)
0002h	4	Remaining capacity, partition 1 (KBytes)
0003h	4	Maximum capacity, partition 0 (KBytes)
0004h	4	Maximum capacity, partition 1 (KBytes)

All capacities are estimates as to the maximum available user-data capacities. The actual capacity may be slightly less because of rewrites. All values are in kilobytes.

Partition 1 is the first partition on a dual-partition tape. For single-partition tapes, only partition 0 is used.

The capacity values return the potential write data capacity according to the current physical tape position. The maximum capacity never changes for a particular formatted cartridge. Because different tape lengths are available, the maximum value is used to determine the length of the cartridge inserted and the associated capacity of its partition(s). To obtain capacity estimates, multiple the values returned by 1024 decimal.

Configuration Information Page (page 3A)

Page 3A, the Configuration Information page, is valid only for the Log Sense command. when Page 3a is requested, the four-byte page header is returned followed by configuration parameter data. The parameter data returned does not contain log parameter headers. Each parameter is displayed in the following format.

	Bits							
Byte	7	6	5	4	3	2	1	0
n	MSB—Parameter Number							
n+1	Parameter Number							
n+2	Parameter Number							
n+3	Parameter Number—LSB							
n+4	MSB—Configuration Parameter							
n+5	Configuration Parameter							
n+6	Configuration Parameter							
n+7	Configuration Parameter—LSB							

The Configuration Parameters are given in the following table.

Parameter Number	Parameter
1	Raw switch settings
2	Compression enabled set by MODE SELECT
3	Decompression enabled set by MODE SELECT
4	Block size used for writing
5	Current partition
6	Prevent (1) or Allow (0) Media Removal
7	Cartridge write-protected
8	Report setmarks
9	Data compressino ratio

Firmware Debug Information Page (page 3B)

Page 3B, the Firmware Debug Information page, is valid only for the Log Sense command. When Page 3B is requested, the four-byte page header is returned followed by firmware debug parameter data. The parameter data returned does not contain log parameter headers. Each parameter is displayed in the following format.

	Bits							
Byte	7	6	5	4	3	2	1	0
n	MSB—Parameter Number							
n+1	Parameter Number							
n+2	Parameter Number							
n+3	Parameter Number—LSB							
n+4	MSB—Debug Parameter							
n+5	Debug Parameter							
n+6	Debug Parameter							
n+7	Debug Parameter—LSB							

The Debug Parameters are given in the following table.

Parameter Number	Parameter
1	Record count
2	Group count
3	Current setting of compression enabled
4	Current setting of decompression enabled
5	PortA/PortB static RAM buffer status
6	Number of bytes in PortA
7	Group buffer status for buffers 0 through 3
8	Group buffer status for buffers 4 through 7
9	Completion status of last data transfer
10	Record offset into entity after spacing

Completion Status

The Completion Status for the LOG SENSE command is shown in the following table.

Code	Message	Description		
00h	Good Status			
02h	**Check Condition**	**Extended Sense Byte 02h**		
		Code	**Message**	**Description**
		02h	Not Ready	No cartridge is inserted in the drive.
		04h	Hardware Error	Parity error on SCSI bus or drive hardware failure detected.
		05h	Illegal Request	• The CDB contains an invalid bit. • The Page Code in the Log Page Header specifies an unsupported log page. • The parameter pointer is invalid.
		06h	Unit Attention	• Cartridge was changed prior to accepting this command • The drive was reset prior to this command.

MODE SELECT (15h)

The MODE SELECT command allows the host to assign device parameters.

After a power-on or SCSI reset condition, the drive sets its device parameters to the default values. By issuing a MODE SELECT command, the host can change the device parameters. The parameters are transferred to the drive as data formatted in a parameter list.

Parameters assigned by the MODE SELECT command remain in effect until the drive receives a subsequent MODE SELECT command or a reset. The MODE SELECT parameters are not unique to the initiator that assigned the parameters.

In multiple-initiator systems, the assigned parameters are used by all initiators that access the drive. However, when a MODE SELECT command changes parameters that apply to other initiators, the drive generates a Unit Attention condition for all initiators except the one that issued the MODE SELECT command. The Additional Sense Code and Additional Sense Code Qualifier are set to Mode Parameters Changed.

The MODE SELECT command immediately checks for invalid parameters or invalid combinations of parameters before executing. If an exception is found, the drive returns a Check Condition, and the request sense data is set to Illegal Request.

You can issue a MODE SENSE command following a MODE SELECT command to determine which parameters (if any) were rounded to the nearest supported value.

MODE SELECT Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	0	1	0	1
1	0	0	0	PF	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	Parameter List Length							
5	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Description

The following table defines the fields in the CDB.

Field Name	Bytes	Bits	Description
PF bit	1	4	The Page Format (PF) bit indicates whether the drive should interpret the MODE SELECT parameters that follow the CDB and the header as SCSI-1 or as SCSI-2 parameters. For SCSI-2, PF equals 1.
Parameter List Length	4		This field specifies the number of bytes in the MODE SELECT parameter list that are transferred from the host to the drive during a Data-Out Phase. A Parameter List Length of zero specifies that no data is to be transferred. This length is valid and is not considered an error. A length in this field that truncates a parameter list (as returned in a MODE SENSE command) causes the drive to return a Check Condition, and the request sense data is set to Illegal Request.

MODE SELECT Parameters

The parameter list for the MODE SELECT command contains

- A four-byte header, followed by
- Zero or one eight-byte Block Descriptor, followed by
- Zero or more variable-length pages.

The following table illustrates the structure.

	Bits							
Byte	7	6	5	4	3	2	1	0
0 . . 3				Parameter List Header				
4 . . 11				Block Descriptor				
12 . . . n				Mode Pages				

The following table shows the Parameter List Header format.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2	X	0	0	1	X	X	X	X
3	Block Descriptor Length							

Parameter List Header Field Descriptions

The following table defines the fields in the Parameter List Header.

Field Name	Bytes	Bits	Description
Block Descriptor Length	3		This field indicates the number of bytes of block descriptor information that follow the MODE SELECT header. The block descriptor length may be set to 00h, which indicates that no block descriptor bytes are included in the parameter list. This selection is valid and is not considered an error. If the block descriptor length is 08h, eight bytes of block descriptor information are specified in the parameter list. The mode pages can be sent immediately following the header depending on the specified parameter list length.

Parameter List—Block Descriptor

The following table presents the Parameter List block descriptor.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Density Code							
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	MSB—Block Length							
6	Block Length							
7	Block Length—LSB							

Parameter List—Block Descriptor Field Descriptions

The following table defines the fields in the Parameter List block descriptor.

Field Name	Bytes	Description
Density Code	0	The following values define this field: **Hex Code** — **Meaning** 00 — Default format (DDS) 13 — DDS format 7F — No-op 24 — DDS-2 25 — DDS-3 26 — DDS-4 Selecting a Density Code value of 00h or 7Fh does not alter the value returned by the MODE SENSE command (always 13h). Selecting any density code value other than 00, 13, or 7F results in a Check Condition. The sense data is set to Illegal Request/Invalid Field Parameter List..
Block Length	5-7	If this field is nonzero, it indicates the length of the fixed-length block to be read or written when the Fixed bit is set in a READ or WRITE command. (It is acceptable to set the Fixed bit to 0.). The default is 512-byte blocks, which may be changed at any time by the host with a MODE SELECT command. If this field is zero, variable-length block mode is specified, and the Fixed bit in the READ or WRITE command must be 0. The Block Length in a READ or WRITE command may be set in a range from 1 to 16 MB (as specified in the READ BLOCK LIMITS command.)

Mode Page Format

The following table shows the generic Mode Page format.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	Page Code					
1	Page Length							
2								
.								
.	Mode Parameters							
.								
n								

The following table explains the page layout fields

Field Name	Bytes	Description
Page Code	0	The Page Code field identifies the format and parameters for this page as follows: **Hex Code** — **Page Name** 01 — Read/write error recovery 02 — Disconnect/reconnect 0A — Control mode 0E — Data comperwssion control 10 — Device configuration 11 — Medium partition 1D — Element address assignment (Autoloader only) 1F — Device capabilities (Autoloader only)
Page Length	1	The Page Length field specifies the length (in bytes) of the mode parameters that follow the Page Length field.
Mode Parameters	2-n	The mode parameters are described in the following subsections.

Read/Write Error Recovery Page (01h)

The Read/Write Error Recovery page allows the host to specify the error recovery parameters that the drive uses when transferring data. The following table illustrates this page.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	Page Code (01h)					
1	Page Length (0Ah)							
2	0	0	0	0	1	PER	0	0
3	Read Retry Count							
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	Write Retry Count							
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0

Read/Write Error Recovery Page Field Descriptions

The following table describes the fields in the Read/Write Error Recovery page.

Field Name	Bytes	Description
Page Code	0	The Page Code field must be set to 01h to select this page.
Page Length	1	The Page Length field must be set to 10 (0Ah), which indicates that 10 parameter bytes follow the Page Length byte.
PER	2	If the Post Error (PER) bit is set and a reread, rewrite, or C3 error occurs, the drive returns a Check Condition on the next media access command.
Read Retry Count	3	The Read Retry Count specifies the number of times the drive attempts the error recovery algorithm during a read operation before an unrecoverable error is reported. If this field is set to zero, the drive does not use the error recovery algorithm during read operations. The maximum value for this field is 16.
Write Retry Count	9	The Write Retry Count specifies the number of times the drive attempts the error recovery algorithm during a write operation before an unrecoverable error is reported. If this field is set to zero, the drive does not use the error recovery algorithm during write operations. The maximum value for this field is 128.

Disconnect/Reconnect Page (02h)

The Disconnect/Reconnect page allows the host to tune performance of the SCSI bus. The following table illustrates this page.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	Page Code (02h)					
1	Page Length (0Eh)							
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	MSB—Maximum Burst Size							
11	Maximum Burst Size—LSB							
12	0	0	0	0	0	0	DTDC	
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0

Disconnect/Reconnect Page Field Descriptions

The following table describes the fields in the Disconnect/Reconnect page.

Field Name	***Bytes***	***Bits***	***Description***
Page Code	0		The Page Code field must be set to 02h to select this page.
Page Length	1		The Page Length field must be set to 14 (0Eh), which indicates that 14 parameter bytes follow the Page Length byte.
Maximum Burst Size	10-11		The Maximum Burst Size field specifies the maximum amount of data that the drive can transfer during a Data phase before disconnecting if the initiator granted the disconnect capability. This value is in increments of 512 bytes. That is, a value of one means 512 bytes; a value of two means 1024 bytes, and so forth. A value of zero (0000h) indicates that no limit exists on the amount of data transferred per connection. In that case, the drive does not have to disconnect until all requested data is transferred. On read operations, the drive disconnects when drive buffer is empty, and the Allocation Length has not been satisfied. On write operations, the drive disconnects when the drive buffer is full, and the Transfer Length has not been exhausted.
DTDC	12	0-1	The Data Transfer Disconnect Control (DTDC) field values are as follows: 00 Data transfer disconnect control is not used. 01 The target does not attempt to disconnect once the data transfer of a command has been started until all data the command is to transfer has been completed. 10 Reserved. 11 The target does not attempt to disconnect once the data transfer of command has been started until the command is complete.

Device Configuration Page (10h)

The Device Configuration page specifies the appropriate sequential access device configuration. The following table illustrates this page.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	Page Code (10h)					
1	Page Length (0Eh)							
2	0	CAP	CAF	DIS RAW EN C3			N-Group	
3	Active Partition							
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	MSB—Write Delay Time							
7	Write Delay Time—LSB							
8	X	X	RSMK	0	0	0	0	REW
9	0	0	0	0	0	0	0	0
10	0	0	0	1	SEW	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0

Device Configuration Page Field Descriptions

The following table describes the fields in the Device Configuration page.

Field Name	Bytes	Bits	Description
Page Code	0	0-5	The Page Code field must be set to 10h to select this page.
Page Length	1		The Page Length field must be set to 14 (0Eh), which indicates that 14 parameter bytes follow the Page Length byte.
CAP bit	2	6	The CAP (Change Active Partition) bit is used to effect a partition change. When the CAP bit is 1, the drive switches to the partition specified in the Active Partition field. Once the MODE SELECT command completes, the logical position is the BOP of the new partition. If the CAP bit is 0, no partition change results
CAF bit	2	5	The CAF (Change Active Format) bit is used to modify the tape format. When the CAF bit is 1, bits 4-0 ofbyte may be changed.
DIS RAW	2	4	The DIS RAW (Disable Read-After-Write) bit enables and disables the read-after-write capability. If the value is 1, read-after-write check and rewrites are disabled. If the value is 0, read-after-write is enabled.
EN C3	2	33	The EN C3 (Enable C3) bit enables and disables C3 ECC code generation during writing. If the value is 1, C3 ECC code is generated during writing; if the value is 0, C3 ECC code is not generated.
N-Group	2	0-3	The N-Group field specifies the number of copies of each tape group to record. Values greater than 0 can be used to increase reliabilty.
Active Partition	3		The Active Partition field is valid only when the CAP bit is 1. This field specifies the partition number of the new partition to which the drive switches when the MODE SELECT command completes. The drive supports a maximum of two partitions. The valid values for this field are 0 (00h) and 1 (01h). Partition 1 is the first partition on a dual-partition tape.
Write Delay time	6-7		For a WRITE command, the Write Delay Time field indicates to the drive how long in 100 millisecond increments, to delay writing buffered data to tape after the last WRITE command.
RSMK bit	8	5	The Report Setmarks (RSMK) bit determines whether or not the drive recognizes setmarks. If the value is 1, the drive recognizes and reports setmarks during appropriate read and space operations. If the value is 0, the drive ignores setmarks. It skips any setmark it finds during execution of read- or space-type commands. A command to write setmarks is rejected with an Illegal Request sense key.

Field Name	Bytes	Bits	Description
REW bit	8	0	The Report Early Warning (REW) bit determines whether or not the drive reports an early-warning condition on a read operation. The effect of this bit is different for read and write operations. For read-type operations, if this bit is 0, the drive does not report the early-warning condition. This setting is recommended for applications where the intent is to read data from tape until the end-of-recorded-data (EOD) or end-of-partition (EOP) is reached. If this bit is 1, the drive returns a Check Condition status with an End-of-Medium (EOM) bit of 1 when the logical early-warning position is encountered. For write-type operations, the drive always reports the Check Condition status when the logical early-warning position is encountered during a WRITE command. The intent of this action is to warn the host that the EOP is approaching and that any additional data will be written at the risk of an unexpected EOP. If REW = 1 and SEW = 1, the drive returns a Check Condition status with the sense key set to Volume Overflow when the early-warning position is encountered during write operations. The default is 0.
SEW bit	10	3	The Synchronize at Early-Warning (SEW) bit must be set to 1. It causes the drive to flush all buffered write data to tape when the early-warning position is encountered during writing.

Control Mode Page (0Ah)

The Control Mode page allows the host to enable or disable the generation of a Check Condition when log parameters whose ETC bits are set to 1 meet their Threshold Condition. The layout of this page is shown in the following table.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	Page Code (0Ah)					
1	Page Length (06h)							
2	0	0	0	0	0	0	0	RLEC
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0

Control Mode Page Field Descriptions

The following table describes the fields in the Control Mode page.

Field Name	Bytes	Bits	Description
Page Code	0	0-5	The Page Code field must be set to 0Ah to select this page.
Page Length	1		The Page Length field must be set to 6 (06h), which indicates that 6 parameter bytes follow the Page Length byte..
Report Log Exception Condition	2	0	A Report Log Exception Condition (RLEC) bit of 1 specifies that the target reports log exception conditions.

Medium Partition Page (11h)

The Medium Partition page specifies the number and size of partitions to be created on the medium. The layout of this page is shown in the following table.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	Page Code (11h)					
1	Page Length (06h)							
2	X	X	X	X	X	X	X	X
3	Additional Partitions Defined							
4	0	SDP	IDP	PSUM	0	0	0	0
5	X	X	X	X	X	X	X	X
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	MSB—Additional Partition Size							
9	Additional Partition Size—LSB							

Medium Partition Page Field Descriptions

The following table describes the fields in the Medium Partition page.

Field Name	Bytes	Bits	Description
Page Code	0	0-5	The Page Code field must be set to 11h to select this page.
Page Length	1		If no additional partition is to be defined or if going from a dual-partition format to a single-partition format, the Page Length field must be set to 6 (06h), which indicates that 6 parameter bytes follow the Page Length byte. If an additional partition is to be defined (dual-partition), this field is set to 8 (08h).
Additional Partitions Defined	3		The Additional Partitions Defined field specifies the number of partitions to add when formatting the tape. This bit may be set by the initiator to 1 (dual partitions) or 0 (single partition), which specifies the desired number of additional partitions to format on the tape when the IDP bit = 1 or the SCP bit = 1..
SDP bit	4	6	If the SDP bit is set to 1, the firmware automatically formats 40% of the drive as partition 1. The following conditions are also required: • The Additional Partition bit =1. If the Additional Partition bit =0, the SDP bit is ignored. • IDP bit = 0. The SDP and IDP bits cannot be set at the same time.
IDP bit	4	5	If set to 1, the Initiator Defined Partitions bit causes the Python drive to partition the tape into 1 or 2 partitions as specified by the Additional Partitions Defined field and the partition size descriptors. **CAUTION:** Setting the IDP bit causes the tape to be reformatted to a 1- or 2-partition tape. All previous information recorded on the cassette is destroyed.
PSUM	4	3-4	The partition Size Unit of Measure field defines the units in which the partition size descriptors select the partition size. The valid values are **4 3 Unit** 0 0 bytes 0 1 kilobytes 1 0 megabytes
Additional Partition Size	8-9		The Partition Size field indicates the size of the additional partition (partition 1) formatted on the tape when formatting a dual-partition tape. The first physical partition is partition 1. The remainder of the tape is partition 0.

Data Compression Control Page (0Fh)

The Data Compression (DC) Control page specifies whether or not data is compressed during a WRITE command and whether or not data is decompressed during a READ command. It also provides for error reporting and selection of the compression algorithm.

The following table illustrates the DC Control page for drives with data compression.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	1	1	1	1
1	Page Length (0Eh)							
2	DCE	0	0	0	0	0	0	0
3	DDE	RED		0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	Compression Algorithm							
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	XX							
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0

For drives without data compression capabilities, some of the bits and bytes contain 0s. The following table illustrates the DC Control page for drives without data compression.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	1	1	1	1
1	Page Length (0Eh)							
2	0	0	0	0	0	0	0	0
3	0	RED		0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0

DC Control Page Field Descriptions

The following table describes the fields in the DC Control page.

Field Name	Bytes	Bits	Description
DCE	2	7	The DCE (Data Compression Enable) bit controls data compression. If the value is 1, the drive compresses data received from the host during a WRITE command before it writes the data to tape in the DDS-DC format. If the value is 0, the drive does not compress data sent during a WRITE command, and the host data is written to tape in the uncompressed DDS format. This value is used for drives without data compression capabilities.
DDE	3	7	The DDE (Data Decompression Enable) bit controls data decompression. If the value is 1, the drive decompresses data that has been compressed on the tape before it sends the data to the host during a READ command. If the value is 0, the drive does not return any DCLZ compressed data that has been read from tape. Instead, the drive generates a Check Condition with Media Error (03/70/20). For drives without data compression capabilities, this bit is 0.
RED	3	5-6	The RED (Report Error on Decompression) bit specifies when Check Conditions are reported to the host. If the value is 0, the drive generates a Check Condition for every compressed entity that it cannot decompress. For drives without data compression capability, a Check Condition is sent to the host for every compressed entity. If the value is 1, the drive generates Check Conditions only when the format of the SCSI data changes. A SCSI format change occurs when data changes from non-DCLZ compressed to uncompressed, from uncompressed to non-DCLZ compressed, or from compressed with one non-DCLZ algorithm to compressed with a different non-DCLZ algorithm. A RED bit of 1 is intended to be used when reading a tape to minimize the number of Check Conditions received by the host when data is present that cannot be decompressed by the drive. Any media-access command, other than the READ command, causes the drive to return to an initial state for determining when to report the Check Conditions. When the RED bit is first set and decompression is enabled, the drive is in an initial state in which it expects to read either uncompressed data or data compressed with the DCLZ algorithm. When the RED bit is first set and decompression is disenabled, the drive is in an initial state in which it expects to read uncompressed data. In either case, if the expected data is not read, a Check Condition is reported. The Request Sense information indicates further information about the format change.

Field Name	Bytes	Bits	Description
Compression Algorithm	7		The Compression Algorithm byte allows the host to specify the algorithm that is to be used to compress data. If the drive does not support the algorithm specified in the Compression Algorithm bytes, a Check Condition is returned with the Sense Key set to Illegal Request.
Decom-pression Algorithm	11		The Decompression Algorithm byte allows the host to specify the algorithm that is to be used to decompress data. If the drive does not support the algorithm specified in the Decompression Algorithm bytes, a Check Condition is returned with the Sense Key set to Illegal Request.

The following table outlines the DDE and RED bit configurations.

DDE	RED	Definition	Sense Key
0	0	Disable decompression and report a Check Condition for every compressed entity encountered.	MEDIUM ERROR
0	1	Disable compression and report a Check Condition for the following format changes:	
		• from compressed to uncompressed	NO SENSE
		• from uncompressed to compressed	MEDIUM ERROR
		• from compressedwith one algorithm to compressed with a different algorithm	MEDIUM ERROR
1	0	Enable decompression and report a Check Condition for every entity compressed with an unsupported algorithm	MEDIUM ERROR
1	1	Enable decompression and report a Check Condition for the following format changes:	
		• from uncompressed to compressed with an unsupported algorithm	MEDIUM ERROR
		• compressed with DCLZ to compressed with an unsupported algorithm	MEDIUM ERROR
		• from compressed with unsupported algorithm to uncompressed	NO SENSE
		• from compressed with an unsupported algorithm to compressed with DCLZ	RECOVERED ERROR
		• from compressed with an unsupported algorithm to compressed with a different unsupported algorithm	MEDIUM ERROR

NOTE: No Check Condition is reported for the following format changes:

- from uncompressed to compressed with DCLZ
- from compressed with DCLZ to uncompressed.

The following table shows the DCE bit configuration and the supported algorithms. An algorithm value of 01, which is the default, can be used to determine the supported algorithm for the drive, DCLZ (20). The value of 20 is returned by the corresponding MODE SENSE command.

DCE	*Algo-rithm*	*Description*
0	XX	Compression is disabled.
1	00	Compression is disabled.
1	01	Compression is enabled using the default algorithm (DCLZ).
1	02-1F	Illegal Request.
1	20	Compression is enabled using the DCLZ algorithm.
1	21-FF	Illegal Request.

Completion Status

The Completion Status for the MODE SELECT command is shown in the following table.

Code	*Message*	*Description*		
00h	Good Status	• The drive is ready to perform any appropriate command. • The defined mode is set and remains set until another MODE SELECT or RESET command is issued. • The tape position is not changed.		
02h	**Check Condition**	**Extended Sense Byte 02h**		
		Code	**Message**	**Description**
		02h	Not Ready	No cartridge is inserted in the drive.
		05h	Illegal Request	• The CDB or Parameter List contains an invalid bit.
		06h	Unit A Attention	• Cartridge was changed prior to accepting this command • The drive was reset prior to this command.

The MODE SELECT command immediately checks the current page for invalid parameters or invalid combinations of parameters before executing. If such an exception is found, the drive returns a Check Condition status byte with an Illegal Request sense key.

If the initiator does not set the Page Length field of the Mode Page to the value indicated in the Mode Page definition (for example, 0Eh for the Device Configuration Page, 01h for the Read/Write Error Recovery Page, and so forth), the drive terminates the MODE SELECT command and returns a Check Condition status bytes with an Illegal Request sense key. The Additional Sense Code and Additional Sense Code Qualifier are set to Invalid Field in Parameter List.

MODE SENSE (1Ah)

The MODE SENSE command allows the host to determine various drive device parameters. These parameters are sent from the drive to the host as data formatted in a parameter list. This command is a complementary command to the MODE SELECT command.

The drive terminates execution of the MODE SENSE command as follows:

- When the number of bytes specified in the Allocation Length field have been sent to the host, or
- When all available MODE SENSE data has been sent to the host.

During execution of this command, the drive does not disconnect from the host. Also, this command performs no media access.

If a MODE SELECT command has not been performed since power-on/SCSI Reset, the default mode parameters are in effect.

All MODE SELECT parameters may be rounded up or down, as appropriate. A MODE SENSE command may be issued after a MODE SELECT command to determine which parameters have been rounded.

MODE SENSE Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	1	0	1	0
1	0	0	0	0	DBD	0	0	0
2		PC			Page Code			
3	0	0	0	0	0	0	0	0
4				Allocation Length				
5	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Description

The following table defines the fields in the CDB.

Field Name	Bytes	Bits	Description
DBD bit	1	3	If the Disable Block Descriptors (DBD) bit is set to 0, the drive always returns the block descriptor in the MODE SENSE data. If the DBD bit is set to 1, the drive does not return the block descriptor in the MODE SENSE data. **NOTE:** When the DBD is 1, the Block Descriptor Length in the parameter header is set to 0.
PC field	2	6-7	The Page Control field defines the type of parameter values to be returned. Valid values are **7 6** **Unit** 0 0 Report current values 0 1 Report changeable values 1 0 Report default values If parameter type 00 (report current values) is specified, the drive returns its current configuration to the host. If parameter type 01 (report changeable values) is specified, any values that may be altered by a subsequent MODE SELECT command are returned. Any bit that can be changed is set to 1; otherwise, the bits are set to 0. If parameter type 10 (report default values) is specified, the drive returns its default (power-up or reset) configuration.
Page Code	2	0-5	The Page Code field lets the initiator select the page or pages to be returned by the drive. If Page Code is 0, only the 4-byte header and 8-byte block descriptor are returned. **Hex** **Page Name** 00 No page returned 01 Read/Write Error Recovery 02 Disconnect/Reconnect 0A Control Mode 0F Data Compression Control 10 Device Configuration 11 Medium Partition 1D Element address assignment (Autoloader only) 1F Device Capabilities (Autoloader only) 3F All available pages

Field Name	Bytes	Bits	Description
Allocation Length	4		The Allocation Length field specifies the number of bytes the host has allocated for returned MODE SENSE data. An Allocation Length of 0 (00h) means that no parameter list data bytes are returned to the host. This condition is not considered an error. The drive terminates the Data In phase in one of two ways based on whichever is less: • When Allocation Length bytes have been transferred. • When all available data have been transferred to the initiator.

MODE SENSE Parameters

The parameter list for the MODE SENSE command contains

- A four-byte header, followed by
- Zero or one eight-byte Block Descriptor, followed by
- Zero or more variable-length pages.

The following table illustrates the structure.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0 . . **3**				Parameter List Header				
4 . . **11**				Block Descriptor				
12 . . . **n**				Mode Pages				

The MODE SENSE response data consists of a four-byte header followed by an eight-byte block descriptor. The following table shows the header format.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0				Mode Sense Data Length				
1				Medium Type Field				
2	WP	0	0	BUF	0	0	0	0

3	Block Descriptor Length

Parameter List Header Field Descriptions

The following table defines the fields in the MODE SENSE Header.

Field Name	Bytes	Bits	Description
Mode Sense Data Length	0		This field specifies the number of bytes in the following Mode Sense data that is available to be transferred If the Transfer Length is smaller than the MODE SENSE Data Length, only Transfer Length bytes of the MODE SENSE data are transferred. The Sense Data Length does not include itself.
BUF	2	4	If this bit is set, the drive operates in buffered mode. In buffered mode, a WRITE command is terminated when the data is transferred to the internal buffer of the drive. If the bit is not set, the drive operates in nonbuffered mode. In nonbuffered mode, a WRITE command is not terminated until all data has been transferred to tape.
WP	2	7	If this bit is 1, the tape is write-protected. If this bit is 0, the tape is write-enabled.
Block Descriptor Length	3		This field indicates the number of bytes of block descriptor information that follow the parameter header. If the DBD bit is set to 1, the block descriptor length is set to 0 (00h), which indicates that no block descriptor is returned in the MODE SENSE data. If the DBD bit is set to 0, the block descriptor length is set to 8 (08h), indicating that an eight-byte block descriptor is returned.

Medium Type Reporting

Byte 1 of the MODE SENSE header format as previously shown is the Medium Type byte (accurate after tape motion completes after the initial tape insertion). This field is available for reporting the cartridge type via the SCSI bus. Before DDS2 cartridges and MRS cartridges became available, this field was not useful for DDS drives.

Because tape format selection is automatic, software applications do not usually need to know the tape format. However, applications that need information about tape format and cartridge type can use the Medium Type field and the Density Code field.

The values for the Medium Type byte are as follows:

30h DDS1 cartridge (13/9 µm), no MRS
31h DDS1 cartridge (13/9 µm), MRS
32h DDS2 cartridge (6.5 µm), MRS
33h DDS3 cartridge, MRS
34h DDS4 cartridge, MRS
3Fh Non-DDS cartridge (cleaning cartridge)

The Medium Type field is currently defined as RESERVED in the ANSI SCSI-2 standard. This field has been used by QIC tape devices; the above values avoid conflict with QIC drives.

Parameter List—Block Descriptor

The following table presents the block descriptor.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Density Code							
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	MSB—Block Length							
6	Block Length							
7	Block Length—LSB							

Parameter List Block Descriptor Field Descriptions

The following table defines the fields in the block descriptor.

Field Name	Bytes	Description
Density Code	0	The values for the Density Code field are as follows: 13h 13µ DDS1 format 24h 24µ DDS-2 format 25h 25µ DDS-3 format 26h 26µ DDS-4 format **NOTE:** Although the above values are approved by the ANSI X3T9 Technical Committee, the values are not published in the SCSI-2 standard.
Block Length	5-7	This field indicates the size of a fixed-length logical block. Byte 5 is the Most-Significant-Byte (MSB); byte 7 is the Least-Significant-Byte (LSB). The default fixed-block size for the drive is 512 bytes (200h). Block Length may be set in a range from 1 to 224-1 bytes (as specified in the READ BLOCK LIMITS command.) When this field is 0, the Block Length bytes indicate variable-block mode.

Mode Page Format

The following table shows the generic Mode Page format.

Byte	Bits 7	6	5	4	3	2	1	0
0	0	0	Page Code					
1	Page Length							
2 . . . n	Mode Parameters							

The following table explains the page layout fields

Field Name	Bytes	Description
Page Code	0	The Page Code field identifies the format and parameters for this page as follows: **Hex Code** — **Page Name** 01 — Read/write error recovery 02 — Disconnect/reconnect 0A — Control mode 10 — Device configuration 11 — Medium partition
Page Length	1	The Page Length field specifies the length (in bytes) of the mode parameters that follow the Page Length field.
Mode Parameters	2-n	The mode parameters are described in the following subsections.

Read/Write Error Recovery Page (01h)

The Read/Write Error Recovery page allows the host to specify the error recovery and reporting parameters that the drive uses when transferring data. These parameters apply to errors encountered by the media access commands The following table illustrates this page.

Byte	Bits 7	6	5	4	3	2	1	0
0	0	0	Page Code (01h)					
1	Page Length (0Ah)							
2	0	0	0	0	1	PER	0	0
3	Read Retry Count							
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	Write Retry Count							
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0

Read/Write Error Recovery Page Field Descriptions

The following table describes the fields in the Read/Write Error Recovery page.

Field Name	Bytes	Bits	Description
Page Code	0	0-5	The Page Code field must be set to 01h to select this page.
Page Length	1		The Page Length field must be set to 10 (0Ah), which indicates that 10 parameter bytes follow the Page Length byte.
PER	2	2	If the Post Error bit (PER) is set and a reread, rewrite, or C3 error occurs, the drive returns a Check Condition on the next media access command.
Read Retry Count	3		The Read Retry Count specifies the number of times the drive attempts the error recovery algorithm during a read operation before an unrecoverable error is reported. The default is 8. The maximum is 16; the minimun is 0.
Write Retry Count	8		The Write Retry Count specifies the number of times the drive attempts the error recovery algorithm during a write operation before an unrecoverable error is reported. The default is 128. The maximum is 128; the minimum is 0.

Disconnect/Reconnect Page (02h)

The Disconnect/Reconnect page allows the host to tune performance of the SCSI bus. The following table illustrates this page.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	Page Code (02h)					
1	Page Length (0Eh)							
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	MSB—Maximum Burst Size							
11	Maximum Burst Size—LSB							
12	0	0	0	0	0	0	DTDC	
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0

Disconnect/Reconnect Page Field Descriptions

The following table describes the fields in the Disconnect/Reconnect page.

Field Name	Bytes	Bits	Description
Page Code	0	0-5	The Page Code field must be set to 02h to select this page.
Page Length	1		The Page Length field must be set to 14 (0Eh), which indicates that 14 parameter bytes follow the Page Length byte.
Maximum Burst Size	10-11		The Maximum Burst Size field specifies the maximum amount of data the drive can transfer during a Data phase before disconnecting if the initiator granted the disconnect privilege. This value is in increments of 512 bytes. That is, a value of one means 512 bytes; a value of two means 1024 bytes, and so forth. The default value is 0 (00h), which indicates that no limit exists on the amount of data transferred per connection.
Data Transfer Disconnect Control (DTDC)	12	0-1	The Data Transfer Disconnect Control (DTDC) field values are as follows: 00 Data transfer disconnect control is not used. 01 The target does not attempt to disconnect once the data transfer of a command has been started until all data the command is to transfer has been completed. 10 Reserved. 11 The target does not attempt to disconnect once the data transfer of command has been started until the command is complete.

Control Mode Page (0Ah)

The Control Mode page allows the host to enable or disable the generation of a Check Condition when log parameters whose ETC bits are set to 1 meet their Threshold Condition. (Refer to the LOG SELECT command and the LOG SENSE command.) The layout of this page is shown in the following table.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	Page Code (0Ah)					
1	Page Length (06h)							
2	0	0	0	0	0	0	0	RLEC
3	0	0	0	0	0	0	0	DQUE
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0

Control Mode Page Field Descriptions

The following table describes the fields in the Control Mode page.

Field Name	Bytes	Description
Page Code	0	The Page Code field must be set to 0Ah to select this page.
Page Length	1	The Page Length field must be set to six (06h), which indicates that 6 parameter bytes follow the Page Length byte.
Report Log Exception Condition (RLEC)	2	A Report Log Exception Condition (RLEC) bit of 1 specifies that the target reports log exception conditions. A RLEC bit of 0 specifies that the target does not report log exception conditions. The default is 0.
Tagged Queuing (DQUE)	3	The Tagged Queuing (DQUE) bit flag must be set (1), which specifies that Tagged Queuing is disabled.

Device Configuration Page (10h)

The Device Configuration page specifies the appropriate sequential access device configuration. The following table illustrates this page.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0 |			Page Code (10h)			
1				Page Length (0Eh)				
2	0	0	0	DIS RAW | EN C3	|	N-Group		
3				Active Partition				
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6				MSB—Write Delay Time				
7				Write Delay Time—LSB				
8	0	1	RSMK	0	0	0	0	REW
9	0	0	0	0	0	0	0	0
10	0	0	0	1	SEW	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0

Device Configuration Page Field Descriptions

The following table describes the fields in the Device Configuration page.

Field Name	Bytes	Bits	Description
Page Code	0	0-5	The Page Code field must be set to 10h to select this page.
Page Length	1		The Page Length field must be set to 14 (0Eh), which indicates that 14 parameter bytes follow the Page Length byte.
DIS RAW	2	4	The DIS RAW (Disable Read-After Write) bit enables and disables the read-after write capabilty. If the value is 1, read-after-write check and rewrites are disabled. If the value is 0, read-after-write is enabled. The defautl value is 0.
EN C3	2	3	The EN C3 (Enable C3 bit enables and disables C3 ECC code generation during writing. if the value is 1, C3 ECC code is generated during writing; if the value is 0, c3 ECC code is not generated. The default value is 1.
N-Group	2	0-2	The N-Group field specifies the number of repeats of each tape group to record. Values greater than 0 can be used to increase reliability. The default value is 0.
Active Partition	3		The Active Partition field is set to the active partition—either 00h or 01h. The default is 0. The first partition on a dual partition tape is partition 1.
Write Delay Time	6-7		The Write Delay Time field indicates the maximum time, in multiples of 100 milliseconds, which the drive waits with a partially full buffer before recording the data to tape. The default value is 258h, indicating a 60-second delay.
RSMK bit	8	5	The Report Setmarks (RSMK) bit determines whether or not the drive recognizes setmarks. If the value is 1, the drive recognizes and reports setmarks during appropriate read and space operations. The default value is 1. If the value is 0, the drive ignores setmarks. It skips setmarks as if they do not exist.
REW bit	8	0	The Report Early Warning (REW) bit determines whether or not the drive reports an early-warning condition for read operations. For read-type operations, if this bit is 0, the drive does not report the early-warning condition. The default setting is 0. If this bit is 1, the drive reports the early-warning condition when the logical early-warning position is encountered during read operations. The drive reports early-warning at completion of READ with no residual.
SEW bit	10	3	If set to 1, the Synchronize at Early-Warning (SEW) bit causes the drive to flush all buffered write data to tape when the early-warning position is encountered. If set to 0, this bit indicates that encountering the early-warning position will nto cause th buffer to flush. The default setting is 0.

Medium Partition Page (11h)

The Medium Partition page indicates single- or dual-partition tape format. the MODE SENSE command specifying a Medium Partition page can be executed at any logical position. The tape does not need to be positioned at BOM. The layout of this page is shown in the following table.

Byte	Bits 7	6	5	4	3	2	1	0
0	0	0	Page Code (11h)					
1	Page Length (06h)							
2	Maximum Additional Partitions							
3	Additional Partitions Defined							
4	0	0	0	PSUM	0	0	0	0
5	0	0	0	0	0	0	1	1
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	MSB—Additional Partition Size							
9	Additional Partition Size—LSB							

Medium Partition Page Field Descriptions

The following table describes the fields in the Medium Partition page.

Field Name	Bytes	Bits	Description
Page Code	0	0-5	The Page Code field must be set to 11h to select this page.
Page Length	1		If the current format is a single-partition tape, the Page Length byte is set to 6 (06h), indicating that 6 parameter bytes follow the Page Length byte.. If the current format is a dual-partition tape, the Page Length is set to 8 (08h), indicating that eight parameter bytes follow the Page Length byte.
Maximum Additional Partitions	2		This field returns a 1 to indicate that at most only 1 additional partition can exist for a dual-partitioned tape.
Additional Partitions Defined	3		This field indicates the number of additional paritions on the current tape. A zero specifies a single-partitioned tape; a one specifies a dual-partitioned tape.
PSUM	4	3-4	The Partition Size Unit of Measure (PSUM) field defines the units i in which the partition size descriptors select the partition size. The valid values are as follwo. The default is 10 (megabytes). **4 3 Unit** 0 0 bytes 0 1 kilobytes 1 0 megabytes
Additional Partition Size	8-9		The Partition Size field defines the size of Partition 1 (the first partition on a dual-partition tape) in the units specified in the PSUM field. Byte 8 is the MSB, and byte 9 is the LSB.

Data Compression Control Page (0Fh)

The Data Compression (DC) Control page returns the last values set by the host with a MODE SELECT command for data compressionnnnn control. Also, refer to the MODE SELECT command Data Compression Control page.

The following table illustrates the DC Control page for drives with data compression.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	1	1	1	1
1	Page Length (0Eh)							
2	DCE	DCC	0	0	0	0	0	0
3	DDE	|	RED |	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	Compression Algorithm							
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	Decompression Algorithm							
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0

For drives without data compression capabilities, some of the bits and bytes contain 0s. The following table illustrates the DC Control page for drives without data compression.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	1	1	1	1
1	Page Length (0Eh)							
2	0	0	0	0	0	0	0	0
3	0	|	RED |	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0

DC Control Page Field Descriptions

The following table describes the fields in the DC Control page.

Field Name	Bytes	Bits	Description
DCE	2	7	The DCE (Data Compression Enable) bit controls data compression. This bit contains the last value set by the host with a MODE SELECT command. If the value is 1, the drive compresses data received from the host during a WRITE command before it writes the data to tape in the DDS-DC format. If the value is 0, the drive does not compress data sent during a WRITE command, and the host data is written to tape in the uncompressed DDS format. This value is used for drives without data compression capabilities.
DCC	2	6	The DCC (Data Compression Capable) bit values are as follows: 1 The drive is capable of doing compression 0 The drive cannot do compression **NOTE:** This bit is ignored during MODE SELECT.
DDE	3	7	The DDE (Data Decompression Enable) bit contains the last value set by teh host with a MODE SELECT command. If the value is 1, the drive decompresses data that has been compressed on the tape before it sends the data to the host during a READ command. If the value is 0, the drive does not decompress any data that it sends to the host during a READ command, and any compressed data read is sent to the host in the entity (DDS-DC) format. The default value is 1. For drives without data compression capabilities, this bit is 0.

Field Name	Bytes	Bits	Description
RED	3	5-6	The RED (Report Error on Decompression) bit contains the last value set by the host with a MODE SELECT command. The value specifies when Check Conditions are reported to the host. If the value is 0, the drive generates a Check Condition for every compressed entity that it cannot decompress. For drives without data compression capability, a Check Condition is sent to the host for every compressed entity. If the value is 1, the drive generates Check Conditions only when the format of the SCSI data changes. A SCSI format change occurs when data changes from non-DCLZ compressed to uncompressed, from uncompressed to non-DCLZ compressed, or from compressed with one non-DCLZ algorithm to compressed with a different non-DCLZ algorithm. The default value is 0.
Compression Algorithm	7		The Compression Algorithm byte specifies the algorith that is to be used to compress data with the DCE bit set to 1. A value of 20h in this byte specifies the DCLZ algorithm, which is the default. If the host selects a value of 01h, for the default algorithm, a value of 20h is returned by the MODE SENSE data. A value of 00 specifies that data compression is disabled. This value is used for drives without data compression capabilities..
Decom-pression Algorithm	11		The Decompression Algorithm byte allows the host to specify the algorithm that is to be used to decompress data. The byte is valid whether or not the drive decompresses the data. The byte defaults to a value of 20h to indicate DCLZ decompression. For drives without data compression capabilities , the value is 00h..

The following table shows the algorithm values and meaning.

Algorithm	Definition
00	The data last sent to the host was uncompressed.
20	The data last sent to the host was compressed using the DCLZ algorithm.
01-1F 21-FF	The data last sent to the host was compressed using an algorithm other than the DCLZ algorithm. The contents of the DDS-DC entity header algorithm byte are returned.

Element Address Assignment Page (Autoloader Only—1Dh)

The data in the Element Address Assignment page informs the host of which type of elements anad how many elements of each type are supported by the current configuration of the Autoloader (as defined in the EXCHANGE MEDIUM COMMAND drive). the following table shows the layout of this page

Byte	Bits 7	6	5	4	3	2	1	0
0			Page Code (1Dh)					
1	0	0	0	1	0	0	1	0
2	0	0	0	0	0	0	0	0
3	0	|	RED |	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	1	0
8	0	0	0	0	0	0	0	0
9			Number of Storage Elements					
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	1
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	1
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0

The MODE SENSE parameter list header is different for LUN 0 and LUN 1. For LUN1, bytes 1 and 2 are always zero. Also, the MODE SENSE parameter list block descriptor is different for LUN 0 and LUN 1. For LUN 1, bytes 0, 5, 6, and 7 are always zero.

Device Capabilities Page (Autoloader Only—1Fh)

The following table shows the layout of this page.

Byte	Bits 7	6	5	4	3	2	1	0
0			Page Code (1Fh)					
1	0	0	0	0	1	1	1	0
2	0	0	0	0	1	0	1	0
3	0	|	RED |	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	1	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	1	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	1	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	1

The data in the Device Capabilities Page informs the initiator of the following:

- A cartridge can be stroed in teh data transfer and storage elements.
- A MOVE operates from storage to dat transfer elements as well as from data transfer to storage elements.
- An EXCHANGE only operates such that the soruce and second destinatino addresses must be storage elements while the first destination address must be the data transfer element.

Completion Status

The Completion Status for the MODE SENSE command is shown in the following table.

<table>
<tr><th>Code</th><th>Message</th><th>Description</th></tr>
<tr><td>00h</td><td>Good Status</td><td>• The drive is ready to perform any appropriate command.
• The drive remains in any previously set mode. MODE SENSE does not set or change any modes.
• The tape position is not changed. It remains at the previous position.</td></tr>
<tr><td>02h</td><td>Check Condition</td><td>Extended Sense Byte 02h
<table>
<tr><th>Code</th><th>Message</th><th>Description</th></tr>
<tr><td>02h</td><td>Not Ready</td><td>No cartridge is inserted in the drive.</td></tr>
<tr><td>04h</td><td>Hardware Error</td><td>Drive hardware failure detected.</td></tr>
<tr><td>05h</td><td>Illegal Request</td><td>• The CDB contains an invalid bit.</td></tr>
<tr><td>06h</td><td>Unit Attention</td><td>• Cartridge was changed prior to accepting this command
• The drive was reset prior to this command.</td></tr>
</table></td></tr>
</table>

MOVE MEDIUM (Autoloader only) (A5h)

The MOVE MEDIUM command requests that the Autoloader move a cartridge form a source element to a destination element. The drive must be either the soruce or destination element.

MOVE MEDIUM Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	0	0	0	0	1	0	1
1		LUN		0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5				Source Address				
6	0	0	0	0	0	0	0	0
7				Destination Address				
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	X	X	0	0	0	0	Flag	Link

The source address specifies the location from which the cartridge is taken; the destination address specifies the location to which the cartridge is moved. If the changer is specified, an Illegal Request error is returne.

The following table shows the addresses of the various elements.

Source/ Destination Address	Source/Destination Element	Magazine Type (# of cartridges)
0	Changer	
1	Drive	
2	Magazine slot 1	5 or 12
3	Magazine slot 2	5 or 12
4	Magazine slot 3	5 or 12
5	Magazine slot 4	5 or 12
6	Magazine slot 5	5 or 12
7	Magazine slot 6	12 only
8	Magazine slot 7	12 only
9	Magazine slot 8	12 only
10	Magazine slot 9	12 only
11	Magazine slot 10	12 only
12	Magazine slot 11	12 only
13	Magazine slot 12	12 only
Other	(Illegal Request)	

If the MOVE MEDIUM command is received and the source element is empty or the destination element (if different from teh source element) is full, the Autoloader returns a Check Condition and an Illegal sense key.

The source and destination address can be the drive element (address 1) or a valid cassette storage element. If the address specified is not assigned to a specific elemtn or the drive is not the source or destination, the Autoloader returns a Check Condition and an Illegal Request sense key.

Completion Status

The Completion Status for the MOVE MEDIUM command is shown in the following table.

Code	Message	Description		
00h	Good Status	• The drive is ready for another command. • The cartridge has been moved to the specified location. If the cartridge was moved to the drive, it is positioned at BOT.		
02h	**Check Condition**	**Extended Sense Byte 02h**		
		Code	**Message**	**Description**
		02h	Not Ready	No magazine present.
		04h	Hardware Error	Drive hardware failure detected.
		05h	Illegal Request	• Source element is empty or destination is full. • Address specified is not assigned to a specific element. • The drive is not the source or destination.
		06h	Unit Attention	• Cartridge was changed prior to accepting this command • The drive was reset prior to this command..

PREVENT/ALLOW MEDIA REMOVAL (1Eh)

If the amber drive LED is ON because of a PREVENT command, the cartridge cannot be ejected with the eject pushbutton. If the amber drive LED is OFF because of an ALLOW command, the cartridge can be ejected. If the cartridge is ejected (while the LED is OFF), Unit Attention or Not Ready is set on the next command. If the PREVENT command is issued, the amber drive LED is always ON. After a Reset, the default state of the drive is in the ALLOW command mode. An UNLOAD command ejects the cartridge even after a PREVENT command.

PREVENT/ALLOW MEDIA REMOVAL Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	1	1	1	0
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	PRVNT
5	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Description

If the prevent (PRVNT) bit (byte 4, bit 0) is 1, the front panel LED is turned on. If the PRVNT bit is 0, the front panel LED is turned off. If ON (1), the cartridge cannot be ejected by using the front panel eject pushbutton.

Completion Status

The Completion Status for the PREVENT/ALLOW MEDIA REMOVAL command is shown in the following table.

<table>
<tr><th>Code</th><th>Message</th><th colspan="3">Description</th></tr>
<tr><td>00h</td><td>Good Status</td><td colspan="3">• The drive is ready to perform any appropriate command.
• The drive remains in any previously set mode.
• The tape position is not changed.
• If a PREVENT command was issued, the amber drive LED is always ON. The cartridge cannot be removed.
• If an ALLOW command was sent, teh drive LED is ON only when the tape is accessed. The tape can be removed at BOT without setting Unit Attention Condition.</td></tr>
<tr><td>02h</td><td>Check Condition</td><td colspan="3">Extended Sense Byte 02h
<table>
<tr><th>Code</th><th>Message</th><th>Description</th></tr>
<tr><td>04h</td><td>Hardware Error</td><td>Drive hardware failure detected.</td></tr>
<tr><td>05h</td><td>Illegal Request</td><td>The CDB or Parameter List contains an invalid bit.</td></tr>
<tr><td>06h</td><td>Unit Attention</td><td>• Cartridge was changed prior to accepting this command
• The drive was reset prior to this command.</td></tr>
</table></td></tr>
</table>

READ (08h)

The READ command transfers one or more bytes or blocks from the drive to the Initiator beginning with the next block on tape.

READ Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	1	0	0	0
1	0	0	0	0	0	0	SILI	Fixed
2	MSB—Transfer Length							
3	Transfer Length							
4	Transfer Length—LSB							
5	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Description

The following table defines the fields in the CDB.

Field Name	Bytes	Bits	Description
Fixed bit	1	0	If this bit is 1, the size of the blocks is fixed, as specified by the MODE SELECT Block Descriptor. If it is 0, the transfer length contains the number of bytes in the block.
Suppress Incorrect Length Indicator	1	1	The SILI (Suppress Incorrect Length Indicator) bit is used to suppress incorrect length error reporting when reading variable-length blocks. If the SILI bit is 1 and the Fixed bit is 1, the drive returns a Check Condition with Illegal Request sense key with an additional sense code of Invalid Field in CDB. When the SILI bit is 1 and Fixed bit is 0 and the only error encountered by the drive is that the actual block length differs from the requested transfer length, then the drive • Returns a Check Condition if the actual block length is larger than the requested transfer length and the Block Length field in the Mode Parameter block descriptor is nonzero. • Does not return a Check Condition if the actual block length is smaller than the requested transfer length or if the actual block is larger than the requested block and the block length in the Mode Parameter block descriptor is 0.
Transfer	2-4		This field specifies the number of bytes or blocks to be read. When a transfer length is 0, no data is transferred. This condition is not considered an error.

Description of the READ Command

The READ command is complete when one of the following conditions is met. These conditions are described in the following paragraphs.

- End-of-Data (EOD) is reached.
- A filemark (FM) is read.
- Transfer length is satisfied
- End-of-Tape (EOT) or end-of-partition (EOP) is reached.
- Unrecoverable data error occurs.
- Detection of incorrect block length.

End-of-Data

If EOD is encountered, the command terminates with a Check Condition status and a Sense Key of 08h. If the Valid bit (byte 0, bit 7) is set indicating a residual count, the Residual length field is determined as follows:

- If the Fixed bit is 1, it equals the difference between the CDB transfer length and the number of actual blocks read.
- If the Fixed bit is 0, it equals the CDB transfer length.

The tape is then positioned to allow an Append Data operation.

Filemark

If a filemark is encountered, the command terminates with a Check Condition, and the filemark bit (byte 2, bit 7) of the sense data is set to 1. If the Valid bit (byte 0, bit 7) is set indicating a residual count, the Residual length field is determined as follows:

- If the Fixed bit is 1, it equals the difference between the CDB transfer length and the number of actual blocks read.
- If the Fixed bit is 0, it equals the CDB transfer length.

On termination, the tape is positioned after the filemark on the EOT side of tape.

Save Setmarks

If the RSMK bit in the Device Configuration Page parameter of the MODE SELECT command is reset (0), Save setmarks are ignored and skipped over.

If the RSMK bit is set (1) and a setmark is encountered, the command terminates with a Check Condition. The Filemark bit (byte 2, bit 7) and the Valid bit (byte 0, bit 7) of the sense data are set.

The Residual Length field is then set as follows:

- If the Fixed bit is 1, it equals the difference between the CDB transfer length and the number of actual blocks read.
- If the Fixed bit is 0, it equals the CDB transfer length.

On termination, the logical position is after the Save Setmark.

Transfer Length Satisfied

If the CDB Transfer Length is satisfied, the command completes successfully with a Good Status, and the tape is positioned on the EOT side of the last block read.

End of Tape (EOT) or End-of-Partition (EOP)

When the end-of-tape or end-of-partition position is encountered, the command terminates with a Check Condition and Medium Error (03h) sense key. The Valid bit (byte 0, bit 7) and the EOM bit (byte 2, bit 6) are set.

The Residual Length field is then set as follows:

- If the Fixed bit is 1, it equals the difference between the CDB transfer length and the number of actual blocks read.
- If the Fixed bit is 0, it equals the CDB transfer length.

The logical position after encountering an end-of-tape or end-of-partition error is undetermined.

Recoverable Data Error

If an error is encountered while reading, the read retry count (in the MODE SELECT Read/Write Error Recovery page) specifies the maximum number of attempts to reread the data. If none of the rereads are successful, the error is considered unrecoverable and is reported a such. The drive might require as much as six minutes to complete its error recovery procedure.

Unrecoverable Data Error

If an Unrecoverable Data Error is encountered, the READ command terminates with Check Condition and a Medium Error (03h) sense key.

If the Valid bit (byte 0, bit 7) is set, Residual Length field equals the difference between the requested Transfer Length and the actual number of blocks or bytes transferred.

Incorrect Length

Writing fixed- and variable-length blocks varies according to the setting of the Fixed bit.

When the Fixed bit is set (1), one or more tape blocks can be read. The CDB Transfer Length field specifies the block count to read. The block size is the current block size of the drive, which is set to 512 at power-up or after a SCSI Bus Reset.

The host can change the current block size by issuing a MODE SELECT command with a new block descriptor parameter that specifies a new block size. If the current block size differs from the actual block size of the block being read, the drive reports an Incorrect Length error.

When the Fixed bit is reset (0), the CDB Transfer Length field indicates the number of bytes to be read. When the actual block size found on tape differs from the CDB Transfer Length, an Incorrect Length error is reported.

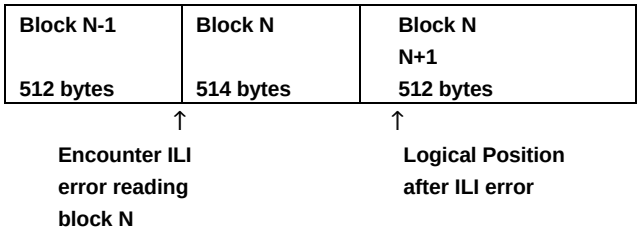
The drive reports the Incorrect Length error based on the Suppress Incorrect Length Indicator (SILI) bit as follows:

- If the actual block length exceeds the CDB Transfer Length, the Incorrect Length error is reported.
- If the actual block length is smaller than the CDB Transfer Length and the SILI bit is 1, the drive ignores (that is, suppresses) the Incorrect Length error.
- If the actual block length is different than the CDB Transfer Length and the SILI bit is 0, the drive reports the Incorrect Length error.

The drive reports the Incorrect Length error by returning a Check Condition. The Incorrect Length Indicator bit (byte 2, bit 5) of the Request Sense data is set (1) indicating the Incorrect Length error. The Valid bit (byte 0, bit 7) of the Request Sense data is also set (1) indicating that the residual data (bytes 3 through 6) is valid. The meaning of the residual data depends on the setting of the Fixed bit.

For reading both fixed- and variable-length blocks, the logical position after encountering an Incorrect Length error in block N is always at the end of block N. The following figure illustrates this position.

Current Block Size = 512 bytes/block



Fixed Mode Residual Data

When the Fixed bit is set (1), the residual data is set to the CDB Transfer Length **minus** the actual number of blocks **correctly** read without encountering an ILI error.

For example, assume the following:

- The current block size is 512 bytes/block.
- The drive is currently positioned before block N.
- Block N contains 514 bytes.

If the host issues a READ command with a CDB Transfer Length of one, indicating one 512-byte block is to be read, the drive transfers the first 512 bytes of block N; then skips the last two bytes (513 and 514) and reports a Check Condition (caused by an Incorrect Length error). The residual is set to one. This residual is determined as follows:

CDB Transfer Length – Number of blocks correctly read without encountering an ILI error (1 - 0 = 1).

The logical position after the error is after byte 514 of block N.

Variable Mode Residual Data

When the Fixed bit is reset (0), the residual data is always set to the CDB Transfer Length.

For example, assume the following:

- The drive is currently positioned before block N.
- Block N + 1 contains 512 bytes.

The host issues a READ command with a CDB Transfer Length of 514, indicating 514 bytes of data to be read. The drive transfers the first 512 bytes of block N; then stops because of an Incorrect Length error. The logical positoin after the error is after byte 512 of block N.

If the SILI bit is set (1), the drive does not report a Check Condition (caused by Incorrect Length error).

If the SILI bit is reset (0), the drive reports a Check Condition, and the residual is set to 2 (CDB Transfer Length = 514).

In the above example, if the block size of block N is 514 bytes and a READ command specifies a Transfer Length of 512 bytes, the drive transfers the first 512 bytes of blcok N; then skips the last two bytes to position itself at the end of byte 514 of block N. The residual is set to -2. Because the actual block length exceeds the CDB Transfer Length, the drive unconditionally reports Check Condition. In this case, the residual is set to -2.

Completion Status

The Completion Status for the READ command is shown in the following table.

Code	Message	Description
00h	Good Status	• The drive is ready to perform any appropriate command. • The drive remains in any previously set mode. • The tape is positioned on the EOT side of the last block read.
02h	**Check Condition**	**Extended Sense Byte 02h**

Code	Message	Description
02h	Not Ready	No cartridge is inserted in the drive.
03h	Media Error	Unrecoverable data error encountered.
04h	Hardware Error	Drive hardware failure detected.
05h	Illegal Request	The CDB contains an invalid bit.
06h	Unit Attention	• Cartridge was changed prior to accepting this command • The drive was reset prior to this command.
08h	Blank Check	The drive encountered EOD.

READ BLOCK LIMITS (05h)

The READ BLOCK LIMITS command causes the drive to transfer the block length limits to the Initiator. The minimum block length is 1 byte; the maximum is 2^{24}-1 bytes. The minimum and maximum block limits are returned to the Initiator in a six-byte data string.

READ BLOCK LIMITS Command Descriptor Block

The following table shows the layout of the CDB.

c	Bits							
	7	6	5	4	3	2	1	0
0	0	0	0	0	0	1	0	1
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Description

The Command Descriptor Block does not contain command dependent fields. The values of the individual bytes in the Block Length fields are shown in the following table in hexadecimal notation.

	Bits							
Byte	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0
1	MSB—Maximum Block Length (FFH)							
2	Maximum Block Length (FFh)							
3	Maximum Block Length—LSB (FFh)							
4	MSB—Minimum Block Length (00h)							
5	Minimum Block Length—LSB (01h)							

Block Size Definition

The host specifies the actual block size in fixed mode with the MODE SELECT command and in variable with the transfer/allocation length of READ and WRITE commands. The use of the MODE SENSE command determines the current block size. The READ BLOCK LIMITS command indicates the minimum and maximum block size that the drive can support. Because the MODE SELECT block descriptor block sie field is 3 bytes in length, the drive is logically limited to this imposed limit. Therefore, the maximum block size is ffffff hexadecimal or 16,777,215 bytes in length.

Completion Status

The Completion Status for the READ BLOCK LIMITS command is shown in the following table.

Code	Message	Description
00h	Good Status	• The drive is ready to perform any appropriate command. • The drive remains in any previously set mode. • The tape position is not changed.
02h	**Check Condition**	**Extended Sense Byte 02h**

Code	Message	Description
04h	Hardware Error	Drive hardware failure detected.
05h	Illegal Request	The CDB or Parameter List contains an invalid bit.
06h	Unit Attention	• Cartridge was changed prior to accepting this command • The drive was reset prior to this command.

READ DATA BUFFER (3Ch)

The READ DATA BUFFER command returns the 4-byte Read Buffer header plus the number of bytes specified by the allocation Length field. This command is used in conjunction with the WRITE DATA BUFFER command as a diagnostic function for testing the drive buffer memory and confirming the SCSI bus integrity. The tape is not accessed during execution of this command.

READ DATA BUFFER Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	1	1	1	1	0	0
1	0	0	0	0	0	Mode		
2	Buffer ID							
3	MSB—Offset							
4	Offset							
5	Offset—LSB							
6	MSB—Allocation Length							
7	Allocation Length							
8	Allocation Length—LSB							
9	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Description

The following table defines the fields in the CDB.

Field Name	Bytes	Bits	Description
MODE	1	0-2	If MODE is 0, data is read starting at offset 0. If MODE is 3, a maximum of four bytes of READ DATA BUFFER Header information is returned.
Buffer ID	2		If MODE is 2, only Buffer ID=0 is valid.
Offset	3-5		If MODE is 2, Offset is the offset where data reading begins. If MODE is 0 or 3, Offset must equal 0.
Allocation Length	6-8		The Allocation Length specifies the maximum number of bytes the Initiator allocated for returned data. For Mode 0, it includes a four-byte header followed by the drives buffer data bytes returned to the Initiator during the Data-In Phase. For Mode 2, it is the total number of drive buffer data returned.

READ DATA BUFFER Header

The following table shows the header layout for the READ DATA BUFFER command.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	0	0	0
1	MSB—Available length							
2	Available length							
3	Available length							

READ DATA BUFFER Header Field Descriptions

The READ BUFFER header contains four bytes.

- the first byte is reserved and set to zero.
- Bytes one, two and three contain the capacity of the space available in the drive buffer. This number is not reduced to reflect the Allocation Length nor is it reduced to reflect the actual number of bytes using the WRITE DATA BUFFER command.

Completion Status

The Completion Status for the READ DATA BUFFER command is shown in the following table.

Code	Message	Description		
00h	Good Status	• The drive is ready to perform any appropriate command. • The drive remains in any previously set mode. • The tape position is not changed.		
02h	**Check Condition**	**Extended Sense Byte 02h**		
		Code	**Message**	**Description**
		04h	Hardware Error	Drive hardware failure detected.
		05h	Illegal Request	• The CDB contains an invalid bit. • Allocation Length exceeds the maximum.
		06h	Unit Attention	• Cartridge was changed prior to accepting this command • The drive was reset prior to this command.

READ ELEMENT STATUS (Autoloader Only) (B8h)

The READ ELEMENT STATUS command requests the Autolaoder to report the status of its elements to the host. The status of ALL element types are reported.

READ ELEMENT STATUS Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	0	1	1	1	0	0	0
1		LUN		0	0	Element Type Code		
2	0	0	0	0	0	0	0	0
3	Starting Element Address							
4	MSB—Number of Elements							
5	Number of Elements—LSB							
6	0	0	0	0	0	0	0	0
7	MSB—Allocation Length							
8	Allocation Length							
9	Allocation Length—LSB							
10	0	0	0	0	0	0	0	0
11	X	X	0	0	0	0	Flag	Link

The starting element address specifies the minimum element address to report. Only element addresses greater than or equal to the starting element address are reported. If the starting element address is undefined, an Illegal Request Check Condition is generated.

The number of elements specifies the maximum number of element descriptors to be reported by the target for this command. If the Allocation Length is not sufficient to transfer all of the requested element descriptors, the Autoloader transfers all the descriptors that can be completely transferred. This situation is not considered an error.

Element Status Data

The data returned by the READ ELEMENT STATUS command consists of an 8-byte header, followed by one or three element status pages. Within each status page are the appropriate element descriptors. The Element type Code can be 0, 1, 2, or 4.

The following example illustrates the data structure returned for a 12-slot magazine.

Element Status Data (8-byte header)
Medium Transport Element (changer) Page (8-byte header)
Medium Transport element Descriptor (12 bytes)
Storage element Page (8-byte header)
Storage Element Descriptors (12 bytes each; for a 12-slot magazine=144 bytes)
.
.
.
Data Transfer Element (drive) Page (8-byte header)
Data Transfer Element Descriptor (12 bytes)

Element Status Data Header

The following table shows the header for the element status data returned from the drive.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	0	0	0
1	First element Address Reported							
2	0	0	0	0	0	0	0	0
3	Number of Elements Available							
4	0	0	0	0	0	0	0	0
5	MSB—Byte Count of Report Available							
6	Byte Count of Report Available							
7	Byte Count of Report Available—LSB							
8	Element Status Page							
.								
.								
.								
n	Element Status Page							

The first element address reported field indicates the element address of the element with the smallest element address found to meet the CDB request. Refer to the MOVE MEDIUM command for the addresses fo the various elements.

The number of elements field indicates the number of elements meeting the request in the CDB. The status for these elements is returned if sufficient allocation length is specified.

The byte count of report available field indicates the number of bytes of element status page and descriptor data available *for all elements meeting the request in the CDB*. This value is not adjusted to match the allocation length available.

Element Status Page Header

Each of the three Autoloader element status pages includes an 8-byte header followed by one or more element descriptors. The following table shows the header for an element status page.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Element Type Code							
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	MSB—Byte Count of Descriptor Available							
6	Byte Count of Descriptor Available							
7	Byte Count of Descriptor Available—LSB							
8	Element Descriptor							
.								
.								
.								
n	Element Descriptor							

The element type code field indicates the element type reported in this field. The following table defines the element type codes.

Code	Element Type	Number of Descriptors
01h	Medium Transport (changer)	1
02h	Storage	5 or 12
04h	Data Transfer (drive)	1

The byte count of descriptor data available field indicates the number of bytes of element descriptor data available for elements of this element type meeting the request in the CDB. This value is not adjusted to match the allocation length available.

If the magazine is not mounted, bothe Medium Transport Element Type Page and the Storage Element Type Page are not returned.

Medium Transport Element (Changer) Descriptor

The Autoloader has only one medium transport element (the changer). The following table shows the medium transport element descriptor.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0

Storage Element Descriptor

The 12-byte storage element descriptor is returned (within the CDB request) for each cartridge slot in the magazine (5 or 12). The following table shows the storage element descriptor.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	0	0	0
1	Element Address							
2	0	0	0	0	1	0	0	Full
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0

A Full bit (byte 2, bit 0) with a value of 1 indicates that the element contains a cartridge. A Full bit with a value of 0 indicates that the element does not contain a cartridge.

Data Transfer Element (Drive) Descriptor

The Autoloader has only one data transfer element (the drive). The following table shows the data transfer element descriptor.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	1
2	0	0	0	0	1	0	0	Full
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	1	0	0	0	0	0
7	SCSI Bus Address							
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0

A Full bit (byte 2, bit 0) with a value of 1 indicates that the element contains a cartridge. A Full bit with a value of 0 indicates that the element does not contain a cartridge.

The SCSI bus address field provides the SCSI address (binary representation) of the DAT drive served by the Autoloader. This field is set by the SCSI address dip-switch or remote connector on the Autoloader unit.

Completion Status

The Completion Status for the READ ELEMENT STATUS command is shown in the following table.

Code	Message	Description		
00h	Good Status	• The drive is ready for another command. • All the status data has been sent.		
02h	**Check Condition**	**Extended Sense Byte 02h**		
		Code	**Message**	**Description**
		04h	Hardware Error	Drive hardware failure detected.
		05h	Illegal Request	• The CDB contains an invalid bit or an invalid element address.
		06h	Unit Attention	• Cartridge was changed prior to accepting this command • The drive was reset prior to this command.

READ POSITION (34h)

The READ POSITION command reports the block address of the current data block. The current data block is the first data block that would be read from the current tape partition if a READ command were issued.

READ POSITION Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	1	1	0	1	0	0
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	X	X	0	0	0	0	Flag	Link

READ POSITION Data Format

The following table shows the layout for the READ POSITION data format.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	BOP	EOP	0	0	0	BPU	0	0
1	Partition Number							
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	MSB—First Block Location							
5	First Block Location							
6	First Block Location							
7	First Block Location—LSB							
8	MSB—Last Block Location							
9	Last Block Location							
10	Last Block							
11	Last Block Location—LSB							
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0

READ POSITION Data Format Field Descriptions

The following table lists the field descriptions.

Field Name	Bytes	Bits	Description
BOP bit	0	7	If the Beginning-of-Partition bit is 1, the current logical position is at the Beginning-of-Partition in the current partition. If this bit is 0, the current logical position is not at the Beginning-of-Partition.
EOP bit	0	6	If the End-of-Partition bit is 1, the current logical position is between Early-Warning and End-of-Partition in the current partition. If this bit is 0, the current logical position is not between Early-Warning and the End-of-Partition.
BPU	0	2	If the Block Position Unknown bit is one, the first and last block locations are not known or cannot be obtained. If this bit is 0, the first and last block location fields contain valid position information.
Partition Number	1		This field reports the partition number for the current logical position. Because the maximum number of partitions supported is two, valid values for this bit are zero (00h) and one (01h). Partition 1 is the first partition on a dual-partition tape.
First Block Location	4-7		These fields indicate the block address associated with the current logical position. The value indicates the block address of the next data block to be transferred between the Initiator and the drive if a READ or WRITE command is issued.
Last Block Location	8-11		These fields indicate the block address associated with the current logical position. The value indicates the block address of the next data block to be transferred between the Initiator and the drive if a READ or WRITE command is issued. Block 0 is the first block on each partition.

Completion Status

The Completion Status for the READ POSITION command is shown in the following table.

Code	Message	Description
00h	Good Status	• The drive is ready to perform any appropriate command. • The drive remains in any previously set mode. • The tape is not moved.
02h	**Check Condition**	**Extended Sense Byte 02h**

Code	Message	Description
02h	Not Ready	No cartridge is inserted in the drive.
04h	Hardware Error	Parity error on the SCSI bus or drive hardware failure detected.
05h	Illegal Request	• The CDB contains an invalid bit.
06h	Unit Attention	• Cartridge was changed prior to accepting this command • The drive was reset prior to this command.

RECEIVE DIAGNOSTIC RESULTS (1Ch)

The RECEIVE DIAGNOSTIC RESULTS command requests any available analysis data be sent to the initiator after completion of a SEND DIAGNOSTIC command. The drive does not use any of the optional diagnostic page data; thus, no data is returned with this command.

RECEIVE DIAGNOSTIC RESULTS Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	1	1	0	0
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	MSB—Allocation Length							
4	Allocation Length—LSB							
5	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Description

The following table defines the fields in the CDB.

Field Name	Bytes	Bits	Description
Allocation Length	3-4		The drive returns 8 bytes of data with results from the last self-test.

The following table shows the Diagnostic parameter values.

Value	Description
00	Page code (80h)
01	Reserved (00h)
02	Reserved (00h)
03	Additional length (04)
04	Last successful test
05	Error code
06	FRA
07	Tape load count

If the Enhanced Diagnostics were not invoked before the RECEIVE DIAGNOSTIC RESULTS command, the last successful test field (byte 4) is set to 0.

If the Enhanced Diagnostics were invoked before the RECEIVE DIAGNOSTIC RESULTS command, the last successful test field (byte 4) is set to 3. If a failure

occurred during one of the tests, byte 4 is set to the previous test that passed successfully.

If no errors occurred during the Enhanced Diagnostics or the Enhanced Diagnostics were not invoked, the Error code field (byte 5) is set to 0.

If an error occurred during one of the tests, byte 5 is set as follows:

Error Code	Description
10	C1 error threshold exceeded
24	Position lost
25	Requested position not found
2A	Write failure, excessive rewrites
2D	Capstan error
2E	Cylinder error
2F	Reel error
3D	Mechanism error
32	Tape jam
36	Dew error

The FRA field (byte 6) of the Diagnostics data is set as follows:

FRA	Indication
0	No errors
1	Drive errors
2	Faulty media
3	Power supply or cable problems
4	Cleaning required

Completion Status

The Completion Status for the RECEIVE DIAGNOSTIC RESULTS command is shown in the following table.

Code	*Message*	*Description*		
00h	Good Status	• The drive is ready to perform any appropriate command. • The drive remains in any previously set mode. • The tape position is not changed.		
02h	**Check Condition**	**Extended Sense Byte 02h**		
		Code	**Message**	**Description**
		04h	Hardware Error	Drive hardware failure detected.
		05h	Illegal Request	• The CDB contains an invalid bit.
		06h	Unit Attention	• Cartridge was changed prior to accepting this command • The drive was reset prior to this command.

RELEASE UNIT (17h)

The RELEASE UNIT command releases a current drive reservation, if the command is received form the Initiator that originally established the reservation. If the original reservation was made for a third party, the RELEASE UNIT command Descriptor Block must also carry the third party data. Any RELEASE UNIT command that arrives from other than the originating requester (including one that arrives from the third party currently in command of the drive) is ignored and Good Status is returned in response to the command.

Additional events and conditions that can cause a reservation to be released are discussed under the RESERVE UNIT command.

þ **Note:** It is not an error to attempt to release an ID that is not currently reserved to the requesting Initiator. A reservation cannot be released, if it is reserved by another Initiator.

RELEASE UNIT Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	0	1	1	1
1	0	0	0	3rd Pty		3rd Pty ID		0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Description

The following table defines the fields in the CDB.

Field Name	Bytes	Bits	Description
3rd Pty bit	1	4	The Third Party bit indicates when a release is for a third party.
3rd Pty ID	1	1-3	The Third Party ID specifies a device ID for which the release was intended. This field is meaningful only when the 3rd Pty bit is set to 1. The drive does not release a third party reservation if this field does not identify the device for which the drive is currently reserved.

Completion Status

The Completion Status for the RELEASE UNIT command is shown in the following table.

Code	Message	Description
00h	Good Status	• The drive is ready to perform any appropriate command. • The drive remains in any previously set mode. • The drive accepts commands from any Initiator. • The tape position is not changed.
02h	**Check Condition**	**Extended Sense Byte 02h**

Code	Message	Description
04h	Hardware Error	Drive hardware failure detected.
05h	Illegal Request	The CDB contains an invalid bit.
06h	Unit Attention	• Cartridge was changed prior to accepting this command • The drive was reset prior to this command.

REQUEST BLOCK ADDRESS (02h)

The REQUEST BLOCK ADDRESS command requests the drive to transfer the current block address to the Initiator. This command returns the block address number on tape.

REQUEST BLOCK ADDRESS Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	0	1	0
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	Allocation Length							
5	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Description

The following table defines the fields in the CDB.

Field Name	Bytes	Bits	Description
Allocation Length	4		Set to 0, the default Transfer Length (3) is used. When nonzero, the number of bytes specified in the Allocation Length (to a maximum of 3 bytes) is transferred.

REQUEST BLOCK ADDRESS Address Data Format

The following table provides the address data format.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	MSB—Block Address							
1	Block Address							
2	Block Address—LSB							

REQUEST BLOCK ADDRESS Address Data Field Description

The Block Address Fields (bytes 0 through 2) report the current tape position block number.

Completion Status

The Completion Status for the REQUEST BLOCK ADDRESS command is shown in the following table.

Code	Message	Description
00h	Good Status	• The drive is ready to perform any appropriate command. • The drive remains in any previously set mode. • The tape position is not changed.
02h	**Check Condition**	**Extended Sense Byte 02h**

Code	Message	Description
04h	Hardware Error	Drive hardware failure detected.
05h	Illegal Request	The CDB contains an invalid bit.
06h	Unit Attention	• Cartridge was changed prior to accepting this command • The drive was reset prior to this command.

REQUEST SENSE (03h)

The REQUEST SENSE command causes the drive to transfer status data to the Initiator pertaining to the last command.

REQUEST SENSE Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	0	1	1
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	Allocation Length							
5	X	X	0	0	0	0	Flag	Link

Sense Data is updated with each command; therefore, the sense data only reports the status of the immediately previous command. If a Check Condition status results, a REQUEST SENSE command should be issued to recover the information form the Sense Data.

The REQUEST SENSE command returns Check Condition status only if a fatal error occurs during execution of the REQUEST SENSE command. If nonfatal errors occur during the REQUEST SENSE execution, Good Status is returned. Sense Data may be invalid following a fatal error on a REQUEST SENSE command.

Sense Data Format

The following table shows the format for the sense data.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Valid	1	1	1	0	0	0	0
1	0	0	0	0	0	0	0	0
2	FM	EOM	ILI	0		Sense Key		
3	MSB—Residual Length (0)							
4	Residual Length (0)							
5	Residual Length (0)							
6	Residual Length—LSB (0)							
7	Additional Sense Length							
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	0	0	0	0	0	0	0	0
15	SKSV	C/D	0	0	BPV		Bit Pointer	
16	MSB—Field Pointer							
17	Field Pointer—LSB							
18	0	0	0	0	0		0	0

Sense Data Field Descriptions

The Sense Data field descriptions are shown in the following table.

Field Name	***Bytes***	***Bits***	***Description***
Valid bit	0	7	The Valid Bit indicates that the Residual Length field (Bytes 3 to 6) is defined. If the Valid Bit is 1, Residual Length is the requested length minus the actual length in blocks or bytes. For example: If: Write Transfer Length = 1000 blocks Residual Length = 896 blocks Blocks transferred to drive = 192 Then: Transfer Length – Residual Length = Data written to tape 1000–896 = 108 And: Blocks transferred to drive – Data to tape = Data trapped in buffer 192 –108 = 84
FM bit	2	7	The FM bit indicates that the current command has read a Filemark or a save setmark (if the RSMK bit is set).
EOM bit	2	6	The EOM bit indicates one of the following: • Early-warning has been reached or passed in the forward direction. • The command could not be completed because BOT was encountered in a space reverse command.

Field Name	Bytes	Bits	Description
Incorrect Length Indicator (ILI	2	5	If this bit is 1, a block was read that has a length different than that which is specified.
Sense Key	2	0-3	This field indicates the status of the last command and provides a generic error category.
Residual Length	3-6		See Valid bit.
Additional Sense Length	7		A number greater that zero in this field indicates that bytes 8 through N contain information.
Additional Sense Code	12		This field provides further detail for the current Sense Key.
Additional Sense Code Qualifier	13		This field provides further detail for the current Additional Sense Code.
SKSV bit	15	7	If the Sense Key Specific Valid (SKSV) bit is set (1), bytes 15-17 may be used to determine the first illegal parameter that caused an Illegal Request sense key (as defined below). The following table lists the vendor unique SKSV reported by the drive when the most significant bit of byte 15 si zero.
C/D bit	15	6	If the Command/Data (C/D) bit is set (1), the illegal parameter is in the CDB. Otherwise, it is in the parameters sent in the Data-Out Phase.
BPV bit	15	3	When the Bit Pointer Valid (BPV) bit is set (1), the Bit Pointer field indicates the bit field in error.
Bit Pointer	15	0-2	This field points to the most significant bit of the field in error.
Field Pointer	16-17		This field points to the most significant byte of the field in error. Bytes are numbered starting from 0. When a Log Exceptin is generated, bytes 16 and 17 indicate the MSB and LSB of the Log Parameter code that caused the Log Exception. Byte 15 indicates the affected page that caused the Log Exception.

The following table lists the vendor unique SKSV codes referenced in the table above.

Byte 15	Definition
02h	Log page 2 exception error.
03h	Log page 3 exception error.
1Dh	Error during timeout flush.
21h	Tape encountered end of data.
22h	Tape encountered end of tape.
23h	Tape encountered beginning of tape.
24h	Tape position has been lost.
25h	Tape cannot find requested position.

Byte 15	Definition
26h	Unable to write additional data to tape.
27h	Cartridge is write-protected.
28h	Tape is not formatted.
29h	Cartridge is not in drive.
2Ah	Write failure.
2Bh	Cartridge did not load properly.
2Ch	Dartridge did not unload properly.
2Dh	Error occurred with capstan servo.
2Eh	Error occurred with tape cylinder.
2Fh	Error occurred with tape reel.
30h	An unknown mechanical error occurred.
31h	The tape is cut.
32h	The tape is jammed.
33h	Error occurred in adjusting AGD.
34h	Internal tape process error occurred.
35h	Loader failure.
36h	Dew error.
37h	Invalid tape status.
38h	Invalid control mode.
39h	Drive error.
3Ah	SDA search failed.
3Bh	Tape erase failed.
3Ch	Invalid Append AFC.
3Dh	Missed SP3 interrupt.
3Eh	Head clog write failure.
3Fh	head clog read/search failure.
43h	Unrecoverable read error occurred.
45h	Cannot read medium, incompatible format.
46h	Medium format is corrupted.
47h	Bad entity header.
50h	SPACE command logic error occurred.
51h	Start of record not found during SPACE command.
52h	Tape process returns incorrect groups during SPACE>
53h	Compress data format corruption.
54h	Block Access Table corruption during reading.
55h	Block Access Table corruption during space.
60h	Compression hardware fault occurred.
61h	Port A parity error occurred.
62h	Port B parity error occurred.

Byte 15	Definition
70h	Error occurred during compression.
71h	Port B control problem occurred.
72h	Compression LSI pause problem occurred.
73h	Error occurred druing buffer swap.
74h	Compression chip is not paused when expected.
75h	FIFO is not empty when expected.
76h	Compression chip not flushed when expected.
C0	Illegal LUN in the CDB

Priority and Definition of Sense Keys

The following table shows the priority and definition of the sense keys.

Key	*Message*	*Definition*
00h	No Sense	The Check Condition occurred in conjunction with detection of FM, EOT, or ILI, or status was not available.
01h	Recovered Error	The Log Sense counter reached its maximum value and the RLEC bit is set.
02h	Not Ready	The drive is not ready to accept tape access commands. Operator intervention may be required to correct this condition, or the drive may be coming ready.
03h	Medium Error	The command terminated with a nonrecoverable error that was probably caused by a flaw in the medium or an error in the recorded data.
04h	Hardware Error	The drive detected a nonrecoverable hardware failure (parity, etc.) while performing the command. Until the cartridge is ejected or a reset is received, the drive continues to return this sense key to any tape motion command.
05h	Illegal Request	The CDB or command parameters contained an illegal parameter.
06h	Unit Attention	One of the following actions occurred: the cartridge was changed; the drive was reset; the operational mode was changed; a Log Exception occurred; or the firmware was changed.
07h	Data Protect	The cartridge is write-protected; the operation was not performed.
08h	Blank Check	A no-data condition was encountered on the tape, or the wrong data format was encountered on tape.
0Bh	Aborted Command	The drive aborted the command. This key is returned if a bus parity error is detected. The Initiator may be able to recover by trying the command again.
ODh	Volume Overflow	The drive reached the physical EOT, and write data remains in the buffer.
0Eh	Miscompare	The source data did not match the tape data during a VERIFY command.

Additional Sense Code and Code Qualifier

Additional sense codes and code qualifiers are returned in the REQUEST SENSE data in bytes 12 and 13. These byte codes are loaded whenever a Check Condition is returned for any SCSI CDB. The purpose of the codes is to further define the cause of an error represented in the REQUEST SENSE Data Sense Key.

The following table lists the additional sense code and code qualifiers.

	Byte		
2	**12**	**13**	**Definition**
0			**NO SENSE**
	00	00	No additional sense data available.
	00	01	Filemark detected.
	00	02	End of tape or partition detected.
	00	03	Setmark detected.
	00	04	Beginning of partition or media.
1			**RECOVERED ERROR**
	18	01	Recovered data with error condition and retries applied.
	37	00	Rounded parameter.
	5B	00	Log exception.
	5B	02	Log counter at maximum
2			**NOT READY**
	04	01	Logical unit is in process of becoming ready.
	04	03	Logical unit not ready, manual intervention required
	30	00	Incompatible medium installed.
	30	03	Cleaning cartridge installed.
	30	04	Diagnostic cartridge installed.
	3A	00	Cartridge or magazine not present.
	53	00	Cartridge load/eject failure.
	5A	91	Eject button pushed.
3			**MEDIUM ERROR**
	00	02	End of tape or partition detected
	03	02	Excessive write errors.
	0C	00	Write error during compression.
	11	00	Unrecovered read error.
	30	00	Bad entity header.
	30	01	Cannot read tape, unknown format.
	30	02	Cannot read tape, incompatible format.
	30	11	Entity header wrong length.
	30	12	Reserve byte not in entity header.
	30	13	Bad algorithm byte in entity header.
	30	C3	Compressed data format corruption.
	30	C4	Block Access Table corruption during reading.
	30	C5	Block Access Table corruption during space.
	31	00	Tape format corrupted.
	3B	00	Sequential positioning error.
	3B	01	Tape position error at BOT.
	3B	08	Lost tape position.
	44	B3	Gain adjustment failure.
	70	xx	Decompression exception where xx specifies the illegal algorithm

	Byte		
2	**12**	**13**	**Definition**
4			**HARDWARE ERROR**
	00	00	SPACE command logic error.
	15	01	Mechanical positioning error.
	20	00	Receive data DMA length error.
	21	00	Send data DMA length error.
	40	80	Diagnostic failed unknown test.
	40	81	Diagnostic failed PROM Checksum test.
	40	82	Diagnostic failed RAM test.
	40	83	Diagnotic failed Memory Controller test.
	40	84	Diagnostic failed Counter/Timer test.
	40	85	Diagnostic failed SCSI LSI test.
	40	86	Diagnostic failed ECC processor test.
	40	87	Diagnostic failed Drive LSI test.
	40	88	Diagnostic failed Compression LSI test.
	40	89	Diagnostic failed EEPROM test
	40	90	Tape read/write test failed.
	44	00	Internal failure.
	44	01	Internal failure: invalid completion code.
	44	02	Internal failure: ISR failure.
	44	80	Compression hardware fault.
	44	81	Port A parity error.
	44	82	Port B parity error.
	44	90	Error during compression.
	44	91	Port B control problem.
	44	92	Compression LSI pause problem.
	44	93	Error during buffer swap.
	44	94	Compression chip not paused when expected.
	44	95	FIFO not empty when expected.
	44	96	Compression chip not flushed when expected.
	44	9A	Timeout during background operation.
	44	AD	Capstan servo error.
	44	AE	Tape cylinder error.
	44	AF	Tape reel error.
	44	B0	Unknown mechanical error.
	44	B1	The tape is cut.
	44	B2	The tape is jammed.
	44	B4	Tape process internal error.
	44	B7	Internal error: invalid tape status.
	44	B8	Internal error: invalid control mode.
	44	B9	Internal error: drive error.
	44	BA	Internal error: SDA search failed.
	44	BB	Internal error: tape erase failed.
	44	BC	Internal error: invalid Append AFC.
	44	BD	Internal error: missed SP3 interrupt.

	Byte		
2	**12**	**13**	**Definition**
	44	C0	Magazine scanning to 1st detectable slot failed during initialization (Autoloader only).
	44	C1	Magazine positioning from one slot to next failed during initializationAutoloader only).
	44	C2	Magazine ejection failure (Autoloader only).
	44	C3	Upward magazine movement failure (Autoloader only).
	44	C4	Downward magazine movement failure (Autoloader only).
	44	C5	Cartridge could not successfully be inserted (Autoloader only).
	44	C6	Cartridge insertion rollers could not engage (Autoloader only).
	44	C7	Cartridge insertion rollers could not disengage (Autoloader only).
	44	C8	Cartridge ejection failure (Autoloader only).
	44	C9	Cartridge rollers could not engage during ejection (Autoloader only).
	44	CA	Cartridge rollers could not disengage during ejection (Autoloader only).
	44	CB	Drawer closing failure (Autoloader only).
	44	CC	Drawer opening failure (Autoloader only).
	44	CD	Magazine could not initialize to a known state after power-up (Autoloader only).
	45	00	Select or reselect failure.
	46	00	Unsuccessful soft reset.
	4B	00	Data Phase error.
	51	00	Erase failure.
	52	00	Cartridge fault.
	53	00	Tape load failure
	53	01	Unload tape failure.
	82	80	Dew sensor
5			**ILLEGAL REQUEST**
	1A	00	Invalid parameter list length.
	20	00	Invalid CDB operation code.
	21	01	Invalid element address.
	24	00	Invalid field in CDB.
	25	00	Logical unit not supported.
	26	00	Invalid field in the parameter list.
	26	01	Parameter not supported.
	26	02	Parameter value invalid.
	26	03	Threshold parameters not supported.
	39	00	Saved bit not supported.
	3A	00	Cartridge or magazine not present
	3B	0D	Destination element full.
	3B	0E	Source element empty.
	3D	00	Invalid bits in Identify message.

	Byte		
2	**13**	**14**	**Definition**
6			**UNIT ATTENTION**
	28	00	Not ready to ready transition (cartridge or magazine change).
	29	00	Power on or reset.
	2A	01	Mode parameters changed.
	5A	01	Cartridge was changed.
	5B	01	Threshold condition met.
7			**DATA PROTECT**
	27	00	Write protected.
	30	00	Nn-MRS media
8			**BLANK CHECK**
	00	05	End of data (EOD) detected.
	30	01	Cannot read tape, unrecorded or unknown format.
B			**ABORTED COMMAND**
	1B	00	Host did not respond to SDTN message.
	43	00	Message error.
	45	00	Select or reselect failure.
	47	00	SCSI parity error detected.
	48	00	Initiator-detected error message received.
	49	00	Invalid message error.
	4A	00	Command Phase error.
	4E	00	Reconnect abort error
	53	00	Cartridge load/eject failure.
	5A	01	Cartridge ejected.
D			**VOLUME OVERFLOW**
	00	02	End of partition/tape detected.
E			**MISCOMPARE**

Autoloader Error Codes

The following table lists the error codes that might be displayed in the LED panel of the Autoloader.

(1) Display and LED Related	
6	Invalid display parameter
(2) Magazine, Cartridge, and Drawer Related	
2	Busy
3	Magazine not inserted
4	Magazine not initialized
5	Invalid slot number
6	Cartridge inserted in drive (or) invalid display parameter (see above)
7	Cartridge not inserted in slot (during insertion)
8	No cartridge in drive (during cartridge eject)
9	Cartridge inserted in slot (during cartridge eject)
F	Hardware error

10	Magazine initialize error (between START and 1st SLOT)
11	Magazine initialize error (between 1st SLOT and END SLOT).
b2	Drawer closed mag. init. error (between START and END SLOT)
b3	Drawer closed mag. init. error (between END SLOT and 2nd positioning)
20	Magazine eject error
30	Magazine upward movement error
31	Magazine downward movement error
40	Cartridge insert error
41	Cartridge insert clamp ON error
42	Cartridge insert clamp OFF error
50	Cartridge eject error
51	Cartridge eject clamp ON error
52	Cartridge eject clamp OFF error
60	Drawer close error
61	Drawer open error
70	Magazine lost (reset request)
a0	Stop by STOP command
f2	Drawer open error at power up. When drawer neither OPEN nor CLOSED at powerup, the Autoloader firmware tries to open the drawer. If OPEN condition is not reached wihtin 8 seconds, the f2 error is displayed.

Completion Status

The Completion Status for the REQUEST SENSE command is shown in the following table.

Code	*Message*	*Description*		
00h	Good Status	• The drive is ready to perform any appropriate command. • The drive remains in any previously set mode. • The tape position is not changed.		
02h	**Check Condition**	**Extended Sense Byte 02h**		
		Code	**Message**	**Description**
		04h	Hardware Error	Drive hardware failure detected.
		05h	Illegal Request	The CDB contains an invalid bit.

RESERVE UNIT (16h)

The RESERVE UNIT command reserves the drive for exclusive use of the requesting Initiator or for the exclusive use of third party specified SCSI device.

The drive reservation once established, remains in effect until occurrence of one of the following:

- Another RESERVE UNIT command arrives from the same Initiator that requested the current reservation (for itself or for a third party). The new reservation supersedes the current one and may be the same as the current one. Redundant use of the command is not considered an error.
- ARELEASE UNIT command arrives from the same Initiator that requested the current reservation. The drive returns to unreserved mode.
- A Bus Device Reset Message arrives from any Initiator.
- A Reset condition occurs.
- Firmware is updated.

When the drive is reserved, it returns Reservation Conflict Status in response to any and all commands received from excluded Initiators. An exception to this is in response to the RELEASE UNIT command and in response to a subsequent RESERVE UNIT command from the original reservation requester. Also, see the RELEASE UNIT command. In addition, INQUIRY, REQUEST SENSE, and PREVENT MEDIUM REMOVAL commands will be accepted from any initiator.

RESERVE UNIT Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	0	1	1	1
1	0	0	0	3rd Pty |		3rd Pty ID		0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Description

The following table defines the fields in the CDB.

Field Name	Bytes	Bits	Description
3rd Pty bit	1	4	The Third Party bit indicates whether or not the reservation is for a third party.
3rd Pty ID	1	1-3	The Third Party ID specifies a Initiator ID for which the release was intended. This field is meaningful only when the 3rd Pty bit is set to 1. The drive does not release a third party reservation if this field does not identify the Initiator currently in control of the drive.

Completion Status

The Completion Status for the RESERVE UNIT command is shown in the following table.

Code	Message	Description
00h	Good Status	• The drive is ready to perform any appropriate command. • The drive remains in any previously set mode. • The drive is reserved for the use of the specified ID. • The tape position is not changed.
02h	**Check Condition**	**Extended Sense Byte 02h**

Code	Message	Description
04h	Hardware Error	Parity error on the SCSI bus or drive hardware failure detected.
05h	Illegal Request	The CDB contains an invalid bit.
06h	Unit Attention	• Cartridge was changed prior to accepting this command • The drive was reset prior to this command.

18h	Reservation Conflict	The drive is reserved for another initiator.

REWIND (01h)

The REWIND command causes the drive to rewind the cartridge to the Beginning-of-Tape (BOT). Any write data remaining in the buffer will be first recorded to the tape, and an EOD marker will be recorded. The REWIND operation is done in the high speed mode.

REWIND Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	0	0	1
1	0	0	0	0	0	0	0	IMMED
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Description

The immediate (IMMED) bit (byte 1, bit 0) can be used to specify that status be returned as soon as the operation is initiated. When this bit is 1, the status is returned as soon as the rewind operation is initiated.

Exception Condition: if the IMMED bit is 1 and a write error occurs while buffered data is being written to tape, Good Status (00h) is returned. However, the next command to execute reports the write reror by returning a Check Condition Medium Error. In this case, the tape may not be rewound.

When this bit is 0, the status is not returned until the REWIND operation is completed.

Completion Status

The Completion Status for the REWIND command is shown in the following table.

Code	Message	Description		
00h	Good Status	• The drive is ready to perform any appropriate command. • The drive remains in any previously set mode. • The tape position is BOT (if not IMM).		
02h	**Check Condition**	**Extended Sense Byte 02h**		
		Code	**Message**	**Description**
		02h	Not Ready	No cartridge is inserted in the drive, or the cartridge is being positioned to BOT.
		03h	Medium Error	See previous Exception Condition.
		04h	Hardware Error	Drive hardware failure detected.
		05h	Illegal Request	• The CDB contains an invalid bit. • The Link bit and IMMED bit are both set to 1.
		06h	Unit Attention	• Cartridge was changed prior to accepting this command • The drive was reset prior to this command.
		08h	Busy	An immediate command is in progress.

SEEK BLOCK (0Ch)

The SEEK BLOCK command is used to position the tape to the specified block address in the current partition. No data is transferred. SEEK BLOCK positions the tape to block locations greater or less than the current block position. Positioning is done with a high speed search and does not require a sequential read for the requested block.

The Initiator may obtain block addresses through the REQUEST BLOCK ADDRESS command as part of its tape write procedures. The block addresses can, in turn, be recorded in a user-defined directory.

When there is no exception condition during a SEEK BLOCK command, the tape is logically positioned before the block specified in the block address. The first data block on tape is block 1; therefore, a zero in the block address is considered an error.

SEEK BLOCK Command Descriptor Block

The following table shows the layout of the CDB.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	1	1	0	0
1	0	0	0	0	0	0	0	IMMED
2	MSB—Block Address							
3	Block Address							
4	Block Address—LSB							
5	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Description

The following table provides descriptions of the CDB fields.

Field Name	Bytes	Bits	Description
IMMED	1	0	If this bit is 1, the status is returned as soon as the operation is initiated. If this bit is 0, the status is returned after the tape is positioned at the specified block.
Block Address	2-4		These fields specify the address of the block to which the tape is to be positioned.

Completion Status

The Completion Status for the SEEK BLOCK command is shown in the following table.

Code	Message	Description		
00h	Good Status	• The drive is ready to perform any appropriate command. • The drive remains in any previously set mode. • The tape is positioned before the requested block.		
02h	**Check Condition**	**Extended Sense Byte 02h**		
		Code	**Message**	**Description**
		02h	Not Ready	No cartridge is inserted in the drive.
		03h	Media Error	Unrecoverable data error encountered.
		04h	Hardware Error	Drive hardware failure detected.
		05h	Illegal Request	• The CDB contains an invalid bit. • Block count of zero was issued.
		06h	Unit Attention	• Cartridge was changed prior to accepting this command • The drive was reset prior to this command.
		08h	Blank Check	• EOD was encountered. • The requested block number is greater than the last block written on tape.

SEND DIAGNOSTIC (1Dh)

The SEND DIAGNOSTIC command causes the drive to perform diagnostic self-tests. The tests are part of the drive-resident firmware. If the Off-Line bit is 0, no data is transferred between the drive and the Initiator during this command. the diagnostics take about 4 seconds to complete.

If the Off-line bit is 1, a tape read/write test is performed. These tests can take up to 60 seconds to complete. All data on the inserted cartridge is lost.

Good Status is returned if the tests are successful; otherwise, the tailed test is indicated in the REQUEST SENSE data.

SEND DIAGNOSTIC Command Descriptor Block

The following table shows the layout of the Command Descriptor Block.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	1	1	0	1
1	0	0	0	0	0	Self-Test	DEVOF	Off-Line
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	X	X	0	0	0	0	Flag	Link

The combinations of bits in byte 1 are defined as shown in the following table.

Self-Test Bit 2	DEVOF Bit 1	Off-Line Bit 0	Description
1	0	0	Power-up self-test
1	0	1	Read/write tests
1	1	1	Enhanced diagnostics

Completion Status

The Completion Status for the SEND DIAGNOSTIC command is shown in the following table.

Code	Message	Description
00h	Good Status	• The drive is ready to perform any appropriate command. • The drive remains in any previously set mode. • The tape position is not changed.
02h	**Check Condition**	**Extended Sense Byte 02h**

Code	Message	Description
02h	Not Ready	No cartridge is inserted in the drive.
04h	Hardware Error	Drive hardware failure detected.
05h	Illegal Request	The CDB contains an invalid bit.
06h	Unit Attention	• Cartridge was changed prior to accepting this command • The drive was reset prior to this command.

NOTE: The amber drive LED flashes rapidly if a hardware fault is detected.

SPACE (11h)

The SPACE command uses five methods to move the tape. This command moves the position:

- Forward or backward a specified number of blocks.
- Forward or backward a specified number of filemarks.
- Forward or backward a specified number of setmarks.
- Forward a specified number of sequential (contiguously grouped) filemarks or setmarks.
- Forward to the end of recorded data.

If the target block or filemark is in the buffer of the drive, no tape motion results. Otherwise, spacing is done at high search speed.

A file example is shown below.

Block	1	2	3	4	5	6	7	8	9	10	11	12	13	
BOT	Data	Data	Data	Data	F/M	Data	Data	F/M	Data	Data	F/M	F/M	F/M	
Position					1								2	3

- When SPACE Block count is 4 from BOT, SPACE positions the tape to the end of the 4th block (position #1).
- When SPACE Sequential filemarks count is 2 from BOT, SPACE positions the tape to the end of the next occurrence of a double filemark (position # 2).
- When SPACE filemarks count is 5 from BOT, SPACE positions the tape to position #3.

SPACE Command Descriptor Block

The following table shows the layout of the Command Descriptor Block.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	0	0	0	1
1	0	0	0	0	0		Code	
2				MSB—Count				
3				Count				
4				Count—LSB				
5	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Descriptions

The following table provides descriptions of the CDB fields.

Field Name	Bytes	Bits	Description
Code	1	0-2	The Code Field designates the desired function as shown below:

Bits 2	1	0	Function
0	0	0	Space blocks
0	0	1	Space filemarks
0	1	0	Space sequential filemarks
0	1	1	Space to end of recorded data
1	0	0	Space setmarks

Count	2-4		This field specifies the number of blocks, filemarks, sequential filemarks, or setmarks to space over. A zero value in the Count field causes no media movement and is not considered an error.

Space-by-Count Functions

The Count field indicates both direction and distance within the current partition. A positive value N in the Count field moves the tape forward over N blocks, filemarks, contiguous filemarks, or setmarks. A negative value -N (2's complement) in the Count field moves the tape backward over N blocks, filemarks, or setmarks. Zero in the count field causes no tape movement and is not considered an error.

When there are no exception conditions during space functions, forward tape motion ends on the EOT side of the last block, filemark, or setmark and reverse motion ends on the BOT side of the last block, filemark, or setmark.

- If a filemark or setmark is encountered while spacing over blocks or a setmark is encountered while spacing filemarks, a Check Condition Status is returned. The Sense FM bit is set unless a setmark is encountered and RSMK=0. The Sense Valid bit is set, indicating Residual Length is non-zero.

  The Residual Length equals the difference in the requested count and the actual number of blocks spaced over not including the filemark or setmark. The tape is positioned on the logical EOT side of the filemark or setmark if movement was forward or on the logical BOT side of the filemark or setmark if movement was reverse.

- If EOD is encountered while spacing forward, Check Condition is returned with 08h Sense Key. Extended Sense Valid bit is set, indicating Residual Length is nonzero.

- If BOT is encountered while spacing in reverse, Check Condition is returned with 40h Sense Key. Extended sense Valid bit is set, indicating a nonzero Residual Length.

- If EOT is encountered while spacing forward, Check Condition is returned with 40h or 43h Sense Key. Extended Sense Valid bit is set, indicating a nonzero Residual Length.

- If an unrecoverable data error is encountered, Check Condition is returned, Extended Sense Key is set to Medium Error, and Extended Sense Valid bit is set, indicating Residual Length is nonzero.

Space by Position Functions

The Count field is not applicable in space-to-EOD functions.

In the space-to-EOD function, the tape is positioned such that a subsequent WRITE command appends data to the last recorded information on the tape. This positioning is done at high search speed.

The space-to-EOD function is useful in support of user-defined directories located at the end of recorded data.

- If physical EOT is encountered while spacing to end of data, Check Condition Status is returned and Extended Sense is set to Medium Error.

- If unrecoverable data error is encountered, Check Condition Status is returned, Extended Sense Key is set to Medium Error, and Extended Sense Valid bit is set, indicating Residual Length is non-zero.

Space and the RSMK Bit

A Report Setmark (RSMK) bit determines whether or not the drive recognizes setmarks during a SPACE operation. If the value of the RSMK bit is 1, the drive recognizes and reports setmarks when searching for the target. If the value of the bit is 0, the drive ignores setmarks during execution of the SPACE command.

Assume that the data was written on the tape as shown in the following table.

Block	1	2	3	4	5	6	7	8	9	10	11	12	13	14
BOT	D	S	S	S	S	S	D	D	D	D	D	D	D	cod
Position	A	B	C			D	E	F						

Similar with the LOCATE command, if the RSMK bit is 0 when the SPACE command is issued, all the setmarks are logically grouped with its nearest Data Block on its BOT side to form a single logical block. The following table shows the logical blocks when the RSMK bit is set to 0. In the table, the data block in block number 1 together with five setmarks in blocks number 12-6 are considered as one logical block.

Block	1	1	1	1	1	1	2	3	4	5	6	7	8	9
BOT	D	S	S	S	S	S	D	D	D	D	D	D	D	cod

If the RSMK bit is 1 in the CDB when the SPACE command is issued, then the setmark is recognized and reported during execution of the SPACE operation. The following table show sthe logical blocks.

Block	1	2	3	4	5	6	7	8	9	10	11	12	13	14
BOT	D	S	S	S	S	S	D	D	D	D	D	D	D	cod

Referring to the first table, the table below shows the tape position after each SPACE command is complete.

SPACE X Blocks	From	RSMK bit	Tape Position
1	BOT	ON	B
-7	EOD	ON	E
1	BOT	OFF	E
-7	EPD	OFF	E
2	BOT	ON	C, chk cond res = 1
-8	EOD	ON	D, chk cond res = -1
2	BOT	OFF	F
-8	EOD	OFF	A

Completion Status

The Completion Status for the SPACE command is shown in the following table.

Code	***Message***	***Description***
00h	Good Status	• The drive is ready to perform any appropriate command. • The drive remains in any previously set mode. • The tape is positioned on the EOT side if space forward and on the BOT side if space reverse.
02h	**Check Condition**	**Extended Sense Byte 02h**

Code	**Message**	**Description**
02h	Not Ready	No cartridge is inserted in the drive.
03h	Media Error	Unrecoverable data error encountered while performing a SPACE command.
04h	Hardware Error	Drive hardware failure detected.
05h	Illegal Request	The CDB contains an invalid bit.
06h	Unit Attention	• Cartridge was changed prior to accepting this command • The drive was reset prior to this command.
08h	Blank Check	• EOD was encountered while executing a SPACE forward.

TEST UNIT READY (00h)

The TEST UNIT READY command tests for three conditions:

- The drive is powered on.
- A cartridge is inserted in the drive.
- The drive is ready to accept a medium-access command.

If these three conditions are met, the drive returns Good Status.

This command does not access the medium or initiate a diagnostic routine.

TEST UNIT READY Command Descriptor Block

The following table shows the layout of the Command Descriptor Block.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	X	X	0	0	0	0	Flag	Link

TEST UNIT READY Detailed Operation

The following text lists the sense keys plus the additional sense codes and qualifiers reported by the drive during various stages of loading and unlaoding cartridges. The format of the values is additional sense code/additional sense qualifier. BUSY means that the drive returns a status byte of 08. In all other cases, CHECK (02) is returned.

In the following table and text, NOT READY indicates a sensee key of 02, and UNIT ATTN indicates a sense key of 06.

Action	First TUR Response	Response while Ejecting	Response after Tape is Out
Press eject	NOT READY 5A/01	NOT READY 04/03	NOT READY 3A/00
UNLOAD command	BUSY, IMMED=1	BUSY, IMMED=1	NOT READY 3A/00
Insert, then eject	UNIT ATTN 28/0-	NOT READY 04/03	NOT READY 3A/00

If a cartridge is in the drive at power up and a TEST UNIT READY command is issued before the tape is positioned at BOT, then the following responses occur:

First TUR Response	Response during Tape Loading	Response after Tape is Out
UNIT ATTN 29/00	Busy	UNIT ATTN 28/00

If a cartridge is in the drive at power up and no TEST UNIT READY command is received until after the tape is positioned at BOT, then the following responses occur:

First TUR Response	Subsequent TUR Response
UNIT ATTN 29/00	GOOD STATUS

Completion Status

The Completion Status for the TEST UNIT READY command is shown in the following table.

Code	Message	Description		
00h	Good Status	• The drive is ready to perform any appropriate command. • The drive remains in any previously set mode. • The tape is not moved.		
02h	**Check Condition**	**Extended Sense Byte 02h**		
		Code	**Message**	**Description**
		02h	Not Ready	No cartridge is inserted in the drive; an immediate command execution is in progress; or an UNLOAD command has been executed. Bytes 12 and 13 of the Sense Data indicate the type of not ready state.
		04h	Hardware Error	Drive hardware failure detected.
		05h	Illegal Request	The CDB contains an invalid bit.
		06h	Unit Attention	• Cartridge was changed prior to accepting this command • The drive was reset prior to this command.
08h	Busy	Tape is being initialized after cartridge insertion,, or the drive is executing a previous immediate command.		

VERIFY (13h)

The VERIFY command verifies one or more blocks of data beginning with the next block from the tape unit.

The command terminates after the specified number of bytes or blocks are verified or when the drive encounters a filemark, the EOT, or an unrecoverable error. On completion the medium is positioned after the last block verified or after a filemark.

If a VERIFY with a zero verification length is issued, no data is verified, and the current position on the tape does not change. This condition is not considered an error.

VERIFY Command Descriptor Block

The following table shows the layout of the Command Descriptor Block.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	0	0	1	1
1	0	0	0	0	0	0	0	Fixed
2	MSB—Verify Length							
3	Verify Length							
4	Verify Length—LSB							
5	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Description

The following table defines the fields in the CDB.

Field Name	Bytes	Bits	Description
Fixed Block Size bit	1	0	If this bit is 0, block is variable length. IF this bit is 1, blocks are fixed length.
Verify Length	2-4		This field specifies the number of contiguous bytes or blocks to be verified in fixed mode or the length of the variable block..

Data Transfers with the VERIFY Command

Comparison errors detected cause a Check Condition with the Sense Key set to 0E hexadecimal, which indicates a miscompare. The residual byte or block count is reflected in the REQUEST SENSE data.

When the Fixed bit is set (1), the Verify Length specifies the number of contiguous blocks to be verified on the tape. When the Fixed bit is reset (0), the Verify Length specifies the number of bytes in the block to verify.

The byte compare starts on a block boundary starting at the current tape block position.

Completion Status

The Completion Status for the VERIFY command is shown in the following table.

Code	Message	Description		
00h	Good Status	• The drive is ready to perform any appropriate command. • The drive remains in any previously set mode. • The tape is positioned on the EOT side of the last block verified.		
02h	**Check Condition**	**Extended Sense Byte 02h**		
		Code	**Message**	**Description**
		02h	Not Ready	No cartridge is inserted in the drive.
		03h	Media Error	Unrecoverable data error was encountered.
		04h	Hardware Error	Drive hardware failure detected.
		05h	Illegal Request	The CDB contains an invalid bit.
		06h	Unit Attention	• Cartridge was changed prior to accepting this command • The drive was reset prior to this command.
		08h	Blank Check	• End of recorded data was encountered.
		0Eh	Miscompare	VERIFY data miscompare.

WRITE (0Ah)

The WRITE command transfers one or more data blocks from the Initiator to the drive. If the Transfer Length is zero, no data is transferred, and the current position of the tape is not changed. This condition is not considered an error.

WRITE Command Descriptor Block

The following table shows the layout of the Command Descriptor Block.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	1	0	1	0
1	0	0	0	0	0	0	0	Fixed
2	MSB—Transfer Length							
3	Transfer Length							
4	Transfer Length—LSB							
5	X	X	0	0	0	0	Flag	Link

The drive calculates the logical Early Warning. The Early Warning point is calculated as greater than ten megabytes before the EOT. This ensures that when Early Warning is encountered, enough space remains to successfully write any unwritten blocks up to ten megabytes.

At Early Warning, the drive completes the current block transfer and terminates the command with a Check Condition, EOM bit set, and Sense Key equal to 0. If the SEW bit (in MODE SELECT Device Configuration Page) is set, the data in the buffer is then written to tape.

Subsequent WRITE commands complete with a Check Condition and the EOM bit set.

If writing the buffer to tape is unsuccesful because of EOT, a Volume Overflow is reported. The Residual count field in the Request Sense data reports the amount of data not transferred. Writing can continue in the Early Warning region until EOT is encountered. Any WRITE command issued within Early Warning and successfully completed, finishes with a Check Condition and the EOM bit set.

If an error is encountered while writing, the Write Retry Count (in MODE SELECT Read/Write Error Recovery Page) specifies the maximum number of attempts to rewrite the data. If none of the rewrites area successful, the error is considered unrecoveralbe and reported as such. This situation may occur if the tape has severe damage. In this case, the green LED flashes rapidly.

Command Descriptor Block Field Description

The following table defines the fields in the CDB.

Field Name	Bytes	Bits	Description
Fixed Block Size bit	1	0	If this bit is 0, the transfer length contains the number of bytes in the block. IF this bit is 1, blocks are of fixed size, as specified by the MODE SELECT Block Descriptor..
Transfer Length	2-4	0-7	These fields specify the number of bytes or blocks to be written at the current tape position, if Fixed=0.

Completion Status

The Completion Status for the WRITE command is shown in the following table.

Code	Message	Description
00h	Good Status	• The SCSI data has been transferred to the data buffer. • The drive remains in any previously set mode.
02h	**Check Condition**	**Extended Sense Byte 02h**

Code	Message	Description
02h	Not Ready	No cartridge is inserted in the drive.
03h	Media Error	Unrecoverable data error encountered. Possibly bad cartridge.
04h	Hardware Error	Drive hardware failure detected.
05h	Illegal Request	The CDB contains an invalid bit.
06h	Unit Attention	• Cartridge was changed prior to accepting this command • The drive was reset prior to this command.
07h	Write Protect	The tape is write-protected; check the cartridge before continuing.
0Dh	Volume Overflow	WRITE command completed with data in the buffer because the end-of-partition was encountered.

WRITE DATA BUFFER (3Bh)

The WRITE DATA BUFFER command is used in conjunction with the READ DATA BUFFER command as a diagnostic function for testing the data buffer memory of the drive and confirming the SCSI bus integrity. The medium is not accessed during the execution of this command.

The WRITE DATA BUFFER command can also be used to download the controller firmware if the drive is equipped with flash EEPROM. Only firmware supplied by Seagate should be downloaded. Once the valid firmware is downloaded to the buffer, the flash EEPROM is programmed. Then, within 30 seconds, control is transferred to the new firmware and a power-on reset occurs. The drive is then ready to accept further commands.

WRITE DATA BUFFER Command Descriptor Block

The following table shows the layout of the Command Descriptor Block.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	1	1	1	0	1	1
1	0	0	0	0	0	MODE		
2	MSB—ADRS/Buffer ID							
3	ADRS							
4	ADRS							
5	ADRS—LSB							
6	MSB—Byte Transfer Length							
7	Byte Transfer Length							
8	Byte Transfer Length—LSB							
9	X	X	0	0	0	0	Flag	Link

ADRS is the buffer offset for Mode 2 and is the buffer address for Modes 4 and 5.

Command Descriptor Block Field Descriptions

The following table provides descriptions of the CDB fields.

Field Name	Bytes	Bits	Description
MODE	1	0-2	If MODE=0, only the data buffer is loaded.If MODE=2, data is loaded starting at the offset location specified by ADRS. If Mode=5, the data is transferred to the controller's flash EEPROM, and the firmware is restarted. The data transferred must be a binary image of the executable firrmware. The transfer length should = 40000h for a 256-KB flash EEPROM. If MODE=4, the firmware is not transferred to EEPROM. Instead, the firmware is executed form the RAM buffer.
Buffer ID	2		If MODE=2, only Buffer ID 0 is valid
ADRS	2-5		If MODE=2, ADRS is the offset where data loading begins. If MODE=4, ADRS must be 80000000. If MODE=5, ADRS must be 20000000 Otherwise, ADRS should be all zeros.
Byte Transfer Length	6-8		The Byte Transfer Length specifies the maximum number of bytes transferred to the drive. If MODE=0, it contains a four-byte header; thus, the data length to be stored in the buffer of the drive is Byte Transfer Length minus 4. If MODE=2, 4, or 5, the header is not used. A Byte Transfer Length of zero indicates that no data are transferred. This condition is not an error. It is not an error to request a Byte Transfer Length less than the Available Length (reported by the READ DATA BUFFER command). If MODE=0, the initiator should ensure that the Byte Transfer Length is not greater than 4 plus the Available Length that is returned in the header of the READ DATA BUFFER command. If the Byte Transfer Length is greater than the Available Length plus 4, the drive returns a Check Condition status with a Sense Key of Illegal Request.

WRITE DATA BUFFER Data Header

The following table shows the layout of the data header Block.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0

Completion Status

The Completion Status for the WRITE DATA BUFFER command is shown in the following table.

Code	Message	Description
00h	Good Status	• The drive is immediately ready to accept any appropriate command if MODE=0. • The tape position is not changed. The drive remains in any previously set mode unless a valid firmware has been downloaded (and MODE=4 or 5). If MODE=4 or 5 and a valid firmware has been downloaded, good status is returned. If the MODE=5, the drive then accepts no further commands until the flash EEPROM is programmed (<30 seconds). Then a power-on reset sequence occurs, after which command will be accepted. (A power-on reset sequence can take 5 seconds to complete.) If the firmware file is not valid, a Check Condition is generated.
02h	**Check Condition**	**Extended Sense Byte 02h**

Code	Message	Description
04h	Hardware Error	Drive hardware failure detected.
05h	Illegal Request	• The CDB contains an invalid bit. • Transfer Length exceeds the maximum (if MODE=0). • The download file is invalid (if MODE=5). The additional sense code and qualifier is set to 26/02.
06h	Unit Attention	• Cartridge was changed prior to accepting this command • The drive was reset prior to this command.

WRITE FILEMARKS (10h)

The WRITE FILEMARKS command causes the specified number of filemarks or setmarks to be written to tape.

This command can be used to force all remaining buffered data blocks to be written to tape without appending filemarks by specifying zero filemarks. When zero filemarks are specified, the command does not return Good Status to the Initiator until all buffered data blocks and filemarks are written correctly on the tape. Otherwise, status is returned immediately.

WRITE FILEMARKS Command Descriptor Block

The following table shows the layout of the Command Descriptor Block.

	Bits							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	0	0	0	0
1	0	0	0	0	0	0	WSMK	X
2	MSB—Number of Filemarks/Setmarks							
3	Number of Filemarks/Setmarks							
4	Number of Filemarks/Setmarks—LSB							
5	X	X	0	0	0	0	Flag	Link

Command Descriptor Block Field Description

The following table defines the fields in the CDB.

Field Name	Bytes	Bits	Description
WSMK bit	1	1	If this bit is 0, bytes 2-4 specify the number of filemarks to be written. If this bit is 1, bytes 2-4 specify the number of setmarks to be written.
Number of Filemarks/ Setmarks	2-4	0-7	These fields specify the number of filemarks or setmarks to record.

Completion Status

The Completion Status for the WRITE FILEMARKS command is shown in the following table.

Code	Message	Description		
00h	Good Status	• The filemarks have been sent to the buffer. • The drive remains in any previously set mode.		
02h	**Check Condition**	**Extended Sense Byte 02h**		
		Code	**Message**	**Description**
		02h	Not Ready	No cartridge is inserted in the drive.
		03h	Media Error	Unrecoverable data error encountered. Possibly bad cartridge.
		04h	Hardware Error	Drive hardware failure detected.
		05h	Illegal Request	The CDB contains an invalid bit.
		06h	Unit Attention	• Cartridge was changed prior to accepting this command • The drive was reset prior to this command.
		07h	Write Protect	The tape is write-protected; check the cartridge before continuing.
		0Dh	Volume Overflow	WRITE FILEMARK command completed with data in the buffer because the end-of-partition was encountered.

Notes